SESSION

EMERGING PRODUCTS AND APPLICATIONS WITH AUGMENTED REALITY FOR E-LEARNING, E-BUSINESS AND E-GOVERNMENT

Chair(s)

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Creating and Maintaining Psychological Flow State in Augmented Reality Applications

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Abstract – *Designing successful products for e-commerce, e-learning, and e-government has many challenges. This is especially true for emerging technologies such as augmented reality (AR) where one of the primary determinant success factors is user acceptance. While much is known about usability and user experience (UX) design, less has been researched about creating designs to support a psychological flow state, where users become fully engaged with a product. Designers should consider flow state as optimum user experience and seek to keep their users in a broadly defined flow channel. Potential interruptions to flow affecting usability are identified as flow exit points and can be actively accounted for in design. Flow exit points indicate potential issues with a continuous interface experience, such as those found in many augmented reality applications. This paper examines psychological flow and offers incremental steps in an application design process to seek optimum user experience for augmented reality applications.*

Keywords: augmented reality, application design, psychology, user experience, flow state

1 Introduction

Designing successful products for e-commerce, e-learning, and e-government has many challenges. This is especially true for emerging technologies such as augmented reality (AR) applications where one of the key determinant success factors is user acceptance. Many factors drive user acceptance, and the most important one is the usability of the product. While much is known about usability and user experience (UX) design in a functional usability domain, less has been researched on the aspects of a psychological flow state, where users become fully engrossed while using a product. Much of the existing literature is in the game domain, but all applications can benefit from considering this advanced form of user experience during the design, development, and test phases of product development.

There are many psychological factors designers should consider for AR application development [1]. All these factors contribute to ease of use and user satisfaction. For example, proper use of color for representation of states can make an important cognitive connection (e.g., red for warning or trouble). The employing of Gestalt principles for pattern making and visual processing where patterns allow or require the user's mind to complete the meaning provides a unique type of user engagement and challenge [2]. For a thorough treatment of user design principles' evolution and frameworks see Johnson [1].

While many factors contribute to better UX, the attainment of optimal experience is dependent on the user's ability to reach a psychological flow state. A flow state is where the user becomes so engaged with the application, that he or she loses track of time and extraneous activities unrelated to that particular experience [3]. Maximum engagement in an experience leads to this flow state, and the conscious planning of flow states and user control to affect and control key aspects of the experience can provide an advantage for augmented reality applications with respect to user acceptance.

Flow has been studied in game design and use [4][5][6][7]. For example, a specific flow-centered study of the game Bejeweled showed attaining flow could alter a user's mood. By measuring heart rate, electroencephalogram (EEG), and evaluating self-questionnaires, users attaining a flow sate were shown to improve mood and decrease stress [4]. These are powerful results from the use of a computer application and demonstrate that application designers who desire an optimum user experience should consider flow state creation as part of their design process.

Flow has also been examined in relation to web site usage for marketing effectiveness as a measure of persuasion [8]. In fact, psychological flow states have been examined in a variety of technology domains from the study of game addiction [9], use of social media sites such as Facebook [10], trust in recommender systems [11], and mobile media adoption [12]. There has been research in flow for exercise and gaming applications known as exergaming [13].

Flow states are important for e-commerce applications because users in a flow state are subject to persuasion [8]. In e-learning, flow states facilitate learning [8]. These implications go beyond simply creating satisfying user experiences and move into the realm of persuasion. For example, in online experiences, flow has been found not only to lead to increased learning, but also exploratory and positive behavior, positive subjective experience, and users' perceived sense of control over their interactions [8]. Once in a flow state, cognitive dissonance, or resistance to contra opinion and information, is lowered and users may be more prone to suggestions. Uneven flow and poor interface design, however, may allow users to pause and reflect, which may allow dissonance to affect the decision process [14]. In all applications seeking to create flow, ease-of-use, general usability, and design all contribute to flow state attainment.

Augmented reality applications vary widely in their utility and many applications, such as navigating to a coffee shop with geographic overlays, do not have considerations for flow. However, a key consideration for all user experience designers is to keep the user engaged in their application.

Therefore, while not all applications require or even attempt to evoke a flow state, those that do will provide an optimum user experience, which will reflect positively on the application.

Game applications in particular are often flow state appropriate, where the user becomes immersed in game play. History domain e-learning AR applications where users can narratively transport back in time to an event they find interesting is an example of an e-learning or e-government application. Narrative transportation is the ultimate form of flow where the users' engagement reaches a point that they are psychologically transported into the story [15]. In summary, psychological flow has a wide range of potential as a new class of applications for e-learning, e-commerce, and e-business emerge.

2 Psychological Flow States

A flow state is achieved when a person experiences a mental state of immersion and engagement. Miháli Csíkszentmihályi described flow states by defining the main properties contributing to flow [3]:

- Challenging activity(ies) requiring skill(s)
- Merging of action and awareness
- Clear goals with feedback
- Concentration on the task at hand
- Sense of control and lack of concern about its loss
- Loss of self-consciousness including awareness of time passage

These points provide the underpinnings of psychological flow state for application designers. Challenging activities requiring skill provide a basic direction where there must be tasks to accomplish a goal. The goals must be clearly defined and reachable. Feedback for both attainment of the goal or failure to reach the goal assists the user in understanding.

Merging of action and awareness provide the subconscious integration of these activities to awareness within the task progression. This consciousness might, from a psychologically perspective, not be a loss of consciousness but more of the balancing of challenges and skills to create the need in the user for focused concentration on the task at hand [16]. Concentration is then balanced with a sense of control and lack of concern about its loss. Finally, users can often lose track of time in this process. Any combination of these components can contribute to a user experiencing a flow state [3].

Massimini and Carli provided an emotional state diagram and distributed range of emotional states corresponding to flow state [17]. Figure 1 illustrates these ranges of emotions from apathy to anxiety and from relaxation to flow. It provides insight for the designer to study where in a flow state diagram emotions reside. This diagram also provides an illustration where the flow channel moves though the center of these emotions, balancing the border between boredom and anxiety. These emotional states are key to understanding because attention is affected by emotion [2], and attention combined with emotion strongly influences whether a person can enter a flow state [10].

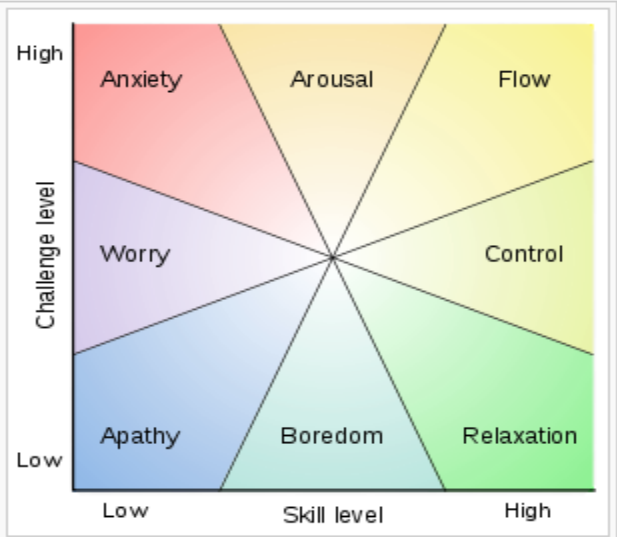

Figure 1: Emotion display challenge versus skill levels (WikiCommons adapted from Massimini and Carli [17])

Designers can incorporate Figure 1 into their initial conversations concerning user experience. For example, this emotional range landscape provides a grounding point for designers to actively discuss the user experience and emotions that are desired during the experience. While game applications are obvious, other applications such as a corporate dashboard monitoring a manufacturing process must battle the boredom and apathy emotions while anxiety over the experience may inhibit the effectiveness of information communication and transfer.

Another potential use of Figure 1 is to gain a better understanding of how emotions are layered in a skill versus challenge paradigm. While application changes can be dramatic and move a user from one extreme state such as apathy to another extreme state such as arousal, the crossover points are narrow and may be difficult to attain. Moving gradually between the adjacent emotional states provides a more continuous experience, which is appropriate for many applications. Obviously, if startling a user in a game with sudden attacks and activities is desired, extreme changes can occur, but designers should be especially cognizant at those points of the potential to exit the flow state.

Flow is not a singular status, and a user is considered in flow state if he or she is in a temporal area timeline known as a flow channel, defined as an area that moves horizontally, and somewhat notionally, at an angle from the bottom left to the top right of the emotional state layout shown in Figure 1 [3]. Figure 2 shows a representative flow channel navigating between user boredom and user anxiety.

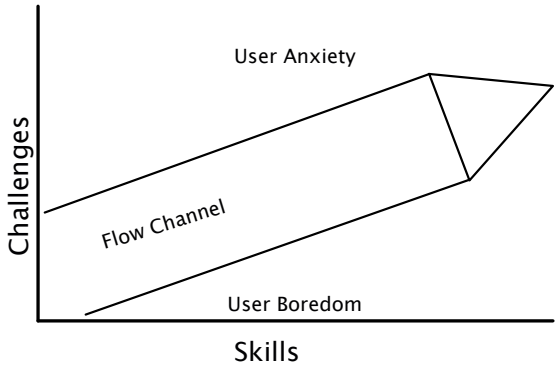

Figure 2: Flow Channel where balance of skills versus challenges occurs (Adapted from Csíkszentmihályi [3])

Figure 2 shows a linear and uniform flow state channel. However, it is unlikely that any user would have experiences that moved in this geometric pattern given differences in skills and emotional reaction to challenges [18]. Additionally, users' experiences vary because of a host of external factors, such as distractions, time of day, and current interest level. This leads to a more realistic flow channel shown in Figure 3 with peaks and valleys along the border of both boredom and anxiety. This diagram is specific to individuals, as different users have different flow zones, which need to be accounted for by designers [18].

In Figure 3, the traditional flow channel is reshaped to form jagged edges, as users would move through an emotional landscape, as depicted in Figure 1. The peaks and valleys would change for different users because skills vary, which impacts emotional reactions to the challenges. The jagged peaks and valleys provide an indication of points where the user is in danger of exiting the flow channel.

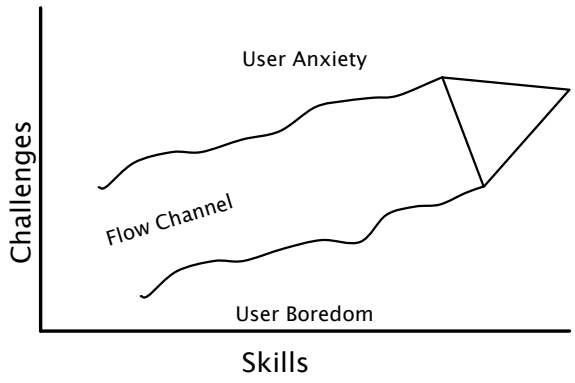

Figure 3: Individual user variations of a flow channel

The uneven lines bordering this channel illustrate points along the increasing skill challenges axis where individual users would be found. For example, new users will likely track nearer the anxiety border while experienced and highly skilled users will track closer to the boredom line. As the lines move outward from the center of the channel, a potential indication of an issue crossing into anxiety or boredom exists. If these states are reached, then flow will end. Thus, designers should be cognizant of these potential flow exit points during design and testing and provide options at those points to keep the user in flow.

2.1 Flow exit points

A flow exit point is often simple to identify. For example, the ultimate flow exit point is exit from the program. Error messages or configuration settings that require user intervention also exit the user from a flow state. In fact, any activity that takes the user's attention away from the task of using skills to meet challenges has potential to exit the user from a flow state.

The varying flow channel in Figure 3 is unique to an actual user. However, if a designer were to attempt to create charts based on empirical data, it is likely that this channel could not be repeated even with the same user. Skills and application knowledge improve, which reduces anxiety and pushes the line towards boredom. This concept of mapping individual user flow channel boundaries, while impractical in practice for individual users, can still serve as a theoretical reference for flow states in user design.

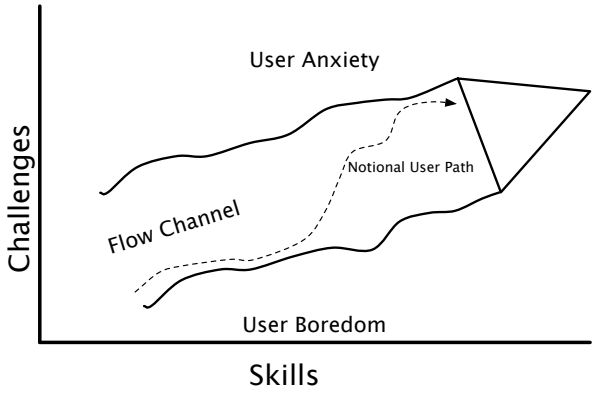

Figure 4. Example user movement through the flow channel.

Flow channel exit points are, however, difficult to identify across a range of widely differently skilled users. One solution is to combine a small range of individual flow channel representations by defined personas, a technique already used in other user interface design tasks to provide a portrait of a user. These personas can represents skill bands to help create realistic diagrams. For example, beginners will likely track near the anxiety line boundary, as they are new to the system, inexperienced with the user interface controls, and potentially unskilled or inexperienced. Advanced users will likely track along the boredom line, at least in areas of the application they have used before. Design and testing can help identify these points along the boundary lines where persona skill bands can assist in predicting flow exit points for user skill levels.

2.2 Flow state measurement and testing

One important consideration for UX design and artifact creation is the ability to measure and track metrics. Testing and measuring flow states are difficult [8], and testing flow in an application presents its own set of challenges. For example, in video games, not only is flow difficult to test, the flow conditions may even change the more a user plays the game, and skills of users can change during the game itself [5].

For measurements, there are two methods available for designers. In one method, psychophysiological devices are required to measure heart rate, pupil dilation, electroencephalogram (EEG), and respiratory activity [4][10]. These tests on human subjects require procedures, expertise, and equipment that may not be available to a project. The second method is self-evaluation through questionnaires. While this is an inexpensive and readily available technique, the accuracy of the results might be in question due to inconsistencies in self-rating by users [8].

Whichever method is chosen, a formal measurement that can be repeated and communicated to stakeholders and designers is essential. It is possible to gain value from a few considerations of flow and tracking through normal tests, but the design team may desire a specific, tailored artifact for their processes. Even if neither of these options is appropriate for a particular design organization, it is important to formalize measurements or quantification of application challenges and skill activities to achieve a flow state. For example, if the application is seeking flow as a main component as its goal, a framework closely matching elements of flow such as concentration, challenge and skills matrix, user control, goal clarity, feedback notion of immersion, and social interaction can be incorporated into a model for evaluating design [7].

3 User Interface Development Processes

No new idea or process change can exist in isolation from the overall product development process. When a new design consideration is added, user experience (UX) engineers and software designers have to first determine where in their process changes can be accommodated. The introduction of any new information and process change must fit into existing process frameworks, or they must at least be able to be integrated at some level. Typically, artifacts are created for requirements details, feature design, and testing. Artifacts can prove valuable, and the addition of a new process step must be done with care. For the integration of flow design considerations, two separate process additions are proposed.

The first step is to formally agree that flow state considerations are appropriate and desirable by the product stakeholders. Varying levels of interest can be accommodated from tacit awareness to detailed user testing. Formal discussion and approval of these goals are recorded in the project UX documentation.

The second process addition is to integrate flow channel user persona definitions and highlight potential flow exit points. Several user persona skill bands can represent the temporal change during application use along the challenges versus skills flow channel. Once flow exit points are identified, one method to deal with these boundary conditions is to embed choices into the application at these exit points [18].

A waterfall process is the most straightforward integration. Steps can be added in the sequential process, which require these actions to complete. An agile development process provides opportunities for iterative user experience design, but it can be more complex for iterations. While there initially appears to be conflict with product iterations and user interface interactions due to cycle time (i.e., product cycle time of 4-8 weeks and user interface cycles of hours or days), careful and purposeful planning can synchronize these nested iterations [19]. These potential conflicts can be managed to allow input of multiple UX iterations into a single agile sprint. Thus, while agile process requires more planning, flow state process changes can also be integrated in a straightforward manner to improve UX design.

4 Flow State in User Experience Design

There are a host of psychological considerations for designers to study before formal user experience design can begin. The augmented reality (AR) user experience differs in several key ways from traditional keyboard display applications, since AR applications work integrated with real-world displays and data.

In AR applications, the goals of most designers are to affect the emotion of the user [20]. This is aided by the integration of real, physical backgrounds, which can provide emotional context [8]. One technique designers should consider is to focus on a cognitive task design versus functional task. Given the greater cognitive demands faced by users of AR products, designers should consider evolving their approaches to match these demands [20]. The typical functional approach to design would give way to one that includes focus on the cognitive aspects. Cognitive task design, with its emphasis on the mental processes of the user, should be one consideration in application design [20]. This is especially true in a decision tree where the designer is striving to keep the user in the flow channel [18].

There are subtle complexities in application usage concerning flow states. For example, user errors leading to messages might outwardly be considered an interruption of a positive flow, but some games might introduce error potential as part of its skills challenge [1]. Focus itself has many dimensions. For example, the triune brain model suggests three main areas of focus for targeting design and analysis, one for each level of the brain: instinctual responses, emotional responses, and identity responses. They can function independently, but, given the inter-relatedness of the brain, are more often simultaneous and mutually reinforcing [21].

Video game designers typically consciously leverage the aspects of flow [18]. Keeping players in the flow zone is a designer's goal, but the difficulty increases with the size of the user base [18]. As feature sets are designed and revised, a list

of questions about the design focused on user goals and skills versus challenges can assist designers [5]. Thus, user base size and diversity necessitates formal documentation (e.g., lists) for challenges versus skills activities.

One final note for designers is to understand the power of flow states. For example, there may be safety concerns for AR applications that create a flow state for a user while he or she is walking down a street immersed in the application. There are also potential ramifications from increased persuasion for immersed users. Therefore, designers should be aware that ethical considerations must also be considered for enhanced user engagement, particularly persuasion [22].

4.1 Flow state design management

When considering techniques to create and maintain a user flow state, designers must first consider interruptions and interface confusion. Causing a user to stop and think outside the experience will break flow, as they become aware of their surroundings. Too many choices are overwhelming and having to pause to make choices and can also be disruptive for a user [18].

Many general UX design principles assist with flow achievement. First, a well-designed interface that provides seamless use and interaction contributes by not distracting the user from the current task/challenge by requiring a conscious non-application activity for every user interaction required. In AR applications specifically, immersive narrative looks to identity for a place in the immersive story.

User experience designers and stakeholders typically understand the desired functional flow of their products quite well. To create and maintain a flow experience, several additional steps are required. Banding by user persona type of expert, average, and beginner skills serves as an overlay to the edge case interactions, which are mapped near the boundaries of these bands. Use case testing by developers and stakeholders can provide illumination as to these boundary cases as well.

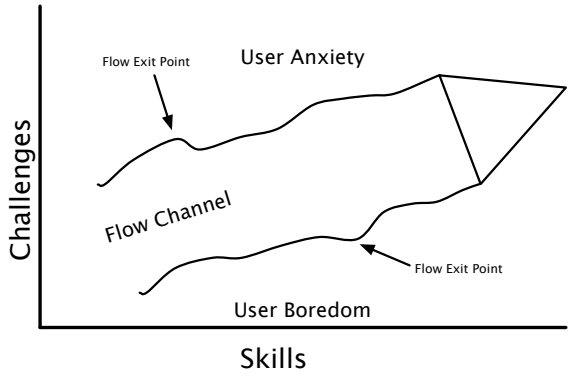

Figure 5: Flow exit points along the flow channel

Boundary points where a measurement (e.g., psychophysiological or self-questionnaire) can show potential flow exit points as anxiety or boredom emotional states are approached. Identification of these potential flow exits allow for planning actions for users when these occur.

The boundary cases must then be examined for options. For example, an action that advances a user a minor next step with minimal intervention and few choices is unlikely to affect flow. In UX functional flow process documents, identify the points where users potentially exit by providing options to maintain state is a goal of this analysis. Alternatives for exit conditions at extreme boundary points should be identified. This can be a tree of options [18] or a branch to a new level in a game or additional data visualization in a corporate application. It is recommended that a small number of potential flow exit points be reviewed and considered with options provided in the user interface and retesting conducted. Once the process works smoothly, the design team can decide how many iterations or exit points to address during test and iterative development.

Adding flow channel representations to a persona will enable discussion about points of concern that may lead to flow exit points for that user profile. The visual nature of this artifact as it was represented in Figure 4. Potential issues that cause flow channel exit are noted and the accompanying design comments will discuss why that point is a potential exit point as well as potential course of action. One likely solution is user or system intervention based on a set of defined parameters (e.g., lapsed time since later user input) that provides the user with options to navigate back to the flow channel and become reengaged with the application.

4.2 Augmenting your design process: The key points

The amount of information presented and potential solutions are additional work for an often time-constrained and burdened development and design team. While implementing enhanced artifacts or even introducing new artifacts to track and address flow state may be most desirable, smaller process changes can also provide benefit. For example, training for designers, product managers, marketing, and quality assurance engineers can provide improvements in general usability as well as provide an understanding of when optimal user experiences are achieved.

There are four key components for creating and maintaining a flow channel for users of AR applications. These are 1) Create and maintain a flow channel for optimum experience, 2) Observe each user as unique, use persona skill bands, 3) Identify flow exit points during design, and 4) Implement incremental, non-evasive process integration. These steps will allow designers and software developers to create a better user experience and help users create and maintain a flow state, which can serve application designers well and enhance the potential for application success.

5 Future Research

Measuring incremental process changes is difficult and often does not provide sufficient justification to perform. Quantitative studies are difficult as well and most product

development teams will chose to continue to focus on improving their product instead of expending time and energy attempting to measure potential benefits. Therefore, future research should be focused on the inclusion of psychological factors leading to flow in overall studies. When appropriate, data can be examined for decision methodology and product improvements. In particular the concept of flow exit points should be considered in user interface design and feature implementations.

6 Conclusion

Designing successful products for e-commerce, e-learning, and E-government has many challenges. This is especially true in emerging technologies such as augmented reality (AR). One of the primary determinant success factors is user acceptance. Several designers' teams are beginning to consider techniques for evoking flow state, but most research has been conducted in game application areas. However, all applications can benefit from considering this advanced form of user experience during the design and test phase of product development.

Designers should consider flow state as optimum user experience and seek to keep their users in a broadly defined flow channel. Potential interruptions to flow affecting usability are identified as flow exit points and can be actively accounted for in design. Flow exit points indicate potential issues with a continuous interface experience, such as those found in many augmented reality applications.

This paper examined psychological flow and offered incremental process steps to incorporate into existing application design processes. Designers and application should seek optimum user experience with a framework for application design process for augmented reality applications in these four steps: 1) Create and maintain a flow channel for optimum experience, 2) Observe each user as unique, use persona skill bands, 3) Identify flow exit points during design, and 4) Implement incremental, non-evasive process integration.

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Cognitive Design Considerations for Augmented Reality

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Abstract

When creating augmented reality applications there are many cognitive design issues that should be considered. Augmented reality technology tools are sophisticated and feature rich technology. The complex applications can offer major advancements in our daily lives. Implementing the multifaceted design for the everyday user can sometimes be challenging. It is essential to keep the end user in mind when creating the design. In this paper we will focus on the cognitive and neuroscience principles of perception including the cognitive process of vision, how we experience color, Gestalt concepts, and perceptual illusions and apply them to how humans respond to design. We will discuss cognitive principles that should be considered when designing augmented reality applications that provide real interaction capabilities.

Keywords: Augmented Reality, Cognition, Design, Color, Information

1 Introduction

Augmented reality (AR) is a sophisticated technology that layers information in a way that facilitates the execution of complex operations in a seamless manner. AR tools can bring together and transfer information from a multitude of sources while operating within a variety of environments. AR technology can afford new perspectives; offer solutions to simultaneous routine tasks, and visually display detailed information in easy and desirable ways. While the sophisticated technology used in AR is amazingly complex and great respect should be given to the design skills required to execute such complexity of design, it is not the only issue that should be considered when creating AR applications. Ultimately effective design cannot be successful without considering the user experience. To take in complex information, even when well presented, creates a sizable cognitive load on the brain. For this reason it is critical for the designer to look beyond the sizable technological features of the application and consider cognitive issues in the user's experience. Clifford Nash, a Stanford professor and expert on human-computer interaction, suggests we respond better when machines appear to interact with human social qualities. His research suggests that we unconsciously apply the same rules of social engagement that we apply to humans. When we interact with technology from our computers and cell phones to our automotive navigation systems we use the same rules of human social interaction [1]. Designing with the user in mind is critical for effective AR applications. This paper will discuss some of the cognitive design considerations in AR application design.

1.1 The paradox of technology

Norman, author of *The Design of Everyday Things* says, "The paradox of technology should never be used as an excuse for poor design [2]." How true. Bells and whistles, extensive options and device capabilities, all make for a dazzling application but often baffle the user when it actually comes to putting the device to use. As the complexity of a design increases usability frequently decreases. AR applications have been faced with challenges. The demanding technology runs into implementation issues. So the really cool application ends up being left at the design table to collect dust; an identified solution without a problem to solve. What can move the sophisticated application off the design table into the hands of the user? Considering the user experience and making the application tailored to the user is key in accomplishing that move. How can the user experience be better understood? Understanding cognition and how the brain interprets through the senses is an important first step. Cognitive design considerations inform principles of good design and can take the complex and make it more manageable.

Cognitively we react from a physiological perspective and also from a psychosocial viewpoint. We respond to color, placement and patterns, change, our past experiences, sound, smell and taste, and our kinesthetic awareness. There are psychological/biological considerations as to how we react. There are also cultural and emotional reasons we react. We have preferences. These preferences are biologically, emotionally, or social culturally based.

2 The cognitive process of vision

We will start with physiological cognitive process of vision. Our eyes are very highly attuned instruments that are able to see using a rather complex process. The basic route is light travels first to the lens of the eye. It then meets up with the rods and the cones of the eye. The rods and cones are

located in the retina. The cones are low sensitivity and need a relatively strong simulation. Since the cones need more stimulation they are used in day vision. The rods on the other hand are highly sensitive and can be stimulated in by weak light. Rods are the primary receptors for night sight. Cones are concentrated in and more centrally located in the retina. Rods are more peripherally located. Color, brightness, and a myriad of other elements of vision are generated based on how and where the light falls on the retina [3]. Electromagnetic radiation pigmentation and energy is converted first to chemical energy and then nerve impulses work together in a chain to finally send a signal to the brain as to what the eye is seeing [4].

We see based on physical properties of objects and how light is absorbed, reflected or emitted by the object. Color is our visual perception to the spectrum of light and how it interacts with the eye. Our visual system attempts to make up for discrepancies and challenges in our sight. Our sight compensates for light sources, filters, and shadows by allowing us to perceive an object as having a consistent color even when in reality it varies. This is a concept called color constancy [5].

The visual condition called color blindness or color perception deficits, starts in the cones of the retina. One or more of these cones has irregularities or differences. Color blindness most commonly results in red/green blindness. The Helmholtz theory [6] states that there are actually three different types of retina cones (the receptors that respond to color). Each of the types responds to a different color with the short responding to blue, middle to green and long to red. Red/green color blindness represents irregularities in the middle and long retina cones. Opponent-process theory proposes that opposing retinal processes enable color vision by the cones being stimulated in various combinations [7]. For example when the blue cones are stimulated and the red and green cones are inhibited we see blue. Other colors are the result of portions of the three types of receptors being stimulated. Being familiar with visual compensations can inform color choices and usage in AR applications. If there is a choice between using red and blue where all else is the same you might be wise to choose the blue.

3 Color

The psychosocial issues include elements of cultural, emotional, and community based responses. An example of a psychosocial cognitive element of vision is the perception of color based on past history. Yee, Ahmed, and Thompson-Schill [8] conducted a study to look at whether or not color could prime people to notice other objects related to a color. He found that if participants were asked to focus on a color that color remained important long after it was not important to the task. So, if you grew up with the red covered *Betty Crocker Cookbook* as the go to cookbook in the house you might logically gravitate to a red covered book when you are looking for a recipe. You are primed for cookbooks to be red [8]. Color has also been shown to influence behavior. Guéguen and Jacob examined tipping behavior and the impact of color. Waitresses presented themselves to customers in the same manner with the exception of switching out the color of their tee shirts. A variety of colors were used. Only the color of red made a difference. Men gave larger tips to waitresses that wore red [9].

Color is an essential component in our visual perception. The use of color can convey meaning beyond a singular value. Color can be used to not only assist in locating objects but also in identifying them. Color can be used to add focus, convey emotion, and increase legibility. Complex and large quantities of information are understood and perceived better by using color and images along with text in representing information. The use of color quickly conveys detailed information in a way that dense text is unable. Tufte [10] and others are well known for using color, images, and graphics to present an overwhelming amount of information in a comprehensive manner. The information becomes not only readable but also easy to understand.

3.1 Color and visual imagery

Color dominates in visual imagery. Probably the most common demonstration of this is the *Stroop effect* [11]. The word names of a color are printed in colors but not necessarily matched to the same color as denoted by word name. The text might spell out green but the actual text color is in yellow. Tested in research over and over again the reader consistently is more challenged to read the actual color named in the text over saying the actual color of the text. The *Stroop effect* has been used for many decades to study cognitive response and control to a variety of technologies. The standard response to a Stroop test is "the color is easier (faster) when a color word appears in the same color, and harder (slower) when it appears in a different color [12]." The visual perception of color dominates over the visual perception of an image making it a principle worth examining with each AR application design.

There is some evidence that color perception is based on expectations and memory. In a study by Mitterer and de Ruiter a top-down process was observed when participants perceived an object to be a certain color when the previous object had been that color. For example, if the participant was shown a carrot they perceived the next object as an orange as oppose to a yellow object such as a lemon [13].

Color as a concept first addressed the different sensations on the eye such as light and dark. Evolving over time the definition of color took on additional properties of hue, saturation, and brightness. When applying the physiological/psychosocial lens to color we can think of color as it is biologically perceived by the body (eye, retina, cones, nervous impulses, and brain) or socially constructed

properties with criteria that allow it to be assigned a specific color name (e.g. blue). Color can be viewed as the perceptual physical experiences represented or perceived qualities represented. The perceptual physical experience of color appears not to vary cross-culturally whereas the psychosocially perceived qualities do [14].

3.2 The experience of color

Psychologist researched the influence of color on imagination. Study participants completed several cognitive tests that were displayed either on red or blue backgrounds (neutral was used as the control). People that took the tests with the red background did a much better job at accuracy and detail. Participants that took the test with the blue condition did better on items that required imagination and creativity. According to the researchers the red evoked a sense of danger making the participants more alert and the blue remind the participants of the sky and ocean (where there is a relaxed mental state for daydreaming and imagination) [15].

3.2.1 The physical experience of color

Perceptual physical experience of color can be illustrated in the office color case study. Employees in some workstations were complaining about always being too cold in their office. The color of the office partitions in the offending workstations was blue. In the same office some wall partitions were colored a peachy red color. The office workers with workstations with peachy red colored office partitions did not complain of being cold. The temperature was the identical in all the workstations. The thermostat was fixed at the same setting. The only difference in the workstations was the color of the wall partitions [16].

3.2.2 The meaning of color

While there is still room for more definitive research several studies support perceptual physical experience of color such as warm colors stimulating active feelings and cooler colors producing soothing or calming feelings as well as culturally interpreted meaning of color [2, 11, 16-22]. We physiologically experience red with a faster heartbeat, more rapid breathing, and stimulation of other organs. The color red can increase anger and vigor. Culturally there is some divergence in how red is interpreted. In western cultures red can represent danger, confrontation, and caution. In eastern cultures red is traditional bridal wear and represents good luck [17]. Orange can stimulate mental activity and appetite. It can also increase oxygen to the brain and bolster the immune system. Psychosocially orange symbolizes optimism, creativity, and purpose. Physiologically green soothes. The famous *green room* or waiting room where television guest wait before going on the air comes by its name easily - a room to calm folks' anxieties before they go on stage. Green shares many of the same characteristics for both western and eastern cultures. Features such as growth, nature, health, prosperity, and money are associated with the color green. Green can take a negative connotation in China where a man wearing a green hat signifies his wife is having an affair. Green can also mean exorcism in China [23].

The most sensitive cones to light are greenish yellow. The brightest on the color spectrum yellow can be the most fatiguing color as the eye is drawn to the color first. A physiological effect of yellow is to evoke alertness. It also can stimulate anger. Both western and eastern cultures link yellow to wealth. Western cultures also perceive elements of hazard, cowardice, or weakness and eastern cultures identify it with proof against evil and royalty. Legal pads in the United States are made of bright yellow paper and pencils are often painted yellow. Yellow legal pads are a natural choice for legal matters with yellow's physiological properties of alertness and decisiveness. The yellow pencil actually relates to the cultural aspects of yellow and the history behind the pencil. China was known for the best graphite in the world. The strong cultural association of yellow as royal allowed early American pencil manufactures to communicate with color that the pencils were of high quality Chinese graphite. The custom of making pencils yellow remains [24].

Physiologically blue can to lower blood pressure and decrease respiration. There also have been higher reported depression scores for individuals in blue rooms. In western cultures blue can signify depression and sadness or steadfastness and trust. Eastern cultures view blue as a color that represents wealth and self-cultivation. Purple has physiological properties of balancing systems in the body. Purple psychosocially symbolizes spirituality, royalty, and femininity. Eastern cultures also associate purple with wealth. Some cultures also use purple as a color for mourning. White, a color that results from all three of the cone types being stimulated, most frequently symbolizes purity and peace. Used as the color of bridal attire in western cultures, white is frequently associated with funerals in eastern cultures. In contrast black results from the cones not being stimulated by light. It symbolizes death, funerals, and evil in western cultures and can represent career, knowledge, and evil in eastern cultures [23].

4 Gestalt

As color is an important factor in visual perception so are the placement and patterns in the visual landscape. Our experience guides how we make meaning of visual information and our mind fills in the blanks. We develop schemas or mental models to simplify cognition. These scripts allow us to store information about a typical event. The schemas allow us to anticipate what is going to happen, assists in averting cognitive overload, lets us understand by filling in the blanks when we don't completely hear or see something, and provide us with a context when we observe visual scenes [25].

The Gestalt concept, that the whole is more than the sum of its parts, allows us to analyze an object as a single integrated entity. In other words, it is a holistic approach of self-organization where the eye sees an object in its end state first and not all the individual pieces. Before we are really aware of seeing something our perceptual processes are already organizing the information and making meaning. We can see images even when part of the information is missing.

Gestalt principles establish how we see figures, organize them, and seek continuity and closure for them. Gestalt psychologists propose that the brain follows a specific set of rules in attempts to order sensory information into a holistic pattern [26]. We scan the visual environment and take in the simplest possible organization. We look for differences and similarities by separate figure from ground, grouping figures that are close together into a single set, grouping figures that are similar to each other into a single set, looking for continuous patterns and viewing them as such rather than disconnected segments, and seeing to fill in gaps to create a whole.

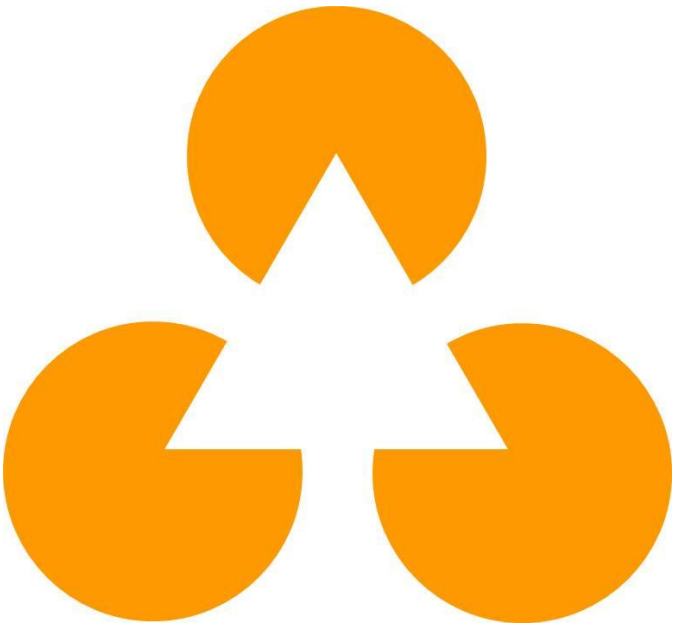

Figure 1. Gestalt principle of closure: We see a complete figure even when information is missing [27].

One way to communicate meaning is through visual groupings. We can create an image even when pieces of information are missing. We formulate associations by looking for connection and meaningfulness and organize items that seem most similar. When parts are enclosed by a completed boundary they are seen as a single unit even if parts outside of the complete boundary are exactly the same as those within. The brain ultimately wants to be holistic in its observations, seeking out patterns that are identifiable. As Manuel Lima, an expert in information visualization states, "the brain's propensity to look for familiar shapes is so strong that we even tend to find meaningful patterns in meaningless noise, a type of behavior usually called patternicity [28]." Interestingly when the two Gestalt grouping principles of similarity (grouping figures because they resemble each other) and proximity (grouping figures together because they are close to each other) are both presented at the same time the brain chooses similarity (similarity of color) over the closeness to other items (proximity) [21].

5 Perceptual Illusions

Perceptual illusions make great parlor tricks and intrigue us on how our eyes can deceive us. See the classical illusion below based on an illustration created in 1889 by Franz Müller-Lyer [29]. It usually takes an actual measurement to believe that line AB is longer than BC. In this case our visual inspection implies otherwise. The theory behind this illusion is that inward pointing arrowheads cue us to think the line is closer to us making it shorter whereas the outward pointing arrowhead cues us to think the line farther away and longer. We make certain assumptions based on cues on depth. For example we expect the smaller of two similar sized objects to be further away; an object that partially blocks another to be closer; and hazy objects to be further away than sharper focused objects. We perceive motion by assuming that shrinking objects are moving away and enlarging objects are getting nearer.

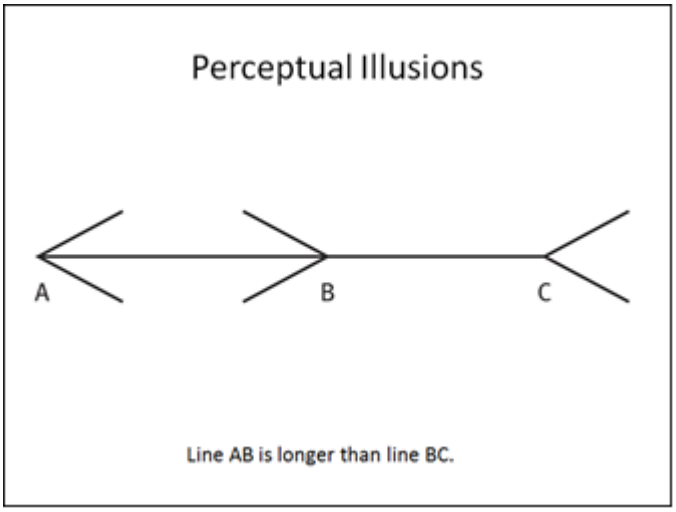

Figure 2. Perceptual Illusion: A perceptual phenomena that causes faulty perception and believe that Line BC is longer than line AB when in reality it is not [30].

AR application design can benefit from the concepts behind perceptual illusion. By using perceptual illusion features the impressions of depth and movement can be created. For example the sense movement can be generated in a simple two-dimensional drawing by creating ripples with patterns of light and shadow. This is in part due to the tendency of visual

dominancy over the other senses and our cognitive analysis of any perception breaking it down into small bits of information and then creating a functional model based on our experience of the world [31].

6 Cognitive clutter

So now we have a better understand of how we group and organize information. But how do we make sense of cognitive clutter? In general our cognitive lens allows us to easily make certain assessments such as how close an object is or from which direction a sound is coming. What is more challenging is focusing our attention when we are confronted with concepts and stimulus that are foreign to us. Hare says that AR requires the brain to approach information and make meaning of it in different ways [32]. Our sensory and perceptual processes assist us in sorting out information from complex images. Absolute threshold theory, Weber's Law, and the concept of contextual cuing all aid in understanding how the cognitive processes detect and distinguish a difference from multiple sources and stimuli.

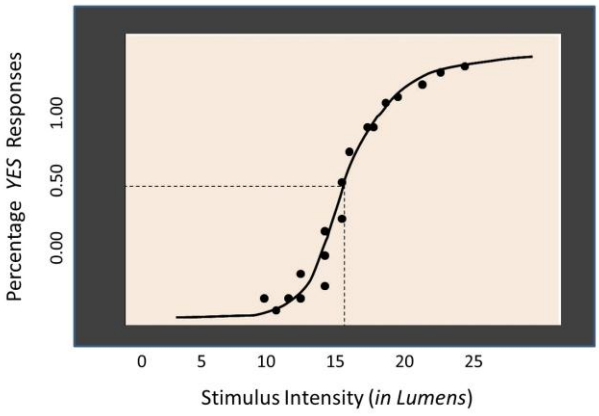

Figure 3. Absolute Threshold: The minimum stimulation needed to detect a particular stimulus fifty percent of the time. In this case it is the intensity of light [33].

Physical energy can be detected. Some kinds of stimuli are easier to detect than others. Think about how little perfume is needed to be able to smell it. Awareness of a stimulus (of light, sound, odor, taste, or pressure) is measured by whether or not it reaches our absolute threshold sufficient times. The absolute threshold is the point where a stimulus is detected 50% of the time [34]. Weber's Law is the rule that two stimuli must differ by a constant minimum percentage to be noticed as different. According to Weber's Law for the average person to perceive a difference there must be a difference of at least 8% intensity in light, 2% of weight in objects, and 3% of frequency in sound [34]. We notice change. Change increases the chance that we will remember an item. The more often we see an object in a specific location the faster we are at finding it there again. By repeating expected design patterns the use of the application is made easier.

We notice global structures before we notice the specific features that make up the global structure (the proverbial seeing the forest before the trees) [35]. The context (the setting, background, or situation) provides information that allows us to better perceive a stimulus [16]. We can take in very detailed information but only retain it for a short period of time. The memory of the detailed information can be overwritten or replaced quickly when a new visual representation is presented. While we think we can easily detect subtle changes in the environment (items being moved, changed, or disappearing) we more often cannot. Numerous studies have been conducted where conversation partners have been swapped out; objects have been removed and changed; or even a person dressed in a gorilla suit has walked through a group and the observer has not noticed [8, 22, 28, 36]. This is particularly important to keep in mind when designing for complex visual display systems and when it is important for the observer to be aware of change. A famously sited example of change blindness (the failure to detect a change) is the Strasbourg, France 1992 accident where a pilot of an Airbus 380 inexplicably crashed into the side of a mountain while in approach for a landing. Did he not notice changes on the visual display panel? [25]

7 Sound, Scent, Taste, & Touch

While vision plays a predominant role in AR application design the other senses of the body can also impact AR design. Sound results from air pressure waves that through a complex process create vibrations in the membranes and small bones of the ear. The ripples of the wave vibrations then bend hair cells nerve cells that transmit a neural message for the brain. Sound can often also be felt as vibrations produce air and bone conduction. Since sound waves usually reach one ear before the other we are able to locate sound based on that information [4]. Similar to visual perception contextual information is helpful in identifying spoken words. Visual information also assists in speech perception (such as following the movement of the speaker) [25].

The sense of smell occurs when air passes over receptor cells in the nose. A message is then sent from the receptor cells in the nose to the brain. Memory is linked with the sense of smell. Without memory the ability to smell disappears [37]. Taste is also inextricably linked with the sense of smell. While the sense of smell can occur without the taste receptors activated, the sense of taste does not seem to be able to work as robustly without the nasal receptors in action. Taste is interconnected with smell. Without the smell receptors located near the front of the nose activated you can only taste the four rudimentary stimulus of sweet, salt, bitter, and sour [38]. Touch has a complex relationship between what we feel on a location and the nerve endings situated there. Pressure is the only sense of touch that has specific receptors; warmth, cold, and pain do not [39].

8 Tools for cognitive overload

We have cognitive tools for organizing and dealing with cognitive overload. But how do we determine which piece of information is more important to pay attention to or worth more of our attention than another? Researchers found that while we can successfully multitask we pay a cognitive price [40]. We can do two things at once but our brain does not give us its full power. It shuts down the advance-learning center to conserve some strength. Directing user attention to a singular focus can minimize the cognitive overload. In a study out of Massachusetts Institute of Technology researchers looked at what makes a photo memorable [41]. Unexpectedly it was not attractiveness. The most memorable images were images that had an element of strangeness, funniness, or interestingness. What were especially important in the pictures were the implications of movement and items that were on a human scale. We feel a connection with the people in the picture (even if we do not know them) and it makes the image more memorable. Human scale objects again connect us with the picture by putting us in the picture and become important features we notice. It evokes a story. Rutledge says that, "the creation of a narrative allows an individual to find the shared meaning (relevance), connection (emotion) and step into an experience as a character (identity)" [42]. Finally, the suggestion of movement, as in a car going down the road becomes imprinted in our memory because we are hardwired to notice movement.

Figure 4. Having people in the picture, even if they are strangers, makes the image more memorable [43].

Figure 5. Implications of movement, such as this vehicle in the picture, make the image more memorable [44].

9 Cognition and AR applications

Understanding how to engage the senses and cognitive demand can maximize the usefulness of AR applications. An example of a recent AR innovation that address cognitive issues in design is the mobile visible search (MVS) global positioning system (GPS) system that is built into the windshield of a vehicle. The MVS-GPS system uses the windshield of the car as a canvas. Lasers are used to project images on the windshield to display directions, driving notifications, retail/services nearby, and safety information. The information is only displayed when it is needed providing fewer cognitive distractions while driving. Location coordinates displayed on the windshield provide a greater illusion of depth. Color-coded data deliver the complex information in an easy to understand manner allowing the driver to respond more efficiently. Drivers can obtain information easily in this seamless application. The dashboard becomes obsolete and the windscreen becomes more like a laptop computer designed to improve the driving experience. [45].

Figure 6. Autoglass® vision for a revolutionary car windshield in 2020 with visual sensors and GPS technology [46].

10 Conclusions

Tools designed well can not only make the way we do things easier but also make a difference in our quality of life.[22] As designers ideally we transform an experience to better serve the needs of the end user. AR application designers are wise to consider cognitive issues and human behaviors in creating applications to best fit the user. Attention to design can make a difference in the quality of the user experience and the success of the AR application. As a designer it is important to understand how the user thinks and make it relevant.

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A Funny Thing Happened on the Way to an Augmented Future: Stumbling Over the Yellow Line

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Abstract – *The introduction of any new visual media is accompanied by projections about how it might be used and what existing media it disrupts. Augmented Reality (AR) was introduced to mobile media with just such fanfare. Aside from market considerations, the full potential of this technology will depend on designers and developers pushing the boundaries of the technology in ways similar to the early days of interactive media. Importantly, AR's full impact, positive and negative, falls to the cognitive sciences. Research questions abound as we look to a visually augmented future. This paper relies on the past as a guide to the future and projects potential uses, psychological outcomes and areas for inquiry.*

Keywords: augmented reality, cognitive science, multiplane visualization, priming effect, psychology

1 A Lens Over Everyday Life

It always starts with the yellow line. When developers and producers, researchers and writers, bloggers and pundits ask, "just what is AR anyway?" we tell them about the yellow line. And it is a good example. The televised first down marker, the yellow line, adds value for the viewer and enhances the televised American football broadcast. It meets one of AR's prime objectives, using a second plane of visual information to enhance the first.

Stan Honey, the 1998 creator of the yellow line, could be cited as the father of augmented reality. There is little doubt that his creation of the football down marker, the short lived comet-tail hockey puck and soon a live-line graphic overlay meant to enhance and dramatically change the televised experience of the upcoming America's Cup yacht race impacts the thinking of AR designers. To be fair, his innovations rely on sophisticated software and mathematical calculations rather than simple graphic overlays but they do illustrate one design path that works: enhance a known experience. It is understandable to conclude that if augmented reality can make open ocean boat racing interesting and entertaining, it should be able to enhance most anything.

2 The Depreciation of Hype

Enhancing most anything is a hallmark of new technology hype. Yet it hardly seems fair that augmented reality is dismissed before it has had its day. Recently Gartner placed AR clearly on the downward slope of its famous hype cycle, cresting the peak of inflated expectations and heading toward disillusionment [1]. It is hard to see how AR climbed to the peak in the first place as it is poorly known even among those carrying the mobile devices that enable it and totally unknown among the rest of the population. Even in rooms filled with technologists, a show of hands on how many have ever used AR results in a small number of raised hands including some confusing AR with QR codes. If anything AR hasn't been hyped enough to be dismissed but there are good reasons for this and some evidence that augmented reality's decent toward disillusionment may be far shallower than the likes of virtual worlds and gesture recognition.

Hype isn't what it used to be. The early days of interactive CD are similar to the expectations for today's AR but the details differ in important ways [2]. In 1986 Microsoft launched the first International Conference on CD ROM. While the conference attracted only a few hundred attendees, seemingly half from Microsoft, speaker after speaker extolled the virtues of CD ROM and its interactive capability. Surely it would disrupt every known form of publishing - from books to magazines, from technical training to

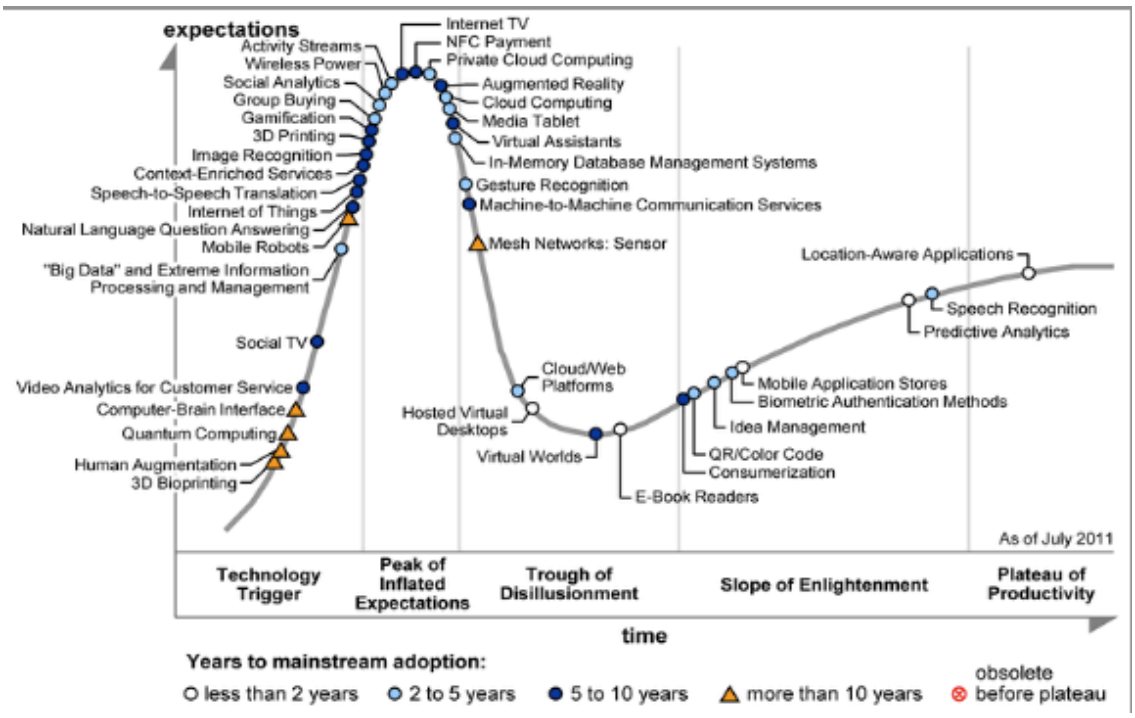

Fig. 1. Gartner Hype Curve 2011

children's education, from music to interactive television. It didn't hurt that some of the prognosticators were from the likes of Sony, Matsushita, Warner Communications, Philips and, of course, Microsoft. Big players were behind the technology and while production environments were unclear, there was little question they would be there, well in advance of the content creators. Clearly CD ROM was a platform not to be ignored.

Only a year later the conference moved to San Francisco, all but filling the very large Moscone Center. Over 7000 attendees listened in on a range of panels on everything from product design and production environments to marketing and distribution. Deal making was rampant. If a content creator could manage to put together a brief demo, on almost any theme, a production contract was not far behind. It didn't take a hype cycle to illustrate that expectations were high. Beyond the number of attendees, a reliable indicator of a media on the rise is as simple as scanning a conference crowd. A few in suits, particularly expensive suits, means the corporate types have arrived and there is money behind the platform. As the percentage of women rises, there is assurance that branding and marketing are not far behind. And there are few more reliable indicators that interested risk money extends beyond Silicon Valley to New York bankers, hedge funds and venture firms than a good number of attendees dressed in pressed khakis and button-down pastel shirts hoping they will blend in with the technical and creative types. The 1989 version of CD ROM may have been at the top of expectations but all the elements were in place to keep it there for a while.

Contrast the above with the first few years following the birth of AR. One telling example is the Augmented Reality Event, also known as the ARE Conference. This Santa Clara based conference bills itself as "the largest international event dedicated to Augmented Reality" and it probably is. Yet the first two years of the event were virtually the same, characterized by low turnout, similar or identical speakers, saying similar or identical things. So few venture capitalists attended that the panel devoted to risk funding consisted of one speaker and he wasn't investing much at the moment. Major corporate interest was limited to Qualcomm and a half-hearted Intel. And no marketing, branding or distribution types were to be seen. It is difficult not to conclude that Gartner's AR hype indicator has been over-hyped.

Against the above backdrop well over a thousand AR applications have been produced. Some are

extraordinarily innovative, some add value to existing landmarks, some bring convenience to everyday activities, some redefine social advocacy and, of course, many are silly marketing gimmicks. In hindsight we now know that CD ROM became an efficient way to distribute pre-produced software, music and film. And the interactive features morphed into the games industry. Yet the past may be a reliable guide to AR's future and, when it comes to AR, the past goes way back.

3 From Snow White to Avatar - Creators Drive the Technology

Walt Disney takes credit for the invention of the multiplane camera enabling the production of Snow White in 1936 [3]. A patent for this device was granted to Disney in 1940. Yet, like today, intellectual property is as good as your ability to protect it. It may be more accurate to say that the camera was re-invented, as a similar set-up had been used a decade earlier in Lotte Reiniger's 1926 animated feature *The Adventures of Prince Achmed* and again in Berthold Bartosch's 1930 film *The Idea.* The genius of Disney, like Cameron after him in the production of Avatar, is that he envisioned how multiplane animation could add visual value to a production and completely change the user experience. The ability to manipulate the background, foreground and character planes brought a visual richness to Snow While that simply hadn't been seen before. Cameron envisioned 3D to similar effect. The background plane created a rich virtual world as the environment for the foreground story. Both Disney and Cameron sought to integrate the planes of their respective technologies resulting in visual innovations separating them from the feature film pack.

Like Disney's camera and Cameron's 3D Avatar, Augmented Reality ushers in the possibility of true multi-plane data on a mobile device. The future will be defined by innovative designers, technologists, producers and storytellers as they bring innovative user experience to mobile media.

4 The Users Are Alright.

The early days of AR featured an ongoing discussion around the question, is it a platform or simply a mobile feature? The platform argument explains Gartner's projection that it might take as long as a decade for user adoption. But Gartner may be overly conservative, as AR becomes a feature built in to mobile devices. Today, over 100 million mobile subscribers own smartphones capable of accessing augmented reality. Almost half of U.S. subscribers own these devices and the installed base is similar over much of the world. The growth of tablets is even more aggressive with global end users reaching almost 70 million today and projected to grow to over 380 million in the next three years. The jury is in - augmented reality is a feature in the pockets of millions of potential users. What is needed now is compelling content.

If you build it will they come? Here, evidence is more valuable than projections. There is every reason to conclude that users not only would interact with interesting multiplane content but that they have already done so. In 1953 CBS introduced a children's television show called *Winky Dink and You*, later praised by Microsoft's Bill Gates as the first interactive TV show. For 50 cents children bought the Winky Dink Magic Kit containing the magic screen which was little more than a transparent piece of vinyl plastic that stuck to the television screen through static electricity, the magic crayons that, when prompted by the show, were used to draw on the magic screen and a magic eraser used to wipe the whole thing away. In each episode Winky Dink would be in a dilemma that could be solved by drawing an escape route, connecting the dots in a simple puzzle, displaying a partial picture which the viewers completed with their magic crayons or decoding secret messages half displayed and half created by

the viewers. While simple, multiplane media, augmented reality, had arrived

From 1953 through 1957 Winky Dink was a huge hit for CBS and if it weren't for an unfortunate glitch, Winky Dink might still be on the air today. The production came to an end in part over concern about x-rays from tube television. To complicate matters, the kids quickly lost their magic screen and took to drawing directly on their parent's new TV sets only to find that their magic eraser wasn't so magic after all. To make matters even worse, losing the magic crayons led to drawing directly on the television screen with markers, finger paint, even nail polish, leading to outraged parents and an embarrassed network. The program was a success. The technology was a failure. Yet the desire for multiplane visual experiences was proven, just make it engaging, make it fun, and involve the user - exactly what augmented reality enables today.

5 Let There Be Games

While more an activity than a game, *Roku's Reward* was widely seen as offering a hint at AR's gaming future [4]. Here, when the smartphone camera function was pointed at an urban environment, a city street, the environment became the background for overlaid game play. Gaming elements were added to the foreground plane. The most dramatic was a large boulder, a la the famous *Indiana Jones* scene, tumbling toward the player. The player has to physically jump out of the way or be virtually crushed, losing a life. A few other elements were added to the environment, targets on buildings that needed to be shot and, in an early nod to storytelling, a magical princess appeared to give the successful player a kiss. While unlikely to displace popular games, *Roku's* value might be in motivating other innovative designers and producers to experiment with two planes of data, pushing the boundaries of both AR, interactivity and potentially, gaming.

In the early days of any new technology, experimentation cannot be over valued. For almost a decade after the introduction of interactive CD, artists, producers and designers ignored the production manuals and pushed technology to its limits. Simple hypertext titles gave way to the beautiful renderings in *Myst* [5], rudimentary flight simulators paved the way for fully controllable driving and flying games. Innovative designers interleaved the original chapter stop CD design resulting in truly interactive experiences. When coupled with traditional, hand painted animation, the result was early interactive movies such as depicted in *Escape from CyberCity* [6]. There were no boundaries. And if production rules existed at all, they were ignored.

It was possible to produce a title, as they were then called, for a few hundred thousand dollars. Dozens of publishers and distributors sprang up all but assuring that these titles might find an audience. Simple activities became interactive, known board games were re-imagined, interactive education was born and new terms became commonplace; first person shooters, role play and adventure games, sports simulations and all stops in between. It was a golden age of technical and artistic experimentation. But technology doesn't stand still and the introduction of fully rendered 3D changed the gaming world.

3D technology truly put the player in the game. Motion capture was perfected enabling character animation nearly as lifelike as film. Sound went from a few blips and squeaks to stereo and surround sounds featuring background scores and interactive dialogue. Over time, the result was visually stunning often rivaling the best of film effects. But production budgets grew from six to seven figures and then into the tens of millions of dollars. The games industry adopted the Hollywood model where a few known titles became franchises and the market became dominated by sequels, each more technically stunning then the last. Sophisticated rendering was king. Technology won but experimentation slowed to a trickle and storytelling was lost along the way. Given the massive production and marketing costs, nothing on the horizon looked like it could disrupt the status quo.

And then in swooped a flock of *Angry Birds*. For almost two decades title franchises drove the platform market. The consumer needed an xBox for this and a PlayStation for that and the latest Nintendo system for yet another popular franchise. The strategy worked until it didn't. Mobile devices, particularly sophisticated smartphones and tablets,

changed all this. To turn Marshall McLuhan's famous *"the medium is the message"* on its head, the device became the message, changing the equation. Users wanted to play games but they weren't as interesting in small screen, truncated versions of know titles as they were in killing a little time while commuting, interacting with friends and children and perhaps tending a few crops. As mobile devices became the culture, the gaming market, as we knew it, was disrupted.

Might AR serve a similar disruptive role? Many factors are in place. There is a very large potential user base, tools are available and you don't need to be a software programmer to create an application. Distribution exists and large companies have a vested interest in new mobile technologies and particularly in engaging the mobile user. What is needed now is that age of experimentation and it looks to be upon us. Creators need to push the boundaries, enticing technologists to fully integrate the foreground and background planes of information and researchers need to address what it all means. What is the impact of multiplane visual display? Is the user experience different? Does real time display have impact beyond entertainment?

6 The Pervasive Power of Real Time Data

From its inception, academics, researchers, social activists and others sought to move gaming from its entertainment roots toward more socially relevant outcomes. Gamification became a catch all for efforts to apply game theory to education, and to simulations meant to enhance understanding; from climate change to the plight of the Darfur refugee. Participation was the key. A good game could grab and keep attention so that the user might fully focus on a specific topic in a distracting world. Jane McGonical in her bestselling, *Reality Is Broken,* explains that "compared with games, reality is hard to get into" [7]. Games motivate us to participate more fully in whatever we are doing". She goes on to explain the value of participation. "To participate wholeheartedly in something means to be self-motivated and self-directed, intensely interested and genuinely enthusiastic."

McGonical and many others have long extolled the value of full participation and the intrinsic rewards all humans crave; satisfying work, hope of success, social connection and meaning. Good games applied to meaningful outcomes can encompass all four and just might positively impact education, raising children, make social media rewarding and fun and add a game element to everyday life.

At first blush, it doesn't seem that augmented reality has much of a role in enhanced participation but, well beyond gaming, it has the potential to focus attention in real time and place. While it is too early to know the full impact, we cannot undervalue the impact of real time information. One telling example comes from Senagal and the Manobi Foundations efforts to improve the lives of rural African farmers [8]. The produce farmer was at the mercy of the middleman, they had little alternative but to sell their perishable crops, often at whatever price they could get and that price was meager. In the developed world, farmers typically receive as mush as 40 - 50% of the retail price for their crops. Even in the lesser-developed countries with transportation, storage and often corruption problems, farmers could count on about 25% of the retail price. In Africa they were getting under 10%. The farmers didn't have market information or pricing leverage but they did have mobile phones. Manobi put a person in each of the public markets and uploaded the wholesale prices in real time. The farmer simply clicked on an icon representing their crop, tomatoes for example, and received real pricing information. Armed with data, the farmer negotiated with the middleman. In a little over a year, annual income to the farmer more than doubled. AR makes this impact even easier, it can eliminate the need for the iconic database, and the camera function can recognize any crop, anywhere and, if pricing data exists, display it in real time. Useful information is as near as the phone.

AR's social impact can, and quite likely will, be far reaching. In many instances data exists but it is in the form of databases, white papers and research journals. It may be important but it is not accessible and never in context. Imagine standing on a beach or lakefront and just before entering the water, pointing the smartphone camera at the water's edge. The GPS function knows the location, and AR overlays the latest water quality information for that

location. AR can do that. Or environmental scientists at climate change conferences talk on and on about the impact of the oceans rising while entire low lying islands and countries try to visualize what it means to have a third or more of their land mass under water. How do they get attention? How can they motivate a call to action? AR can do that, too. With an *oceans rising* app, visualizing the impact of a rising sea becomes real, meaningful and location specific. Wherever existing data has an impact in real time and place, an AR app shouldn't be far behind. Many foundations are beginning to notice and, always seeking new ways to trigger emotional impact, the most innovative foundations are likely to be early adopters.

Beyond advocacy, AR can bring emotional impact to the existing world. Text recognition has become so sophisticated that the camera function can actually read. An application already exits that can translate printed text from one language to another but use won't stop there. *Portrait of a King* is an augmented reality memorial room installed in the House of King Peter l in Belgrade, Serbia [9] . Here the room becomes alive. When the camera is pointed at the installation, the scene comes to life with added information, photographs, manuscripts even short full motion video. AR becomes a window into a historical world. This type of installation can add life to monuments, presidential libraries and landmarks. Imagine the emotional impact of visiting the Vietnam Memorial, for example. Thousand upon thousands of names are engraved in black stone; it is all but impossible to fully understand the magnitude of the site. But, AR and its text recognition could access information about any of the individual names; perhaps a family remembrance, a historical document, a video history, a high school yearbook - anything that might bring life to the static environment. Here, AR can enhance the emotional reaction.

It is likely that these and more applications will be developed in the not so distant future. In the nearer term, product marketers have their eye on the technology. Capturing customer's attention in real time is a product marketer's dream. Imagine walking by a coffee shop and the smartphone GPS function triggers an AR overlay offering 20% off a latte, right now, just for you. The problem is if every storefront on the street or mall did the same thing the camera view would be a confusing jumble of bubbles and overlays. The hardware store next door to the coffee shop might be offering a special deal on chain saws but if I've already had a latte and don't need a chain saw, the data is useless to me, real time of not. We are going to need filters enabling the user to receive the visual information they want, when and where they want it. But this is likely a small bump on the road to the future.

7 Visual Layering and the Cognitive Effect

A far bigger bump leads to the behavioral researcher and cognitive psychologist. The cognitive impact of immersive real time information is not known. It hasn't been around long enough to be the subject of serious research. But we do have some clues and some concerns.

When it comes to media, any media, but particularly the new and visual, the role of the cognitive sciences is often seen as asking and answering very practical questions. When overlaying graphics, where should they be located on the screen? The top? Left margin? In the center? The researcher often goes on to look at color, shape, intensity and occasionally how sound enhances or distracts from visual display. These are interesting, even important concerns and, just as they apply to interface design, they apply to augmented reality. Johnson in *Design with the Mind in Mind* brings this point home. "In computer jargon, the human mind has only one serial processor for emulation mode, controlled execution of processes. That processor is severely limited in its temporary storage capacity and its clock is an order of magnitude slower than that of the brain's highly parallelized and compiled automatic processing. "Stepping away from computer speak, the brain just isn't very good at calculation and it doesn't seem to be designed for it"[10]. In fact, our brain isn't very good at quite a few things and to make up for these deficiencies, it seeks short cuts. Kahneman, in his discussion of *the priming effect,* introduces an interesting implication for the AR designer [11]. If the background plane is familiar where the camera view depicts an environment that

is known, the brain reacts entirely differently than if the view is unique and unfamiliar. The brain thinks it knows what is sees and attracting attention to the foreground plane is more difficult. Researchers in the aviation industry, working on heads-up display, have known this for some time. Here the act of flying is known and all but automatic. Data overlaid onto the cockpit window needs to be carefully designed as the brain may simply fill what it thinks it knows and ignore new information. Some games designers have found the same but through trial and error rather than cognitive research.

Basically, our brains are a bit lazy and gravitate toward activities that are automatic. We quickly and automatically recognize if an object is close or in the distance, we instantly know direction of a sound, we readily access knowledge stored in memory and recall it without effort. What we are not so good at is focused attention and when confronted by the unfamiliar, the brain has to do some work. AR asks the brain to understand and process information in different ways. Some of these different ways are understood but the less known will need to be further explored.

In a way, AR adds a new dimension to multitasking. It seems that walking down a street, smartphone camera at the ready, is a simple act. And while "you can do several things at once, but only if they are easy and undemanding" [12], and AR is demanding. At its best, AR demands attention - and multitasking is the enemy of focused attention.

Since the inception of television, teenagers have tried to convince their parents that doing homework while watching TV just isn't a problem. The parents retort that it is distracting, while true, doesn't hold a candle to multitasking today. It is common to work on a project, move away to check e-mail, jump to updating the Facebook page, return to the project, be interrupted by a mobile call, checks your stocks and as long as we are at it, water the Farmville crops. As Nicholas Carr in his bestseller *The Shallows,* describes it, "When we go online, we enter an environment that promotes cursory reading, hurried and distracted thinking, and superficial learning. It is possible to think deeply while surfing the Net, just as it is possible to think shallowly while reading a book, but that is not the type of thinking the technology encourages and rewards" [13]. While shallow thinking can be a bit of a problem, from the brain's perspective, it is more than that. Gary Small of UCLA's Memory and Aging Center cautions that our addiction to multitasking is changing the brain itself. He states, "The current explosion of digital technology not only is changing the way we live and communicate but is rapidly and profoundly altering our brains." In brief, we are losing the ability to pay attention. AR, at its best, demands that we do something that we are getting worse at. The designer has to take this into consideration. The best designs will need to stay away from data in the foreground plane that attracts the lazy brain. Visual data will need to demand attention and disrupt the brain's tendency to seek effortless information. Surprise will be the key.

In conclusion and returning to lessons from McLuhan [14], in the long run AR's content will matter less than AR itself. It will determine how we think and act, and like the Internet before it, alter perception, memory and the brain itself. These considerations impact design today and cognitive research tomorrow.

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Augmented Reality: Brain-based Persuasion Model

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Abstract. *Augmented Reality (AR) applications are unique in that they project virtual information into the user's physical environment. This blending of real and virtual changes the level of impact and persuasive power of the experience. Persuasive impact is the key to technology adoption and use. Traditional models of persuasion that focus on technology affordances or information processing overlook the importance of unconscious and instinctual level filtering on cognition and perception. This risks the underemployment of features that trigger critical instinct-level responses, such as pleasure, engagement, and satisfaction, which ultimately drive an application's commercial success. This essay argues that the triune brain model, increasingly adopted in marketing, leadership and product design, is a more effective heuristic for developers because it ensures the incorporation of persuasive principles, such as flow, narrative, and social influence in AR. I conclude by offering designers, developers and producers a brain-based checklist to enhance the persuasive power of AR applications.*

Keywords: Persuasion, augmented reality, triune model, three brain model, emotions, instincts, identity

1 Introduction

Technology is redefining our understanding of the persuasion equation. Until recently, the elements of persuasion were attributed to communication rhetoric; computers and technology were not seen as persuasive experiences independent of message [1]. The ubiquity of computers, tablets, and mobile devices that are increasingly customizable and interactive has drawn attention to the power of technology, devices, and objects to communicate experience, identity, and emotion [2]. Human contact remains the most effective means of persuasion, but technology can go beyond what people can do, by virtue of technology's portability and concomitant ability to be unrelentingly present and persistent as long as the power supply lasts. These potentials make understanding persuasion principles fundamental to the design of effective human computer interaction and interactive experience, such as augmented reality (AR).

Persuasion has been the topic of inquiry since Aristotle [3] and the definition continues to be debated [4]. The field of Captology, the study of computers as a persuasive technology, defines persuasion as the active endeavor to change another person's attitudes or behavior [1]. In the context of technology and human-computer interaction (HCI), persuasion is an intentional structure or action to influence, not an accidental side effect or the result of deceitful manipulation or coercion.

Prior to the public adoption of the Internet, the persuasive power of most software and technology received little attention [5]. This has changed as increasingly sophisticated technologies with lower costs and access barriers have enabled the society-wide adoption mobile and social technologies. By March 2012, over 80% of Americans owned a cell phone and 46% of Americans owned a smartphone, up 35% over the previous year [6]. Recent data from the International Telecommunications Union (ITU) estimates suggest that as of 2011, cellular coverage is available to 90% of the world's population, or 6.9 billion people [7]. Technologies continue to become more mobile, more customizable, and more interactive, and therefore, inherently more persuasive [8, 9]. Nowhere is this trend more apparent than in augmented reality applications.

Understanding the persuasive factors in the user-technology eco-system is a necessary component of design and development because both the adoption and outcome rest on the ability of the device attributes and content to influence user attitudes and behavior. It is also important to acknowledge that as the field of immersive technologies grows, it will be essential to address the intentional inclusion of implicit and explicit persuasive mechanisms and content to responsibly address inherent ethical and moral issues [10]. This can only be done by integrating psychology and ethics into the development and design process.

There is an implicit goal in every human-technology interaction. Individuals use technology

to satisfy their needs; technology is designed to facilitate human behavior and goals. The implicit goals in persuasive design can be subtle, such as design structures that help people to navigate effectively on a website, or overtly purposeful, such as software or device-supported time management. Users also experience the interaction holistically, often independent of the goals, accompanied by an emotional response. A successful and rewarding experience reflects positively on the user's sense of self-confidence and self-efficacy, increasing their self-image. This in turn influences the user's attitude and liking for the application and their willingness to recommend and reuse. A disruptive, frustrating, or ineffective interaction challenges the user's self-competence. This 'attack' on the ego creates cognitive dissonance that is quickly resolved by rejecting and publicly criticizing the application [11, 12]. Psychologically positive user experiences create an upward spiral of mutually reinforcing rewarding experiences. Negative user experiences don't spiral; they crash.

Growing user control and expanding technological capabilities that allow the delivery of rich content and social connectivity increase the potential for persuasive experiences. Accordingly, AR applications are highly persuasive technologies, as they enables the on-demand addition of virtual information to a user's sensory perceptions and create opportunities for immersion, simulation, and interaction [13, 14].

2 Brain-based model of persuasion

The critical component for persuasion is engagement—the ability to attract and keep attention—no matter what the technology. All physical and psychological experience, including our ability to notice and attend, is first filtered and then constructed by subconscious sensory processing systems [15], therefore persuasion, as the outcome of attention, starts in the brain [16, 17].

2.1 The triune model of the brain

In the 1960s, the neuroscientist and physician Paul MacLean proposed the triune, or three brain hypothesis [18] that has been increasingly adopted by the fields of marketing ('neuromarketing'), design, and leadership [19-23] . While simplistic relative to the physical complexity of the human brain, this model highlights instinct-, emotion- and identity-driven motivations and provides an accurate and useful framework for understanding and triggering human response to different stimuli and experiences [24-27]. I suggest that the three-brain model is a powerful approach for understanding the persuasiveness of AR, because AR applications integrate virtual information with direct multi-sensory experience and create multiple conscious and unconscious entry points of engagement and influence.

2.1.1 Unconscious and conscious thought: instincts, emotions and identity

The human brain evolved new capabilities over the millennia by layering functional areas on to its physical mass. The result is a composite of evolutionary progress [28]. MacLean's three-brain model links the differences in the behaviors from each major functional area to the evolution of animal life, arguing that the brain effectively has three parts that are representative of their stage of evolution: the reptilian or old brain, the emotional center or mammalian brain, and the neocortex or the new brain, as illustrated in Figure 1 [29].

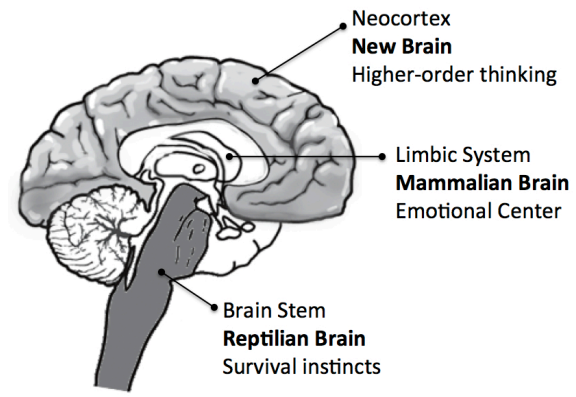
The most primitive sections of the brain, the reptilian brain and the mammalian brain, operate subconsciously. The reptilian brain, comprised of the brain stem, mid brain and basal ganglia, is the oldest and most primitive. It controls instinctive physical behaviors, such as breathing, as well as survival-related responses such as aggression and fear. Although primitive, the reptilian brain is highly sensitive to proximity, self-relevance, reward, and threat. It continually monitors the environment for potential danger by assessing change, and identifying patterns and familiarity.

The emotions were the next functions to develop in the brain. The mammalian brain is the emotional center located in the limbic system, which includes the amygdala, hippocampus, hypothalamus and other structures. It mediates social emotions such as attachment, liking, love, pride, guilt, shame, and scorn as well as behaviors related to maternal nurturing and play [30-32]. Where the reptilian brain responds to primitive, physical-survival instincts, the mammalian brain supports the survival of the organism through socially-based emotional response and the drive for social connection. Together, the reptilian and mammalian brains are responsible for instinctive responses that activate multiple physical and emotional systems for quick reactions, such as fight or flight or protecting offspring [33].

The third part of the three-brain model is the neocortex. From an evolutionary perspective, the neocortex is the newest part of the brain and is what distinguishes humans from other mammals [34]. It is the center for conscious thought, such as conceptual, higher order learning, language, problem-solving, sequential thought such as planning, and the ability to have conscious awareness of a 'self' and identity

that are central to concepts such as self-esteem, self-efficacy, and agency [17].

Figure 1. Triune Brain Model



These distinctions in functionality represent the dichotomy between primitive brains' unconscious holistic cognition derived from sensations, bodily symptoms, drive and emotions [35], and the 'new' brain's conscious analytical, linear processing of information. The unconscious brain speaks the language of image and feelings and can experience only the present. By contrast, the neocortex consciously processes information as what Bertrand Russell famously described as 'knowledge by description' versus 'knowledge by acquaintance,' or knowledge that results from judgment and interpretation rather than from direct sensory awareness [36]. This is a relevant distinction for AR as technology becomes more experiential.

2.1.2 Theoretical links: Brains as information processors

The triune brain theory can be mapped to several psychological theories of information processing and persuasion. The unconscious versus conscious processing of information in the triune theory is analogous to William James' [37] theory of awareness as a composite of the focused attention, or nucleus, and the unattended awareness, or fringe. The preconscious processing of the reptilian brain can also be equated with Daniel Schacter's [38] implicit knowledge — things we know that are not in awareness — and with Ulric Neisser's [39] investigation of attended and preattended content. It can also be seen as the difference between direct perception and information 'pickup' as applied to visual perception by James J. Gibson [40].

Comparably, dual pathways theorist Chaiken's [41] Heuristic-Systematic model posits that people process information in both systemic and heuristic ways where systemic processing is attended and intentional and heuristic processing involves patterns and cues that unconsciously influence a decision. The Elaboration Likelihood Model (ELM) similarly proposes multiple routes for message processing [42, 43]. In the ELM model, commonly applied in marketing research, messages received in the central route receive careful scrutiny and evaluation, where messages received in the peripheral route are not consciously processed but may exercise significant influence in unpredictable ways [44].

2.2 The benefit of the brain perspective

The triune brain model, unlike dual pathways persuasion models, places the emphasis on the relative influence of the conscious/direct versus unconscious/peripheral pathways to persuasive processes. The triune model stresses the dominance of the reptilian brain in information filtering and subsequent research has supported this contention, demonstrating that initial preconscious processing is responsible for as much as 95% of decision-making [24, 45]. Thanks to the philosopher Descartes, we are culturally predisposed to think of the brain and body as separate [17, 46]. There is ample evidence, however, that thoughts, emotions and the body are mutually influential [16]. Advances in neuroscience and brain scan technologies, however, support the application of the triune brain model to understand how motivation, trust, and attitude change can activate the brain. Researchers have applied fMRI (functional Magnetic Resonance Imaging) and measured the level of the reward system neurotransmitters, such as oxytocin, to track the way the brain receives and responds to different messages and images. They have been able to track positive emotional responses to stimuli such as puppies, babies and even Twitter retweets [21, 30, 47]. The unconscious brain response translates into many daily experiences. Studies show, for example, that stress interferes with sleep and digestion, petting a dog lowers blood pressure [48], and when someone smiles at another person, mirror neurons trigger a smile response that is accompanied by a chemical pay-off through dopaminergic reward systems in both people [49, 50].

Psychologist Jonathan Haidt [51] provides a useful visual metaphor of an elephant and a rider to illustrate the imbalance of power between the brain's instinctive responses as the giant elephant and the conscious brain's abilities as the small rider to control attitudes and behavior. While the separate systems of the brain are inextricably linked through the continuous communication of neurotransmitters, the strength of instinctual processing at the

unconscious level dictates most decisions and actions [34].

No matter their origin, persuasive effects operate at multiple levels simultaneously, from motivating initial product engagement and ease of use (e.g., can an individual easily and effectively use a device?) to specific targeted behavior or attitude change (e.g., will this help the individual achieve a goal, such as an eating healthier?). Fogg makes the distinction between macro level persuasion that has a distinct persuasion-based outcome goal, such as smoking cessation, compared to the micro level persuasion that is inherent in usability design that increases productivity and enhances the subjective experience, such as self-efficacy, of the user [1]. At any level, the goal or desired outcome of an application is for an individual to process a persuasive communication so that it becomes internalized into his/her core belief system to achieve an attitude or behavioral change at some level. In other words, the AR experience must be immersive and seamless. For this to happen, the AR application must arouse the primitive instincts in the reptilian brain. Based on the three-brain model, this can only happen if it the application is clearly relevant to the user, solves a problem, offers a reward or poses a threat.

3 AR

AR uses technology to augment real world environments by overlaying virtual information, on demand, that expand the user's sensory perceptions with the three-dimensional registration and integration of digital data [52]. The persuasive power of AR lies in its ability to create immediacy and relevance by shifting the loci of control and interaction through situated simulations within the control and environment of the user. Combining visual simulation of data in situ creates and enhances meaning and engagement [53]. The on-demand, self-generation of the experience promotes positive affect. The threat or reward is, to some degree, content dependent, however, the act of generating the virtual overlay creates a micro persuasive effect of increased self-efficacy for the user and triggers a reward response in the brain at more than one level [54].

The AR experience, once cumbersome and costly, is now increasingly accessible at little or no costs to nonexpert users through applications on smartphones and computers. Companies such as Total Immersion[1] and Metaio[2] are racing to develop AR platforms and applications for customer demand to incorporate AR experience into everything from product visualization and marketing [55], therapeutic interventions [56], education [57], tourism [58], to AR events, games and entertainment [59, 60]. The continuing development of increasingly robust mobile devices has untethered AR technology, increasing mobility and the sense of user control through enabled compass functions and GPS-based and object recognition-based experiences[3].

In contrast to virtual reality, whose mass adoption is limited by its relatively intensive equipment and immersive requirements and frequent individual resistance to 'simulated reality' [61], AR is additive, layering virtual information over the real world, allowing it to be displayed in a spatial context [62], creating less cognitive dissonance and, therefore, easier adoption. The combination of mobility and cognitive ease, along with the increasing focus on 'qualitative customer experience'[4] predicts that the rising trend AR use will continue. As AR applications become widely applied, it will be increasingly important to understand the way the brain engages with AR applications to effectively and responsibly integrate persuasive design experiences.

4 Applying brain-based guidelines

The triune brain model suggests three main areas of focus for targeting design and analysis, one for each level of the brain: instinctual responses, emotional responses, and identity responses. They can function independently, but, given the inter-relatedness of the brain, are more often simultaneous and mutually reinforcing.

As described above, the primitive reptilian brain is only focused on information that directly impacts survival: immediate relevance followed by reward or threat.

4.1 Relevance and reward

Recognition and immediacy determine whether information in the environment will trigger the attention of the primitive brain. Human brains are wired to notice indicators of danger; this includes change and contrast, things that are new or unusual, emotionally as well as perceptually. As the reptilian

[1] www.t-immersion.com
[2] www.metaio.com
[3] www.layar.com
[4] Personal reflection from Transmedia Hollywood3 Conference, Los Angeles, CA April 3, 2012 as repeated theme across full day of panels made up of multiple industries: marketers, media producers, media scholars, and entertainment professionals.

brain scans the environment for patterns and movement, the appearance of an AR simulation with rich media produce novelty and change, enhance attention and physical arousal, and make delivered information more salient, memorable, and actionable [21].

Once information is attended, cognitive processing continues by comparing new information to previous experience to determine the level of reward or threat. The more familiar the information, the less likely it is to trigger a threat response, and the more likely the brain is to interpret the stimuli as positive or being of value. Content is perceived as self-referent and suggests similarity in addition to relevance delivers increased perception of value [63]. Historically, our likelihood of survival was increased by affiliating with those things most familiar to us, from people to environments. The ability to self-reference and self-identify leads to a favorable evaluation of a product or experience no matter what the quality of content logic or information. Similarity increases relevance and positive perceptions, or 'liking' [13, 64, 65]

AR applications are on demand, enhancing the sense of control (safety) and personal investment (identity) [66]. The content is, by definition, self-relevant because it is pulled to the user on demand, not pushed as in traditional advertising. Useful and accurate content provides a solution to a problem or question, creating a sense of safety and enhanced self-efficacy. Additional preferences give the user control over how the information is displayed. The user has choice over exactly where, with whom, and on what device to activate and experience the information. The sensation of success and control by the reptilian brain is processed as reward and triggers positive emotions (pride, happiness) through the dopamine system [67] and is translated by the conscious brain as successful, personal validation and efficacy (identity) [68, 69].

4.2 Emotion

AR has the ability to tap multiple levels of emotion by linking the affect in present experiences with triggers from virtual experiences. Visual representations are the most effective ways to trigger emotions. Over 50% of the cerebral cortex is devoted to visual processing [70]. The visual system evolved with the haptic nervous system and, therefore, a large proportion of tactile signals trigger the visual cortex [71, 72]. Virtual responses activate the same neural networks as real experiences, recalling all associated sensory and emotional memories, thus virtual overlays will meaningfully enhance emotional and somatic experience [70]

4.3 Social connection

Social needs are some of the most powerful forces in persuasion. Humans are neurologically-wired to seek social attachment [73]; they are acutely sensitive to social perceptions, inclusion, acceptance and rejection [74].

The pattern-seeking reptilian brain looks for meaning in the environment and is particularly attuned to the arrangement of shapes suggesting human faces. This socially-oriented biological predisposition also causes humans to attribute personalities and motivations to others, both humans and nonhuman, such as animals and objects [75]. Consequently, people are not only able to see human faces in everything from the moon to potato chips and attribute complex emotions to pets, but the act of anthropomorphizing even inanimate objects, such as computer devices creates a genuine emotional attachment and enhances the persuasive effect [76].

The human predisposition to attribute human characteristics to objects and devices suggests that AR applications can leverage social rules and dynamics when they successfully reinforce human attributes and interactions, such as the social conventions of praise or support enhanced by the proximity and blended reality of content projected into the user's physical space. The reptilian and mammalian brain responses, biologically driven to seek affiliation, interpret these as genuine social behaviors and social exchange, activating the powerful persuasive effects of the rule of reciprocity, that we must return favors to others, and social validation, that we are valued by others in our group [13].

The mobility of AR also allows for collaboration among users locally and virtually. Connected to social networks, AR applications can leverage the impact of social proof, that people are influenced by what others around them do, and affiliation or social identity, that we are similar to others we value. Researchers have shown correlations between behavior change and neural activity in regions involved in monitoring social perceptions and have affirmed the role of social factors in the persuasion process [77, 78]. Behavior change is correlated with increased neural activity in areas involved in memory, attention, visual imagery, motor execution and imitation and affective experience. This is consistent with theories of social learning and persuasion suggesting that behavior change can result in social norms into self-concept [77], underscoring the roles of safety, connection, emotion and identity represented by the three brain theory.

4.4 Identity

The new brain categorizes and interprets the information it receives from the unconscious brains in order to commit it to memory for future recall. AR can have powerful impact on conscious cognition through the psychological experiences that enhance identity: self-efficacy, competence and validation [11, 79]. Successful experiences retrieving and manipulating data and being able to act successful and pleasurably result in goal achievements. Sense of reward can be minor, such as ease of use or finding a local coffee shop, to larger milestones such as achieving weight loss. The positive achievements will be reflected both in self-image and in product appreciation and loyalty [12].

4.5 Persuasion using narrative

The most powerful method for coherently engaging all levels of the brain is through narrative. 'Story' may sound unscientific, but stories (or narratives) are how the human brain organizes information. Stories create authentic human experiences and they are how humans have passed online culture, knowledge and social norms from generation to generation throughout history. Narratives leap frog the individual attributes of technology by creating a holistic experience that engages the brain at all levels: instinctive, emotional and identity [80, 81]. The experience of narrative immersion inhibits cognitive challenge and increases the potential for persuasive influence. AR is inherently a narrative experience because, beyond the content, the act of engagement brings AR into the user's reality and personal story.

Stories take place in the imagination but they are a multisensory experience. The brain processes imagined experiences using the same physical and neural mechanism as real ones, creating genuine emotions and sense of place in AR applications [82].

Cognitive psychologists use terms such as schemas, scripts, cognitive maps, mental models, metaphors, and narratives to describe the processes individuals use, consciously and unconsciously, to construct meaning and integrate our experience so it can be stored in memory [e.g., 83, 84, 85]. In order for something to be committed to memory, it has to have context in a linear structure that can be enriched and linked with multisensory information, for example, 'A happened, then B,' or 'C happened with D because of E.' Isolated facts are not retained; stories are the mnemonics for memory retention, creating neural networks for future recall and reactivation.

The creation of a narrative allows an individual to find the shared meaning (relevance), connection (emotion) and step into an experience as a character (identity). This is what creates an immersive experience and enable the ability to feel empathy and envision new opportunities for ourselves, while simultaneously reducing negative cognitive response and increasing positive affect [86].

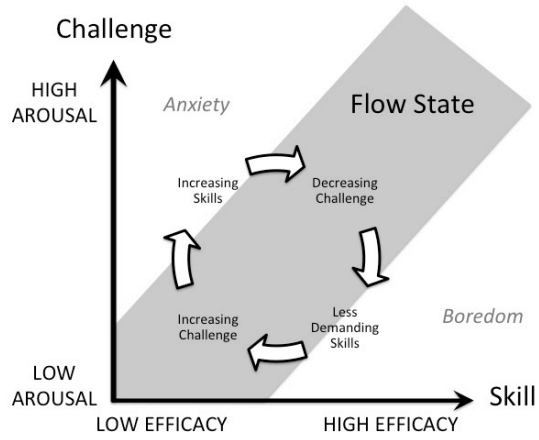
Narrative transportation theory describes persuasion as a function of an individual's ability to process information and messaging in the context of narrative [87] that also supports self-referencing. Self-referent processing is the cognitive process by which each person compares new information to his/her existing memories, beliefs, feelings, and experiences in order to give it context and meaning [64]. When information is salient, i.e. it can be linked to self-referent meanings, it has been shown to enhance learning, memory, and recall [e.g., 88].

AR is the ultimate 'product placement' because it links real life with virtual objects and stories [63]. Persuasion research has primarily focused on consumer processing of rhetorical product messaging (ads) rather than examine the narratives within which the placements occur. With narrative transportation and AR, however, the user has the opportunity to lose him/herself in story with the product as a companion on the journey [89-91]. Green and Brock argue that mental immersion is persuasive because it leads to disinhibiting of the critical thinking functions and heighten affective responses [92, 93]. In other words, it activates and engages the primitive brain levels that are driving decision-making. Escalas confirmed this where audience members were able to imagine themselves as the 'star' of the narrative [14]. Heightened affective responses led to more favorable evaluation of the experience, ad, brand or product.

4.6 Persuasion and optimal experience

The triune brain model can also be used to contextualize persuasion in the theory of optimal experience as defined by Csikszentmihalyi in his theory of Flow [94]. Flow is the state of complete engagement where the challenge of an activity matches the skills of the user at the level that requires effort and concentration yet is within the boundaries of the user's capabilities [see also, 95]. This balance creates a zone of "flow" that increases opportunities for persuasion by inhibiting cognitive opposition and creating positive affect.

Figure 2: Brain-Based Model View of Flow



Maintaining flow requires balancing the challenge of an activity with the requisite skill level for successful accomplishment, as shown in Figure 2. Imbalance results in either boredom or anxiety and disrupts the feelings of flow. Applying the triune brain model lets us conceptualize the flow process as a primitive balance between threat and reward. The challenge of an activity must be difficult enough to achieve arousal to generate attention and concentration of the reptilian brain without escalating arousal to a level that is perceived as a threat to survival. The skill and challenge equilibrium must work within the zone that enhances self-efficacy to trigger the dopaminergic reward system and bolsters identity and self-esteem at the conscious level. Challenges that overwhelm skills threaten identity and self-competence, triggering the threat response unconsciously which is interpreted as dislike and frustration, consciously [96].

Unconscious negative experiences create a cognitive challenge to individual identity. This cognitive dissonance is resolved by preserving a positive sense of identity and attributing the negative experience to the activity, application or experience [97]. The flow state can also be equated to narrative immersion with similar impact on persuasive effects [98, 99].

5 Implications for design and development

The application of the triune brain model of persuasion has implications for design decisions throughout the development process as summarized in Table 1. (For a discussion of a decision-tree and evaluation matrix that integrates brain-based theory for optimal user experience, see Rutledge and Neal, 2012). Designing for the brain means following the neurological processing path in order to align design decisions with innate biological priorities and attention hurdles. In other words, start with old brain considerations.

5.1 Old brain design considerations

1. Use emotion.
2. Trigger multiple senses using image and use visual rather than textual cues. Images are processed 40 times faster than other sensory input.
3. Highlight the pain and gain. Fear of loss is often as persuasive as possibility of gain.
4. Provide a clear path to task accomplishment and reward to avoid uncertainty and fear of failure.
5. Make everything user-centric and personal.

5.2 New brain design considerations

Once the old brain is engaged, the new brain will respond to stimuli that impact identity enhancement. To integrate new brain considerations:

1. Provide skill-building opportunities with responsive feedback to shorten the behavior-reward circuit and increase self-competence.
2. Integrate success markers to provide social validation and trigger the brain's reward systems.
3. Allow for participation, content creation and collaboration to create social reciprocity and a sense of personal commitment through ownership.
4. Build in a narrative structure to engage old and new brain processes simultaneously by triggering emotions and creating empathy, ownership and presence.

Table 1. Brain-Based Design Guidelines

OLD BRAIN	NEW BRAIN
Emotions	Skill-building
Visual images	Responsive feedback
Pain and gain	Participation, ownership
User-centric, personal	Social collaboration
Certainty	Empathy
← Narrative →	

6 Conclusion

There are several persuasion models. Because the human brain filters and processes most

information unconsciously, the triune brain model provides a clearer framework for evaluation of the experiential and social characteristics of AR. Traditional dual processing models fall short because they don't provide a heuristic for the relative imbalance of power of unconscious versus conscious processing on persuasion and decision-making. Unlike other media technologies and applications, the features and structure of AR applications take advantage of this imbalance of power by allowing new information to be delivered to the user's environment upon demand as he/she moves about the world. The ability to merge the virtual information with real experience enhances the ability to persuade by delivering relevance and newness. The brain enhances the power of AR because it unifies and amplifies the combination of sensory input overlaid on the real world. AR also provides positive affect through introduction of media rich channels, and enhances individual sense of self-competence and identity through the successful manipulation of information in situ. The three-brain model gives designers, developers, and media strategists an effective heuristic to understand and apply the principles of persuasion in order to leverage the unique capabilities of AR for effective applications that deliver meaningful user experience.

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Ethical Considerations in Augmented Reality Applications

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Abstract **–** Augmented reality (AR) is a powerful technology that has a direct effect on the end user experience. AR is a persuasive technology that is already having direct impact on the end user, all the while collecting information about them and their actions. AR is currently being used to advise, inform, track, manipulate, entertain and persuade the end user while collecting and utilizing their data. This technology raises significant ethical concerns. Some of the ethical concerns include how end users will be affected, manipulated, persuaded, or informed by the technology. Further, there are ethical concerns about the use of end user information, privacy and privacy protection. Finally, due to the immersive and persuasive nature of AR applications, the actual physical safety of end users and those around them becomes an ethical concern. Some ethical guidelines are presented for consideration.

Keywords: augmented reality, ethics, legal considerations, persuasion

1 Introduction

Augmented reality (AR) is a technology that currently utilizes visual and auditory information to instantaneously enhance the end users' experience through various digital technologies in a potentially powerful way. AR is growing at a rapid pace and will continue to become more pervasive [1]. It is a persuasive technology that is already having direct impact on the lives of end users and, potentially, bystanders as well. Because of the interactive nature of this technology, it has the potential to engage and immerse the end user, all the while collecting information about them and their actions [1, 18]. AR is already being used to advise, inform, track, manipulate, entertain and persuade the end user while collecting and utilizing their data.

While this technology provides incredible opportunities for developers, businesses, marketers, and end users, it also raises significant ethical concerns and question. Some of the ethical concerns surrounding AR include how end users will be affected, manipulated, persuaded, or informed by the technology. Further, there are ethical concerns about how information about the end user is being collected and used by the application, and ultimately those who design it, pay for the design, and pay for the information. Issues of personal privacy and privacy protection abound. Further, due to the immersive and persuasive nature of AR applications, the actual physical safety of end users and those around them become an ethical concern.

This paper will explore various forms of augmented reality applications, and the potential ethical concerns they raise. Further, this paper will discuss ways for designers, developers, marketers and businesses interested in utilizing AR technology to determine their role in addressing ethical issues.

2 AR Applications Are Persuasive

Persuasive computing, or CAPtology (Computers As Persuasive technology) is the designing and use of technology with the specific intent of influencing or modifying behaviors, values or attitudes [1, 2]. Augmented reality (AR) falls within the definition of persuasive technology and computing [1, 3, 4]. Following this logic, the theories on ethics from the field of persuasive technology can also be applied to augmented reality.

Almost all AR applications contain some sort of persuasive element or are designed with the direct intention of persuading the end user in some way [3]. Persuasive intention in AR applications can be as simple as a prompt for the end user to click a button to move on in the application, or as complex as a series of activities and directives in the application with the intention of having the end user change a typical behavior, or develop a new attitude about a product or idea [2, 3]. AR is a powerful tool for persuasion because it can create a convincing experience that changes our thoughts and perceptions, and thus behaviors, by changing how we see, expect, interact with and experience the world around us [1, 4, 5]. It is because AR applications have the potential to be such powerful persuasive tools that ethical concerns are significant.

2.1 AR Applications Are Better Persuaders

Augmented reality applications are functionally better at persuasion than humans for many reasons and, therefore, more likely to be successful persuaders [1, 2, 3]. The main reason the applications are better persuaders is AR applications can simply do things humans cannot. AR applications are more persistent [1, 4]. When human persuaders give up on their persuasive attempts, technology can continue without such concerns as losing their voice, offending someone, taking too much time, experiencing cognitive dissonance or giving in to resistance towards their persuasive attempts [2, 3].

AR applications are anonymous [2]. When designing a persuasive AR application, those behind that application can generally remain personally anonymous. This provides an advantage over human persuaders who are likely to be directly involved and immediately identifiable with those whom they are trying to persuade. This creates an opportunity for the human persuader to be less effective based on the responses and interactions with their targets [2, 3]. AR applications have a virtually unlimited ability to store and manage data [2]. Whereas human persuaders are limited to the amount of data they can memorize and recall, AR applications can store, access and cross reference data sources with high speed and little error [2, 3].

AR applications have a virtually unlimited access to multiple modalities of influence and the ability to seamlessly switch between them [2]. While human persuaders may be familiar with many types of persuasive techniques, they may not be able to recognize when it is time to change techniques, or which is the most appropriate technique based on the present situation. AR applications can be programmed with numerous techniques and can seamlessly move between those techniques with expertise based on the situation, including end user input and feedback, geolocation information, and many other types of data [2, 3].

AR applications are easily scalable [2]. While human persuaders may not immediately recognize the need to adjust their persuasive attempts, AR applications have the ability to immediately increase, decrease, or maintain persuasive efforts based on the feedback and other information they receive from the end user [2, 3]. Finally, AR applications are better than human persuaders because the platforms that utilize AR applications, such as smartphones and tablet computers, are ubiquitous [2]. While human persuaders have to be in the right place at the right time they can certainly not always be in the right place and time. AR applications, because of the devices they are employed on, and their ability to utilize timing, user data and GPS, are able to offer persuasive opportunities at nearly always the right time and place [2, 3, 5]. Taking these abilities together, AR applications provide developers an powerful tool to persuade end users. This necessitates the need for careful scrutiny about the uses and potential ethical dilemmas that may exist.

2.2 Unique Ethical Concerns of Persuasive AR Applications

While persuasion is commonly used, the more general question remains: Can persuasion be considered unethical? The answer is yes. As a persuasive technology, AR applications have the ability to intrude into people's lives and to manipulate them [6, 9].

There are several areas of consideration when examining the ethics of an AR application. Some of these areas should lead to further review of the intentions of the application while others should cause immediate concerns to be raised. AR, as a persuasive technology, carries unique ethical implications that are described in the following subsections.

2.2.1 Novelty

AR applications are relatively new and novel. The persuasive intentions of the designers can be masked or completely hidden [2]. Frequently, because of the novelty the persuasive elements are not immediately obvious. If an end user is unaware that persuasive attempts are being directed at them in the application, then he or she is no longer an informed or willing participant. The persuasive efforts are then considered covert, questionably unethical, and potentially coercive [2, 3, 6].

2.2.2 Positive Reputation Exploitation

With literally hundreds of millions of smart phones and tablet computers being sold worldwide, and people waiting in massive lines to obtain a new product on launch day, it is safe to say that many of the devices that run AR applications have positive reputation. Due to this positive relationship, there is a built-in trust with many aspects of the devices including the applications that can be utilized on them [2]. This creates an opportunity for persuasive AR applications to exploit the trust the end users have in their devices, applications and information being delivered [2, 6]. This exploitation opens possibilities for persuasion to be carried out covertly, or in other unethical fashions such as the use of deception [2, 3].

2.2.3 Persistence

As previously discussed, AR applications have the ability for unlimited persistence [2]. Long after human persuaders have lost their voice, run out of ideas, or simply lost the attention of the target, AR applications can endlessly prompt the end user for action and attention. This can be done through pop-ups, reminder alerts, continuation prompts, texts, and emails [3]. The ethical concern arises when the end user is repeatedly bombarded with persuasive elements that are difficult to avoid [2]. Because AR applications can utilize user patterns, GPS, and crucial timing, the repeated persuasive efforts can be extremely effective, but must be examined carefully for potentially unethical effects it has on the end user [3].

2.2.4 AR in Control

When dealing with human persuaders, people have the ability to question, recant, debate, and argue with the persuader. This ability for a truly interactive encounter allows for an element of control by both parties involved [2]. When dealing with a persuasive AR application, however, there is limited or no ability for the end user to engage in such opportunities. The only engagement available is what is programmed into the application. This makes the persuasive intent one sided and takes a significant element of control away from the end user [2, 3]. The lack of control is potentially unethical, particularly if the end user is unaware that they have no true control in the situation.

2.2.5 Emotions

AR applications have a tremendous ability to utilize persuasive techniques that can affect the emotions of the end user; however, the reverse is impossible [2]. Human persuaders are able to observe various cues displayed by those they are interacting with, including physical, emotional and verbal cues, and thus modify their techniques to ensure a more ethical exchange and outcome [2]. AR applications are at a significant disadvantage as they currently are unable to observe these types of cues without direct end user input, and are therefore unable to adjust their techniques in the face of these cues [3]. If an end user is uncomfortable with the techniques being used at that moment by the AR application and has no ability to modify it, then it is potentially unethical [2]. As technology continues to evolve, AR applications may gain the ability to observe, read, and react to physical cues such as facial changes, eye movement and pupil dilation, which signal an emotional response, thus allowing it to modify the persuasive techniques being utilized.

2.2.6 Responsibility

The ability to take responsibility for one's own persuasive actions creates an interesting dilemma for AR applications [3]. A human persuader is clearly able to take responsibility, or at least to be held accountable, for their persuasive actions [2]. Human persuaders can make adjustments, apologize, and make restitutions for any unethical actions they may engage in. AR applications, on the other hand, have no ability to accept personal responsibility, which creates potential for an ethical dilemma [2]. Designers of AR applications can face legal responsibility for any damages their product causes [7, 8, 9, 10]. However, there have been no product liability cases as of the writing of this paper [8, 9, 10, 11]. Fogg states it may be difficult to seek accountability from those who develop the applications as they may have absolved themselves from the application, or the company may be out of business [2]. To complicate matters, because the Internet can perpetuate software applications long after a developer is out of business, it creates further dilemma for assigning responsibility and seeking restitution for someone who has suffered some sort of harm from the persuasive application long after the company has closed [2].

2.3 Questionable, Concerning, and Dangerous Persuasive Techniques

While persuasive techniques are commonly used without significant concern, and have significant positive outcomes, there are several types of techniques that can be utilized in persuasive AR applications that require attention. When these techniques are observed, they should cause concern for end users, and developers alike [3]. Though these techniques should raise attention and scrutiny it does not necessarily mean they are being used in unethical ways, so caution is required when utilizing and interacting with them [4]. Finally, there are some techniques that should always be considered to be unethical and should be avoided [2]. Examples of these techniques are presented in the following subsections.

2.3.1 Operant Conditioning

Noted behaviorist B. F. Skinner developed the theory known as Operant Conditioning. Briefly, it is the theory that you can modify behavior (persuade) through repetition paired with reward and punishment. It is generally acceptable, and common, to reward an end user of a persuasive AR application for completing a requested task, following directions, or modifying a targeted behavior. However, the use of punishments in an attempt to modify behaviors, or force an end user action, is typically considered to be unethical [2, 3]. Such use of punishments, or negative reinforcements should be avoided.

2.3.2 Surveillance

Surveillance is another persuasive technique available to an AR application that should raise suspicion, depending on the context and purpose for its use [2]. Fogg states that as long as surveillance is being used in a way that positively reinforces or is helpful, then it can generally be considered to be positive [2]. However, if it used in order to covertly observe, collect private information, or to punish, then it should be considered unethical and should be avoided [2, 7].

2.3.3 Vulnerable Groups

Another use of persuasive AR applications that should be scrutinized is any use that attempts to persuade members of a vulnerable group [2]. Such groups include children, the elderly, those in poverty or of a low socio-economic status, the developmentally disabled, the intellectually challenged, and the mentally ill. This technique should be examined for its persuasive intent. If the intention is to reward or positively reinforce the actions of an end user in a vulnerable group, then it is generally not considered to be unethical. However, if the intention appears to attempt to exploit or punish, then it should be considered unethical and should be avoided. In some cases where exploitation is obvious, reports should be made to advocacy groups, and in some cases, such as child pornography, the police, to ensure the safety of those being exploited.

2.3.4 Coercion, Punishment and Deception

While some persuasive techniques are open to debate and scrutiny as to their ethical use, coercion, punishment and deception are considered taboo [2]. These types of persuasion involve forcing end users to make a choice, usually with a threat of a negative consequence, or by blatantly lying to them, which ultimately only benefits the application developer, or advertisers. These techniques force end users to do things they normally would not do, and something they likely do not want to do. Techniques involving coercion, punishment and deception are always unethical and could

potentially be dangerous and illegal depending on the outcomes of their use.

3 Privacy

In the limited number of published articles on AR and ethics the topic that appears most frequently is that of privacy [3, 6, 7, 9, 11, 12, 13]. Privacy in the United States is protected by federal law under the Constitution. When it comes to mobile technology privacy remains a key concern to consumers [7, 8]. Many anecdotal reports in the media claim that most consumers, especially those younger than 30, are less concerned about their privacy rights, and are willing to increasingly give them up for improved access to mobile and online content and applications [14]. However, in one of the first scholarly articles written on the subject the opposite was found to be true. While younger consumers are more active users of mobile applications, and participants in online networks, they continue to have similar views to those of consumers over 30 when it comes to their privacy, norms, and policies. Further, they report their privacy continues to be of great value to them and of significant concern for protection [14].

Even if younger consumers are not as concerned about private data, applications developers must be. Personal and private data collection of the end user remains a significant point of ethical concern in AR applications. With developers, advertisers, and retailers trying to figure out the most effective way to gain consumer attention, end user data becomes very valuable [7]. Developers of AR applications are often eager to obtain as much hard data as possible on how to effectively engage, maintain, and persuade their end users with their product [7]. Such data allows products to be better tailored to such end goals, and can ultimately lead to increase revenues [7]. These desires must be tempered by ethical considerations such as privacy protection, informed release of information, informed consent, and user safety.

3.1 Types of Privacy That Raise Ethical Concerns

Consumers' public reaction to perceived and real violations of privacy remain strong, and they hold negative opinions of companies that track their movement and activities online [7]. This is true for consumers of augmented reality applications as well [7]. While it is clear that privacy remains a key concern to consumers, and information remains a target of interest for developers, advertisers and retailers, most of the online information tracking and gathering is lawful [7]. Consumer concern and reaction has led to recurring calls for action across both the US and Europe, resulting in multiple laws and regulations across various jurisdictions and municipalities [7]. Wassom calls this "patchwork legislation and regulation," and states it leaves developers confused about what information they are allowed to gather [7].

3.1.1 Personal Information and Data

The collection of personal information poses ethical concerns. With applications asking for blanket permission to access user data, ethical concerns are raised about how that information is used, how it is protected, and who has access to the information. For example, when using an AR web browser, does the application track users' every move, and what types of locations a user visits based on GPS data? Does it track how long they stay, or how many times they frequent the locations? With the increased proliferation of being able to make purchases with a smartphone, are all of the end user's purchases being tracked? If applications are tracking such information, how is that information being stored? Is it secured or is it being sold to marketers and advertisers? Are the end users aware of the information being derived from their using the applications? What control, if any do they have over what information is retrievable and disseminated?

Further, what if the information was being used in an effort to survey the end user? Could the information be used to target the person based on their religious affiliation because their data shows them visiting a specific house of worship such as a mosque? In 2006 the US government disclosed that they had obtained literally hundreds of millions of phone calls and cellphone data from telecom companies in the name of fighting terrorism without warrants or disclosure to the public. When raw information is accessible to others, they are able to make assumptions about the users that might be good, bad, or simply incorrect without the end user's knowledge or ability to correct or defend against those assumptions [13]. This creates a significant ethical dilemma, and AR application designers can look to this series of questions as a template for the types of issues they must address in their application design.

3.1.2 Facial Recognition

Perhaps no other development in AR holds as much excitement, anticipation and concern as facial recognition software. Current technology is being developed by major computing and online companies that would allow public, and potentially private, data and information to be displayed through facial recognition AR applications. The ethical concerns over privacy violations for such ability are great [7, 12, 13, 15, 16]. The use of AR data including GPS and other data mined information, when combined with the facial recognition will lead to a seamless blending of online, and offline, as well as public and private lives [17].

AR facial recognition applications are currently being developed that will scan a person's face, and then go online in an attempt to compare the unique facial features of that person to photos posted on public social sites in an effort to identify that person. When applications like this become available, concerns for how that information will be used are significant. If a person is interested in someone they randomly encounter, it will be possible to find personal information about that person, potentially without their knowledge and without their permission, if they are unaware the application was being used on them [12]. Their friends, marital status, general interests, personal contact information, political and religious affiliations, and other private data might all be available at the push of a button and on display for anyone who uses the application to see. This can lead to serious concerns over

privacy, stalking, being targeted by misleading advertisements and scams, social stereotyping and profiling [3, 17]. Ethical concerns are further raised by the abilities of the person who is being identified by the applications. Does the person have the ability to opt in or out of the recognition? If they opt in, do they have any control over what information is allowed to be shared? Do they have any ability to know where, when and who has used the applications to identify them? Is there any disclosure that the technology will be deployed and therefore give them the opportunity to opt in or out?

Further, concerns have been raised about this particular application because the company developing it has total control over what information is presented about an identified person in the application. Potentially, the company could present only negative information that could damage a person's reputation. While there is market excitement surrounding facial recognition, the risks of ethical violations concerning privacy are significant.

4 Safety

There are real ethical concerns regarding safety for people who use AR applications and for those around them. This holds especially true for AR games and navigation applications, as they require an end user's attention and focus. Human beings have limited capacity to focus on multiple activities. This is due to the brain's limited capacity to process multiple actions and to handle the processing and memorizing of the activities and stimulus [3]. When a person is focused on using an AR application, they tend to be focused on the screen of their smartphone or tablet (and in the very near future, on glasses as well on car windshields), as well as the information that is being presented on the devices [3]. This leaves limited ability to focus on the rest of the world around them.

4.1 Potential Pitfalls of Immersive AR

AR applications can provide an immersive experience [7, 9, 18]. The utilization of visual and auditory elements, while demanding the user's focus, creates the immersive potential [3]. When an application becomes immersive and commands the continued attention from the end user, it creates the potential for the end user to become so engaged in the experience that they become completely engrossed in the activity, and lose awareness of time and what is happening around them. This is referred to as a "flow state" [3, 18].

When users of an AR application enters a flow state, they are at risk for real injury. If they are walking down the street holding their phone in front of their faces playing the latest AR scavenger hunt game, will they be able to pay attention to other pedestrians sharing the sidewalk? Will they be able to notice the broken concrete, or other obstacles, and avoid tripping and falling? Will they be so engrossed that they step off the curb into oncoming traffic because they are so focused on the latest rating tagged on a nearby restaurant?

The potential injury from intense focus on AR applications goes beyond a simple trip and fall. Applications, such as navigation, and games, rely on GPS information and user input to guide an end user to a goal or target. What if the information listed in the application is bad, or the developer is unaware of the general safety of the location? For example, a developer creates and AR game that requires users to travel from location to location in the real world while using their mobile device. If the developer was unaware of the true nature of the area the game was directing the user to, the user may find him or herself in a bad neighborhood, or trespassing on private property [9]. Both scenarios could put the user in actual danger.

With car windshields with AR capability on the near horizon, ethical concerns for real harm to occur begin to surface. If simply walking down the street while engaged in an AR application can lead to injury because a person trips and falls, imagine the potential for serious damage and injuries that can occur by a driver distracted by information displayed on their windshield! Accidents while driving with distractions such as talking on the phone, eating, putting on make up, texting, adjusting the radio, having conversations, have all led to accidents. In fact many states have banned the use of cellphones and texting while driving because of the increased risk for accidents these activities pose [20]. With AR applications being immersive and attention grabbing, AR windshields (depending on the type, amount and placement of information displayed) have the potential to create a further distraction to the driver, thus placing them at increased risk for an accident.

4.2 Liability and Avoidance

The potential for actual harm, both physical and emotional, should be of serious concern for application developers and those who fund them [3, 7, 9, 10]. While no litigation has yet been filed for injuries sustained while engaged with an AR application, it is just a matter of time [11]. Wassom predicts that litigation due to injuries is unavoidable, and states that other liability cases have already laid the groundwork for AR cases to be tried [9, 11].

While the desire for many AR developers is to keep the user engaged and engrossed in their applications, considerations should be given to ways to limit the potential for injury from using their products. Some simple measures can be taken to limit the potential for harm. First, while an immersive experience is optimal for maintaining a users attention, it is not optimal for avoiding the potential for injuries. In mobile AR applications a simple "time out" feature could be placed in the program that pauses the game and thus gives the user an opportunity to be aware of their surroundings. Second, a warning disclosure could be placed at the launch of the application that briefly informs the user of the potential for immersion and injury. Lastly, for all AR applications, limiting the amount of information displayed will limit the potential for distraction of the user. This is especially important for AR windshields and AR glasses and goggles.

5 What To Do?

So how do developers, advertisers, investors, marketers, and retailers determine what is ethical and what is not when it

comes to their AR applications? There is no one clear answer for this. While seemingly obvious to many, ethics are personal and individual. Ethics involving augmented reality are based on the views of the individual of developers, designers, investors, end users, bystanders, researchers, lawyers, judges and legislators. One person's serious ethical dilemma brought on by the ability of an application can be another person's glowing success of that same application! Each individual involved must determine their own ethical standards and how they will apply, adapt, or abandon those ethics based on the needs of others. One ethicist states that in order to limit ethical dilemmas of technology, personal data should always be ultimately owned by the individual, and he should have final say on how, and if, the personal data is to be used, any use of the individual's personal information without their consent is a violation of their free will, and thus highly unethical [13]. However, data that is obtained that is generalizable and not tied directly to an individual should be considered fair use [13].

5.1 The Ethical Decision Tree

When developers are creating persuasive AR applications they should critically examine their design, the ability and intention of the technology, and their desired outcomes [2]. This can help them determine what potential ethical concerns surround their design. Fogg developed the "stakeholder analysis" to help developers truly examine their application and the implications it has. It helps a developer determine ethical concerns by examining who will be potentially involved with all levels of the application, who has the most to gain or lose, what they have to gain or lose, and then determining the ethics of the gains and losses based on the values of those developing the application [2]. This analysis is completed prior to the development of the application, but can be used upon its completion.

5.2 Ethical Codes of Conduct and Review Boards

While not all involved in the development, funding and delivery of AR applications are members of formal organizations that provide ethical standards for members, such organizations and codes exist to provide guidance. Most importantly for the developers of AR applications is the ACM Software Engineering Code of Ethics and Professional Practice [19]. The code provides an excellent standard for professionals to adhere to, or at least be advised by this code.

For those who plan to research AR applications and their effects, they will most likely have to present their research proposal to a review board. A board examines the potential research and determines what, if any, potential harm the research could pose. Further, those who seek any governmental funding for research typically have to present to a review board [10]. Any ethical violations during research done through governmental funding in the US is potentially actionable [10].

5.3 Disclosure

Another way AR developers can limit ethical concerns is to simply provide full, accessible, and understandable disclosure to the end user. This disclosure should include what information the application uses, how it is used, and any options the users may have to adjust how this information is used. Further, as discussed previously, disclosures can be placed at the beginning of the application to indicate the potential for immersion and the risks it poses. While simple upfront disclosures can never suffice for full legal disclosure as to limit exposure to liability, it will at least provide some limitations of ethical dilemma.

6 Future Research

Future research is needed in many areas of AR but especially those in cognitive psychology [1, 3, 21]. This research will help developers have a better understanding of how the technology is used, understood, processed, and engaged with by users [21]. Further, more scholarly studies should be conducted on the ethics of privacy in AR applications.

7 Conclusions

While AR applications present exciting opportunities for developers, advertisers, retailers and end users alike, they also raise serious ethical concerns. Concerns over persuasive ability, manipulation, user privacy, and safety abound. As AR applications continue to invade the market place they are likely to face legal tests in the near future on the grounds of liability, and copyright [11]. While there are no agreed upon set of ethical guidelines and standards for those developing and designing AR applications, other formal ethical standards, such as those set out by ACM Software Engineering Code of Ethics and Professional Practice can be utilized by professionals. Another tool for determining the ethical nature of an application is that of the ethical decision tree [2]. Future research is needed in many areas of AR but this is especially true for the ethics of AR applications.

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Positive Engagement Evaluation Model for Interactive and Mobile Technologies

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Abstract - *Interactive technologies and applications are pushing the boundaries of traditional user experience (UX) design, development, and testing. Users are mobile and actively interact with content across multiple media and technologies. On the content producer side, the trend toward collaborative, transmedia narrative-based properties unfolding over time and multiple devices, challenges the utility of domain or technology-specific evaluation frameworks. As user expectations rise and multi-device applications become more complex, traditional and singularly-focused usability and functionality testing provides insufficient requirements to create user engagement. This paper introduces the Positive Engagement Evaluation Model (PEEM), designed to incorporate qualitative experience in interactive and mobile applications. To identify the core drivers of user experience, the PEEM integrates current findings in neuroscience, cognition, and perception with theories of optimal engagement, flow, narrative transportation, persuasion, and motivation. Currently in pilot testing, this model incorporates a decision-tree and evaluation matrix that distinguishes between the critical differences of task-based and narrative-based applications. This paper discusses the theoretical development of the model and the task-based matrix, the first of the two evaluation matrices in development. The matrix presents evaluation criteria framed from both the designer/developer and user perspectives. Our goal is to provide developers, designers, and producers with a customizable tool based on current findings across the social sciences and neurosciences, to guide decisions and iterative processes of testing and development. Limitations and implications for further research are discussed.*

Keywords: flow, user experience, evaluation matrix, optimal engagement

1 Introduction

Interactive technologies in immersive and mobile applications are pushing the boundaries of traditional user experience (UX) design, development, and testing. Users are no longer confined to a single device, application or geographic location. They are mobile and actively interact with content across multiple media and technologies. On the content producer side, the burgeoning trend of transmedia narrative-based properties, where intentionally created narratives trigger knowledge creation and interpretation in users over time and multiple devices, challenges the utility of domain or technology-specific evaluation frameworks. Sophisticated and innovative technologies and applications are changing user expectations, creating a rising demand for technologies where traditional and singularly-focused usability and functionality testing are insufficient requirements to create user engagement. In this new environment, the need to shift UX beyond functional usability to a holistic, multi-dimensional assessment that incorporates qualitative experience and a deep understanding of the psychological aspects of optimum user experience is an imperative for successful products.

Successful UX invites individuals to engage by facilitating psychological immersion and an experience of presence in a mediated experience. The increasingly frequent inclusion of rich multi-device content with augmented and hybrid reality interactions are an indication of the trend towards immersive, transmedia experiences that are challenging developers to create a seamless experience for users across platforms and devices. Sustainable positive engagement comes from tapping into critical psychological domains. Product developers need a way to recognize and incorporate these fundamentals in order to make judgments about which novel, innovative, and creative content and affordances can enhance the holistic user experience and identify those which can detract.

This paper introduces the Positive Engagement Evaluation Model (PEEM) designed to incorporate holistic, qualitative experience in interactive and mobile applications. To identify the core drivers of user experience, the PEEM integrates current findings in neuroscience, cognition, and perception with theories of optimal engagement, flow, narrative transportation, persuasion, and motivation. Currently in pilot testing, this model incorporates a decision-tree and evaluation matrices that distinguish between the critical differences of task-based and narrative-based applications. It was developed to integrate theories and heuristics at a fundamental level to bridge the theoretical and functional silos in the fields of HCI, UX, gaming, interactive media, and ubiquitous computing. PEEM is a framework to evaluate the potential for immersion and engagement in *and across* new technologies. This model is proposed so that developers and producers can shift from a technology-focused paradigm to a more user-centric approach for optimal engagement recognizing the increasing fluidity and

complexity of the media and technology landscape. PEEM will also enable developers to evaluate media and technology experience based on core domains that integrate conscious and subconscious processing and control attention, flow, engagement, enjoyment, and social connection. This new level of UX design and measurement will help ensure product designers and developers will have maximum user engagement in this increasingly complex mode of interaction.

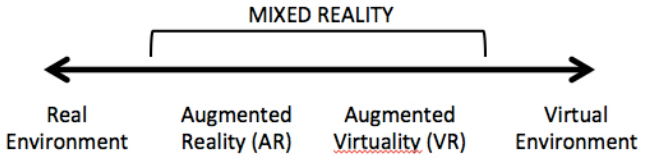
2 The evolution of user experience

User experience (UX) is a broad topic and has been used as an umbrella term for a wide variety of human-technology interactions [1]. Human-computer interaction (HCI) research has been based in theories and applications of cognitive psychology and the science of human factors, engineering, and computer science [2]. Norman initially popularized the term 'user experience' to emphasize that user experience involves much more than efficiency and conventional understandings of satisfaction [3]. Informed by cognitive psychology, Norman emphasized the need for effective interface design to accommodate human perception, specifically the propensity to make errors and inaccurate attributions and the need for memory reminders [4]. Norman, however, did not extend his guideline to the full qualitative experience of outcomes. Therefore, although user design guidelines have their roots in human psychology, the focus has remained on perception and cognitive skills and not on more subjective user experiences, such as meaning-making, identity, immersion, efficacy and enjoyment [3].

According to Overbeeke, et al. [5], all the discussion surrounding the need for design to be 'user-centered,' has not had much result. They still see a predominately cognitive approach that neglects the user somatically and emotionally. Hassenzahl [6] concurs that the few existing UX models that do incorporate hedonic experience are rare and simplistic. The inclusion of qualitative evaluation is complicated by the necessity of researchers and evaluators to not just specify, but agree upon, definitions. Law, et al. [7] note that a universal understanding of user experience is further complicated since extending beyond the traditional usability framework of user cognition and performance means operationalizing individual subjective experience across cultures.

Nevertheless, HCI practitioners continue to explore several approaches, aspects, and perspectives in an effort to define the principles behind non-utilitarian concepts in order to develop more effective technologies. Turkle [8] and Reeves and Nass [9] explored the social meaning of technology on attributions for self and projected understandings. Ehn and Löwgren [10] used the term 'quality in use' to describe the balance of aesthetic, ethical, and functional qualities. Hassenzahl [6] proposed an integration of the subjective nature of experience as it impacts the perception of a product with the emotional response to a product and the variations in context. Broader interpretations such as these try to address the balance between reductivist cognitive approaches and holistic, socially-constructed phenomenological perspectives. Meta-analyses of evaluation approaches have tried to identify the relationship between objective, task-oriented performance measures and non-utilitarian hedonic aspects, such as aesthetics, enjoyment, stimulation and self-expression [see, for example: 3, 11, 12].

Evaluative frameworks for emerging technologies, however, continue to have a domain-specific emphasis, rather than one focused on user-centric goals and experience that moves individuals across devices and platforms [13]. Augmented reality evaluations, for example, tend to concentrate on perception, performance, and collaboration [12] within the context of application functionality rather than on beliefs and motivations. Gaming and other entertainment-focused technologies highlight the concept of enjoyment over usability, although the two are mutually dependent [14]. Sweetser and Wyeth [15] argue that there is no common heuristic for evaluating user enjoyment of games. They suggest that many of the theories, such as attitude attributions, social context, narrative transportation and cognitive appraisal, are too discrete and lack the universality necessary for broad application. Therefore, they propose Csikszentmihalyi's theory of flow as a unifying principle. Roth, et al. [16] have examined the role of narrative-rich games and recommended an assessment approach informed by entertainment research. McCall, et al. [17] propose the use of presence, defined as the feeling of being in a particular place or with another real or virtual person, in the context of the Milgram and Kishino [18] 'virtuality' continuum ranging from real to virtual environments.



Source: Milgram & Kishino, 1994

3 The theoretical underpinnings of the Positive Engagement Evaluation Model (PEEM)

We agree with those who suggest that an evaluative system for any type of immersive or interactive mediated experience must be based on human psychology. However, we argue that most models overlook the interrelationship of unconscious processing and integration of sensory stimuli in the human brain with conscious understanding of experience [19]. Research from neuropsychology has shown that the individual's sense of human experience—the conscious awareness of self and existence in an environment—is created within the continually evolving exchange between conscious and unconscious processes that integrate multisensory information in the context of previous experience and beliefs.

Based on psychological theory and findings in neuroscience, we theorize that:

- Attention is the precursor to user experience and is the product of unconscious processing at the instinctual level
- Engagement is a by-product of attention when the brain consciously processes affective experience and assigns meaning
- The ability of a user to interact, navigate, and experience immersion and enjoyment that underlie theories of optimal engagement, such as flow, rely on a designer's ability to understand principles of sensory perception
  - 95% of human processing happens at the unconscious level
  - Unconscious processing is driven by primary human goals focused around social connection as central to the survival instinct [20].
- Humans exhibit a biological preference for real over virtual, however both virtual and physical stimuli impact the psychological sense of presence and activate unconscious arousal responses. This response directs attention and results in the individual's ability to consciously interpret an activity or action as relevant, desirable, valuable and pleasurable
- Narrative is fundamental to human communication. The brain processes all information using narrative structure as the sorting device to link multisensory perceptions and meaning for later recall
- Narrative is the universal factor in the ability of the 'suspension of disbelief' that underlies immersion. Where Roth, et al. [16] suggest that the introduction of narratives requires a new evaluation of user experience, we argue that, based on the way human brains process and store information, narrative experience does not require an overt storyline. Narrative experience, or what Green [21] calls 'narrative transportation,' can occur whenever a mediated experience allows an individual to immerse in such as way where even a simple task-completion to become part of the user's identity and personal story
- Theories of narrative transportation [22], flow [23] and presence [24, 25] all involve the fading away of conscious reality and sense of time, while attention is focused on the targeted task or mediated experience
- Flow and transportation theories differ in the relative engagement of conscious to unconscious processing related to the task (higher directed focus) or narrative (higher sense of presence) [26]. Both result in positive qualitative experience with enhanced sense of self
- Sustained focus described by flow and transportation theories require the coordination of conscious and subconscious processing and the maintenance of a continual balance between unconscious arousal and conscious control.
- Enjoyment is a by-product of the positive reward system triggered by meaningful immersion
- Research based on cognitive learning theories demonstrates the importance of responsive feedback to improve and reinforce learning, skill-building and mastery, enhancing self-efficacy and social validation
- Self-efficacy is a primary influencer of positive experience and the future motivation to engage with and share applications and devices

4 The influence of flow and transportation in UX evaluation

Until recently, the distinction between games and productivity was as clear as the delineation between different media technologies and devices. As those boundaries blur, there remain some fundamental differences among application goals that influence design and development decisions. Pagulayan, et al. [27] made several distinctions between productivity applications and games, as summarized in Table 1.

Table 1. Games versus Productivity Applications

Games	Productivity Applications
Process focus	Task/goal focus
Internally-defined goals	User-defined goals
Artificial world context	Reality context
Impose restraints	Remove constraints
Variety	Consistency
Emotion focus	Function focus

Consumer software, however, is becoming 'gamified,' just as devices have become multi-functional and media flows across devices. Applications, such as *Foursquare* or Microsoft's *Elevation of Privilege*[1], are part of a growing trend to integrate game design elements to non-game context to motivate users and increase user efficiency, behavior change, civic participation, and learning [30, 31]. Concurrently, the serious games movement is stretching the traditional limits of games through pervasive gaming, expanding the 'magic circle' of play into new contexts, situations and environments, socially, temporally, and spatially [32].

[1] *Elevation of Privilege* is a game developed at Microsoft to make the process of assessing security vulnerabilities in software system diagrams less tedious and more engaging by integrating game mechanics based on the card game *Spades* [28] J. E. Corter and D. C. Zahner, "Use of external visual representations in probability problem solving," *Statistics Education Research Journal,* vol. 6, pp. 22-50, 2007, [29] C. Padesky, "Schema Change Processes in Cognitive Therapy," *Clinical Psychology and Psychotherapy,* vol. 1, pp. 267-278, 1994..

We believe that the limitations of domain- or application-specific user evaluation tools pose serious problems for designers and developers in a world with converging technologies and mobile interactive content models. While both task-based and narrative-based applications can generate the flow state in users, tasks and narrative activate different areas of the brain. We, therefore, propose an evaluation model that distinguishes between task-based and narrative-based interactive and mobile technologies that is applicable to entertainment, gaming, education, or productivity implementations.

4.1 Flow Theory in game design

Csikszentmihalyi's Flow Theory has been frequently used to evaluate engagement and media enjoyment in gaming, interface design, and technology use [for example, see: 15, 33, 34-37]. Flow is the psychological state of optimal engagement where the user becomes so engaged with the application, that he or she loses track of time and peripheral activities and consciously directs his or her attention to a goal or task with clear objectives. The tennis legend Pete Sampras, for example, described his experience of playing 'in the zone,' where he felt that nothing could go wrong and the tennis ball seemed as "big as a grapefruit" [38]. For a discussion of flow theory applied to augmented reality applications, see Neal [26].

Many games, gamified practical applications, interactive marketing properties and educational technologies, however, create a narrative structure that obscures the task focus and goal clarity and activates the user's emotions, enhancing empathy and the psychological sense of presence, or the subjective sense of 'being there' within a virtual, imagined, or hybrid environment [39]. In this condition, the user also loses track of time, as described in the flow state, but rather than conscious-directed attention to the task, experiences the sense of being transported by the narrative [40, 41].

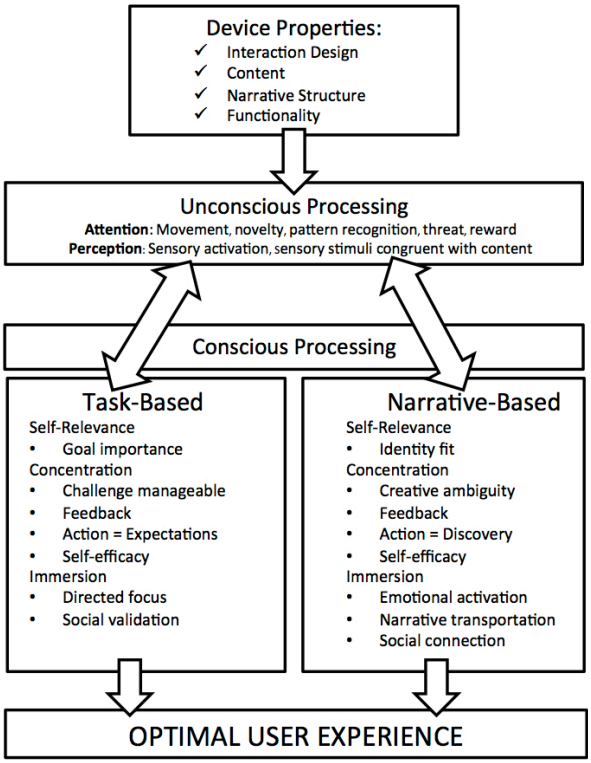
5 Capturing drivers of optimal engagement

Task and narrative-based applications activate different brain regions when users experience state of optimal engagement, or flow. In task-based applications, the state of flow depends on acute attention to the task at hand. In narrative-based applications, the experience of flow is contingent upon the engagement of user empathy and imagination to produce the sense of 'narrative transportation,' or stepping into a story and feeling present, or psychologically immersed, in the imagined or virtual reality. The task versus narrative distinction in the evaluation process keeps the product developer focused on the primary drivers of optimal user experience and behavior and avoids the semantic traps of artificial categorization such as 'useful,' 'fun,' 'entertainment' or 'work.'

We propose that developers and designers can increase the probability of creating optimal user experience and engagement by using the PEEM decision tree and appropriate task- or narrative-based matrix to guide their design and evaluation process. Within the context of the task-based or narrative-based matrix, the PEEM isolates the dominant conscious and unconscious psychological variables and triggers appropriate to each, as depicted in Figure 1. Evaluation can then be made from the perspective of the designer/developer as intention or from the perspective of the user as experience.

By linking the conscious and unconscious processes behind cognition, motivation and perception with optimal engagement theories of flow and narrative transportation, the PEEM provides a holistic assessment model that reflects the behavioral and emotional implications of the underlying neurological structure of the human brain.

Figure 1. Rutledge and Neal's Positive Engagement Evaluation Model (PEEM)



6 The PEEM matrix for positive engagement evaluation

The PEEM begins with a decision tree that guides designers and product developers to an evaluation matrix based on the task- versus narrative-based goals and structure of the product. The evaluation matrix distills the theoretical framework into a series of evaluation prompts from either the developer or the user's point of view through eight domains:

goals, attention, concentration, interaction, content, identity, collaboration and emotional outcome. The PEEM Task-Based Matrix is currently in pilot studies with the Narrative-Based Matrix to follow. For example, we are testing a preliminary version of the task-based PEEM matrix on augmented reality applications [42].

6.1 Goals

Goals and expectations are the motivators of human behavior and are inherent in any interaction, human to human or human to device [43, 44]. Flow experiences are goal-directed, requiring mental energy and appropriate skills. Clear goals establish the boundary of accomplishment and the field of endeavor by providing a static point by which to measure. The process of progressing towards a goal is the dominant source of the reward experience in optimal engagement. Goals are obvious components of applications that are task-oriented, from games to productivity, however goals are equally important in narrative-based experiences [45, 46]. Throughout western culture, narrative structure has a built-in pattern, or story arc, that creates a powerful expectation of resolution and disclosure. The pursuit of resolution motivates exploration of the story. Lack of resolution of a story arc creates cognitive dissonance, dissatisfaction and displeasure [47, 48].

6.2 Attention

The critical component for engagement is the ability to attract and keep attention, no matter what the technology. All physical and psychological experience, including our ability to notice and attend, is first filtered and then constructed by subconscious sensory processing systems [49], therefore user experience, as the outcome of attention, starts in the brain [19, 50].

The brain processes new information based on the survival imperative, and gathers multi-sensory input to evaluate relevance, novelty (movement, newness, unusual behaviors), and pattern comparison (familiarity, sense-making) to determine the potential for threat or reward. Conscious attention is the result of unconscious arousal that occurs in response to the 'pain or gain' threshold [20].

6.3 Concentration

Once information is attended, cognitive processing continues by comparing new information to previous experience to determine the level of reward or threat. Content that is perceived as a reward will also engage conscious processing to evaluate the positive potential. Research demonstrates that information that is both relevant to the user's goal and self-referent (consistent with or enhancing the user's sense of self) heightens the perception of value and motivates further attention [51]. Continued attention creates concentration. The ability to self-reference and self-identify promotes the favorable evaluation of a product or experience no matter what the quality of content logic or information. This is the neuromarketing rationale behind product placement [52-54].

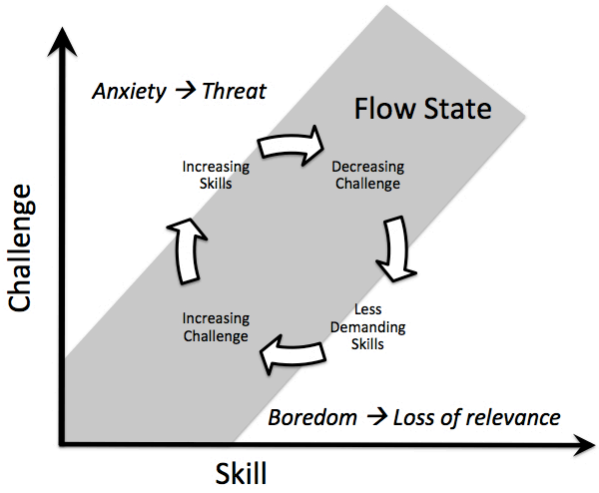
The greater the amount of cognitive and emotional investment in meeting a challenge or task, the more absorbing it becomes. In flow theory, optimal engagement occurs when all available energy and skills are devoted to an activity [23]. This demands balance between challenge and skills to maintain concentration without the task triggering a threat response that creates cognitive withdrawal to protect the user's identity and self-esteem. Thus the activity must be responsive to player cognitive, as well as emotional and perceptual limits. As illustrated in **Error! Reference source not found.**, optimal experience is not a steady state but an evolving process of skill matching challenge through increasing and decreasing difficulty levels and opportunities for skill-building and mastery.

6.4 Interaction

Interactive and mobile applications are designed for on-demand performance, allowing the product developer to create opportunities for user control (safety) and personal investment (identity) [55]. To maximize positive engagement, product developers can intentionally target the five aspects identified within the PEEM matrix.

Goals and action steps toward goal achievement need to be visible early and the path reinforced at fitting times to prevent concentration gaps (loss of relevance) or frustration leading to anxiety, triggering a threat. Both of these situations represent flow exit points [26] and disrupt and often discontinue application or product use and negatively impact the emotional valence of the experience.

Figure 2. The responsive relationship between challenge and skill for optimal engagement



6.5 Content

Content choices blend traditional UX, such as ease of navigation, with product development design decisions that promote positive emotional and identity-based engagement. These frameworks are not an 'either/or' proposition. The balance of function versus experience is the essential conundrum in UX. The purpose of the development of the PEEM is to provide a way to approach integration of practical functionality with an understanding of the resultant triggering of the emotional center and subsequent translations of emotions into conscious attributions of value. Functionality that supports positive emotions includes:

6.5.1 On-demand, self-relevant content

By definition, interactive content is self-relevant because it is pulled to the user on-demand, not pushed as in mass media distribution or marketing. Useful and accurate content provides a solution to a problem or question, creating a sense of safety and enhanced self-efficacy. Additional preferences give the user control over how the information is displayed. The user has choice over exactly where, with whom, and on what device to activate and experience the information. The sensation of success and control by the brain is processed as reward and triggers positive emotions (pride, happiness) through the dopamine system [56] and is translated by the conscious brain as successful, personal validation and efficacy (identity) [57, 58].

6.5.1.1 Filter and control of content

The ability of a user to filter content assures that information and experience are self-relevant and timely. The content needs to be consistent with activity logic and purpose, contributing to user understanding of the process while simultaneously enhancing experience and avoiding the potential for activity or attention disruption.

6.5.2 Rich media content with emotional triggers

The integration of fluid and seamless rich media, allows designers to trigger and engage specific emotions that enhance enjoyment, such as wonder, sense of adventure, pleasure, anticipation, and curiosity. Product designers can also anticipate and build in support to moderate negative experience, such as frustration, confusion, or anger, by creating accessible and 'human' help messaging, obvious means of escaping a problem, such as 'escape' icons, and error-proofing interface design to avoid user-generated disruptions.

6.5.3 Technology with social behaviors

The integration of social behaviors in HCI increases the propensity of individuals to anthropomorphize technology, attributing human qualities and sensibilities and interacting with technologies based on habitual social norms [59]. Interfaces that incorporate avatars with human-like images and qualities and friendly, interaction styles, such as 'Good job!' 'How can I help you?" or 'What would you like to do next,' increase user trust. Interaction opportunities that provide a sense of control and participation create ownership through the psychological sense of reciprocity. When individuals receive something of value, they feel a sense of connection and social obligation that motivates further engagement and enhances feelings of belonging and identity enhancement [60, 61]. The increase in personal mobile devices has accelerated the psychological adoption of device as extension of self and amplified the identity effect [9].

6.6 Identity

Effective interactive design allows opportunities for skill-building and mastery and responsive feedback of progression. Skill building allows users to maintain a sense of flow in tackling increasingly difficult challenges [45]. Knowledge of success in the face of challenge reinforces positive beliefs about self-competence and self-efficacy, expands attention and thought-action repertoires and promotes self-esteem, resilience, and intrinsic motivation [62, 63].

Identity and self-image are also enhanced through adoption and visualization of new ways of being and thinking. A hallmark of cognitive behavioral therapies and creativity work, the act of imagining, projecting and transportation creates new images of self that create somatic changes and increase neural processing connections [28, 29]. Both task-based and narrative-based interactive technologies contribute to increased self-efficacy and self-esteem through the adoption of new competencies and enhance social identity flexibility through imagination and transportation.

6.7 Social connection and collaboration

Social needs are some of the most powerful forces of persuasion. Humans are neurologically-wired to seek social attachment [64]; they are highly motivated by social perceptions, influence, inclusion, acceptance and comparison [65]. The popularity of social networks and social gaming illustrates the drive toward connection, social validation and social comparison that drives human behavior. Design decisions that integrate opportunities for users to voluntarily engage with others, increase motivation for future use, user satisfaction and user recommendations through the persuasive power of social connection, competition, and collaboration.

6.8 Emotional outcome: Attitudes, enjoyment, satisfaction

The net user experience of a device or application is the distillation of the experience into an attitude or emotion, such as enjoyment or satisfaction. This becomes the representative shorthand, heuristic, or mental model of the user's understanding that is passed on to friends and retold to oneself in memory recall. The integration of reward systems that encourage intrinsic motivation and highlight personal accomplishment enhances positive attitudes and emotions.

Gameplay structures and the gamification of various activities are a way of describing effective cognitive learning strategies: the integration of visible goals, clear progress markers, responsive feedback, earned rewards, and social validation. Product developers can enhance net user experience by conscious building in reward systems, such as scores, rewards, badges and leaderboards. Social connectivity, social validation and social comparison also function as motivators and trigger reward systems in the brain. Social connectivity and social identity can be increased through incorporating sharing features, such as ratings, comments, leaderboards, or 'send to friends.'

7 Limitations and implications

The Task-Based Matrix of the PEEM is currently being validated in several studies (see Table 2). Results from these studies will be used to adjust the Task-Based Matrix and inform the Narrative-Based Matrix prior to its evaluation and the completion of validity and internal consistency measures. The purpose of the PEEM is to 1) further the work done in creating a theoretically integration approach to user experience and 2) provide a customizable tool that facilitates the design and development process for product development and increases the probability of optimal user engagement.

8 Conclusion

Mobile users, interactive technologies and applications, and fluid media boundaries are redefining user experience, design, development, and testing. The trend toward collaborative, transmedia narrative-based properties challenges domain or technology-specific evaluation frameworks and makes singularly focused usability and functionality testing insufficient to design for optimal user experience. This paper introduces the Positive Engagement Evaluation Model (PEEM), to incorporate qualitative experience in interactive and mobile applications. The PEEM integrates current findings in neuroscience, cognition, and perception with theories of optimal engagement, flow, narrative transportation, persuasion, and motivation. Currently in pilot testing, this model incorporates decision-tree and evaluation matrixes that distinguish between the critical differences of task-based and narrative-based applications. The task-based matrix presented here is the first of the two evaluation matrices in development based on the PEEM. The matrix presents evaluation criteria framed from both the designer/developer and user perspectives to maximize its usefulness in the design process. Our goal is to provide developers, designers, and producers with a customizable tool based on current findings across the social sciences and neurosciences, to guide decisions and iterative processes of testing and development.

Table 2. Positive Engagement Evaluation Model: Task-Based Matrix

	ELEMENT	CRITERIA		DESIGNER INTENTION	USER EXPERIENCE
1	**Goals**	Clear alignment to task and user goals. Application designed to address user problem or task; provides evidence of clear solution path	1	Activity and goals are clear	I felt the activities, goals and purpose were clear
			2	Tasks and activities align to goals	The tasks and activities made sense to the goals and purpose
			3	Visible path or steps to goals with manageable solutions	I understood how to reach the goals and felt capable of doing it
2	**Attention**	Ability to stay focused on tasks application; ease of interaction; immediate feedback to validate effort required for interaction	1	Tasks sequence seamlessly	I was able to move through the steps and tasks seamlessly
			2	UI controls easy to understand and follow	Application controls were easy to use and did not distract me from the application
			3	Visual or auditory support enhance and directs understanding	The visuals and sounds contributed to my ability to understand what to do
3	**Concentration**	Ability to attend to relevant information; cognitive clarity and congruence; perceptual organization Feedback to guide actions through process and redirect attention to task	1	UI keeps attention on tasks and display through adequate and appropriate challenge levels	The application kept me interested and challenged
			2	Tasks are easy to understand and is purpose clear	I could tell what to do and the purpose of the actions
			3	Feedback provides learning structure through task completion	I received the feedback I needed to advance or achieve my goals.
4	**Interaction**	Clear action steps, content choices, lack of interruptions; integration of social patterns into HCI; responsive to user	1	Player has multiple avenues to experience sense of control, such as personalization, activity choices, or filtering	I felt in control over my actions and strategies
			2	No interruptions such as configuration, error messages, or irrelevant data.	I was not bothered by interruptions such as error messages or irrelevant data.
			3	Interaction, help and messaging from application use social behaviors (first person communication)	The messaging, help and other information within the application felt human and personal
			4	Content and tasks adjust to user needs and skills	The content and tasks adjusted to my needs and skills
5	**Content**	Ease of navigation and filtering to keep information and experience self-relevant and timely; integration of emotional triggers to enhance enjoyment and commitment; interaction opportunities to create ownership	1	Sound, touch, and rich media (imagery, overlays, video, display enhancements) are seamless	The images, overlays, video, and information displays are seamless
			2	Content designed to target specific emotions (wonder, adventure, pleasure, intrigue)	The content engaged positive emotions (e.g., wonder, adventure, pleasure, anticipation, curiosity)
				Content designed to provide support for negative experience (help messaging, 'escape' icons)	The content engaged negative emotions (e.g., frustration, confusion, anger)
			3	Content designed to fit affordances to eliminate task disruption (i.e. retrieval time)	The content flowed well and did not interfere with achieving my tasks or goals
			4	Content is relevant to task and supports activity logic and purpose	The content such as images, video or audio made sense with the activity and purpose
6	**Identity**	Self-relevant, obvious solution to need; actions reinforce self-efficacy, accomplishment and self-esteem	1	Activities provide integration or imaginative projection of user into experience.	I felt absorbed in the application or it engaged my imagination in the experience
			2	Structured skill-building and mastery	I increased my skills or knowledge
			3	Responsive feedback of progression and accomplishment	I received evidence of my progress and accomplishment

Table 2. Positive Engagement Evaluation Model: Task-Based Matrix

ELEMENT	CRITERIA		DESIGNER INTENTION	USER EXPERIENCE
7**Collaboration**	Reinforces social connection and encourages social validation	1	Integrated social connection or comparison (leaderboards, social network links)	I could compare my experience to others or engage socially in real time, shared use or social networks links
		2	Validation, reinforcing feedback from social element.	I received feedback on my experience relative to other users
		3	Ability to create, participate or personalize content	I was able to create or personalize content
8**Attitudes, Enjoyment, Satisfaction**	Positive experience for motivation to use again; motivation to tell others, ease of sharing	1	Inherent motivation or reinforcement to redo or repeat activity (emotional, reward-based, or social)	The rewards or feedback made me want to redo or repeat the activity in the future
		2	Opportunities for comparison or competition (scores, rewards, badges)	There were multiple points where I could collaboration or share my experience through scores, rewards, or badges-mrn-or display and shared tasks
		3	Integrated sharing feature with ratings, comments, leaderboards, or 'send to friends'	There were sharing features where I could see and contribute ratings, comments, or votes

INSTRUCTIONS:
Evaluate each numbered item as follows:

Not at all	1
Partially	2
Mid-range	3
Mostly	4
Consistently	5

Add all three scores for each item and post as the net task score. Scores will range from 0-15 for each net task score. This gives an average score for each task.
Net experience = addition of all net Task Scores /10

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Quality Augmented Reality: Cognitive Task Design

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Abstract – *The sensory stimulations experienced by modern people have become increasingly more powerful and persistent with the advent of newer technologies. Visual, aural, and tactile sensations that used to be relegated to destination sources (e.g. computers), to be called upon by demand, are now appearing in what was once open space. The human brain, the ultimate source of our cognitions of the environment, is called upon to understand the merger of real and virtual. The brain, however, is a physical entity whose capabilities are vast, but finite. Cognitive science informs us that people are subject to cognitive load issues that can affect their responses to sensory stimulation. Augmented reality designers, company owners, and project funders should be alert to cognitive demands as they design or fund their AR products. It can make the difference between a successful adoption by the end-user of the AR product, or product rejection.*

Keywords: Augmented reality, cognitive load, cognitive task design, media psychology

1 Introduction

Augmented Reality (AR) is poised to change our perceptions of the world in both subtle and very dramatic ways. The merger of actual reality with virtual reality has been steadily progressing for several decades, branching out into more diverse aspects of human experiences. Because the human experience of the world is usually visually perceived [1], the inclusion of virtual objects into the actual environment requires increased awareness by AR developers of how the human brain operates in order to make meaning of these merged realities. Fortunately, there is foundational work from within the social sciences that can aid technical designers, managers, and funders in the planning, development, implementation, and assessment of their AR initiatives. Of special interest will be three related topics that, essentially, serve to aid in the deconstruction of how humans make sense of all that they perceive, and how they respond to those perceptions: Cognitive science, cognitive load, and cognitive task design.

Cognitive science, cognitive load, and cognitive task design each play an important role in the AR lifecycle. They describe the capabilities and limitations of the mind when exposed to various stimuli and, from them, we can learn how to structure those stimuli in a way that maximizes the mind's potential to respond in a way that is intended [2, 3]. They offer powerful insights into how we behave, and provide endless opportunity for developers to design AR projects that are more likely to resonate with the end-user in a meaningful way. In this article, the role of cognition in AR design will be overviewed and will include design tips based on sound cognitive principles and theories. The overall purpose is aid all AR stakeholders in their decision-making so that the end product is more likely to be adopted by the end-user.

2 About cognitive science

Cognitive science studies the human mind and machine processes to describe how they operate, especially with regard to how information is perceived, processed and transformed [4]. It is a field of study that encompasses many social science and technological science disciplines, including psychology, neuroscience, sociology, artificial intelligence, and now … augmented reality. Foundationally, the cognitive sciences seek to describe precise functions whose stimulus-response patterns can be reliably observed [5]. Its essence is based on the idea that thought occurs through mental representations, much like computer data structures, and that the processing of thought occurs in a manner that is analogous to algorithmic computation [6][26]. In the AR design process, cognitive science principles are invoked along every step of the way, as questions are asked about the meaning and experiences that go into or arise out of the design concepts.

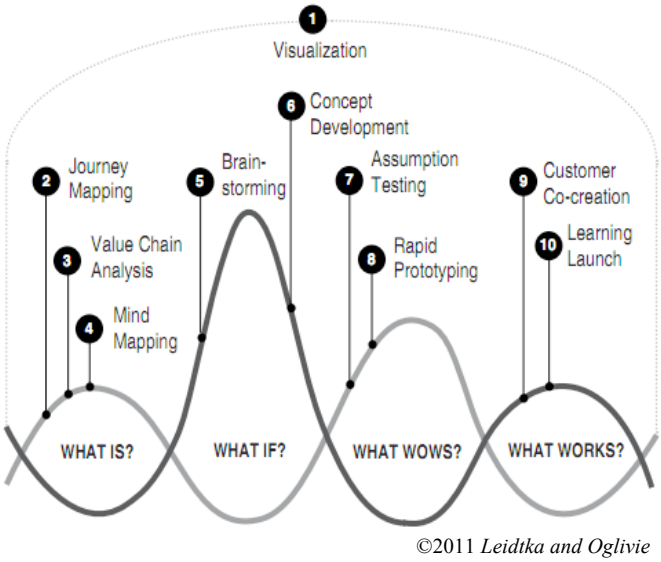

Figure 1 Cognitive Science in the AR Product Lifecycle [26]

In augmented reality initiatives, certain sensory stimulations are provided that draw upon existing experiences

in the mind of the end user. It is expected that the end-user will respond, with some level of acceptance, to the merged layers of real and artifice in such a way that they will function normally. That is, the mind will utilize its processing power to analyze the AR stimuli, relate it to experiences already stored in the mind, create sense and meaning of the stimuli, and engage with it in a manner that provides an expected outcome. For example, in an AR gaming program, in which live human players interact with AR human images, within an environment that is in real space with digital objects, the design of this game must be such that the brain does not reject the artifice at any point [7, 8]. Instead, it remains engaged and immersed at a level in which awareness of real and artifice disappears. If the design is flawed in some way, the mind will reject the environment and the premise: the goals of the AR game producers will not have been met. Certainly, this example is fundamental to any activity where people are asked to suspend disbelief; yet, the principles involved are complex and require deep understanding.

This brief overview of cognitive science serves as the basis for the more important aspects of this article: Cognitive Load and Cognitive Task Design. Cognitive load looks at how the mind chooses which information to process, and which information to ignore [9]. Cognitive Task Design looks at how AR products are designed to maximize human interaction [10].

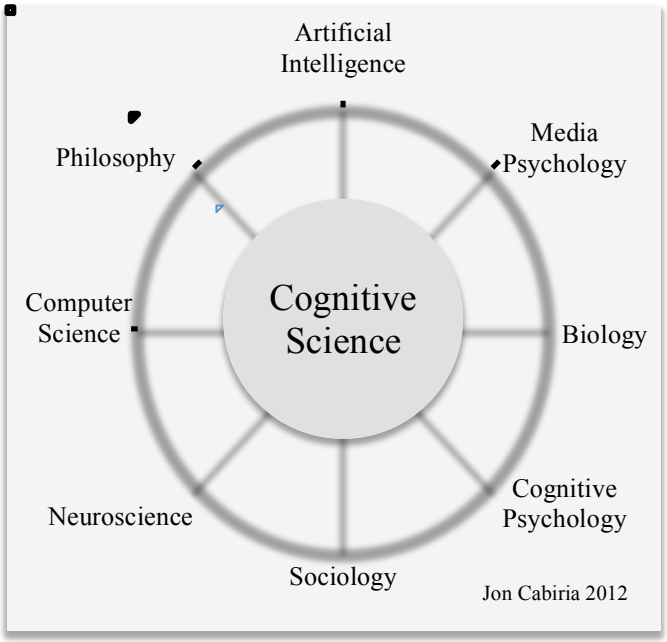

Figure 2 Cognitive Science informs and is informed by representative disciplines

3 Cognitive load theory

Cognitive load theory proposes that human beings are limited in their capacity to attend to and, therefore, store and recall sensory information [1]. As in a computer system, there are multiple procedures that are involved in information transmission and processing, and the capabilities of the body and brain to do this are limited [9]. There are considerations of available resources, as well as bottlenecks that occur when processing demands exceed capabilities. Therefore, cognitive load is an extremely important concept when designing AR applications due to the mental resource requirements of the end-user. In many other digital products, the cognitive load is generally relegated to the 'world' of the product itself (e.g. the digital gaming environment, the web page, the video stream, the social network forum or display). There is a new level of cognitive demand once the scenario includes blended environments, which requires the end-user to constantly cross-check multiple environmental sensory stimuli against real and digital relationships [11]. In essence, the brain is constantly translating what it perceives in a merged environment, based on stored similar memories, and at a higher level than it usually does individually, in either its own native (i.e. real world) environment or in a digital one [11].

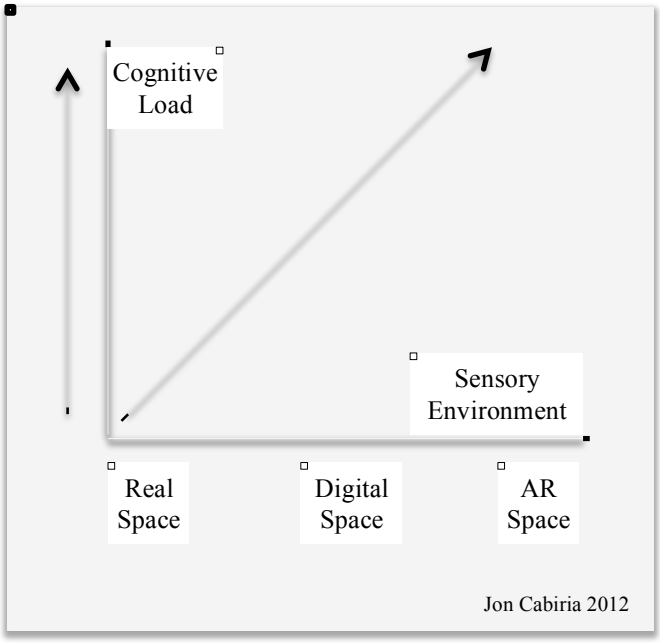

Figure 3 Cognitive load increases when sensory input includes digital aspects

An example of cognitive load process in merged environments is when an AR visual display incorporates both 3D and 2D objects. The natural context of human visual activity is 3D [12]. Cognitive load increases when the brain is presented with a 2D object because it must mentally reconstruct the object into a 3D representation in order to make better sense of it (12). When we add 2D objects into 3D spaces, the brain becomes further taxed trying to reconcile not only the 'intrusion' of virtuality, but also the conversion factors required [12]. This relates directly to the power of presence in AR functioning.

Sense of presence is a critical concept in measuring the effectiveness of an AR environment, part of which is

accomplished by reducing cognitive load. Presence is a mental state in which the end-user has either little or no awareness of the mediated environment [13]. Reaching a state of presence in an AR environment means the end-user's brain has accepted the environment as real, and it responds in a manner that would be expected if the environment were real. In recent studies, it was found that participants with higher levels of sense of presence experienced lower cognitive loads when interacting in an AR environment [14]. This is an important consideration when designing AR products, regardless of their purpose. High cognitive loads cause discomfort. At some levels, they even cause anxiety and distress [3].

For successful adoption of an AR product, designers would be advised to understand the cognitive load levels placed upon the end-user, especially during the end-user's initial introduction to the product. While some anxiety and tension can be pleasurable, the cognitive load, the load effects, and the AR product type should to be carefully aligned to avoid unpleasurable tension.

Cognitive loads have three distinct types: Intrinsic load, extraneous load, and germane load [9]. The first, *intrinsic cognitive load*, is a fixed stimulus response that addresses the end-user's actual exposure to the AR product, her or his existing understanding of how to use or respond to the AR product, and the effects it creates. The end-user's past life experiences and knowledge directly influence the ability to comprehend, or make meaning of, what is required to successfully interact with what is being presented [9]. The next type, *extraneous cognitive load*, is concerned with peripheral sensory stimuli that can interfere with the brain's ability to focus directly on what is needed for a successful AR experience [9]. An example would be a design that does not attract quick attention to create, more or less, an immediate sense of presence. The brain is still trying to process real world information, digital information, and disruptive information from the real world. Finally, the last type is the *germane cognitive load*. This is the most important type because it is focused solely on addressing the appropriate load level to enhance successful engagement with the AR environment [9]. Although the first type, intrinsic cognitive load, cannot be easily addressed by the AR designer because it deals with the embedded experiences and knowledge that the end-user brings to the initial AR experience, the other two load types can be manipulated by the AR designer.

Table 1 Cognitive Load Types

Type	Description	Example	Designer Power
Intrinsic Cognitive Load	Life-experiences and knowledge that the end-user brings to the AR product exposure.	End-user's existing understanding of menus, touch technology, GPS functioning, gaming controls, etc. can enhance initial experience. Lack of understanding can increase learning curve and create adoption resistance.	Low power to change what the end-user knows prior to engagement with the AR product.
Extraneous Cognitive Load	Information, generally in the form of distractions, that prevents direct focus on the AR experience; Stimuli that prevent the required level of sense of presence in the AR environment.	Guides (e.g. user manuals) on how to operate or use an AR program that are accessed within the AR environment; environmental visuals and sounds not pertinent to the AR experience; Glitches in the AR environment that create breaks in attention.	High power to design learning materials, user controls, visual layout, noise-cancelling devices, and quick-response processes that address product issues. All serve to help reduce cognitive load.
Germane Cognitive Load	Information and processes that attract end-user attention and direct it toward the AR environment; Stimuli that engage, and that create sense of presence.	Seamless AR stimuli that draw the end-user into the environment and then provide ongoing stimuli to maintain attention / engagement / immersion; intuitive, ease-of use processes; levels of engagement that match end-user's skills and ability to learn.	High power to engage end-users through skillful application of cognitive design principles. Companies have the power to hire/train those who know about cognitive design to aid in the planning, designing, implementing, and evolution of the AR product.

Jon Cabiria 2012

The key strategic consideration in thinking about designing the AR product for end-user application is the exploration how much cognitive load can be applied so that the end-user feels comfortable with the experience, yet challenged in a way that releases pleasure-inducing neurotransmitters in the brain. It is the nature of mammals, including human beings, to learn new things and to master new skills [15]. It is also the nature of mammals, including human beings, to have a certain level of environmental comfort when learning and using new skills [16]. The more pleasure that accompanies the use of a product, especially in the initial exposures before habituation occurs, the more likely the end-user will continue with the product through the learning curve and into adoption and integration into her or his life [17].

Here is an interesting example of cognitive load based on the Google promotion for their Projectglass AR glasses :

http://www.youtube.com/watch?v=_mRF0rBXIeg&feature=youtu.be

The video piece is a spoof of the Google promotion that incorporates advertising images into the visual field. It does a great job indicating what can go wrong with design from a cognitive perspective.

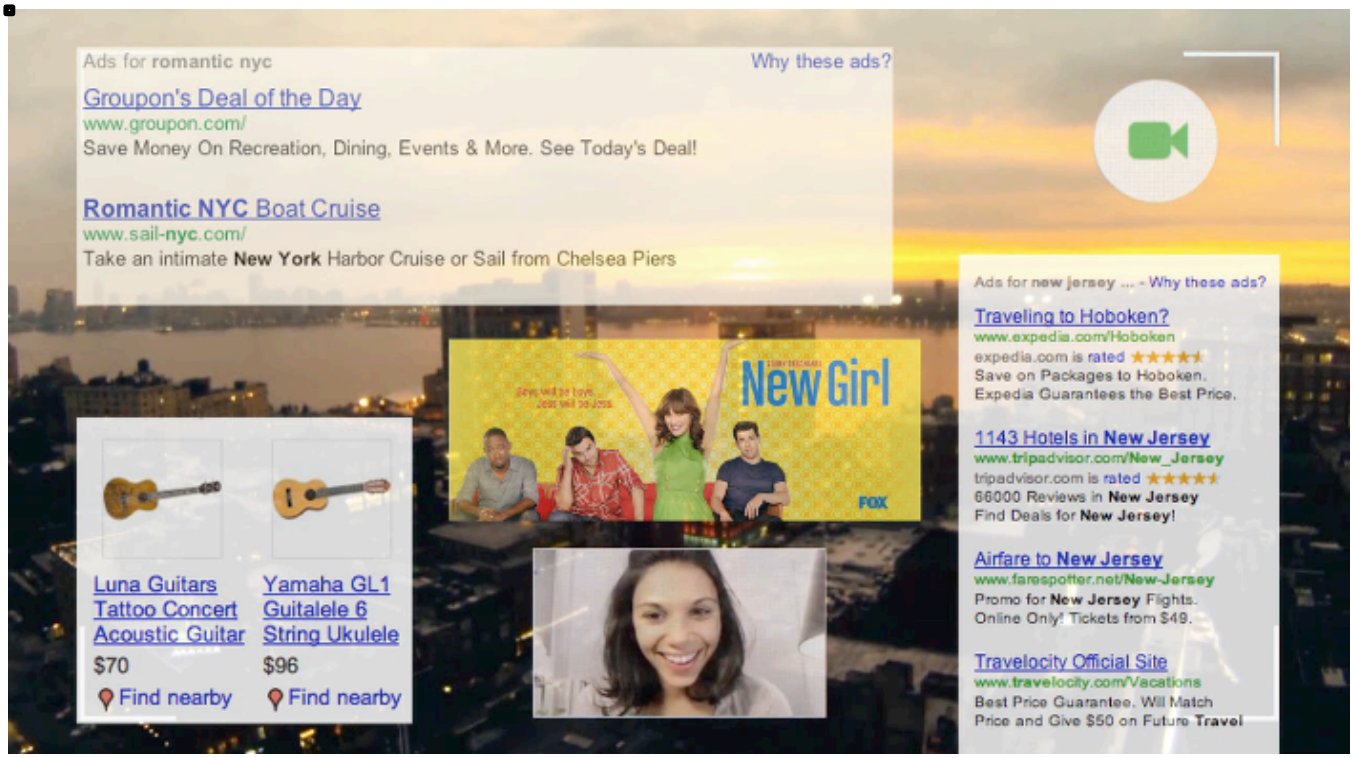

Figure 4 Crowded visual display creating high cognitive load Rebbeliouspixels.com

4 Cognitive Task Design

It is a matter of consequences. Basically, the question being asked is, "What are the goals that the AR design teams want to achieve as a result of the creation of the AR product, from a human sensory experience?" It all comes down to influencing human emotions in some way to create some level of positive connection with the product. Without a sufficient cognitive response by the end-user, the AR product will have a short market lifespan[18, 19]. Lacking the ability to experience ongoing cognitive stimuli at desired levels, the end-user gradually loses interest in the product and is more apt to seek engagement elsewhere. Therefore, the consequences of product use, cognitively speaking, need to be clearly understood in the beginning of the product lifecycle and need to be designed into every procedure of the design process.

It is recommended that the current mindset of 'task design' be elevated to include one that is more relevant - *cognitive task design*. It is important to note that cognitive task design is concerned not only with the sensory stimuli that are an output of the product (what the end-user experiences), but also the function and structure of the components in the context of world in which it exists. Any change in product technologies that end-users have become accustomed to can have important cognitive considerations on how the end-user thinks and behaves, right down to the essential brain wiring [20]. Intentional and unintentional changes to the world of the end-user via the technologies they use inevitably change their cognitive processes [21].

4.1 Through the eyes of the AR designer

The AR designer is a skilled professional who has a very definite and focused knowledge of her or his craft. This knowledge is typically years in the making and exists at a level beyond that of the consumer that will be using the AR products. It is not uncommon for the AR designer to lose track of the ability to see the basics.[10]. In fact, what the designer perceives as the basics may still be beyond the abilities of the end users. For example, in the above image (Figure 4) and its accompanying video of the spoofed Google Project Glass promotion (see the insert), the AR designer might very easily be able to cognitively parse out the real environment from the rapidly changing digital environment. The designer, having created how the product works, will have already adjusted to the cognitive load by virtue of selective attention [22] and familiarity.

Selective attention: tendency to give attention only to those things that address a need or interest.

The AR designer, in reviewing the product during the formative stages, will block out information in the sensory field that does not require her or his focus, in favor of items that do. As a result, the designer, over time, can lose the ability to experience the impact of the product in the way that a first time user would, or even a repeat user [22]. The designer 'experiences' discrete packets of information, while the end-user is inundated with all of it. The designer, operating on 'gut instinct', assumes that the cognitive load is light because she or he does not feel overwhelmed. For the designer, the load is light because she or he does not perceive everything in the same way as the end-user. The designer might see the AR landscape as distinct elements or as relationships among elements rather than holistically.

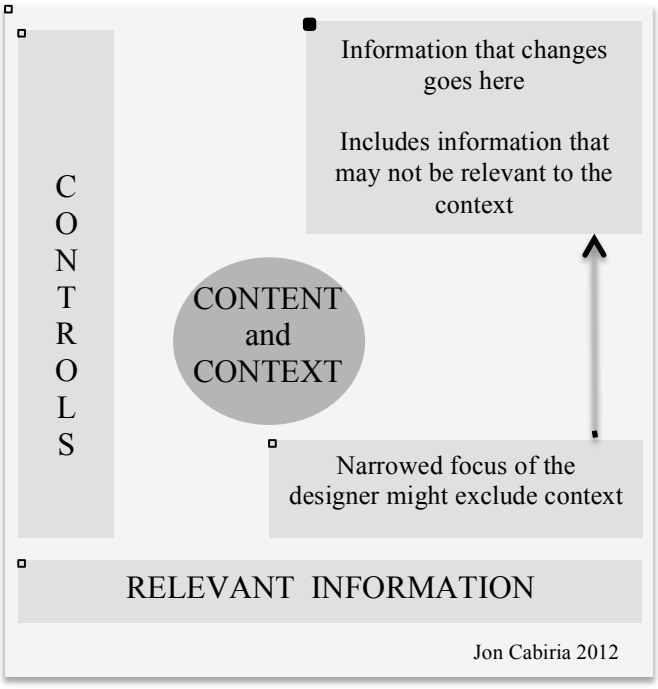

Figure 5 Design may not capture cognitive load issues

Ultimately, it becomes incumbent upon the AR designer, the project lead, and/or the technology psychologist to perform incremental assessments of cognitive load as part of the cognitive task design process. How information is presented, and when, is as much an art and science as any other part of the design process.

4.2 Through the eyes of the end-user

Typically, the end-user has no real experience with the design process and is usually unable to parse out design elements on which to focus or ignore. For the end-user, all of the information is relevant and, therefore, the cognitive load can be higher than that of the designer [11]. Each design element requires that the brain identify what the element is, the element's purpose, and its relationship to the other design elements. Additionally, it has to deal with areas of uncertainty or lack of procedural information that requires initiation of a learning process [9]. Finally, aside from the functional design elements, it must deal with the cognitive displays of color, images, and objects in ways that affect memory and emotion. In milliseconds, it searches its memory archives of information to make meaning of the display and accompanying sounds, along with the context in which it all appears. If the display environment includes a change or sequences of change, the cognitive load continues to remain high [11].

Augmentedplanet.com, 2010

Figure 6 AR Crowded Visual Field

Note in the above image how the brain needs to attend to a multitude of new, constantly changing information in both the real and digital environment. The brain has an extensive, yet still finite, ability to process information [3, 9]. The AR designer might see skillful layout and well-timed changes in content; yet, be only marginally aware of the real world background upon which the digital content is layered [selective attention]. A cognitive task design would be considered flawed if it did not take into account the more holistic experience of the end-user, and the needs of the brain to process sensory information effectively and efficiently.

For the AR designer to help decrease end-user cognitive load, the end-user must have more control over the display and the elements of the design need to be considered in unison with the expected real environment in which they will exist.

5 Implications

In the end, the goal is to create a useful product and to make a profit. Given the large amounts of time, money, and energy that go into the creation of AR products, it is important that the steps between the generation of an idea, all the way through to the end-user experience, be carefully attended to from multiple perspectives. One of those important perspectives is the focus on the desired cognitive sensations that arise from the end-user's engagement with the product, and how to incorporate that perspective into the design. Knowing how to identify, measure, and incorporate cognitive loads as part of a cognitive task design process is of considerable interest, or should be, to not only AR designers, but to company owners, venture capitalists, and other funders and stakeholders.

5.1 AR designers and cognitive design implications

It should be clear by now that the AR designer straddles the world between art and science. She or he not only needs to know the technical functioning of the AR product, but also have the knowledge or skill to incorporate how various cognitive effects, such as color, landscape change, velocity and frequency of change, object shapes, and sound (to name a few) influence end-user behavior. Beyond this, the designer also needs to understand the full context in which the product will be used, including the demographics of the end-user, the likely location of use, cultural considerations, and a host of other more complex intermingling of variables. Just as AR coding contains complexities and nuances of great precision, so, too, does the 'coding' of cognitive effects. The skill of the designer to blend technical art and science with the art and science of cognitive display, and resulting behavioral effects, is highly desirable because it increases the likelihood of successful adoption of the AR product [23].

5.2 AR company owners and cognitive design implications

Obviously, the owner of the AR company has a vested interest in the successful launch and adoption of the AR product. In a highly competitive environment, which will only grow more competitive as the industry matures, the creative and financial reputation of the owner is on the line. Criticism of flawed products is easily and quickly delivered to all sectors – technology, finance, media, and customers. It is imperative that the company owner be knowledgeable about more than the technical and financial aspects of the company and its products, but also to have base knowledge of the psychological implications of her or his products. Additionally, she or he would want to be networked with skilled cognitive experts for guidance in creating products most likely to be adopted by the intended customer and, more importantly, used and promoted by a growing, loyal customer base. Marketing experts can make the sale, but other professionals are needed to make sure that the product the customer purchases will address psychological expectations.

5.3 AR funders and cognitive design

Venture capitalists and other potential funders are understandably nervous when considering the funding of a company or project. They seek certain assurances. One of those assurances is quite simple – How do they know that the identified potential end-user will actually want the product? In essence, how does the owner and the designer know, beyond their own excitement and that of their friends, family, and co-workers, that the product will have any meaning for the targeted customer base? Some venture capitalists or angels will fund on 'intuition' and a great presentation, while others will go to extraordinary lengths to discover likely customer interest. Surveys, focus groups, trend analysis, and various kinds of statistical and qualitative research certainly offer insights. However, time and again, gaps between expectations and realities occur [25]. It could be that the right questions, the right prototypes, and/or the right contexts were not part of the discovery process: The 'mind' of the end-user was not fully explored beyond initial exposure to the product in a test environment. Even beta testing in the field doesn't always predict eventual adoption at the desired level to produce a profit. Funders would be wise to bring in technology psychologists or other experts in cognition to more fully explore important aspects of human perceptions and stimuli response as part of the design process. This would better accomplish the goal of answering the question, "How do I know this AR product will create the claimed effect?"

6 Conclusion

The days of simple, low-cognitive load experiences are fading quickly. Consumers are inundated with sensory stimuli from innumerable sources. Questions now to be asked are, "What determines which AR experiences are preferred over others, and which of these AR experiences have 'staying power'?" Human beings, while having strong intellectual abilities, are primarily creatures of emotions triggered by cognitive processes – they respond to everything on some emotional or reflexive level, and it is these very primary responses that compel them to seek out certain kinds of sensory stimulation over others [24]. Because of this, they are also subject to sensory, or cognitive, overload or deficit [23]. This is an unpleasant experience, which causes the person to reject certain stimuli in order to achieve more acceptable levels of cognitive input [7, 8]. AR designers, the company owners that employ them, and the funders that finance their projects, want to position themselves to create the best possible product that addresses the needs and desires of the intended end-user in a way that enhances reputations and profits. Toward this end, stronger attention to the art and science of cognitive task design is highly recommended.

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Assessing User Experience in Augmented Reality Applications Using the Positive Engagement Evaluation Model

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Abstract – *To take advantage of expanding digital and mobile markets across all sectors, from e-learning, e-commerce, and e-government to entertainment, designers and developers must gain an increased understanding of how related technologies affect holistic user experience. Augmented reality (AR), the ability to superimpose virtual information over real, is increasing in popularity due to its potential for impact and influence. Like any emerging technology, however, thus it is important to understand how it can be applied most appropriately and effectively. Focus groups and consumer surveys are often used to evaluate user experience, but it is more efficient, flexible and cost-effective to have validated guidelines and evaluation matrices that can be easily applied to inform design decisions. Psychology is the key to understanding user experience and should be at the basis of any evaluation approach. This paper compares AR applications that represent various AR foci and goals in e-learning, e-business, and e-government using the Positive Engagement Evaluation Model (PEEM). Developed to integrate the psychological theories of optimal user experience based on flow, immersion, and narrative transportation with neuroscience, the PEEM provides a decision tree and set of psychologically-based evaluation criteria for interactive and immersive media. This paper evaluates these applications in the light of the PEEM model based on the results from a series of independent raters to further the ability of designers to construct interactive media incorporating the factors that contribute to optimal engagement.*

Keywords: Augmented reality, case study, applications, evaluation, psychological flow, user engagement, user experience

1 Introduction

Augmented reality (AR) is an emerging technology that is increasingly integrated across many applications, from marketing to education [1][2]. AR is the use of digital information virtually integrated with real life information. This combining of digital and real information is performed to enhance, or 'augment' reality for a variety of applications for e-commerce, e-learning, e-government, and more [4][5]. Any time of media, from text or audio to interactive media, can be used to augment the existing field of experience through the use of a digital device, such as a smartphone. Unlike virtual reality, which replaces one reality with another, AR enriches user experience by overlaying information onto the user's reality and physical space [1]. The merging of physical reality and digital media into a single experience immerses users into a multi-sensory, interactive environment in real time [1][24].

AR technology has been successfully applied to many applications, including advertising, education, and psychotherapy, with varying degrees of complexity [1]. To function properly, AR applications are technology-dependent. They require the integration of sensors, Internet-connectivity, software interfaces and displays to create the data integration. Many AR applications are designed for smartphones and integrate built-in cameras to provide real time feedback and interaction [1]. Smartphones are a popular device for distributing and using AR applications due to their ready availability, size, and the decreasing costs of devices and data plans. Mobile devices give users the added benefit of freedom, untethered from computers and power sources, while increasing user control and creating a more natural and intuitive user experience.

AR applications employ different mechanisms to triggers virtual information for delivery to the user. Common approaches include two-dimensional 'Quick Response' (QR) matrix bar codes, GPS location-based tracking, and context and object recognition technology [7]. AR can deliver multi-sensory information within the limitations of the available technology [13]. AR has been applied to automotive windshields, personal glasses, and contact lenses in recent years [19], but many of these delivery technologies are not yet commercially feasible. As technology continues to evolve and become more robust, products like these will become more available.

For AR to make a significant impact, both commercially and socially, more than technology capabilities must be considered. As with any new technology, users and developers must understand how and why AR affects the end-users. Theories such as psychological flow and visual perception become essential for understanding user engagement and experience. This paper will assess several AR applications in light of such theories, using the Positive Experience Evaluation Model by Rutledge and Neal, and enhance the ability of designers to create applications that incorporate features that contribute to optimal user engagement.

2 Theoretical Framework

Applications will be evaluated using a matrix based on psychological components from the Positive Engagement Evaluation Model (PEEM), as developed by Rutledge and Neal [22]. This matrix was formulated based on psychological flow theory, narrative transportation theory, and several neurological concepts in order to evaluate the engagement and effectiveness of interactive and immersive media examples.

Csikszentmihalyi's theory of flow posits that humans only have an "optimal experience" when they are in control of that experience, do not have disruptions to their attention, and have clear goals they can achieve [5]. According to the flow theory, individuals want to be challenged and want to overcome their challenges, pleasant or not, by their own accord [5][17]. As far as flow and engagement is concerned, a successful application will immerse the user into the experience to a particular level of ongoing interest [2]. Flow is described as the state where individuals become so engaged with and focused on an activity they lose track of time and experience the satisfaction of being totally absorbed [5]. Flow theory has been applied to many situations in different fields, including management theory, education, creativity and game design to improve the quality and effectiveness of the user experience [6][8][11][13]. The optimal experience of flow requires a conscious sense of control and order to bypass the obstacles and distractions that detract from the sense of fulfillment from focused attention [8]. Csikszentmihalyi and others have demonstrated that fulfillment is not related to possessions: people with great material wealth can feel unhappy and unfulfilled [8]. People are able to achieve feelings of fulfillment and satisfaction by focusing on the present, rather than on future achievements or possessions.

Augmented reality (AR) applications can present extremely complex information and it is important to understand what is involved with cognitive processing for the user's brain and the best way to present this information [3]. Applications can utilize features such as color and grouping in order to make the cognitive visual process as simple as possible for users, but users will continue to rely on previous personal experience to process what is seen as well [18]. The Gestalt theory of vision is influential for application development and design; the principles include similarity, proximity, closure, and more [12]. Gestalt theory is based on the idea that the human brain wants to find patterns and organization, and therefore will complete information as necessary to make it whole [12][18]. Visual perception concepts help explain the way the human mind processes visual stimuli [20]. The human mind can only effectively process a certain amount of information at once; there is only so much that the brain can cognitively handle [3][12]. Not only is cognitive clutter important as far as the quantity of information is concerned, but also in terms of how the information is presented over time. For instance, if an application presents a graphic or button in the same place on every screen, a user will have a much easier time finding it when needed [9][12]. At the same time, individuals are more likely to notice an object if it has suddenly changed [9][12]. Understanding features of visual perception such as these help make the cognitive load of an application much lighter for the user [3].

3 Methodology

Applications were evaluated using the Positive Engagement Evaluation Matrix (PEEM) created by Rutledge and Neal [21]. The evaluation matrix looks at positive engagement for an experience, in this case, a specific augmented reality (AR) application. The PEEM includes a decision-tree to assist in determining which matrix to utilize: one that focuses on task-based experiences or one that focuses on narrative-based experiences [21]. The matrix related to task-based experiences and applications was used for this case study. Five AR applications were assessed: ARSoccer (gaming), Word Lens (travel/language), Ziprealty (real estate), Recovery.gov (social topic/government information) and Star Walk (education). PEEM is based on several concepts from positive psychology, narrative transportation theory, psychological flow theory, cognitive psychology, and perception theory. PEEM includes nine elements: goals, attention, concentration, interaction, content, identity, collaboration, and enjoyment/satisfaction [21].

The *goals* element addresses whether the goals of the application are clear and align accordingly to user needs and tasks as well as whether a clear path to pursue those goals is presented to users. This feature is related to psychological flow. Clear goals are of utmost importance to achieving a flow state [17]. Providing an obvious progression for achieving the goals within the application allows the user to focus entirely on the task at hand and achieve those goals [17].

The *attention* element investigates the application tasks and their sequence as well as whether user controls are easy to understand and follow. This element includes perception principles that should be used to support the user's processing and understanding of the application and interface. Engagement is the ultimate goal of an experience, but before users can even begin to be engaged, their attention must be focused, which is a product of their unconscious processing [21].

For *concentration*, the application's interface should keep user attentions on the task at hand, the tasks should be easy to understand with obvious purposes, and users should receive feedback to assist with learning and guidance through the tasks. Without being able to keep the user's attention, the application cannot engage or immerse the user in any experience, feeling, or activity [21]. Feedback from the application, whether programmed in or from other users, helps to keep the user connected [17].

The *interaction* element investigates whether the application provides a clear progression from task to task/display to display, does not have any significant interruptions such as organization or errors, and has content

that adjusts to the user's needs and/or skill level. Designers may believe their display decisions are perfect but there is a difference between what designers see in an application and what users will process [3]. Designers know exactly which information is pertinent and needs to be attended to, whereas users will cognitively process every bit of stimuli before deciding which is important. Therefore interfaces should efficient in order to reduce the cognitive processing load for users [3].

The *content* element addresses the media used in the application and whether the media used are seamless in execution, target the user's emotional needs, eliminate interruptions, and are relevant to the tasks at hand and application goals. Emotion should not be overlooked when it comes to technology; the various forms of media utilized in AR applications create opportunities for multiple levels of stimulation of the user's memory and emotion [20]. Emotion is also related to achieving a flow state, as emotion is linked to a user's attention [17].

For *identity*, the application must include tasks that integrate the user into the experience, allow for structured tasks that promote skill-building and mastery, and provide the user with responsive feedback of user accomplishments and progress. Applications that encourage the user to call upon personal memories and mental capabilities lead to increased feelings of accomplishment and competence [20]. These feelings of achievement do not need to be connected to large rewards in order to be effective [8].

The *collaboration* element encourages social aspects of the application. The application should include opportunities for connecting with others, and support social interaction and engagement, along with validation and reinforcement from the social network. Humans are biologically programmed to want and need social connection [20]. In order for a particular experience to be ideally engaging, it must involve a social component in order to fill that inherent need for the user. The necessary mobility of AR applications allows for many collaboration possibilities and options on new levels [20].

For *attitudes/enjoyment/satisfaction*, users should have structured motivation or encouragement to repeat their use of the application, as well as multiple opportunities for sharing their experience with others in the form of ratings, comments, and more. The enjoyment of an activity for an individual is not necessarily tied to the activity itself being pleasurable [8]. Enjoyment is a by-product of engaging in activities, and even those like work or chores can be pleasurable in a similar way as gaming or athletics. Conscious decisions can make an otherwise tedious task enjoyable by focusing on the process and achievement. This reframing adds complexity to 'mindless' work to give it meaning [8].

3.1 Evaluation process

The applications were reviewed and rated by three independent individuals. Raters were chosen independently, so they did not discuss their findings or experiences, to increase the reliability of their evaluations [14]. Each rater was given a copy of the PEEM guidelines and was asked to complete an evaluation for all five applications. All applications were evaluated by a total of three individuals and scores for each were averaged across raters to increase reliability in the results [14]. Using multiple raters ensured the results would represent actual variations among the application evaluations and would not be the results of rater biases, personal preferences, or extraordinary circumstances [14]. While the reliability of multiple raters does not guarantee the accuracy of results, this method helps to ensure the evaluations ratings were not based on chance. Interrater reliability was calculated by using the online tool, *Reliability Calculator for Ordinal, Interval, and Ratio Data* (ReCal OIR) from Dr. Freelon's website (http://dfreelon.org/utils/recalfront/recal-oir/#doc). Krippendorff's alpha was calculated for each set of ordinal application evaluation data to ensure reliability was as high as possible and to the satisfaction of the researcher. It was discovered that reliability among evaluation scores was higher when researcher evaluations were not included among the raters so they were not included. Reliability ratings ranged from 0.427 to 0.871.

Each element included 3-4 items on which raters assessed the applications based on a Likert scale of 1-5, one being *not at all* and five being *consistently*. Scores for each element were added and then divided by eight (the number of elements) to give a net experience score for each application. Resulting net experience scores will be reported with each application; a summary comparison and discussion of all applications and element scores will be presented in the discussion section and a comparison chart will appear in appendix A.

3.2 Application selection

Augmented reality (AR) technology can be utilized in a number of fields with various purposes, especially with the recent advances in mobile device technology. Location and orientation sensors in smartphones and other devices have increased the ease with which the technology is able to augment the user's environment and experience [10]. The advances in technology have allowed AR to function in a less disruptive or obtrusive manner; users are no longer required to carry around cumbersome but portable computers in backpacks, but can utilize the phones they already carry constantly [10].

The versatility of AR technology can be seen in the wide range of applications currently available. Not only is AR being used for fun interactive marketing campaigns, but even entities such as the government are beginning to see the potential value and power AR could provide [25]. Because of its diverse applicability, AR has the potential to be used in any number of fields for a myriad of purposes. The applications for this case study were selected based on the following criteria: utilize AR technology in a clear and decisive manner;

must include AR technology as a necessary component of the application; connect to e-learning, e-business, or e-government; do not use markers or QR codes for functionality; and do not require in-depth previous knowledge of the application background/focus.

4 Application Evaluations

4.1 ARSoccer

ARSoccer (as seen in Figure 1) is an augmented reality (AR) gaming application that places a digital soccer ball in the camera view that interacts with the user's feet in order to stay in motion. The user points the camera at the floor and the game prompts the user to begin by kicking the ball out of the pulsing circle. The user gains points for juggling the soccer ball and not allowing it to fall to the bottom of the screen. ARSoccer is a simple game for anyone to play. The game prompts and interfaces are simple and vibrant in color. It is not a flashy or complicated application that requires a deep understanding of technology or soccer itself. The current iTunes price is $1.99. It has various difficulty levels and different modes (arcade and free play). Users can even play with multiple people if the feet fit within the screen.

Figure 1. ARSoccer screenshot

	Rater 1	Rater 2	Rater 3
Scores	11.125	9.625	9.875

Table 1. Net experience scores for ARSoccer

ARSoccer scored consistently high on the *goals*, *attention*, and *concentration* elements. There is, in fact, only one task required: keep the ball in motion. The ball responds immediately to user interaction and moves constantly. This requires high levels of concentration by the user in order to keep the ball in play. The ball reacts as it remains in constant motion, whether on the screen or outside of the display. The only change available to the user as far as this game is concerned is in skill level. The user is able to choose how difficult the play is but there are no challenges or varying tasks to accomplish in order to succeed. The simplicity of the application lends itself to simple design and content, and the designers seem to understand this concept.

In terms of *interaction*, the user does not have to worry about interruptions in play or distractions within the application itself. The only visual interruptions occur if there is a pattern on the ground; any recognizable pattern on the ground will cause issues with user interaction, as the ball will react to the pattern as well as the user's feet. The application provides smooth transitions between screens and within the display once the user has begun to play. There are no messages or distractions that occur once play has commenced; the user is in control of the duration of the game, depending on interest and skill.

4.2 Word Lens

Word Lens is an application that allows the user to translate written words from one language to another by using augmented reality (AR) technology (http://questvisual.com). It uses the camera view and replaces the words on the screen with the requested translation in real time. A suggested use for this application is for assistance while traveling in foreign places. Travelers often find themselves lost or simply in need of basic information. A network connection is not required, which simplifies the requirements of use. There is also an option to type in words for translation if desired or if the camera view is not working properly. To date, it offers Spanish to English, English to Spanish, French to English, and English to French. The app itself is a free download but each language pack is an additional $9.99. The free download allows the user to preview the technology as it demonstrates its ability to either erase text or reverse the letters in a word without a translation.

Figure 2 and Figure 3 show screenshots from an example of the application's use on a sign written in Spanish. Figure 2 is a screenshot of the sign before using Word Lens. Figure 3 is a screen shot of Word Lens and its translation. It clearly translates "perro peligroso" into "dog dangerous" but it fails to translate "cuidado" into "caution" in this situation.

Figure 2. iPhone screenshot before Word Lens

Figure 3. Word Lens screenshot after translation

	Rater 1	Rater 2	Rater 3
Scores	10.000	12.000	12.000

Table 2. Net experience scores for Word Lens

Word Lens scored high on evaluations of its goal; it serves no other purpose than to translate words from one language to another. This makes it easy for the user to understand its purpose and the application design is straightforward and simple in its guidelines for translation. The translation begins immediately and there is little processing time before it completes. Word Lens has no available social aspect, to date. There is no larger social community or network for the users. However, this did not deter all raters from enjoying the application and its function. While Word Lens may not be more than a translation dictionary, its design and technology may enhance the experience enough for the user that it adds an element of enjoyment and pleasure that would not occur with traditional translation methods. Word Lens received the highest net experience scores from raters overall.

4.3 Ziprealty

Ziprealty is an application that allows the user to search for real estate in close proximity, including the availability, estimated value, selling price, and more in an augmented reality (AR) *StreetScan* mode, seen in Figure 4 (www.ziprealty.com/iphone). The application is available for free for Android, iPhone, or iPad. The application allows users instant access to Multiple Listing Service (MLS) listings, including the property information and any available photos. The application allows users to search using *StreetSketch* to create a custom user-drawn area on an interactive map or use the *StreetScan* AR function to see homes in close proximity. The application has many search options available, will update users on requested information, and even connect them with realtors.

Figure 4. Image of Ziprealty StreetScan (ziprealty.com)

	Rater 1	Rater 2	Rater 3
Scores	-	8.375	6.375

Table 3. Net experience scores for Ziprealty

One rater had difficulties finding the AR features of this particular application and therefore did not complete the evaluation for Ziprealty. To avoid biasing the rater, no advice or guidance was provided to change the experience. The application received its lowest scores for the lack of social element. While there is an option to connect to realtors, there is no interaction with other users. Ziprealty scores are included in the final comparison of applications but it must be noted that there are only two scores for this application, rather than three.

4.4 Recovery.gov layer

This application utilizes the free augmented reality (AR) Layar platform and can be found by searching for *recovery* or *sunlight*, as Sunlight Labs developed it. The application displays companies or organizations near the user that contracted for funding from the American Recovery and Reinvestment Act (see Figure 5). This application works best in larger cities where there are likely more funding contracts, and there are filter options that allow the user to select how much information is displayed. The resulting information was derived directly from the Recovery Act government website.

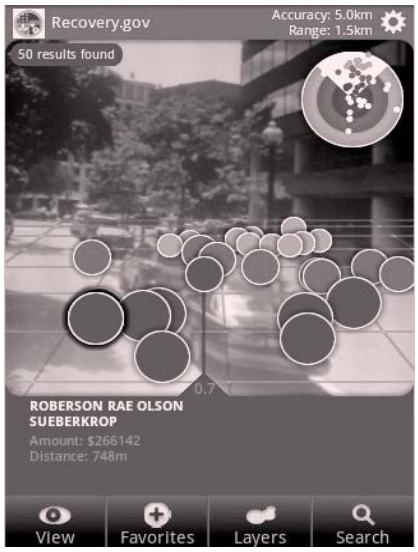

Figure 5. Screenshot of Recovery.gov layer (sunlightlabs.com)

	Rater 1	Rater 2	Rater 3
Scores	-	8.000	7.250

Table 4. Net experience scores for Recovery.gov

An application like this one within Layar could be valuable for corporate branding and government public relations, as well as providing information to interested citizens. Sunlight Labs has worked on additional applications for the Android platform that provide congressional information and more for any curious user. However, with this particular layer, several raters experienced issues finding any data at all, while others were forced to input a city other than their physical location in order to retrieve information. Upon comparison with the data on the Recovery Act website, it was discovered the application data was not accurate for many locations, the application did not show data points where there should have been several. Raters expressed the most frustration with this application. Recovery.gov received the lowest net experience scores in this case study. The application was still included in the comparison, but it should be noted that the applications' designs are being evaluated and not their content as far as accuracy is concerned.

4.5 Star Walk

Star Walk is an application available for iPhone and iPad that allows users to utilize augmented reality (AR) technology to instantly locate stars and constellations, planets, satellites, and galaxies from anywhere on Earth and an active internet or data connection is not required (http://vitotechnology.com/star-walk.html). For iPhone, the application is priced at $2.99 and $4.99 for iPad. Not only does the camera view allow the user to see the stars on top of the existing live view but it provides information about moon phases, sun movement, potential meteor showers, and much more. Users can view information about the sky in real time or based on a date and time of their choosing. Star Walk also offers a community feature where users are able to connect to one another via Twitter and the location sharing option.

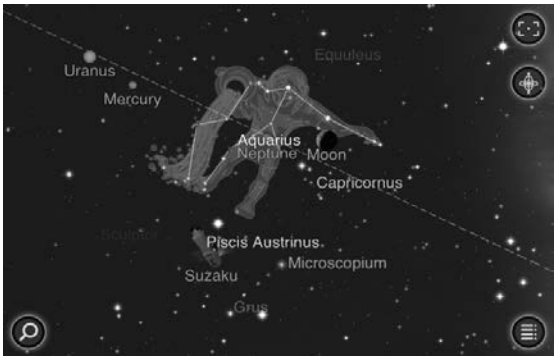

Figure 6. Star Walk screenshot in Star Spotter mode

	Rater 1	Rater 2	Rater 3
Scores	9.875	9.875	10.500

Table 5. Net experience scores for Star Walk

Star Walk received the highest application scores for *content*. This application provides, arguably, the widest range and largest quantity of information compared to the other applications evaluated in this study. However, it also received the lowest application score for *enjoyment* and this means the application is not as effective and engaging as it could be. Its score for *collaboration* was among the lowest as well despite mention of a social element in its application description.

5 Discussion

The Positive Engagement Evaluation Matrix (PEEM) and the use of multiple raters allowed researchers to assess the applications on various features of user experience. Appendix A is a comparison of scores of all of the raters for each application. Net experience scores range from 7.188 to 11.330. The median net experience score possible would be 7.813 and only Ziprealty and Recovery.gov fall beneath this median score. This confirms rater feedback, as they were the two applications that caused severe user experience issues. The Recovery.gov application received the lowest net experience scores overall, and it also had the most functionality issues for users in terms of accuracy and ease in use. Word Lens received the highest net experience scores overall with its lowest scores in the *collaboration* element. This particular application does not claim to contain a social element and a social element would not add to the application functionality itself. It is possible that a social connection may help users feel a part of a larger language community but the application itself would still translate words in the same way as it does now.

Applications scored some of their highest scores on the *goals* element. These particular applications were chosen, in

part, because of their simple goals, and their high scores for this feature confirms their successful focus on a simple goal. The *goal* element may be the easiest feature to satisfy for task-based applications. *Identity* appears to be a more difficult element to achieve for these task-based applications. Particularly for the information-driven applications like Star Walk, Recovery.gov, and Ziprealty as these applications convey information to the user and require little to no user personalized prompting or feedback.

The low *enjoyment* results are potentially problematic, whether there is an issue with the evaluation tool itself or the applications is unclear. Raters verbally expressed interest and enjoyment during their evaluations and yet their scores did not necessarily reflect these feelings. The definitions expressed by the PEEM may have been confusing or misleading or there may simply be differences in their expressed feelings and the evaluation descriptors/questions.

The PEEM acknowledges the importance of the social aspects of human experiences, however, the applications chosen for this case study were not socially focused. The applications may benefit from adding more social features, but at the same time, the PEEM may place too high a value upon social aspects of the task-based experiences. This does not go to say the elements are not important to every experience or application. However, the PEEM could possibly benefit from being able to placing weights on certain elements, depending on the type of experience being evaluated. For instance, for an experience focused solely on social community the *collaboration* element may be slightly more important than another element.

6 Limitations and Implications for Future Research

The results of this case study were limited by the number of available raters and time frame. A larger group of raters could potentially yield more reliable results. Reliability varied for each application and could be increased if more raters were added or if there were not use issues to disrupt the rating of applications. Raters were given minimal instruction and contact in order to limit researcher influence on the results. Future studies could investigate age or gender differences in experience in order to determine the most effective way to focus on a particular population for applications, especially those focused on e-commerce. Adding more applications to the final comparison, preferably of different types and foci, would add to the understanding and application of the concepts within the Positive Engagement Evaluation Model (PEEM).

This case study begins to address the need for a more regimented evaluation method for interactive and immersive experiences. The PEEM was developed to address any kind of interactive or mobile technology and therefore has a much wider range than augmented reality (AR) applications alone. AR applications were assessed in this particular study, but the PEEM could be utilized to assess effectiveness and engagement for a number of activities. The PEEM, and evaluation models like it, could inform researchers about the user experience for public spaces, video games (both traditional and alternative reality gaming), transmedia storytelling, and more. Revisions of the PEEM or additional methods may benefit designers in the future.

7 Conclusions

It is possible that augmented reality (AR) has indeed already achieved its peak of hype and expectation [7]. This does not mean there is not opportunity for AR to make lasting contributions to areas such as e-learning, e-business, or e-government. There is value in the real time and real place layering of information that AR is able to provide [7]. Regardless of the inherent value AR may or may not have, designers must begin to take psychological theories and concepts into consideration during the design and production phases. The human mind is capable of wondrous feats, but it is still limited in its ability to process information accurately and efficiently [12].

The Positive Engagement Evaluation Matrix (PEEM) sets forth practical guidelines and criteria for application designers interested in creating the most effective immersive or interactive experiences [21]. In this study, it was used to evaluate AR applications to assess the user interface and experience. The PEEM itself has room for revisions and updates, as changes in the element wording may help raters understand the researcher intentions and thus increase reliability of the results. The PEEM results revealed potential for improvement in some application features and supported application design decisions in other aspects. The results and comparisons inform researchers about the strengths of various applications and some user preferences. The PEEM acknowledges the need for integration of theories across fields in order to further and improve upon current understanding of modern technology [21].

AR technology and its uses may be limited if developers are not aware of the theories and important criteria mentioned here. A deeper knowledge of technology requires an integrated understanding, such as that put forth by the PEEM. The interactive and responsive nature of AR technology lends itself to flow theory and the potential for immersion and engagement is significant. It is clear from the evaluation of these applications that executing a perfect user interface and experience is not a simple task. It is more than graphics, content, and technology; it is the ways in which those combine to engage the user. The PEEM provides a basic framework with which to assess AR applications and their features, but a deeper understanding of psychological theories and user interaction is necessary in order to truly evaluate user experience and engagement for an experience.

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Appendix A. Comparison chart of application evaluation scores sorted by elements and raters.

	ARSoccer				Word Lens				Ziprealty				Recovery.gov				Star Walk			
	Rater 1	Rater 2	Rater 3	Avg.	Rater 1	Rater 2	Rater 3	Avg.	Rater 1	Rater 2	Rater 3	Avg.	Rater 1	Rater 2	Rater 3	Avg.	Rater 1	Rater 2	Rater 3	Avg.
Goals (1)	12	12	12	12.00	12	15	15	14.00	--	11	10	10.50	--	9	9	9.00	15	15	15	15.00
Attention (2)	11	10	10	10.33	12	15	15	14.00	--	12	6	9.00	--	9	9	9.00	15	12	12	13.00
Concentration (3)	15	13	11	13.33	15	15	15	15.00	--	10	7	8.50	--	10	10	10.00	11	14	15	13.33
Interaction (4)	13	11	11	11.67	11	14	14	13.00	--	8	7	7.50	--	11	9	10.00	11	11	11	11.00
Content (5)	11	10	15	12.00	14	16	16	15.33	--	10	7	8.50	--	11	9	10.00	16	16	18	16.67
Identity (6)	11	12	11	11.30	5	11	11	9.00	--	6	6	6.00	--	5	5	5.00	5	5	5	5.00
Collaboration (7)	12	3	3	6.00	3	3	3	3.00	--	3	3	3.00	--	3	3	3.00	3	3	3	3.00
Enjoyment (8)	4	6	6	5.33	5	7	7	6.33	--	7	5	6.00	--	6	4	5.00	3	3	5	3.67
Total Score	89	77	79	82.00	80	96	96	90.67	--	67	51	59.00	--	64	58	57.50	79	79	84	80.67
Net Experience	11.125	9.625	9.875	10.210	10.000	12.000	12.000	11.330	--	8.375	6.375	7.375	--	8.000	7.250	7.188	9.875	9.875	10.500	10.080
Krippendorff's alpha score (reliability)	α = 0.610				α = 0.772				α = 0.427				α = 0.763				α = 0.871			

SESSION

MANAGEMENT, FRAMEWORKS, TOOLS, APPLICATIONS AND STANDARDS + SOCIAL MEDIA

Chair(s)

TBA

Managerial Guide to Intrusion Detection Systems

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Abstract- Many intrusion detection systems (IDSs) are developed with no or little emphasis on management requirements, preferences or concerns. Relying on already developed commercial IDSs is inadequate because they are not specifically tailored to a facility's specific needs and available resources. This paper summarizes a combination of metrics that may aid managers and administrators select suitable IDS for their facilities. The managerial criteria are for evaluating data processing techniques used by intrusion detection systems. Data can be processed using Bayesian networks, neural networks, data mining techniques, agents, immune based techniques, genetic algorithms, fuzzy logic, expert systems, signature analysis, state machines, and Petri nets.

Keywords-intrudion detection systems, management requirment, evaluation criteria

1. Introduction

IDSs have been traditionally classified as misuse or anomaly based. Misuse IDS match current log files with an attack signatures database. They are efficient in capturing intrusions previously identified in the database and produce low false positives. However, they can only detect attacks with known signatures. In an anomaly based IDS, models of normal behavior of users or applications are used to detect deviations. Deviation from normal behavior will be flagged as an intrusion. They are able to detect novel attacks and consider any deviation from normal behavior as an attack resulting in high false positives. IDSs can also be classified as network based where the network activities are monitored or as host based where the activities on one system is monitored for intrusion traces [1] [2]. Due to the increasing number of intrusions, organizations are employing one or more IDSs. System developers are trying to improve the performance of IDSs by increasing detection rates, lowering false positive and false negative rates, achieving faster detection and using low system resources. Often system designers give little consideration to the managerial requirements or preferences while developing such systems. For example, management is concerned with installment, deployment and training costs. They also want systems that are easy to operate, maintain and produce custom reports. In general, the developer team and management may have conflicting concerns. This paper will explain some managerial evaluation criteria and metrics. IDS data processing techniques will be identified and briefly explained. Some selected managerial criteria will be examined and tested against eleven data processing techniques used in developing IDSs to indicate which system(s) is preferred by management.

2. Evaluation Criteria

When evaluating a system it is critical to use generic grading criteria to evaluate multiple platforms. The following criteria include items checked before the system is purchased as well as items that are checked after purchasing the optimal IDS. This is because in addition to selection, an organization must properly and efficiently deploy the IDS to achieve the required security. Many types of metrics can be used to evaluate IDSs such as [3][4][5] in which a low, average and high score can be given to a specific characteristic.

Logistical matrices [3] can be used to evaluate an IDS. Logistical matrices measure direct costs as well as indirect costs associated with IDS maintainability, and manageability. For example, it is important for a manger to evaluate whether an IDS has:

- Distributed Management: securely manages the IDS securely remotely.
- Ease of Configuration: as it is important to know if it is difficult to initially install and configure the IDS.
- Ease of Policy Maintenance: describes the ease of designing and modifying intrusion detection and prevention rules the IDS.
- License Management: assesses the difficulty of installing, updating, and maintaining IDS's licenses.
- Outsourced Solution: documents the IDS services contracted from a third party.
- Quality of Documentation: checking if the system's documentation is well written, explanatory and easy to understand.
- Evaluation Copy Availability: checks if a document explaining how to evaluate the system is available.
- Level of Administration: describes and measures the level of administration required to manage and administrate the system.
- Product Lifetime: measures the expected lifetime or availability of the system and checks if the tools used to develop the system will become outdated.

- Quality of Technical Support: makes sure that the developers will provide technical support to their system and what will be the quality of their support.
- Training Support: checks if the developers will provide training support to their system and for how long and for how much.

For example, a low grade will be given to "distributed management" if managing the different nodes in the organization must be done locally. It will be given an average score, if remote management is possible at each node. Finally, a high score is granted if all nodes may be completely managed by remote systems.

Architectural metrics [3] help managers assess the "as-is" architecture with the "to-be" architecture incorporating the IDS. Examples of architectural metrics include:

- Adjustable Sensitivity: This measures the ability to control the IDS's sensitivity in relation to false positive or false negative ratios.
- Data Pool Selectability: this helps identify the protocol, source and destination addresses of data sources that will be analyzed by the IDS.
- Data Storage: indicates the average amount of storage required for storing data per megabyte.
- Host-based: handling host based intrusion attacks that rely on using, for example, log files.
- Scalable Load balancing: the system should be able to partition traffic into independent balanced loads which can be scaled upwards or downwards.
- System Throughput: measures the number of packets processed by a network based IDS per second or amount of megabytes processed by a host based IDS per second.
- Anomaly Based: describes if the system can identify novel attacks.
- Signature Based: describes if the system can identify previously identified attacks

For example, "Scalable Load-balancing" will be given a low score if there is no load balancing. It will be given an average score if load balancing is performed using static methods such as placement. Scalable Load-balancing will be given a high score if dynamic load balancing is supported and intelligent load balancing aids are available.

Performance metrics [3] measures IDS task performance against the performance time budget of the evaluated system. Related metrics are:

- Analysis of Compromise: mangers are concerned about the ability of the IDS to the degree of penetration from each intrusion.
- Error Reporting and Recovery: managers prefer having the IDS behave appropriately under error/failure conditions.
- Induced Traffic Latency: it is important to know the traffic's delay degree especially when the IDS in operation.
- Observed False Negative and False Positive Ratios: It is important to know the ratio of the number of alarms raised or not raised in relation to actual attacks that has or has not been detected by the system.
- Operational Performance Impact: measures the percentage of processing power affected by the host after installing the IDS.
- Timeliness: how fast can the IDS report the intrusion?
- Analysis of Intruder Intent: it is concerned with performing analysis to intrusion intent.
- Clarity of Reports: Are the generated reports clear, understandable and useful?

For example, "Error Reporting and Recovery" will be given a low score if the IDS does not notify administrator that there was an intrusion and did not log such activity. It will be given an average score if the intrusion instance is logged and the administrator was notified at some point. Finally, it will be given a high score if intrusion is reported in real time.

Generic grading criteria help mangers evaluate multiple platforms including items checked before the system is purchased as well as items that are checked after purchasing the optimal IDS. Some major concerns of the managerial committee and questions asked for each category include concerns regarding:

- Management Interface: It is important to know if the product allows operating systems to access and manage the product. It is preferable to have a system that is capable of allowing the status views to be customized to meet the management needs and having multiple ways of alerting personnel to events. Since the users of the system are not always experts, the product should provide a way of ranking security events and help identifying the event, and indicate what corrective action should be carried out [4].
- System Architecture: One concern is the product's ability to collect information from multiple locations while keeping it centralized. The system needs to be scalable, keep original log information intact and not tampered with and allow filtering certain events and incorporate a self-monitoring capability [4].
- Third Party Vendor Support : Another concerns is the ability of the system to support third party vendor systems already employed in the organization. They mainly desire the system to be able to aggregate information from firewall devices, other Intrusion Detection devices, routers, mainframe logs, host based intrusion devices, host and application logs, and anti-virus systems [4].
- Reporting / Information Gathering: Both technical and management personnel require the system to provide status reports, preferably customized ones. Administrative and management level personnel,

especially non-engineers or developers, prefer a visualized form of the collected information and to be able to query against all or almost all data fields [4].

- Documentation, Integration and Maintenance: Providing documentation of the product is very important. Managers, also, need to know if the developer will integrate the system or if a third party provider is required to perform this service. Some organizations may also need to know if the developer will provide source code escrows and provide, preferable, fixed pricing for long-term maintenance agreements [4].
- Developing an Intrusion Detection Policy: it is important to discuss questions such as: Who will decide on who will be authorized to make changes to the configuration of the IDS and its policies? The machines on which the IDS will be installed need to be identified. The frequency of analyzing the IDS logs needs to be specified [5][6].
- Integration and Deployment of the IDS: Management needs to consider staffing, configuration, training of users, how to update signatures, and how to handle being located at geographically diverse locations. Other factors will include deciding on how many employees will monitor the IDS for output and their required technical skill level [5][6].

3. IDS Data Processing Approches

IDSs apply various analytical techniques to process data. Next are brief summaries of widely used IDS analytical techniques:

- Bayesian networks [7]: In general, Bayesian networks are a graphical modeling tools used to model decision problems containing uncertainty. For a given observed event, they calculate the conditional probability of possible causes. This is achieved by knowing "the probability of each cause and the conditional probability of the outcome of causes."
- Neural networks [8]: are best used to learn about existing relationships and develop new relationships. For example, knowing the relationship between input and output behavior of users in the system. Then new input/output relationships can be generated based on these observed behaviors.
- Data mining [9]: Is used to extract previously unknown and potentially useful information from large sets of data. Data mining techniques include using decision trees [10], segmentation [11], warehoused unknown attacks [12], and association rules [13].
- Agents [14]: are useful because they are self-contained processes that utilize sensors, to evaluate and act within their environment. They collect information that related to the attacks and trace intruders.
- Immune-based [15]: applies similar concepts used by the human immune system including innate and adaptive immunity. The first step is creating a baseline profile based on observed normal behavior. The patterns in this profile are then used to monitor actual data for deviation.
- Genetic Algorithms [16]: It starts with a collection of functions and randomly combines them into programs; then runs the programs and sees which gives the best results. The best programs are kept (natural selection), some of the rest are mutated, and the new generation is then tested. This process is repeated until a clear best program emerges.
- Fuzzy Logic [17]: Is the logic of "dealing with the concept of partial truth with values ranging between completely true and completely false." It provides a set of rules, allowing the imprecise expression of facts.
- Expert Systems [18]: Intrusion scenarios are encoded as a set of rules. The rules reflect the partially ordered sequence of actions compromising an intrusion scenario. Statistical profiles are created for different entities such as users, hosts and applications. Then statically unusual behavior is used to detect intruders.
- Signature Analysis [19]: from log files semantic descriptions of attacks are identified and formatted for presentation as part of the overall audit trail. Attack scenarios are decomposed into a sequence of events. In the detection mode, events are compared using string matching mechanisms.
- State machines [20]: State machines model behavior defining states and modeling the transition between states. An attack is modeled as a set of destination states and activities. The destination states are system compromises and the paths modeled are those leading to a system compromise.
- Petri nets [21]: IDSs that use Petri net describe events or activities as places, transitions, and directed arcs. Arcs connect a place and a transition. Each place may have a number of tokens which can be distributed to other places and is consumed if the transition is activated.

4. Simplified Evaluation of IDS data processing Techniques

In table I, a selected set of evaluation criteria and deployment challenges when choosing an IDS is presented. The table compares the IDS data processing techniques and scores them as low (not desirable), average or high (desirable). According to this simple comparison among the IDS data processing techniques, an IDS based on an expert system would be the preferred choice. This will be followed by data mining and then by agents. The most difficult or hardest to manage is the one based on neural networks.

TABLE I. MANAGERIAL REQUIREMENTS COMPARISON OF IDS DATA PROCESSING TECHNIQUES. L: LOW (NOT DESIRABLE), A: AVERAGE, AND H: HIGH (DESIRABLE).

	Bayesian Networks	Neural networks	Data Mining	Agents	Immune based	Genetic	Fuzzy logic	Expert systems	Signature Analysis	State machines	Petri Nets
Have easy management interface	A	L	H	A	A	L	H	H	H	A	A
The system is scalable	A	L	A	H	H	A	A	H	L	H	H
The system is self contained (i.e. updating	A	A	A	A	H	A	A	A	L	L	L
The system can generate reports	L	L	H	A	L	L	A	H	A	H	H
The system have available documentation and can be easily	L	L	A	A	L	L	A	A	A	A	A
The system can be maintained easily	L	L	A	A	L	L	A	A	A	A	A
Easy to mange policy document	L	L	H	A	L	L	A	H	A	A	A
The system is easy to install	L	L	H	H	A	L	H	H	H	A	A
The system is easy deployed	A	L	H	H	A	L	A	H	H	A	A
Ease of use (i.e. 1: best.)	7	9	2	3	6	8	4	1	5	5	5

5. Conclusion

With the increasing number of both host-based and network-based attacks, organizations employ various IDSs to monitor for any security breaches. In this paper eleven IDS data processing techniques are identified. They are compared with regard to selected managerial requirements and they are graded accordingly. This paper in general provided a summary of desirable management criteria to evaluate IDSs. When developing a good security system and especially and IDS, we should not only concentrate on performance. The managerial view and expectations should be incorporated in such process because understanding and making use of the results is important. Also, being able to deploy and maintain a system is critical as well as considering ease of training and use.

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A Virtual Programming Lab for Moodle with automatic assessment and anti-plagiarism features

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Abstract - *This paper describes VPL, a Virtual Programming Lab module for Moodle, developed at the University of Las Palmas of Gran Canaria (ULPGC) and released for free uses under GNU/GPL license. For the students, it is a simple development environment with auto evaluation capabilities. For the instructors, it is a students' work management system, with features to facilitate the preparation of assignments, manage the submissions, check for plagiarism, and do assessments with the aid of powerful and flexible assessment tools based on program testing, all of that being independent of the programming language used for the assignments and taken into account critical security issues.*

Keywords: programming learning, virtual lab, automatic assessment, plagiarism.

1 Introduction

Achievement of computer programming skills requires a lot of training by means of real program-development assignments. Managing and assess the students' submissions for those assignments could be a very complex task. Availability of tools to organize the assignments, receive and storage the submissions, support automatic or semi-automatic assessment and provide feedback could be very helpful. Furthermore, integration of that kind of tools into a Learning Management System is an essential feature in order to improve their performance.

Some tools for this purpose have developed along the time. STYLE [1] and CAP [2] focus on the automatic evaluation of program's style and syntax. PASS [3] focus on assessment capabilities. Some tools focus on execution for a specific programming language, as PACER [4], for ELI, a language similar to C, or HoGG [5] and ELP [6] for Java. More general tools focus on course management features, as Ceilidh [7], CourseMaster [8] and Boss [9].

This paper describes VPL, a Virtual Programming Lab module for Moodle, developed at the University of Las Palmas of Gran Canaria (ULPGC) and released for free uses under GNU/GPL license. Downloading of VPL is available at *http://vpl.dis.ulpgc.es*; also an on-line demo site is available at *http://demovpl.dis.ulpgc.es*. Figure 1 shows the VPL homepage.

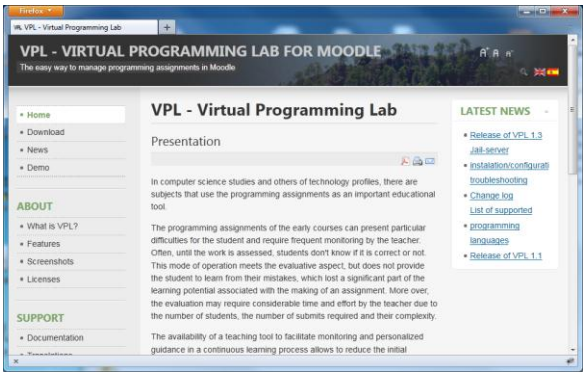

Figure 1. VPL homepage

VPL is designed to achieve the following goals:

- To be an open source tool, freely distributable and capable to be enriched with external contributions. For this reason it is distributed under GNU/GPL license.
- To be independent of the programming language. To use a particular programming language it is only required that the appropriate compiler is installed in the jail system (see section II for details). Currently, there are available jail systems with installations for Ada, C, C++, C#, FORTRAN, Haskell, java, Octave, Pascal, Perl, PHP, Prolog, Python, Ruby, Scheme, SQL and VHDL. Any user can install other languages if required.
- To provide a very simple development environment in order to smooth the learning curve to the beginners.
- To provide tools to support automatic and semi-automatic assessment, including tools for plagiarism checking.
- To be conscious of security issues. To avoid security breaches when executing students' code, all executions are performed in a separated and restricted environment (the above mentioned jail system).

Following sections describe the VPL architecture, the types of activities that can be done using VPL, how to

configure those activities, the use of VPL to assess submissions an check for plagiarism, and our experience as VPL users along the test phase of the module.

2 VPL architecture

1.1 General features

VPL is composed of three elements: a Moodle´s module, a browser-based code editor and a jail component (Fig. 2).

The code editor is a java applet providing basic features to edit, run, debug and evaluate programs code in a very simple code-development environment. To use full features a web browser with JavaScript and support for Java 1.5 applets is required.

The Moodle's module provides the typical features of this kind of component (backup and restore, integration with the grading book, course reset, events control, role-based access …) but also specific features such as: submission management, assessment support and anti-plagiarism features. The VPL module requires a Moodle version 1.9.x and PHP5 or higher.

The jail component is the server in charge of compile and executes the code submitted by the students in a secure environment. It runs a linux chroot command to provide a restricted version of the host file system with some read-only limitations. To run or evaluate a submission is required to have at least one jail server. The jail service needs Ubuntu (recommended) or Red Hat compatible linux distribution..

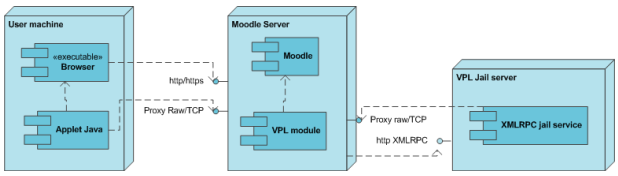

Figure 2. VPL components

The jail server attends requests for both interactive and non-interactive executions (Fig. 3), the difference between then is that the second type requires to the request data include a key, a server and a communication port, which are used to redirect the execution input/output data.

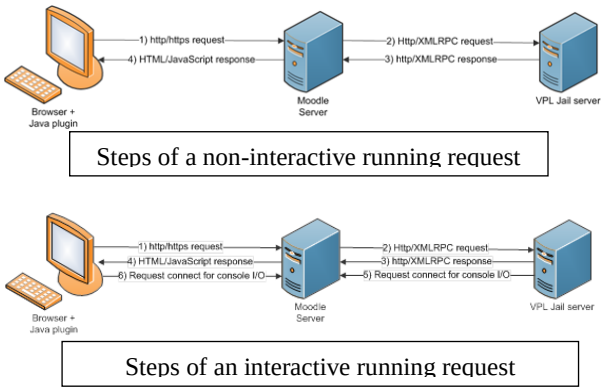

Figure 3. Types of execution request

To provide execution in console the Moodle servers need to open at least two ports, a larger number is recommended. It takes more time than usual to execute the PHP scripts that run a submission so it is necessary increase time limit in the PHP configuration.

1.2 Network topologies

The VPL module uses a double proxy to communicate, by a side with the Internet clients, to attend their requests, and by other side with the jail servers, to perform the running tasks associated to those requests. This permits a variety of network topologies. The simplest topology runs both the jail server and the Moodle server in the same computer, although they have to communicate via an intranet. This solution loses the security advantages provided by the isolation of the servers on different computers. A more suitable topology joins a Moodle server with one or more separate jail servers, which may be in a private network.

A more powerful topology, that improves the resources spending, is to share multiple jail servers among multiple Moodle servers (Fig. 4). This configuration may adapt itself to workload peaks by changing the number of jail servers in use by a Moodle server in order to attend in a proper way the variations on the requirements of the execution tasks. The drawback of this configuration is that the jail servers must be in a public domain in order to make them available to all the Moodle's servers without increasing the network complexity.

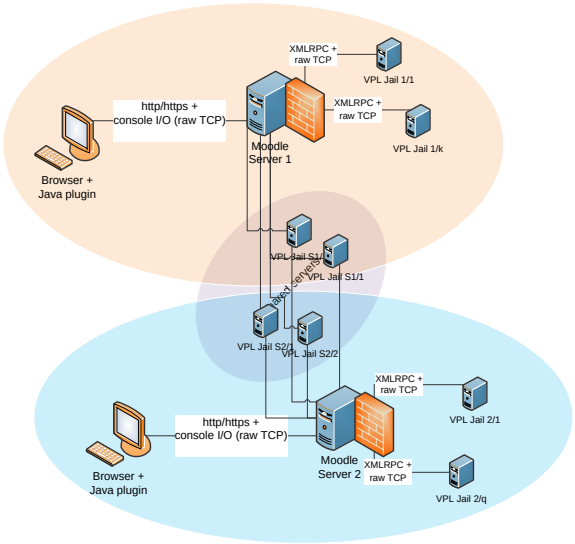

Figure 4. A complex net topology

Using multiple jails serves not only support scalability and improves performance, but also provides fault tolerance. When an execution request is received by the VPL module, it takes the list of available jail servers and randomly selects one that is not marked as having a previous fail into a specific range of time. Then VPL sends the server an availability request; if the response to this request is true, the execution request is assigned to the server, else a new server is selected. If no server is found, the process is repeated taken into account the servers previously failed.

3 Types of VPL activities

VPL can be used to configure, manage and assess a range of learning activities which can be classified by type or scope [10]. By type, the learning activities may be: examples, cloze or puzzle exercises, and code development exercises. By scope they may be: out-classroom tasks, or in-classroom exams.

1.3 Learning activities by type

Examples are activities where the students are provided with both the description of a problem and the program code that solves that problem. The students may interact with the code (running or debugging) to see how it works.

Examples may be mutable or immutable, depending on if the student can or no modify the code. An immutable example must be marked as "example" in the activity's configuration window. The student who modifies the code of a mutable example can always reset it to its original state.

Cloze exercises and puzzle exercises are especially appropriate for beginners. In the same way than the previous activity, they provide the students with the description of a problem and the program code that solves that problem, but now the student must modify the code.

In the case of the cloze exercises, portions of the code have been deleted and the student has to fill in the blanks in order to do the code works in the appropriate way.

In the case of the puzzle exercises, the code has been disordered and the student has to sort it in order to do the code works in the appropriate way.

A code development exercise provides the students only with the description of a problem (although some code may be sometimes included). The student has to develop the code to solve the problem using the appropriate techniques. This kind of exercises is a traditional way to achieve programming skills at any level by means of an intensive training in solving problems, in the believe that: 'doing programs is how we can learn to programming'.

1.4 Learning activities by scope

Attending to the conditions under what a VPL's activity can be done; there are two ways to use VPL: out-classroom tasks, or in-classroom exams.

Out-classroom tasks are designed as long-term activities to be done into a time period that may extend by days or weeks. During the active period of the activity the student may try so many solutions as he or she likes.

Out-classroom activities can be done anywhere, without direct supervision of an instructor, although help can be obtained from the instructors as long as they offer it in some way (e-mail, forums, face-to-face...).

In-classroom exams are activities designed to be done in a short-term and in a restricted environment, under instructor's supervision. So, they can be configured to require a password, be done in a specific local area network, or do not permit the editor's copy and paste features.

As for our-classroom activities, multiple attempts of solution could be tried. In both cases, the student can get immediate feedback for each try, if so configured.

4 Configuring VPL activities

1.5 Basic configuration form

The creation of a VPL activity begins by filling its basic configuration form, which includes, as for majority of Moodle's modules: activity's name, short description, availability period (with visibility and due dates), grading options, grouping... In addition, an VPL activity may include data as: maximum number of files to submit, maximum size of those files, restrictions on editing, network, password... (Fig. 5).

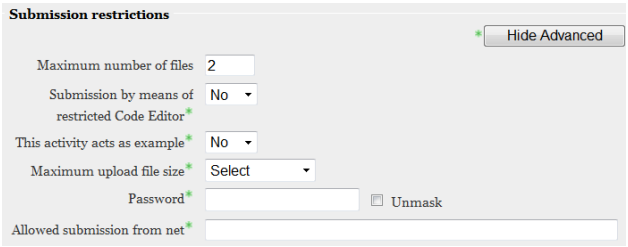

Figure 5. VPL basic configuration form restrictions

When the basic configuration form is completed, the instructor can configure five other groups of features: full description, tests cases, options, requested files and advanced features.

1.6 Full description and test cases

The Full description tabsheet shows a html editor where the description of the problem to solve must be written to be shown to the student.

The Tests cases tabsheet permits configure simple input-output based test cases to check programs correctness in order to elaborate an assessment reports both to provide feedback to the students and to support grading. The configuration of each test case must include: case short description, input to test the program, expected output for that input, and grade reduction when the test case fails (Fig. 6).

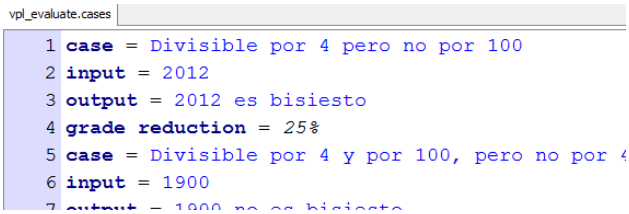

Figure 6. Example of test case configuration

1.7 The Options tabsheet

The Options tabsheet (Fig 7) serves to configure some general options for execution of submissions tests. The first feature in the Options tabsheet serves to indicate if

the activity is based on another VPL activity, on this way it is possible to build a hierarchy of activities which share some features via heritage.

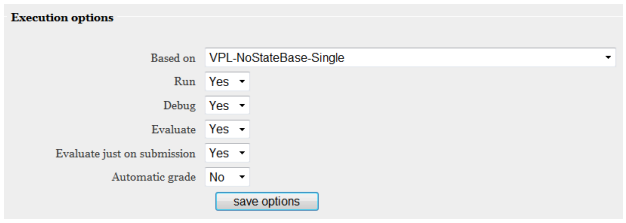

Figure 7. Options tabsheet

The rest of the options in the Options tabsheet are for configuring if the students can run, debug or evaluate their submissions, if the exercises will be evaluated just when submitted, and if the results of the automatic evaluation will become in the final assessment or they will be used only as a help for a human evaluator.

1.8 Requested files

The Requested files tabsheet (Fig. 8) serves to put obligatory names for the files that the student have to submit to complete the activity. The max number of files was put in the basic configuration form. The studen can submit any number of files, until the max, with any names, but if names for files are specified in the Requested files tabsheet, the student must submit at least those files.

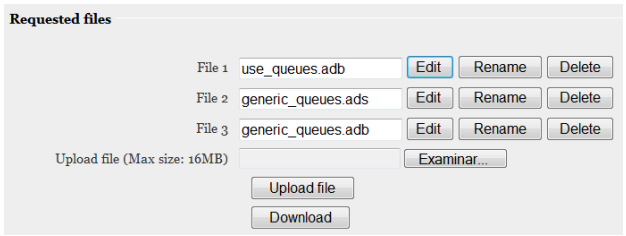

Figure 8. Requested files tabsheet

The instructor may provide initial contents for the specified files, by example, to configure a cloze exercise.

1.9 The advanced tabsheet

The configuration options described in the previous sections suffice to configure an activity with an useful test system. The Advanced tabsheet serves, among other things, to configure a more powerful test system.

The basic tests are black-box tests based on console input-output that check for functionality of the submitted code. Using the advanced options we can configure more powerful functionality tests, based on unit testing frameworks than can be similar, for example, to the well-known JUnit fo Java [11]. In addition to the unit tests, we can also configure other types of test like style checking or coverage tests, so producing an assessment report that takes into account not only functionality, but many other parameters linked to the code quality. To configure the advanced tests we can include some files (Fig. 9) to be joined with the submitted files to prepare the tests. We must also configure some script files that will control the execution, debugging and evaluation (running the tests) of the submissions.

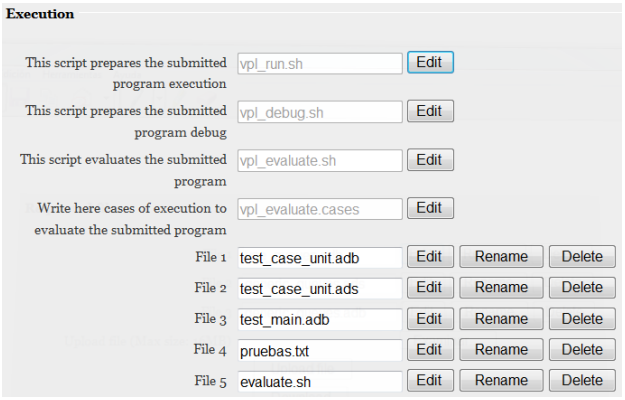

Figure 9. Execution files for advanced testing

The Advanced tabsheet includes also the configuration of other features (Fig. 10) which usually do not need modification, such as limits for execution (time, memory and disk use) or designation of specified jails for the activity.

Figure 10. Advanced options tabsheet

5 Assessment support

VPL offers both automatic and computer-aided assessment. Selection of one of them is made by checking the appropriate option in the Options tabsheet, as described above.

The key for the assessment support is the configuration of the program tests; this can be made by simply listing a set of input-output tests cases or by configuring a more complex tests framework.

VPL automatically executes the configured tests and produces a report that includes a list of failed tests, with explanatory comments, and a grade proposal. This report could be used in three ways: to provide feedback to the students while they are developing their solutions to the exercise (formative assessment), to produce the final assessment if automatic evaluation is configured, or to help a human evaluator to assess the submission.

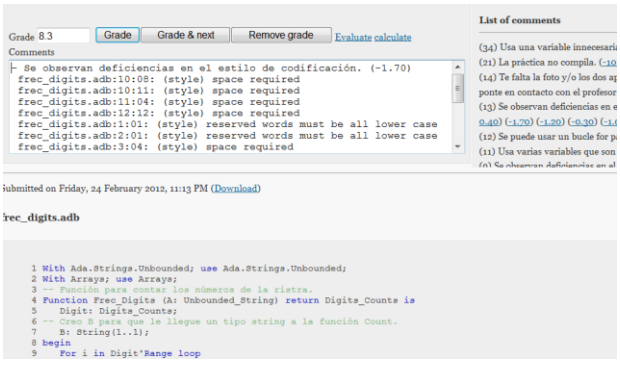

Figure 11. Evaluation window

When evaluating a submission the human evaluator uses a window (Fig. 11) where appears the assessment report produced by the test system and a list of the comments added to other submissions previously evaluated. The human evaluator can modify the report deleting comments, adding new comments or reusing comments from the list, and recalculate the grade.

6 Plagiarism checking

Plagiarism is a real problem ([12], [13], [14]) that must be faced from different perspectives: formation, prevention, and prosecution. Both, prevention and prosecution can benefit from technological development as plagiarism itself does.

VPL includes a tool to check plagiarism among source code. The main goal of this tool is to detect plagiarism among submissions for a task in a course, but it can include other sources, like submissions for the same task in previous semesters, or similar tasks from other courses, which are a probable source of plagiarism.

The process to find similarities among source files is composed of three steps: tokenization, comparison and clusterization (Fig. 12).

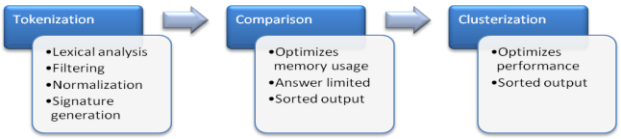

Figure 12. Steps to find similarities among source files

Tokenization is the process to get a normalized signature from every file in order to perform an efficient comparing to find similarities among them. It is composed of three phases: lexical analysis, filtering and normalization (Fig. 13). The lexical analysis extracts the tokens that represent the elements of a program (they depend on the programming language), then those tokens are filtered to delete those that are irrelevant for comparison, and finally expressions are normalized into a canonical form, producing the program signature.

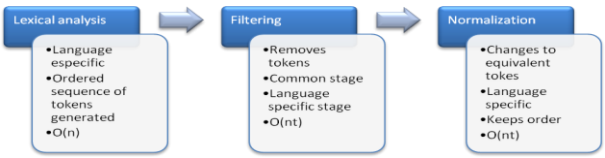

Figure 13. Tokenization phases

Signatures are normalized representation for the source code files, extracted from them in order to optimize the comparison process. The form of the signature depends on the metric to be used in comparison. VPL use three different metrics [15] which, when comparing two signatures, produce a number in the range 0.0 to 1.0, where 0.0 means "totally equals" and 1.0 means "totally different". Using three metrics takes advantage of the fact that they are affected in a different way by the modifications of the code. Table I shows the effect of typical code changes on the metrics (F = Filtered, A = Affected, NA = Not Affected, SA = Slightly affected, ASC = Affected by Size of Changes, ANC = Affected by Number of Changes).

TABLE I. METRICS AFFECTATION

Change / Metric	Comments	Name of Identifiers	Code reorder	Systematic change	Complex change
Metric 1	F	F	NA	SA	A
Metric 2	F	F	NA	ASC	ASC
Metric 3	F	F	A	ANC	ANC

Experience using the tool has shown that some plagiarism cases present not a one-to-one relationship, but a group relationship where usually nobody has a detailed knowledge of all the participants, for example, student A may lend its work to students B and C, without mutually knowledge of B and C; student C may lend the work to student D, without knowledge of A and B, and so on [16]. To provide the reviewers with information about that kind of event, the system incorporates algorithms to identify clusters of most similar files.

The visualization system of the anti-plagiarism tool permits to visualize lists of pairs of similar files, clusters of similar files, or file-to-file similarities (Fig. 14).

Figure 14. File-to-file visual comparison

7 Experience of use

VPL current version was released in September 2011, and is used for nine courses in the current academic year (2011/2012) with a total of 1181 students. At the moment of writing this paper (the second semester is not ended) 376 VPL activities have been configured for those courses, producing 18664 submissions (these counts only the final submissions, not the multiple tentative submissions done during the submission period).

A previous release was tested during the academic year 2009/2010 using only a course with 208 students and 42 activities, producing 1315 final submissions, and then it was used in the academic year 2010/2011 for five courses, with 661 students and 264 activities, producing 5140 final submissions.

During this period, VPL was publicly available and was developed and used for about 50 academic institutions over the world. The comments and suggestions made by these users also have contributed to the current version.

Some polls made to the students during the academic year 2011/2012 reveal that VPL activities were the best valued learning resources, with about a 80% of students declaring that the utility of VPL activities for their learning was very high and about a 16% declaring that it was high.

8 Conclusions and future work

This paper describes VPL, a powerful tool to manage and assess computer programming exercises freely distributable under GNU/GPL license. The main advantage of this tool is its integration in a popular learning management system, as Moodle is. This integration provides access to all the features of that kind of platforms.

A major feature of VPL is its capacity to produce complete assessment reports based on program testing. Moreover the required program tests can be configured in a very flexible way, ranging from simple input-output tests to complex combinations of unit tests, coverage tests or style tests.

Another important feature of VPL is the embedded tool to check submissions for plagiarism. It is important because plagiarism is a big problem in academia, as many studies have shown.

The current version of VPL (1.4) runs under Moodle 1.9.x. By the beginning of the 2012 summer will be released the version adapted to Moodle 2.x, including new and improved features.

The architecture of VPL will be re-engineered to include the case when the Moodle server is running in a cluster. The problem with the clusters is that, using the current design, the communication between the console and the jail for an interactive execution must be done through the Moodle server, but, if there are a cluster of servers responding the requests, it is not possible know what server has to manage the communication.

The Java applet editor will be changed by one developed using HTML5. Currently the Java applets do not work properly on systems like iPad, or tablets running Android.

Acknowledges

We wish to acknowledge the support of the Department of Informática y Sistemas of the University of Las Palmas de Gran Canaria to the development of VPL. We also wish to acknowledge the coordinators and teachers of the courses that have used VPL during its test phase for their useful comments.

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The Performance of Ubiquitous Video Conferencing Application

N. Arellano[1], S. Mendoza[1], E. Tsai[1], G. Nunez[1], A. Lin[1], G. Carter[1], A. Lam[1], JP. Adigwu[1], J. Estrada[1], A. Milshteyn[1], S. Beltran[1], H. Boussalis[1], and C. Liu[1]
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Abstract - *Based on the concepts and the collaborative movement of the Semantic Web, the CSULA SPACE Center[1] has proposed and developed the Semantic Information System (SIS) Network for the real-time project collaboration [1] [2]. The SIS allows users to create, modify, and organize project data in a hierarchical manner. In order to effectively communicate with each other, SIS project collaborators require a uniform, real-time communication platform. In order to avoid the dependency on the third-party applications, as well as to provide a uniform and integrated environment, the Ubiquitous Video Conferencing (UVC) application has been developed. It fulfills the intended SIS design specifications by providing participants with interactive functionalities necessary for performing real-time collaborations [3].*

The UVC offers options such as audio/video recording, multimedia playback, and multi-touch drawing. These services are built upon the robust and integrated libraries belonging to Qt, cross-platform audio/video solution FFMPEG, and the image-processing library Open Computer Vision (OpenCV)[4][5][6].

Keywords: Ubiquitous Video Conferencing, Semantic Information System, Bandwidth Analysis, Project Collaboration, Audio Compression, Multithreading

1 Introduction

The trends of increasing computing power, affordability of hardware, and emergence of embedded networked systems have enabled businesses, researchers, and students the capability of accessing the information through technologies such as the Internet, technical software, and peer-to-peer communication.

Although web-browsers, social network applications, and voice/video communication enable users to indentify "birds of a feather" communities, information is often scattered among various networks often hindering the ability for information updates to be synchronized in a seamless fashion.

[1]Acknowledgement to NASA University Research Center Program, GRANT # NNX08A44A

Figure 1 shows an innovative SIS model of software architecture. It provides facilitation and management of client requests across a distributed server network. It is particularity suitable for information dissemination between project collaborators, particularly for researchers, educators, and students; specifically the use of the network by groups where geographic location, time, and computing resources limit information exchange and collaborative efforts amongst each other.

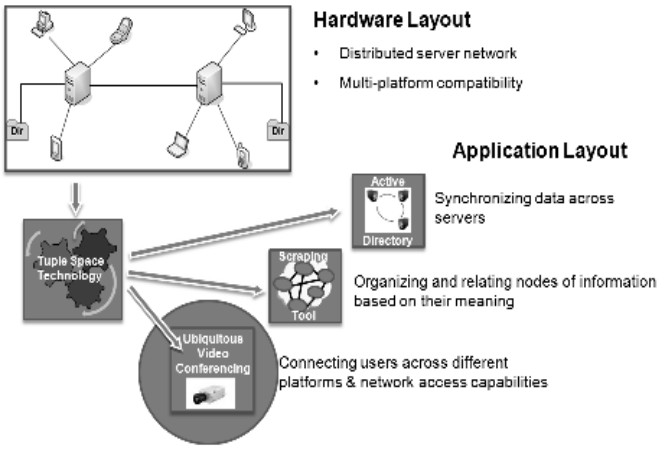

Figure 1: Semantic Information System model

Semantic Information System platform is best suited for educators, researchers, and team-project members with common interest of information generation, analysis, interpretation, and dissemination. SIS users will be able to "objectize" information nodes of their projects, which will be generated in a hierarchical tree structure model to interrelate those nodes based on their semantic meaning and relationship with respect to each other. These user-generated contents can be accessed, updated, and shared with other network participants.

For the aforementioned SIS platform, a need for communication interface was born. In order for the project collaborators to interact with each other a Ubiquitous Video Conferencing (UVC) has been developed. It provides SIS users with real-time interactive application features.

The organizational flow of the paper is outlined as follows: The need for the SIS and its background are described within the Introduction section. It is followed by

the System Technologies implemented to comprise the SIS network. Then, the Application User Controls section describes the application interface and features of the UVC application itself. The last sections, Performance Analysis and Conclusion, present, discuss, and summarize experimental performance data obtained for real-time video and audio processing.

2 System Technologies

The key components that comprise the backbone of the Semantic Information System Network are Scraping Tool, PostgreSQL-based participant database, Qt API, and the UVC software.

The Scraping Tool is the application that has a mechanism for gathering content from network resources and populating its tree structure in a hierarchical manner. Figure 2 shows the 3D representation of such content structure. Through this data publishing process, SIS users can gather relevant content from various sources and store, or integrate them in a central location.

Figure 2: 3D Visual Representation of the SIS

A PostgreSQL Relational Database Management System performs data warehouse storage allocation and unique key assignments to the content within the network. The database also keeps track of registered SIS users and stores their access privileges, which play an important role in system security. Qt API is an open-source development platform that is geared toward design of Graphical User Interface (GUI) applications with extensive set of modules and libraries available. To facilitate audio and video and perform multimedia compression, Open Computer Vision (OpenCV), FFMPEG, and Speex library tools were assembled to the application development project in order to create the Ubiquitous Video Conferencing application.

3 Application User Controls

UVC is intended for interactive communication over the Semantic Network, where conference participants are able to collaborate on their ongoing project via multimedia communication channels. To ensure well-organized project environment, it is necessary to grant certain member(s) session moderation privileges. In moderated sessions, an initiator of the videoconferencing is automatically assigned with Forum Coordinator regulatory privileges. When establishing a videoconference link, the Forum Coordinator of the group will initiate a session, thus relevant group members can join by authentication. Members will have their unique credentials and will be required to enter an additional verification code for a specific conferencing room. Its main GUI is displayed on Figure 3. Upon joining, members' data such as the user name, IP address, application device capabilities (webcam/microphone/text chat only) will be logged in the "lookup table". The Forum Coordinator will be in charge of placing and lifting restrictions on each participant such as who can use video/audio channels and when. Figure 4 displays UVC Voting System used during decision-making operations of real-time project collaboration.

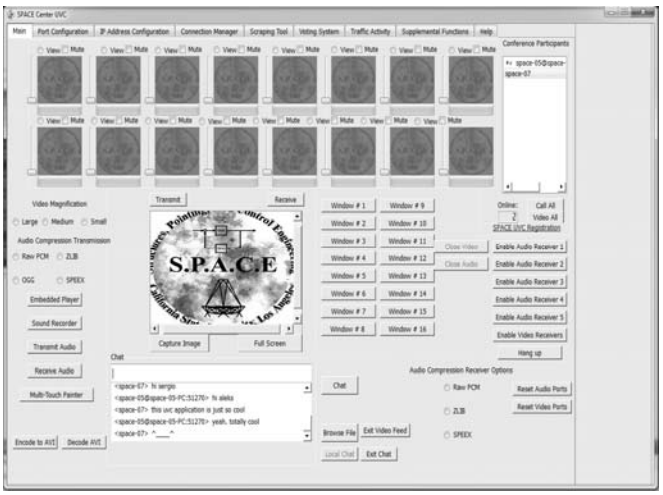

Figure 3: Main GUI of the UVC Application

Figure 4: Voting System of the UVC Application

4 Performance Analysis

4.1 Video

The Performance of Network utilization has been conducted to determine the network traffic due to various transmission rates of video and audio data. The three experiments have been performed in order to find the average ratio of the network usage compared to the maximum available traffic. The sender is able to vary the FPS (frames per second) rate and hence, impact on the availability of network resources. This feature of real-time frame rate control assists to the application users in determining the appropriate frame rate settings during videoconferencing sessions. Users are able to free up their network resources by lowering their transmission frame rates. Oppositely, they can improve quality of their transmitted video data sacrificing more bandwidth. This tradeoff allows for real-time network resource management by the application participants. The default frame-rate setting has been set to 7fps, which on average takes 5.95% of the Network Resources over IEEE 802.11g -54 Mbps network connection. In order to avoid system instability, no more than seven participants of the same network, should be broadcasting their video at that frame rate. In order to accommodate more video streams, participants must lower their transmission frame rate.

4.2 Audio

This section presents and discusses the experiments performed to analyze the integration of audio transmission within the UVC application. The video and audio channels run in a multithreading environment, with each channel having a dedicated processing thread. The UVC application provides its participants with direct multimedia channel control, where system participants are able to close and (re)-open video and/or audio channel streams with individual participants. The UVC GUI has various options that provide users with an easy and efficient control panel. Audio Codec selection is the primary audio bandwidth regulator that UVC offers to the end user. A participant may choose from the three following types of audio transmission: Pulse-Code Modulation (PCM) Raw audio streaming, Zlib codec and Speex audio codec [7] [8]. The experiments on audio performance were done over IEEE 802.11g -54 Mbps network connection. The experiments were conducted to determine the compression ratios of Zlib and Speex codec to the Raw PCM data. They are shown in Figure 3.

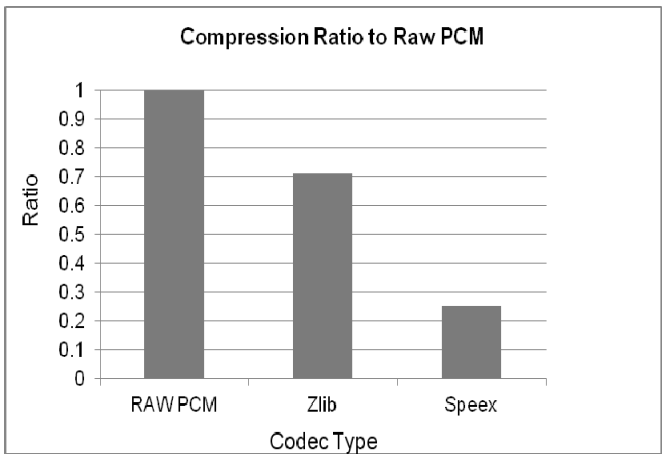

Figure 3 : Codec Type Compression Ratio to Raw PCM Data

The compression solutions are offered within UVC application in order to reduce the amount of network bandwidth during audio data transmissions. There is no extra penalty incurred by the processing time of compression codecs. All three audio methods have similar processing time measured and the obtained data is recorded in the Table 1.

Table 1: Processing Time of UVC Audio Transmissions

Codec Type	**Processing Time per 1000 cycles Exp. 1 (ms)**	**Processing Time per 1000 cycles Exp. 2 (ms)**	**Processing Time per 1000 cycles Exp. 3 (ms)**	**Ave. Time per cycle (ms)**
Raw PCM	38823	38700	38625	38
Zlib	38241	38299	38265	38
Speex	38518	38587	38605	38

Table 2 shows three bandwidth measurements of aforementioned audio codecs with a constant video feed of 25 FPS. These average values have been also obtained for a 54Mbps Wireless Network.

Table 2: Bandwidth of single Audio and Video stream

Codec Type	**Network Utilization Exp. 1 %**	**Network Utilization Exp. 2 %**	**Network Utilization Exp. 3 %**	**Average Network Utilization %**
Raw PCM	19.30	19.35	19.31	19.32
Zlib	19.20	19.26	19.25	19.24
Speex	19.09	19.08	19.08	19.08

5 Conclusion

This paper focused on analyzing performance characteristics of the interactive functionalities within the Ubiquitous Video Conferencing application. The real-time optimization of video and audio data offers multiple configurations to the SIS collaborators in terms of adjusting their transmission and receiving parameters. These configuration options provide flexibility for bandwidth control, as the participants can regulate their network bandwidth in order to raise the multimedia quality, or increase participating session capacity. The multithreading nature of the application provides dedicated transmission of individual audio and video channels. The performance characteristics obtained from the bandwidth analysis demonstrated the strength of the application's real-time configurability and flexibility. During project collaborations over the SIS platform, users are given the tools to self-regulate the scalability of the rapidly varying videoconferencing session environment.

6 References

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Design of a Chinese Electronic Word of Mouth Analysis Method

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Abstract - *Since eWOM provides rich and objective information about products or services, eWOM has become one of the major sources by which consumers collect information about products or services. However, the problem of eWOM overload has caused difficulty for consumers to effectively collect information about products or services, and it further hampers consumers' decision making about purchasing products or services. eWOM content is characterized by unstructured text formats, oversimplified expressions, and newly coined phrases (textspeak), and these all have contributed to the difficulty of analyzing Chinese eWOM. Therefore, this study purposes a eWOM analysis method. The eWOM analysis method may result in an effective analysis of eWOM content, may extract positive and negative appraisal from e WOM content, and most importantly, may help consumers process their decision making.*

***Keywords*:** Electronic Word-of-Mouth (eWOM), Sentiment Analysis, Consumer Decision Making, Knowledge Management

1 Introduction

With the development of technology, more and more consumer are sharing their opinions or appraisals of products or services through their blogs, web forums, bulletin board systems (BBS), or email, and therefore, some scholars have named the phenomenon "electronic word-of-mouth" (eWOM) or "online word-of-mouth". Since eWOM provides rich and objective information about products or services, it has become one of the major sources for the collection of product or service information by consumers [1, 2].

More and more studies have proven that consumers tend to be more interested in products discussed on blogs and web forums than they are in those marketed in traditional ways. eWOM can contribute to higher credibility and may have more relevance to consumer opinions and appraisals [3]; therefore, eWOM plays an important role in consumer decision making [4-6].

In China, it has been estimated that around 41.1% of consumers will try to look at appraisals of products or services through eWOM, and it has been shown to facilitate the consumer decision making process [7]. Therefore, Chinese eWOM is viewed as an important appraisal for consumers in China. Currently, more and more Chinese consumers use search engines and keywords to collect Chinese eWOM before they make their decisions about purchasing products or services. Nevertheless, the overload of eWOM online data causes difficulty in effectively collecting information about products [8]. Consumers often cannot use the right keywords on the search engine, so they usually cannot get the exact eWOM content or content features they need. [9, 10]. In order to get the right information, the current information retrieval models usually require consumers to take a great amount of time reading, selecting, and filtering their search results [11]. Therefore, how to computerize the analysis of Chinese eWOM information has become an important issue for both researchers and consumers.

Therefore, this study purposes a eWOM analysis method, in order to assist consumers in analyzing, filtering, and extracting eWOM appraisals. It is intended to help consumers understand eWOM appraisals about products or services. The method is also expected to help consumers in their decision making regarding purchases. Specifically, this study focuses on the following tasks: (i) designing an eWOM management framework; (ii) constructing an eWOM analysis model; (iii) designing an eWOM analysis method, and (iv) developing an eWOM analyzing system.

2 Electronic Word of Mouth Analysis Model Design

2.1 Design on Electronic Word of Mouth Management Model for Service Experien

eWOM is constructed using words or phrases about products or service opinions, eWOM content usually includes consumers' experience of purchasing or using products. Therefore, eWOM content is an important source of consumer knowledge.

In order to effectively organize and manage that eWOM content, this section introduces an eWOM management framework, as shown in Fig 1. Effectiveness of the proposed framework is illustrated by a knowledge management procedure, which consists of eWOM collection, eWOM analysis, eWOM knowledge representation and reasoning, and a consumer evaluation criteria analysis. [12, 13]. They are explained as follow:

As can be seen in Fig 1, eWOM management framework is displayed. This study focuses on eWOM analysis, and the following section explains the procedures

of eWOM analysis method development. The procedures, methods, and results are as follows:

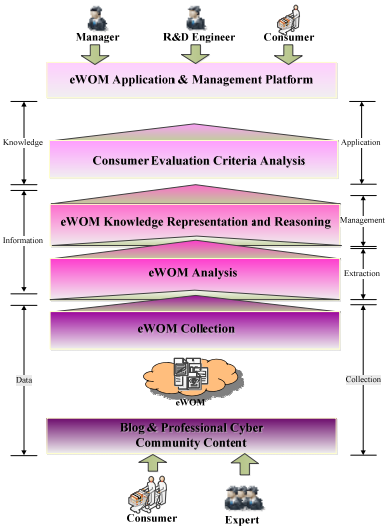

Fig 1. eWOM Management Framework

2.2 Analysis of eWON Content Characteristics

The most significant characteristic of eWOM is that consumers can express their opinions about or appraisals of products or services. They usually use their own writing style or coined phrases to express their feelings about their product and service experiences or opinions. This has caused problems for the analysis of eWOM content. The problems are explained as follows:

1. The diversity of eWOM content: eWOM consists of a number of subjects (products or service) and appraisal words. Consumers usually only care about one of the subjects in the eWOM content. However, the syntactic expressions in the Chinese language are complicated and tend to influence the accuracy of extracting the target words. Therefore, the effectiveness of extracting accurate words is eWOM's primary concern.
2. The inconsistent formats of eWOM content: There is no specific writing format for eWOM content. There are also lots of coined patterns or special symbols, such as: (⊙ o ⊙); (☆_☆); (*^_^*)…etc. Additionally, eWOM authors usually do not follow the convention of writing with correct punctuation in their comments. This causes difficulty to recognize parts of speech in eWOM content in computer analysis.

The complexity of word combinations in eWOM content: Sentences consist of words or phrases; however, different combinations of words or phrases may have very different meanings. For example, in Chinese, the character 『不』 is a reverse word. When it is used in sentences, it usually reverses the meaning of the sentence. In the appraisal sentence 『餅乾不吃會後悔 (You will regret it if you do not eat the cookies.)』, the reverse word 『不 (do not)』 and the appraisal word 『後悔 (regret)』 both hold negative meanings; however, when the two words are put together in the same appraisal sentence, a positive meaning is generated. Therefore, we have to take the reverse word "不 (do not)" into consideration. Reverse words usually change negative appraisal words into positive ones; on the contrary, they may change positive appraisal words into negative ones. This is also a major problem that hinders eWOM analysis through the use of computer programs.

2.3 Analysis of Appraisal Sentence Characteristics

According to the abovementioned difficulties, for the purpose of this study, appraisal sentences are analyzed and organized. The analyses and organization may help computer programs to identify the meaning of appraisal sentences with a higher degree of accuracy. Appraisal sentences include descriptive sentences about consumer opinions about products or services, and descriptive sentences focus on describing their experiences or opinions about these products or services. Similarly, appraisal words indicate those words or phrases that are related to consumer opinions. For example, appraisal words such as "香 (smells good)", "臭 (stinky)", and "便宜 (inexpensive)". In order to identify appraisal words from complicated word or phrases combinations in appraisal sentences, NOR gate from logical gates is employed in this study as an analytical method by which to express reverse words and appraisal words.

1. Reverse Words "NOR" Positive Appraisal Words: When reverse words and positive appraisal words appear in the same appraisal sentence, the meaning of the sentence is negative. For example, in the appraisal sentence "炸雞不好吃 (The fried chicken does not taste good.)", the reverse word "不 (does not)" has a negative meaning. The appraisal words "好吃(taste good)" have a positive meaning. As a result, when they are put together, the sentence has a negative meaning, as shown in Fig 2.

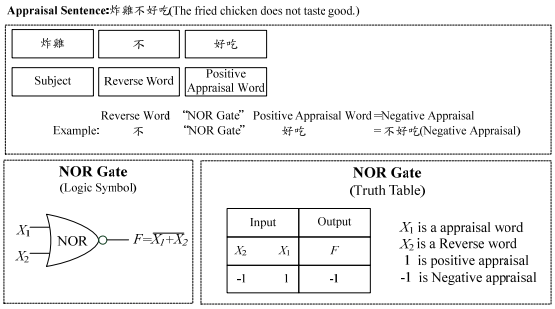

Fig 2. Analysis of Negative Appraisal Sentence

2. Reverse Word "NOR" Negative Appraisal Word: When a reverse word and a negative appraisal word appear in the same appraisal sentence, the meaning of the sentence is always positive. For example, the appraisal sentence "炸雞很不錯 (The fried chicken tastes not bad.)", the reverse word "不 (not)" has a negative meaning. The appraisal word "錯 (bad)" also has a negative meaning. Therefore, putting the two words together brings the sentence a positive meaning, as shown in Fig 3.

Drawing from the abovementioned examples, it is apparent that different appraisal words and reverse word combinations may produce different meanings. As a result, reverse words are taken into consideration, and rules are organized to analyze appraisal sentences. By doing so, computerized analysis may be able to identify the meaning

of appraisal sentence with a higher degree of accuracy, as explained in Table 1.

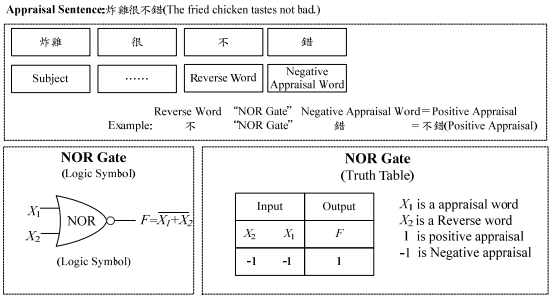

Fig 3. Analysis of Positive Appraisal Sentence

2.4 Design of Electronic Word-of-Mouth Analysis Model

Based on the results of section 2.2, "analysis of electronic word-of-mouth characteristics" and section 2.3, "analysis of appraisal sentence characteristics", an electronic word-of-mouth analysis model is designed. The purpose of designing the model is to improve the effectiveness of eWOM analysis. It may also yield fruitful results in helping computer programs to separate positive appraisal content from negative content, as can be seen in Fig 4.

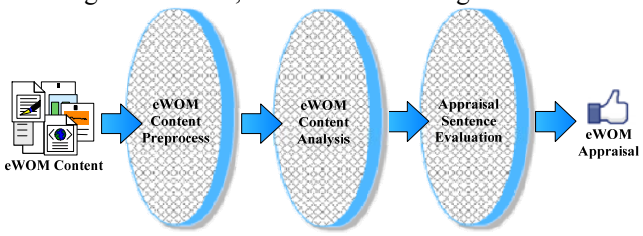

Fig 4. Electronic Word-of-Mouth Analysis Model

3 eWOM Analysis Method Development

3.1 Analysis Procedure for Electronic Word-of-Mouth

Based on section 2.4, electronic word-of-mouth analysis model, analytical eWOM procedures are developed to assist consumers in their understanding of the appraisals of products or services, as can be seen in Fig 5. The eWOM analytical procedures contain mainly the eWOM content preprocess, eWOM content analysis, appraisal sentence evaluation, and subject matching. Among them, the eWOM content preprocess includes HTML structure analysis, automatic marking, and HTML tag refinement. The eWOM content analysis contains part of speech tagging, appraisal word monitoring, subject collection, and subject filtering. The appraisal sentence evaluation includes appraisal sentence marking and appraisal sentence analysis. The subject matching mainly provides a function for consumers to look for eWOM appraisals. They are discussed in the following sections.

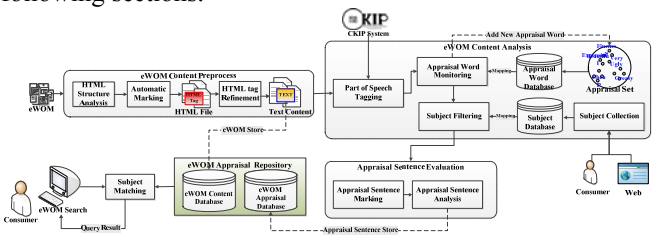

Fig 5. The Procedure for Electronic Word-of-Mouth Analysis

3.2 eWOM Content Preprocess

Based on the findings in section 2.2, the result of analysis of eWOM content characters, a function for the eWOM content preprocess is developed in this study. It serves to organize and filter the content of the target eWOM so that the reliability of the content can be raised. The analytical process is elaborated as follows:

1. HTML Structure Analysis: every blog or web forum has its own HTML tag. Therefore, after we get the web content, we analyze the HTML structure of the target web content. In this way, it will be easier to extract the eWOM content.
2. Automatic Marking: eWOM content is usually non-structural or semi-structural. It is mixed with a lot of textspeak, special symbols, and non-punctuated excerpts. The difficulty of analyzing the part of speech of the text is further complicated by non-punctuated excerpts. Therefore, an automatic marking function is developed to analyze and categorize HTML language. It also serves to punctuate the eWOM content by creating a rule database. Finally, it may raise the validity of marking or analyzing the part of speech in Chinese texts.
3. HTML Tag Refinement: It serves to remove the HTML tag and web link. It also retains the web content. In this way, it is expected to raise the efficiency of processing. Finally, the content is saved as a "txt" file.

Table 1. Appraisal Sentence Analysis Rules

Positive Appraisal word	Negative Appraisal Word	Reverse Word	Explanation
●			In an appraisal sentence, if there is only a positive appraisal word, the sentence is valued as positive.
	●		In an appraisal sentence, if there is only a negative appraisal word, the sentence is valued as negative.
●		●	In an appraisal sentence, if there are both a positive appraisal word and a reverse word, the sentence is valued as negative.
	●	●	In an appraisal sentence, if there are both a negative appraisal word and a reverse word, the sentence is valued as positive.

3.3 eWOM Content Analysis

eWOM content analysis is the analytical process for the semantics of eWOM content. It aims to find out the products or services related to subject and appraisal words. The analytical processes are elaborated as follows:

3.3.1. Part of Speech Tagging

It utilizes the CKIP (Chinese Knowledge Information Processing) developed by Taiwan's Academic Sinica to analyze the eWOM content. The CKIP analyzes and tags the part of speech in the eWOM content. In this way, the part of speech of the words in eWOM content is marked. Based on the results of part of speech tagging, VH and Na words are extracted in this study to conduct appraisal word monitoring.

3.3.2. Appraisal Word Monitoring

A lot of products or services appraisals are still expressed as sentiment words [14]; therefore, we can get the appraisals from consumers through sentiment words. The technology of sentiment analysis is widely applied in the analysis of sentiment words [15, 16]. Therefore, Ku's [17] sentiment analysis approach is employed in this study as the basis for appraisal word analysis, and the analysis can be seen in Fig 6:

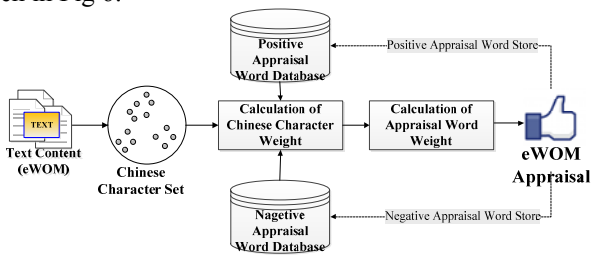

Fig 6. Process of Appraisal Word Monitoring

The appraisal word monitoring consists mainly of "calculation of Chinese character weight" and "calculation of appraisal word weight". They are explained as follows:

Step 1. *Calculation of Appraisal Character Weight*

The appraisal character weight, which denotes positive or negative values, is calculated with *equations* (1) and (2).

$$P_{ci} = \frac{fp_{ci}}{fp_{ci} + fn_{ci}} \quad (1)$$

$$N_{ci} = \frac{fn_{ci}}{fp_{ci} + fn_{ci}} \quad (2)$$

Where ci is the i^{th} character in the appraisal character set, fp_{ci} is the number of appraisal character ci appears in the positive appraisal word database, fn_{ci} is the number of appraisal character ci appears in the negative appraisal word database, P_{ci} is the positive weight of the appraisal character ci, *and* N_{ci} is the negative weight of the appraisal character ci. *Equations* (1) and (2) denote the number of times an appraisal character appears in the positive and negative appraisal word databases. *Equations* (3) and (4) regularize *equations* (1) and (2), respectively.

$$NP_{ci} = \frac{fp_{ci} / \sum_{j=1}^{n} fp_{cj}}{fp_{ci} / \sum_{j=1}^{n} fp_{cj} + fp_{ci} / \sum_{j=1}^{m} fn_{cj}} \quad (3)$$

$$NN_{ci} = \frac{fn_{ci} / \sum_{j=1}^{m} fn_{cj}}{fp_{ci} / \sum_{j=1}^{n} fp_{cj} + fp_{ci} / \sum_{j=1}^{m} fn_{cj}} \quad (4)$$

Where fp_{ci} is the number of appraisal character ci appears in the positive appraisal word database, fn_{ci} is the number of appraisal character ci appears in the negative appraisal word database, n is the total number of appraisal words in the positive appraisal word database, m is the total number of appraisal words in the negative appraisal word database, NP_{ci} is the positive weight of appraisal character ci in the positive appraisal word database, and NN_{ci} is the negative weight of appraisal character ci in the negative appraisal word database.

Step 2. *Calculation of Appraisal Word Weight*

In *Equation* (5), S_{cj} is the appraisal character weight of each appraisal character. NP_{ci} and NN_{ci} are the positive and negative weights of the appraisal character, and NP_{ci} and NN_{ci} are used to assess the meanings of appraisal characters. For example, if NP_{ci} is greater than NN_{ci}, the appraisal character is positive, and vice versa.

$$S_{ci} = NP_{ci} - NN_{ci} \quad (5)$$

$$S_w = \frac{1}{p} \times \sum_{j=1}^{p} S_{cj} \quad (6)$$

Equation (6) primarily evaluates whether the appraisal word is positive or negative. S_w is the appraisal word weight of the appraisal word and is either positive or negative, p is the number of appraisal characters in the appraisal word and S_{cj} is the appraisal character weight of each appraisal character.

3.3.3. Subject Collection

In this study, subject names were collected that were related to products and services. There were two approaches to subject collection. The first one was to collect subject names entered by consumers. The second approach used a web platform to collect subject names. Therefore, a web platform was used to design the subject collection process. A computerized subject name collecting process was developed, as can be seen in Fig 7.

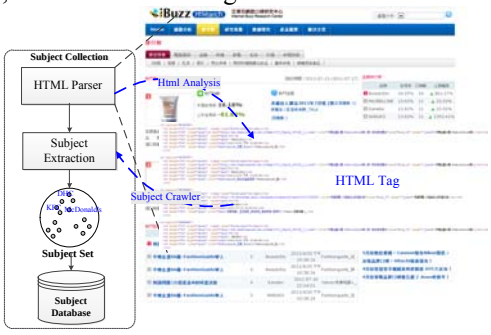

Fig 7. Subject Collection Process

1. HTML Parser: A popular keyword collection website was used as the sample for subject name collection. Every website has its own HTML tag format. As a result, using an HTML parser to analyze the HTML structure of a keyword collection website may facilitate subject name extraction.
2. Subject Extraction: This process deleted HTML tag and web links and preserved popular frequent keywords. The

process also saved frequent keywords to a subject database.

3.3.4. Subject Filtering

Based on the subject collection results in section 3.3.3. The subject names from eWOM content were compared and filtered in this study. The purpose was to find out the subject names in the eWOM content related to products and services.

3.4 Appraisal Sentence Evaluation

According to the results from the analysis of appraisal sentence characteristics in section 2.3, an appraisal sentence evaluation was conducted; in doing so, the value of appraisal sentences could be judged to be either positive or negative. Therefore, a process was designed for appraisal sentence evaluation. The main process included two parts, appraisal sentence marking and appraisal sentence analysis. The two parts are elaborated upon in the following section:

3.4.1. Appraisal Sentence Marking

Based on the results derived from the eWOM content analysis in section 3.3, the appraisal sentences related to products or services in the eWOM content were determined. As shown in Fig 8, the operational steps are described as follows:

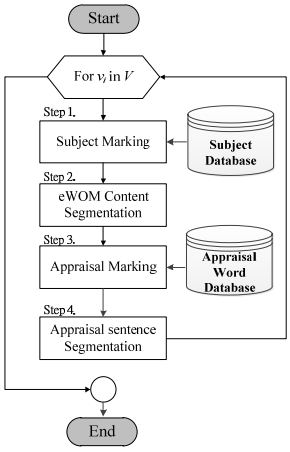

Fig 8. Appraisal Sentence Evaluation Process

INPUT: V is a text content set of eWOM content, presented numerically as $v_i \in \{v_1, v_2, v_3, \ldots, v_g\}$; V is the number of eWOM content set（g=1~V）.

Step1. Subject Marking: Judging from the results of subject filtering in section 3.3.4, the subject of current eWOM content v_i is indicated, as shown in Fig 9.

Step2. eWOM Content Segmentation: The process singled out the appraisal content. If the eWOM content had two subjects, the eWOM content was separated into two parts. The separation process was based on the length of the paragraph between one subject and the next subject. When there were two subjects, eWOM content segmentation was launched. Fig 10 is an example. When the first subject (香菇街) in an eWOM content subject appeared, the program started recording the range of content for part_1. As soon as subject_2 appeared, the program stopped recording the content of part_1 and began recording the range of content for subject_2 (一中街).

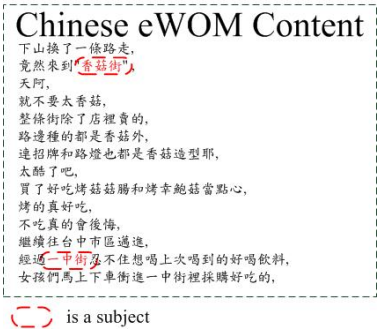

Fig 9. Example of Subject Marking

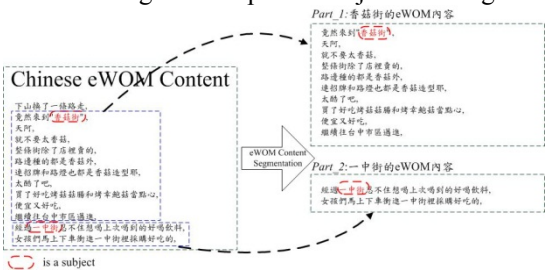

Fig 10. Example of eWOM Content Segmentation

Step3. Appraisal Marking: Based on the results of appraisal word monitoring in section 3.3.4, the appraisal words appear in eWOM content v_i, as shown in Fig 11.

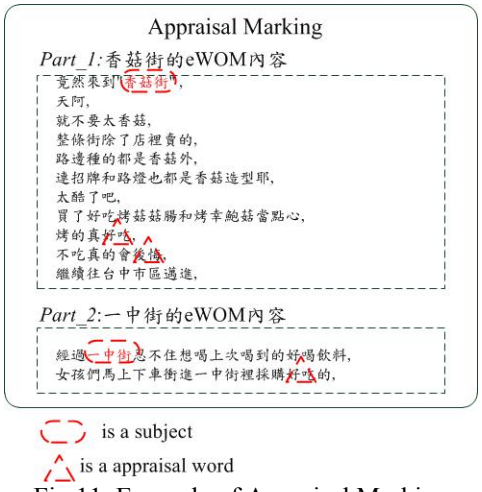

Fig 11. Example of Appraisal Marking

Step4. Appraisal Sentence Segmentation: According to the findings of eWOM content segmentation and appraisal marking, appraisal sentence segmentation was applied. As shown in Fig 12, sentences were selected that contain appraisal words.

3.4.2. Appraisal Sentence Analysis

Based on the findings of appraisal sentence marking in section 3.4.1, reverse words and appraisal words were analyzed and confirmed. This process helped us understand the meanings of appraisal sentences (positive or negative) so that consumer opinions could be valued correctly.

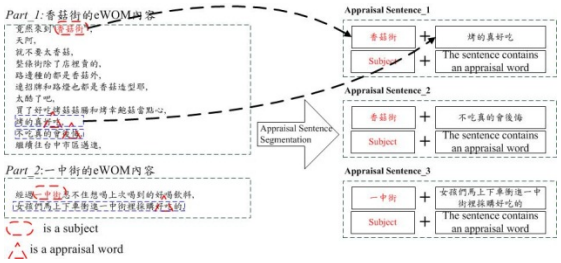

Fig 12. Example of Appraisal Sentence Segmentation

The results of analysis of appraisal sentence characteristics from section 2.3 were applied to design the process for appraisal sentence analysis. The purpose of this was to value an appraisal sentence as to whether it held positive or negative meanings. As shown in Fig 13, they were elaborated upon as follows: Whenever there were reverse words and positive appraisals word in the same sentence, it was determined to have a negative value. On the contrary, when there were reverse words with no negative appraisals word in the same sentence, it was determined to have a positive value. Moreover, when reverse words were absent, and the sentence had positive appraisal words, it had a positive value. In contrast, when reverse words were absent, and the sentence did not have positive appraisals word, it had a negative value.

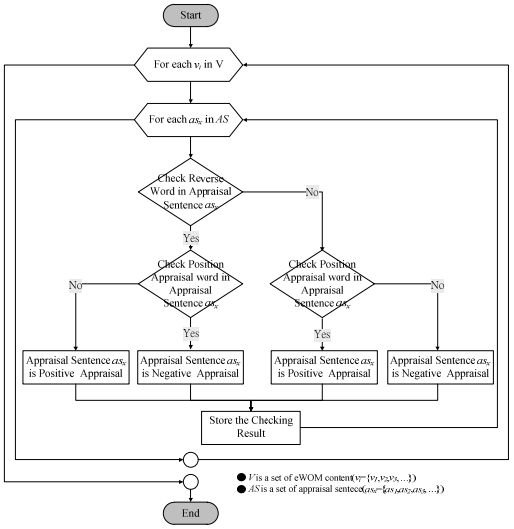

Fig 13. Process for Appraisal Sentence Analysis

3.5 Subject Matching

In order to promote the use of and search for eWOM analysis results, a subject matching process was designed. It offers consumers a means by which to search for eWOM appraisals, as shown in Fig 14. The search compares the search subject and the subject database so that related eWOM appraisal may be extracted. It also helps consumers to understand whether the appraisal is positive or negative. The process is explained in the following section:

Subject matching uses Jaccard Coefficient approach to compare subjects. It calculates the degree of similarity between search subject and subject database. The formula is indicated as in *Equation* (7).

$$SubjectSimilarity(CT, DT_i) = \left|\frac{CT \cap DT_i}{CT \cup DT_i}\right| \quad (7)$$

CT is the subject name that consumers would like to investigate. DT_i is the i_{th} subject name term set from the subject database (i.e., $SD_i=\{SD_1,SD_2,SD_3,\ldots,SD_i\}$). MR_j is a set of subject similarity values (i.e., $MR_j=\{MR_1,MR_2,MR_3,\ldots,MR_j\}$).

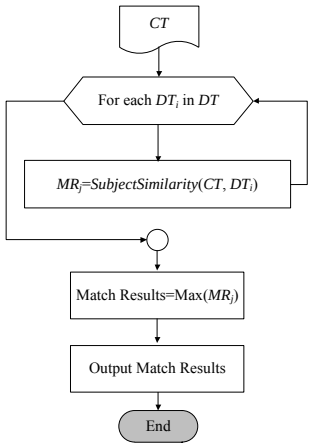

Fig 14. Algorithm for Subject Matching

4 Prototype Implementation

These implementation displays are presented in Fig 15-18. Fig 15 shows the appraisal extraction of eWOM content. Fig 16 shows a user interface screen for entering the search subject. Fig 17 shows the results of subject matching. Fig 18 displays the results of an eWOM search.

Fig 15. Appraisal Extraction of eWOM Content

Fig 16. Entering the Search Subject

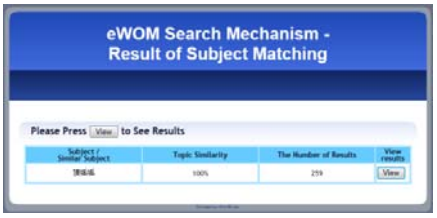

Fig 17. Results of Subject Matching

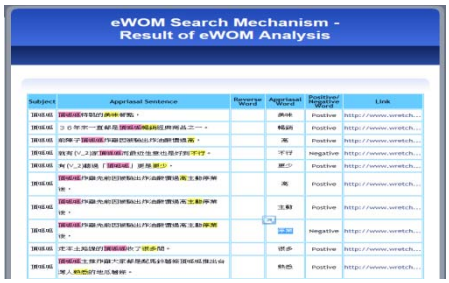

Fig 18. Results for an eWOM Search

5 Conclusions

This study was intended to develop a eWOM analysis mechanism through the application of sentiment analysis. Through the mechanism, it was expected that eWOM would be converted into valuable information. In this way, consumer understanding of product or service appraisals could be facilitated, and decision making time could be shortened. Furthermore, through systematic analysis, it promoted the value of eWOM. The primary results and contributions of this study are summarized as follows:

The main results and contributions of this study are as follows:

- eWOM management framework: Based on knowledge management theory, an eWOM management framework for service experience was designed. It effectively collected, analyzed, managed, and applied eWOM knowledge.
- eWOM analysis model: Based on eWOM content and the characteristics of appraisal sentences, an eWOM analysis model for service experience was developed. It served to effectively analyze eWOM appraisals.
- eWOM analysis method : Based on the eWOM analysis model for service experience, techniques for eWOM analysis were developed. They included an eWOM content preprocess, eWOM content analysis, appraisal sentence evaluation, and subject matching.
- eWOM analysis mechanism: this study provides a new mechanism for eWOM analysis. A computerized program can automatically extract and recognize the important appraisals in eWOM. It facilitates the sharing and management of eWOM information.

Acknowledgment

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Keeping negative Facebook comments leads to more trust in your brand

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Abstract - *Many companies spend a lot of time controlling what's said on their Facebook pages. Deleting negative comments is one way to ensure customers don't form negative impressions about the brand. However, in this research we document experimental evidence showing that leaving negative comments can actually enhance brand credibility and trustworthiness.*

Keywords: online consumer psychology, Facebook, Social Media

1 Introduction

Many companies spend a lot of time controlling what's said on their Facebook pages. Deleting negative comments is one way to ensure customers don't form negative impressions about the brand. On the face of it, this makes sense. Public comments that are all positive should instill trust towards the brand, building associations with high quality. Positive comments mixed with negative suggest flaws in the brand's ability to provide a consistent high quality product or service. Or does it?

Consumers form relationships with brands, much like we form relationships with other people. In the same way we form impressions of other people, we also form impressions of brands. Who wants a friend that is not genuine in the way they communicate with us? We want honesty, because honesty suggests that person cares about us. Our closest friends will tell us what they think, and will also help us when we need it. Only telling people what you think they want to hear is not a good way to build lasting strong relationships.

To demonstrate how this works, we conducted an experiment. We exposed three separate groups to three separate Facebook Pages. Group one saw a Facebook Page where the comments were 100% positive. Group two saw a Facebook page where the comments were a mixture of positive and negative. Group three saw a Facebook page where the negative comments where responded to by the brand. Our results find the group with negative comments and response viewed the brand as more genuine and more trustworthy than the positive comment only group. This was despite the positive comment only group being perceived as being more positive in valance.

2 Theory

Valence, describing either positive or negative nature of Word-orMouth (WOM), is considered a significant factor for perception of a product or brand attitude (Davis & Khazanchi, 2008). In the context of consumer reviews, valence of content exerts a significant influence upon message recipients. However, the eWOM literature has resulted in contrasting research findings about valence direction related to persuasiveness and consumers' evaluative processes. Some research has shown negative eWOM is more influential than positive eWOM (Chatterjee, 2001; Hennig-Thurau & Walsh, 2004; Park & Lee, 2009), while other studies have shown positive messages are perceived as more persuasive than negative ones (Gershoff et al., 2003). Other research studies have demonstrated that eWOM valence does not affect product sales (Davis & Khazanchi, 2008). This is due in part to methodological differences, such as the type of product used in the study.

Product type is recognised as a moderating variable influencing the effect of review valence upon the message recipient (Sen & Lerman, 2007). Drawing upon regulatory focus theory, Zhang et al. (2010) found that the consumption goals consumers associate with reviewed products moderate the effect of review valence on persuasiveness. That is, positive reviews are viewed as more persuasive for products associated with promotion consumption goals and negative reviews are viewed as more persuasive for products associated with prevention consumption goals (Zhang et al., 2010, p.1336). Similarly, consumers exhibit a negativity bias for utilitarian product reviews, which was not observed for hedonic product reviews (Sen & Lerman, 2007; Etgar & Goodwin, 1982).

The valence issue has also been extensively focused upon in the context of advertising, and many of the key findings and theories are applicable to the management of online consumer reviews. Advertisements with a one-sided appeal compared to a two-sided appeal have been studied to assess credibility and

message acceptance (Crowley & Hoyer, 1994). A one-sided appeal in advertising involves including claims that are purely supportive of the product or brand (Kamins & Assael, 1987). Whereas, a two-sided appeal includes both positive and negative information in the communication. Repeatedly, the literature has revealed that two-sided appeals are more effective (Etgar & Goodwin, 1982; Kamins & Assael 1987). This is in part due to the enhanced credibility of the message (Etgar & Goodwin, 1982) as well as the priming of optimal arousal theory. This theory posits a preference of stimuli that is moderately novel will occur over stimuli that offers too much or too little novelty (Crowley & Hoyer, 1994). Perceived novelty is increased due to the two-sidedness of the message, therefore there is a heightened chance of consumers attending to and processing the message (Crowley & Hoyer, 1994). This in turn potentially leads to a deeper level of encoding and enhanced storage in long-term memory.

Extending the study of two-sided appeals in advertising, an inclusion of refutation from the organization reveals additional benefits. The first studies to incorporate a one-sided, two-sided and two-sided reputational appeal into research design (Etgar & Goodwin, 1982; Kamins & Assael, 1987) unveiled the benefits of refutation due to the priming of inoculation theory. This physiological-based theory involves 'strengthening cognitions by including mild attacking arguments and then refuting these negative arguments within the same communication' (Crowley & Hoyer, 1994, p. 562). Importantly, two-sided arguments with refutation can immunize the message recipient against future negative attacks upon the brand (Etgar & Goodwin, 1982). That is, if a consumer confronts a negative claim they may disregard it as a result of their past experience with the company's reputational style. It appears that refuting negative claims in order to overcome consumer dissatisfaction while simultaneously enhancing perceptions of the organization corresponds with service recovery principles.

For most firms, it is inevitable that service failure will occur, varying in nature, intensity and impact. Generally, service failure leads to customer dissatisfaction which negatively influences customer retention and long-term profitability (Robinson, Neeley & Williamson, 2011). However, through the application of appropriate service recovery strategies these outcomes can be counteracted, and even lead to a positive long-term evaluation of the firm despite the initial customer dissatisfaction (Bitner, 1990; Robinson et al., 2011). An inherent focus upon the customer is paramount for these strategies, and drawing from customer relationship management (CRM) theory, the aim is to establish and maintain long-term, profitable, mutually beneficial customer relationships (Reinartz, Krafft & Hoyer, 2004). Robinson et al. (2011) demonstrate that combining elements of service recovery and CRM can lead to a positive outcome for service providers. Organisations must manage the CRM process in the contemporary technological business environment.

Due to the proliferation of online channels the number of consumer touch-points with companies has significantly increased. This implies an increased risk of service failure, and equally, increased opportunities for service recovery performance. By implementing aspects of CRM in service recovery, firms can create a competitive advantage by capitalizing upon service failure information while simultaneously improving customer loyalty (Robinson et al., 2011). This theory is applicable to consumer reviews, as practitioners have the ability to respond to negative comments with the aim of rectifying customer grievances. The service recovery principles provide an opportunity for management of eWOM.

Buttle (1998) asserts that eWOM causes impact on a range of cognitive conditions including awareness, attitude, expectations, perceptions, behaviour and intentions. The constructs that have predominantly been chosen for research pertaining to valence in eWOM communications are attitude (Sen & Lerman, 2007; Laczniak et al., 2001) and purchase intention (Gupta & Harris, 2010). In order to capture a holistic assessment of consumer behaviour relating to different consumer review strategies, six constructs will be used to measure Hypothesis 2: attitude, perceptions of honesty, genuineness and trustworthiness, intention to buy and post-purchase satisfaction.

The literature has frequently included attitudinal variables in valence studies as favourable beliefs about a product should lead to favourable evaluations about the brand (Schlosser, 2011). The priming of inoculation theory in a consumer review strategy by including a company response to customer grievances has the opportunity to enhance both perceptions of credibility and overall positive attitude towards the organisation. Inclusion of two-sided content with refutation in the marketing communications results in an immediate strengthening of attitude towards the brand (Etgar & Goodwin, 1982). Therefore, it is proposed,

Hypothesis 1: *Impression of a company will be more positive for companies displaying consumer reviews with mixed sentiment and a company response, than reviews which feature purely positive sentiment or mixed sentiment with no company response.*

Consumer perceptions of honesty, genuineness and trust are important constructs for organisations. Previously, the role of trust and effect of eWOM has been studied in the direct e-business environment (Hsiao, Lin, Wang, Lu & Yu, 2010; Bart, Shankar, Sultan & Urban, 2005). This study aims to extend the study of consumer-organisation trust into a consumer review context. It has been found that the building of consumer trust is particularly important for firms wishing to create long-term relationships with consumers (Bart et al., 2005). Lack of trust has been shown to discourage potential consumers from using online resources and purchasing online (Awad & Ragowsky, 2008). The antecedents related to trust

provision have experienced change as a result of the fundamental differences between traditional WOM and eWOM.

The major difference between WOM and eWOM has been acknowledged to be related to the differing strength of social context cues, relationship strength and subsequent attribution of trust (Brown, Broderick & Lee, 2007; Kozinets et al. 2010). Interpersonal ties between WOM participants are strong as they reside in the same social network (Davis & Khazanchi, 2008) implying the degree of trust is relatively high. Due to the lack of social cues and eWOM participants not being personally known to each other (Chatterjee, 2001), social ties are weak and the dynamics of trust are made complex. In the online environment the low relationship strength causes trust of the eWOM message to be based purely on linguistic content (Brown et al., 2007). The literature has shown that consumers' trust of online content is dependent upon eWOM quality and average peer-rating of the reviewer and agreement with their viewpoint (Awad & Ragowsky, 2008; Forman, Ghose & Wiesenfeld, 2008).

Additionally, in the online context, manipulation of consumer review content by companies is prevalent. Mayzlin (2006) asserts that some firms disguise their promotions as consumer recommendations in order to positively influence consumers' evaluations. This tactic capitalizes upon the anonymity provided to eWOM reviewers (Mayzlin, 2006), albeit in a misleading manner. Consumers place value upon genuineness and honesty, implying that self-serving behaviour (Buttle, 1998) employed by organizations is likely to adversely affect consumers' trust of online reviews.

Implementing service recovery into consumer reviews is likely to overcome this trend by enhancing credibility and transparency of information. I propose that including a service recovery component into consumer reviews will positively moderate perceptions of honesty, genuineness and trustworthiness. Thus,

Hypothesis 2. *Companies displaying consumer reviews with mixed sentiment and a company response will be deemed to be more honest than companies displaying consumer reviews with purely positive sentiment or mixed sentiment with no company response.*

Hypothesis 3. *Companies displaying consumer reviews with mixed sentiment and a company response will be deemed to be more genuine than companies displaying consumer reviews with purely positive sentiment or mixed sentiment with no company response.*

Hypothesis 4: *Companies displaying consumer reviews with mixed sentiment and a company response will be deemed to be more trustworthy than companies displaying consumer reviews with purely positive sentiment or mixed sentiment with no company response.*

3 Results

3.1 Manipulation Check

In order to assess the accuracy of the review valence in the minds of participants, a manipulation check was administered. Participants rated the reviews on a single item scale from one (not positive at all) to seven (very positive). This construct aimed to clarify if the researcher achieved a display of positivity in the reviews in descending order from purely positive reviews, mixed reviews with a company response and finally mixed reviews. An ANOVA showed that as expected, the positive reviews ($M = 6.07$; $SD = 1.04$) were deemed as more positive than the mixed reviews with a company response ($M = 5.44$; $SD = 0.95$), $F = (1, 361) = 35.99$, $p < 0.001$. In addition, the mixed reviews with a response were seen as more positive than mixed reviews without a response ($M = 4.39$; $SD = 1.01$), $F = (1, 381) = 110.67$, $p < 0.001$. The significant results indicate that the participants perceived positivity in the consumer reviews as intended.

3.2 Attitude

The measurement of overall impression of the company assessed perceived attitude towards the two companies. It was predicted that viewing a company's Facebook consumer review thread with mixed sentiment and a direct company response would result in a more positive attitudinal rating of the company, compared to purely positive reviews, or mixed reviews with no company input. Hypothesis 2a was partially supported as participants who viewed the mixed reviews with a company response recorded a higher impression of the companies ($M = 5.29$; $SD = 1.06$) than participants who viewed the mixed reviews with no company response ($M = 4.21$; $SD = 1.08$), $F = (1,383) = 96.91$, $p < 0.001$. However, a non-significant result ensued when comparing the positive review ($M = 5.41$; $SD = 1.17$) with the mixed with response review condition $F = (1,361) = 1.15$, $p > 0.05$. In addition, it was found that the impressions of companies displaying the positive sentiment reviews were significantly higher than companies displaying mixed sentiment reviews with no company response, $F = (1,381) = 109.35$, $p < 0.001$.

3.3 Honesty

It was predicted that companies adopting the mixed review with a company response strategy would be deemed to be more honest than companies adopting the alternative strategies. Hypothesis 2b was strongly supported as participants in the mixed sentiment review with a company response condition viewed the companies as more honest ($M = 5.26$; $SD = 1.11$) than those in the positive review condition ($M = 4.60$, $SD = 1.21$), $F = (1, 361) = 29.62$, $p < 0.001$, as well as those in the mixed review without a company response condition ($M = 4.23$; $SD = 0.96$), $F = (1,383) = 95.43$, $p < 0.001$. Further, the positive review condition resulted in a significantly higher honesty rating ($M = 4.60$; $SD = 1.21$) than

the mixed review condition (M = 4.23; SD = 0.96), F = (1,381) = 10.96, p < 0.01.

3.4 Genuineness

Support for hypothesis 2c is provided as those exposed to the Facebook thread including mixed sentiment comments with a service recovery response viewed the companies as more genuine (M = 5.24; SD = 1.15), than those who viewed only positive comments (*M* = 4.68; *SD* = 1.27), F (1, 361) = 19.17, p < 0.001, as well as those who viewed mixed sentiment comments and no company response (M = 4.25; SD = 1.06), F = 1, 383) = 76.13, p < 0.001. In a similar fashion to the honesty construct of Hypothesis 2b, the positive group viewed the companies as more genuine than the mixed group, F = (1,381). F = 12.74, p < 0.001.

3.5 Trustworthiness

Next the trustworthy construct was analysed to reveal that participants considered the companies displaying consumer reviews with mixed sentiment and a company response as more trustworthy (M = 5.05; SD = 1.07) than the companies displaying purely positive reviews (M = 4.64; SD = 1.18), F = (1,361) = 12.40, p < 0.001, as well as the mixed reviews without company intervention (M = 4.14; SD = 1.02), F = (1,383) = 73.90, p < 0.001. Therefore, Hypothesis 2d is supported. In addition, the positive sentiment condition viewed the companies as significantly more trustworthy when compared to the mixed group without a company response F = (1,381) = 19.69, p < 0.001.

3.6 Intent to Purchase

It was predicted that intent to purchase likelihood would be highest for the mixed reviews with a company response condition. The hypothesis was partially supported as participants who viewed the mixed review with a company response (M = 4.87; SD = 1.42) were more likely to purchase the software compared to a mixed review without a response (M = 3.84; SD = 1.45), F = (1,383) = 49.05, p < 0.001. However, those who viewed the purely positive reviews had a non-significant higher intent to buy (M = 4.88; SD = 1.40) compared with those who viewed mixed reviews with a company response F = (1,361) = 0.11, p > 0.05. Additionally, those who viewed the purely positive review were more likely to purchase from the company than those who viewed the mixed review without a company response, F = (1,381) = 39.31, p < 0.001.

3.7 Post-Purchase Satisfaction

Finally the relationship between types of consumer reviews and post-purchase satisfaction was investigated. Participants of Survey 3 who viewed the reviews with mixed sentiment and a company response stated a post-purchase satisfaction level (M = 4.92; SD = 1.12) significantly higher than those who viewed the mixed reviews with no company response (M = 4.04; SD = 1.16), F = (1, 383) = 57.48, p < 0.001. A statistically non-significant result was attained when comparing participants who viewed the reviews with mixed sentiment and a company response and participants who viewed the reviews with positive sentiment (M = 4.81; SD = 1.22), F = (1, 361) = 0.91, p > 0.05. Additionally, participants who viewed the positive reviews recorded a higher post-purchase satisfaction level than those who viewed the mixed reviews, F = (1,381) = 39.31, p < 0.001. Therefore, Hypothesis 2f is partially supported.

The results are summarized in Table 1.

Table 1.
ANOVA between conditions and significance.

Hypothesis	Condition 1 & Condition 3	Condition 2 & Condition 3	Result
2a.	p > .05 (n.s)	p < .05 (s)	Partially supported
2b.	p < .05 (s)	p < .05 (s)	Supported
2c.	p < .05 (s)	p < .05 (s)	Supported
2d.	p < .05 (s)	p < .05 (s)	Supported

Notes: (s) signifies significance, (n.s) signifies non-significance.
Condition 1 refers to the positive review condition.
Condition 2 refers to the mixed review condition.
Condition 3 refers to the mixed review with a company response condition.

4 Discussion

This research documented evidence suggesting that brands who delete negative Facebook comments are perceived less honest, less genuine, and less trustworthy than brands who simply respond to the negative comments.

Partial non-significant results for the post-purchase satisfaction construct may in part be due to the difficulty faced by participants in conceptualising an imaginary and future state of mind. Future research could aim to improve the validity of this construct, as well as undertaking a within-subjects analysis of the effect of consumption goal product type upon the 6 constructs.

The inclusion of two product types was in order to enhance generalisability. However, it is interesting to note that reviews for prevention goal products resulted in lower means across all variables, and this was particularly noticeable for the negative review condition. In line with the findings of Zhang et al. (2010), this indicates that the consumption goal consumers associate with a product type moderates the evaluations of positive and negative reviews. As this is not the focus of the study, these results will be analyzed no further. See Appendix B (Table 4) for means and standard deviations for each product type.

Online consumer reviews have revolutionalised the information search process. Consumers are empowered to disseminate information to a broad audience and as a result

organisations have had to reassess their concept of value creation and marketing strategy in the eWOM environment (Burton & Khammash, 2010). The findings of this study entail strategic implications for eWOM management and for the everyday roles of organisations' social media teams.

Further, as a result of the findings it is recommended that online retailers and companies with a social media presence adopt a strategic approach to managing consumer review content. In line with the recommendation made by Zhang et al. (2010), companies should not censor negative reviews as these reviews may be helpful to consumers, especially for products associated with prevention consumption goals. However, if a company is to allow negative content to feature on their online presence it is recommended that the social media team closely monitor the content and respond to consumer queries and complaints. The results of this study show that performing this leads to enhanced consumer perceptions of company honesty, genuineness and trustworthiness.

The adoption of this strategy has implications for the allocation of organisational resources. Management of eWOM channels must recognise restrictions placed upon them by the organisation's financial strategy and budget. Admittedly, a possible criticism of the recommendation to respond to customer grievances is that it is a time-consuming and resource intensive process that may not be applicable or appropriate for all online retailers. However, due to the potentially detrimental effects to company reputation and sales by not incorporating a service recovery element into the online servicescape, managers should strive to actively manage consumer review content. The cost of managing this process may be alleviated by the unique opportunity eWOM provides for explicit and traceable customer-to-customer communications (Prendergast et al., 2010; Trusov, Bucklin & Pauwels, 2009).

Additionally, organisations who choose to adopt a service recovery review strategy can overcome initial financial disadvantages as a result of inoculation theory. As shown by the findings, organisations that include refutation in their message are perceived positively. This has the potential to inoculate the audience from future complaints or attacks (Crowley & Hoyer, 1994), due to the customers' prior experience with the refutational strategy style. Further, benefits can be gained from positive organisation-customer interaction during the service recovery process. Vargo and Lusch (2004, p.15) assert that a service-centred dominant logic of marketing shifts focus from an economic process towards intangibles, such as interactivity and ongoing relationships. Value is created for customers as a result of positive interaction experiences (Zhang et al., 2010), enhancing the possibility of developing brand loyalty; advantageous for customer and business alike. In a service recovery consumer review strategy the customer whose complaint is addressed possibly experiences a positive interaction process and this has the potential to spill-over to other readers of the message. Overall, organisations that effectively manage their eWOM channels can harness negativity and potentially translate it into increased brand loyalty and profitability.

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Integration Model for Students Relation Management System to Improve Higher Education Communities Quality

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Abstract - *This Study presents an intelligent agent model for Management Information System (MIS) of higher education communities. This model based on the qualitative and quantitative methodology for Electronic Students Relationship Management System (E-SRMS) for high education faculties to support the high performance and quality management operations for high educational Organization. We are using in this study the techniques of programming base on Web2.0 and Information Technology (IT) infrastructure to design this model. Also we cover the organization, management and technology dimensions of information system for High Educations Faculties Communities (HEFC). These dimensions are related to the behavior and technical hierarchical structure for HEFC which effects directly in competitive forces that play importance role to satisfy the survival for it. This is forces aid to present high quality performance for an educational services and researches.*

Keywords: Educations Faculties Communities (HEFC); Management Information System (MIS); Information Technology (IT); Electronic Students Relationship Management System (E-SRMS);

1 Introduction

These are instructions for authors typesetting for the *WORLDCOMP'12* (Monte Carlo Resort, Las Vegas, Nevada, U.S.A. July 16-19, 2012). This template has been prepared using the required format (Microsoft *Word* version 6.0 or later).

Today the world becomes as a one village by using the different tools for many types of communications and internet. These tools contribute to reach the educational operations for higher educational communities. Also help to increasing the exchanging for educational information which is related with educational processes and research. That is lead to fast development in different sciences fields. This field reacts with our life and our requirements to continuity with the future requirements. From all the previous we need to support these educational operations by all requirements surround 24 hour over the earth to go with the sciences train to make sunny futures for next generations and building the bases of the future science and contributes to design new higher educational communities frame work have a stander measurements for management system to high educational universities over internet.

This paper is divided into six sections. Section 2 presents surveys and lecture reviews for previous work in student's relation management system and proposed model to design a framework for E-SRMS System are presented in section 3. Section 4 presents an Integration Frame Work Model for MIS Based on E-SRMS and present a case study for E-SRMS that is related with faculty of computers and information, Helwan University. Finally section 6, presents conclusion and future work for this study.

2 Survey and previous work

García[5], presented a Virtual E-Learning model for the Higher Education based on Web 2.0. This model as shown in figures 1, 2 to explorer the all operations that is related with electronic educational process. Figure 1 illustrates the. graphic representation of the Virtual Model Learning and, Figure 2 illustrates the construction of the knowledge. Management system.

Moraru [6] used modern IT and software programs in teaching physics and chemistry curriculum to assessment the study lesson and make comparative analysis between traditional and modern techniques.

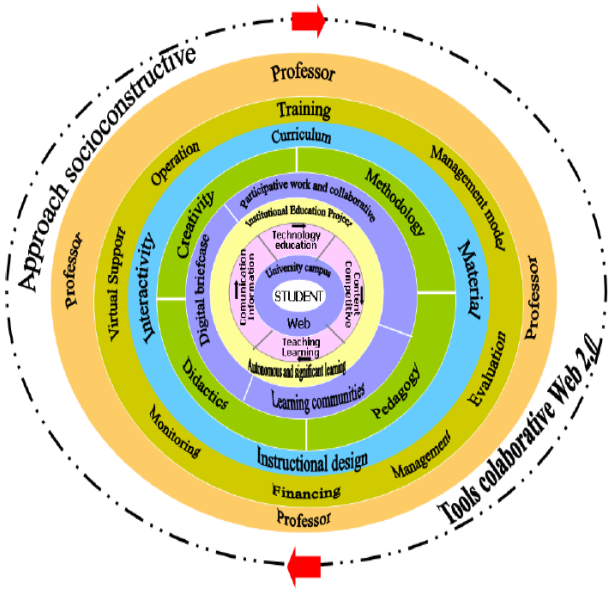

Figure 1. Graphic representation of the Virtual Model Learning.
Source: Garcia et al. , 2010.

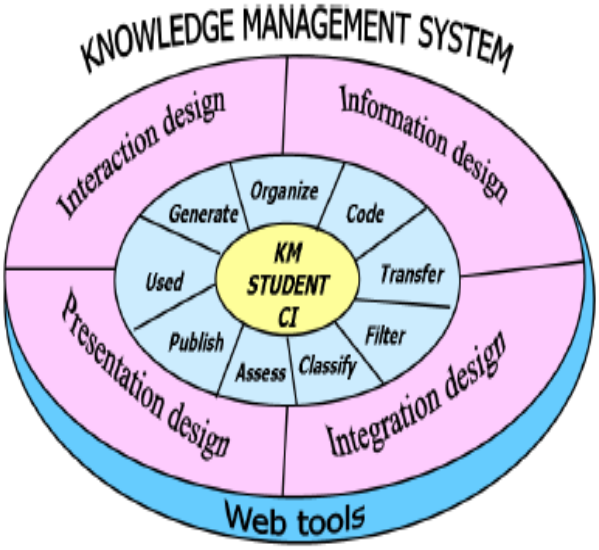

Figure 2. Construction of the knowledge. Management system
Source: Garcia et al. , 2010.

The effect of academic discipline on technology acceptance based on the effect of Unified Theory of Acceptance and Use of Technology (UTAUT) to produced Academic Discipline based Unified Theory of Acceptance and Use of Technology (ADUTAUT) model. UTAUT model are Electronic Library System (ELS) for university graduate students. When we making analysis and group for students and groups according to academic disciplines to determine UTAUT independent variables as shown performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating condition (FC) will impact on behavior intention (BI) differently and BI with FC will also impact on use behavior (UB) differently when moderated by academic discipline [15].Tables 1 illustrate components of ADUTAUT model.

Table1 ADUTAUT COMPONENTS
Source: Orji, 2010.

Determinant	Description
Performance expectancy (PE)	Degree to which an individual believes that using the system will help attain gains in job performance
Effort Expectancy (EE)	The degree of ease associated with the use of the system
Social Influence (SI)	The degree to which an individual perceives that important others believe he or she should use the new system
Facilitating conditions (FC)	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system

The previous components related with other moderators such as the type of gender, age, experience, voluntariness of use, Academic Discipline… etc. table 2 illustrates ADUTAUT moderator.

. TABLE 2. ADUTAUT MODERATOR
Source: Orji , 2010.

Moderator	Description
Gender	*Gender* roles have a strong psychological basis and are enduring.
Age	*Age* has an effect on attitudes.
Experience	Effort is expected to decrease with *Experience*.
Voluntariness of use	If usage is voluntary or mandated
Academic Discipline	*Whether the person is in Engineering, Art & Science or Social Science faculty.*
Behavioral Intention (BI)	The measure of the likelihood of an individual to employ the application.
Use Behavior (UB)	This measures the acceptance of the technology.

Figure 3 illustrate Nationality Based UTAUT (NBUTAUT) which shown the relation between ADUTAUT moderator and ADUTAUT components.

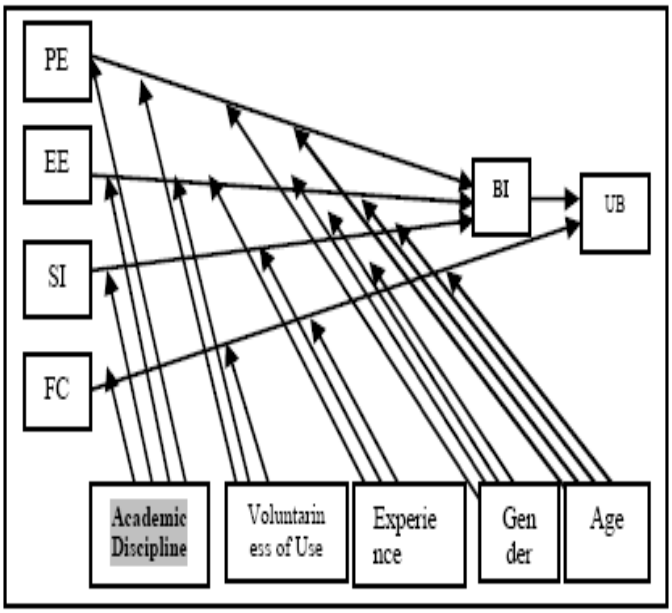

Figure 3. Nationality Based UTAUT (NBUTAUT)
Source: Orji, 2010.

Another study presents an evaluation framework for Learning Management Systems (LMS) which several processes as the following

- Content Management: including content adding, importing, and other functions.
- Curriculum mapping and planning: including accessibility, lesson adding, and personalization, assignments and assessment
- Learner engagement and administration: including different administration and tracking tools for the learners and their behavior
- Tools and services: including discussion forums, email, messaging.

Bhanu [9]. Present a study for knowledge management (KM) perspective of electronic customer relationship management systems (E-CRM). This study has four E-CRM models . table3 illustrates the KM-CRM models and E-CRM models based on four E-CRM models .

Table 3: KM-CRM models and E-CRM models in four
Source: Bhanu etal., 2010.

Dimensions KM-based e-CRM	Model 1 - Stefanou & Sarmaniotis (2003)	Model 2 – Lin et al (2006)	Model 3 – Nicholas & Castillo (2008)	Model 4 – Kımılog'lu and Zaralı (2009)
Technology	IT Level	Unclear tie	• perceived risk associated to each CKM tool	• Increasing usage of technology
Customer	• Customer Satisfaction-Complain Management • Customer Accounts-Orders Management	Unclear tie	• perceived risk • Internet preference	• Improved customer awareness & perceptions • Increased amount, satisfaction, transaction, and loyalty
Knowledge	• Customer Personalization Management	• Customer-knowledge sources • Customer knowledge management	• Internet knowledge	• Learning • Development of new services
Business	• Defensive relationship marketing	Unclear tie	Unclear tie	• Faster, more effective, high-quality and more reliable business processes

3 The Proposed Model

3.1 Selecting the basic Entity that effect in the framework of E-SRMS System

the faculty has basic entities such as : Topic, Student, Staff, Project, exam, location, … etc.

3.2 Selecting the SRM roles that related with organization

Administration business roles, services business roles, costumer business roles, transaction data flow between departments, determine the communication sets with system stakeholders, efficient and effective quality business roles.

- For each staff has more than one course or zero
- For each staff has more than one course or zero
- For each staff has more than one course or zero

3.3 Automated Transaction Data

The new registration or any updating processing in data it must be transfer and execute for online publishing after making automate or manual administration review and testing

3.4 Maintaining the Integrity of the Specifications

For any new specifications in any parts of system or when we adding a new parts or sub models for E-SRM system. It should be review, update and test the system to be integrity forever according to the architecture of SRM framework model

4 Integration Framework Model for MIS based on E-SRMS

The synthesis framework discusses of E-SRMS the streaming data flow through the system. The framework illustrates immediately effective business decision for E-SRM system for specific an organization. This is framework include the all possible processes that executes in a strategic, management and operational levels in an organization. Figure 4. Illustrates the structure of Electronic Students Relationship Management System (E-SRMS) system for Faculty of computers and information (FCI) in Helwan University

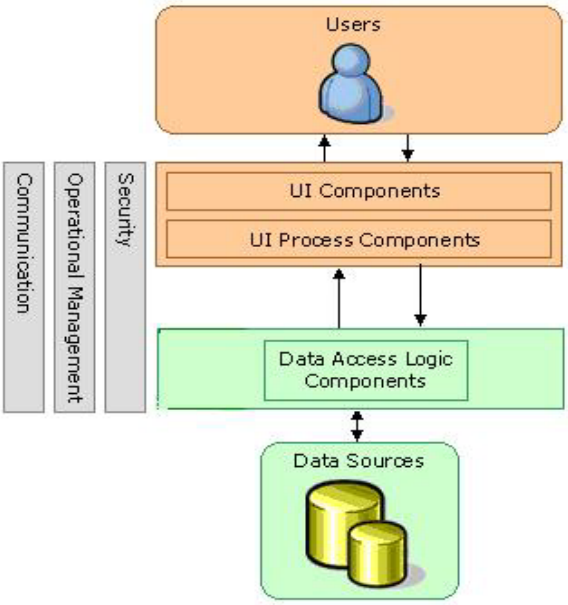

Figure 4. Structure of E-SRM system for FCI

Users will interact with the system through user interface component. We will have two types of users: backend users and front-end users. The backend users have the responsibility for managing the content of the web site. The front-end users include all site visitors. User interface process component will have the responsibility to check user privileges and to communicate with the database through data access logic component.

5 Case Study : E-SRMS for Faculty of computers and information, Helwan University

We need to Electronic SRM System for Faculty of computers and information (FCI), Helwan University to present electronic services for faculty users in over 24 hours. Also support them by specific services and other requirements to development the scientific and education life of research for Higher Education Communities. This is services such as:

5.1 Basic Entities for SRM system

We determine basic entities and all requirements from available information and documentations for different stakeholders in FCI according to the user stats.

5.2 E-SRM Roles and Modules for FCI System.

E-SRM of FCI system consists the following modules {Students , Staff , Projects, Thesis, Entertainments , Lectures Schedule , Faculty Map , Exams , Results , Conference}. The previous models have many relations between them, also it have some of roles determined by Owner or Egyptian universities requirements. Figure 5 illustrates FCI E-SRM system module.

Figure 5. FCI E-SRM system modules

5.3 E-SRM Components for FCI System and Transaction Processes.

E-SRM for FCI system consists two components "backend and front-end " which are interact automatically dynamic with inserting data in the previous modules.

E-SRM for FCI system has consists some of modules such as Students, Stuff, Projects, Thesis, Lectures Schedule, Exams, Results and Conference. We find a relation process between student and lecture schedule; relation process between Stuff and lecture schedule, relation process between Stuff, student and lecture schedule; relation process between student, thesis and Stuff; …etc.

5.4 Maintaining the Integrity of the Specifications

Any update or maintaining in system components or in any sub-model is integrity. SRMS have a high efficiency internal transaction processing mechanism to adding and removing or updating for any part of SRMS components. Figure 6 illustrates GUI for FCI E-SRM system to login

Figure 6. GUI for FCI E-SRM system to login

Now we discuss FCI E-SRM system components "backend and front-end " with attachment explain by using some example of GUI for FCI E-SRM system.

Backend component provides the data management functionalities that enable each stockholder to enter/update/delete/publish data items. Figure 7 illustrates the insertion or update process for Student member in FCI E-SRM system.

Figure 7 GUI for FCI E-SRM system to add student

Front end component provides the information retrieving/browsing/accessing functionalities, and is available for any site user. We explore some of front end GUI for end users where Figure 8. Illustrates the Exams times, location, level and topics …etc, in FCI. Figure 9. Illustrates the Entertainment actives and Figure 10. Show student's results in FCI.

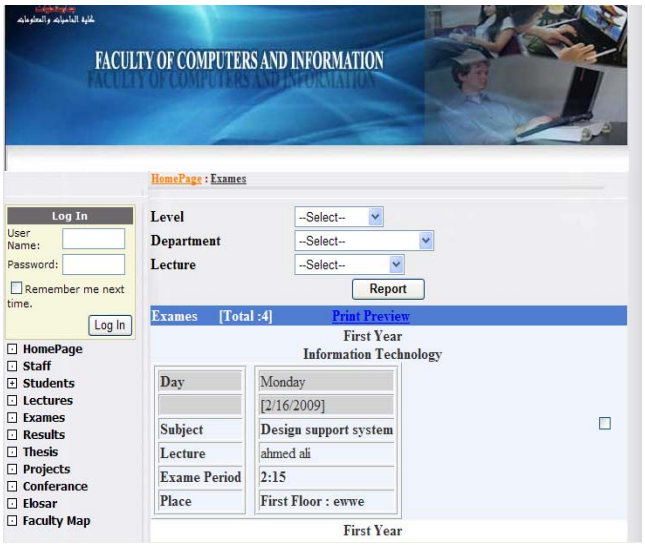

Figure 8 GUI for Exams in FCI E-SRM system

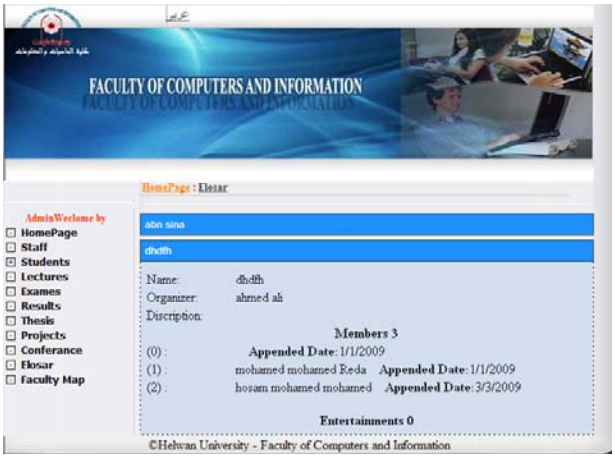

Figure 9 GUI for Entertainment of FCI E-SRMS

Figure 10 GUI for FCI E-SRMS to student's results

6 Conclusion and future work

- FCI E-SRMS model can be used in different faculties in different places.
- FCI E-SRMS model available over 24 hours for users and includes all information and faculty services.
- E-SRMS approach increase the flexibility of traditional and electronics management systems to the higher educational communities.
- In the future we hope to add new modules for E-SRMS model to satisfy the standers of international high educational to achieves the quality of performance operations in higher educational communities.

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Applying Data Privacy Techniques on Published Data in Uganda

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Abstract - *The growth of information technology (IT) in Africa has led to an increase in the utilization of communication networks for data transaction across that continent. Thus, many in Africa have become increasingly dependent on the Internet for data transactions. In the country of Uganda, for example, exponential growth in data transaction has presented a new challenge. Namely, what is the most efficient way to implement data privacy? While studies on data privacy have been done for developed nations such as in the European Union, studies for data privacy implementation in emerging markets have been minimal. It is with such background that we discuss data privacy challenges in Uganda. We also present an implementation of data privacy techniques for a published Ugandan dataset and suggest how this approach may be generalized to provide data privacy in the country.*

Keywords: Data Privacy; Database Security; Statistical Disclosure Control; k-anonymity; Tabular data.

1. Introduction

The exponential growth of Information Technology (IT) in Africa has led to an increase in data transaction across Africa's communication networks, with 110 million Internet users and 500 million mobile phone subscriptions as of 2010[1]. In Uganda's case, higher education institutions routinely post student admission and graduation data online and grant access to student records online [2]. The Ugandan Electoral Commission posted the national voter's register online [3][4]. While the Uganda Bureau of Statistics publishes statistical data routinely, and takes great care to remove personal identifiable information (PII), a review of the published datasets from other Ugandan entities such as educational institutions and the Electoral Commission of Uganda show PII was included in published datasets. At the same time a growing number of young Ugandans are fans of large Online Social Networks (OSN) like Facebook, resulting in large amounts of PII leaked from online auxiliary data sources.

While case studies on data privacy have been done for developed nations such as in the European Union, studies for data privacy and security implementation in emerging markets such as Uganda have been minimal [48]. Yet with the growth of the globalized economy and multinational entities, demands for data privacy and security while transacting in business in the emerging markets is critical. Therefore in this paper, we take a look at current data privacy and security laws and present an implementation of data privacy techniques for a published Ugandan dataset and suggest how this approach may be generalized to provide data privacy in the country.

The rest of this paper is organized as follows. Section 2 looks at current data privacy and security policies in Uganda. Section 3 describes related work on data privacy and security in Uganda. Section 4 looks at the essential data privacy terms used in this paper. Section 5 gives an overview on data privacy techniques discussed in this paper. Section 6 discusses the implementation while Section 7 presents the results; and finally, Section 8 provides the conclusion.

2. Data Privacy and Security Policies

In developed countries like the USA, data gathering institutions are bounded by state and federal privacy laws that require that privacy of individuals be protected. One example in the USA is the Privacy Act of 1974, Health Insurance Portability and Accountability Act (HIPAA) of 1996, and the Personal Data Privacy and Security Act of 2009, requiring entities to protect and secure PII in data [5][6][7]. The Ugandan constitution defines the rights of an individual to privacy in terms of interference, stating that no person shall be subjected to interference with the privacy of that person's home, correspondence, communication or other property, however, no precise definition is given in the context of PII, data privacy, and computer security [8]. Ugandan Bureau of Statistics Act of 1998 describes Ugandan government policy on data collected by the Ugandan Bureau of Statistics (UBS). Absent from that description is how non-governmental entities collect and disseminate data. The Ugandan Bureau of Statistics Act of 1998 does not discuss what PII is in the Ugandan context. The only close reference is the "removal of identifiers" before data is granted to researchers [9]. In this case "identifiers" is ambiguous and could perhaps reference 'names' but not 'geographical location'. However, UBS with expert care

does publish de-identified micro datasets online but at the same time, many entities in Uganda publish non de-identified tabular datasets.

A look at documents from authorities that govern communication technology in Uganda, the Uganda Communications Commission (UCC) and the Ministry of Information and Communications Technology (ICT) show that policies on data privacy and security have not been clearly formulated [9][10][11][12][13][14]. In the USA for instance, PII could include an individual's social security number yet in Uganda, social security numbers are non-existent; thus, the set of PII in the USA differs from that in Uganda. Therefore, there is a need to expand Uganda's policy on how government and non-government entities collect and disseminate data. To date, no clear legal and technological data privacy framework exists in Uganda. Despite the absence of any clearly formulated policy on data privacy in Uganda, this work suggest the application of data privacy techniques that could be utilized to provide basic data privacy in this context.

3. Related work on data privacy in Uganda

Our study of the literature reveals that work on data privacy in Uganda and much of sub-Saharan Africa is sparse. To date and to the best our knowledge, this work's focus on the application of data privacy techniques to the Ugandan context might be novel. While research on computer security in Uganda exists, most of the work centers on network accessibility control methodologies [15][16][17][18][19]. For example, Mutyaba [20] and Makori [21] offer an excellent presentation on cryptographic methodologies for computer security, and Okwangale and Ogao [22] discuss data mining techniques; however, privacy preserving data mining (PPDM) methodologies are not discussed. Bakibinga [23] has articulated the need for electronic privacy in Uganda from a policy view point. Frameworks for secure management of electronic records have been proposed by Luyombya [24], Ssekibule and Mirembe [25], and Kayondo [26]; however, these works focus on data security and access control. But data privacy differs from data security in that data privacy has to do with the confidentiality of data, while data security focuses on its accessibility. Even when a database system is physically secured, an inference attack could occur on published datasets [27]. It should be noted that the Ugandan Bureau of Statistics Act of 1998 does provide a legal framework for data privacy that focuses on data gathered by the UBS. What is absent from the Ugandan computational literature is the data privacy technological framework that entities other than the Ugandan Bureau of Statistics, such as health, academia, and private business could employ [28]. To date, no work has come to our attention on if data privacy methodologies employed by UBS have been applied to private sector. Therefore, it is in this light that we make the case for data privacy in Uganda and the need for more research on data privacy and PPDM methodologies tailored to the Ugandan and African context.

4. Essential data privacy terms

The following definitions will be important in the sequel: *Data privacy* is the protection of an individual's data against unauthorized disclosure while *Data security* is the safety of data from unauthorized access [29] [30]. *Personally identifiable information* (PII) is any data about an individual that could be used to construct the full identity of that individual [31][32]. *Data De-identification* is a process in which PII attributes are removed such that when the data is published, an individual's identity cannot be reconstructed [33] [34]. *Data utility verses privacy* has to do with how useful a published dataset is to a consumer of that published dataset [35] [36]. Often the usefulness of data is lost when PII and quasi-attributes, are removed or transformed; a balance between privacy and data utility is always sought [37]. It has been determined that achieving optimal data privacy while not distorting data utility is a continual NP-hard challenge [38]. *Statistical databases* are published data sets that do not change, in many cases released in aggregated format [39]. *Attributes* in statistical databases, are field names or columns [29]. *PII attributes* are properties that uniquely identify an individual; an example includes social security number. *Quasi-attributes* are attributes not in the PII category but can be used to reconstruct an individual's identity in conjunction with external data. *Confidential attributes* are attributes not in the PII and quasi-attributes category but contain sensitive information, such as salary, HIV status, etc. *Non confidential attributes* are attributes that individuals do not consider sensitive as causing disclosure. However, non-confidential attributes can still be used to re-identify an individual given auxiliary data, thus making the explicit description of what PII is and is not even more challenging [40]. *Inference and reconstruction attacks* are methods of attack in which separate pieces of data are used to derive a conclusion about a subject, in this case, reconstruct their identity [41].

5. Data privacy techniques

Data privacy methods are categorized as *non-perturbative* techniques in which original data is not modified, some data is suppressed or some sensitive details removed while with *perturbative techniques*, original data is altered or disguised so as to protect PII and sensitive data [29]. While a number of data privacy techniques exist, we focus on application of *k-anonymity*, *suppression*, and *generalization*. *Suppression is* a popular data privacy method in which data values that are unique and can be used to establish an individual's identity are omitted from the published dataset [42][43]. *Generalization* is a data privacy method in which attributes that could cause identity disclosure are made less informative. An example includes replacing the

gender attribute value with "person" instead of "Male" or "Female" [44]. *K-anonymity* is a data privacy enhancing mechanism that utilizes *generalization*, and *suppression* as outlined extensively by Samarati [45] and Sweeney [27]. *k-anonymity* requires that for a dataset with quasi-identifier attributes in database to be published, values in the quasi-identifier attributes be repeated at least ***k*** times to ensure privacy; that is, $k > 1$ [27]. However, achieving the optimal *k-anonymized* dataset has been shown to be an NP-Hard problem [46].

6. Data privacy implementation

In this section, we describe our implementation of basic data privacy algorithms on a Ugandan dataset, utilizing open source technologies that are freely available for all to download. In this way, nations from emerging markets such as Uganda could incur minimal costs when it comes to data privacy implementation. We express our implementation using the set theory notation, relational database notation, and lastly MySQL implementation. The initial step was to de-identify a Ugandan dataset of 1200 records from a Makerere University student admission list that is published publicly online by the University, by removing PII as defined by the US data privacy laws [3]. While no explicit data privacy laws exist in Uganda, we utilized the definitions of what constitutes PII as defined by the US data privacy laws (HIPAA), considering that they could be universally applicable. We employed SQL, utilizing MySQL Sever, an open source tool freely available for download.

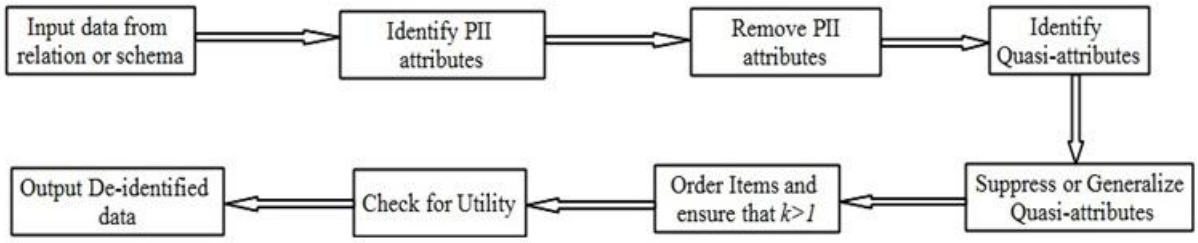

***Figure 1**: A Data De-identification procedure utilizing k-anonymity*

RegNo	StudentNo	Lname	Fname	Mname	Sex	BirthDate	Nationality	Hall	Program	IndexNo	Year
09/U//EVE	20900	Annet	Anna		F	01/01/67	UGANDAN	AFRICA	LIS	U0166	2008
09/U//EVE	20901	Green	RICE		F	01/01/80	UGANDAN	MARY STUART	ARM	U0763	2008
09/U//EVE	20902	Timothy	NICE		F	01/01/81	KENYAN	MARY STUART	BLE	U0063	2007
09/U//EVE	20903	Jones	Jane	GRACE	F	01/01/73	TANZANIA	MARY STUART	LIS	U0198	2007
09/U//EVE	20904	Carter	James		M	01/01/74	UGANDAN		RAM	U0160	2007
09/U//EVE	20905	Brown	Britain	N	F	01/01/83	KENYAN	AFRICA	ARM	U0715	2008
09/U//EVE	20906	Sams	Sam		F	01/01/84	TANZANIA	MARY STUART	RAM	U0725	2007
09/U//EVE	20907	Faster	Master		M	01/01/85	UGANDAN		BLE	U1148	2008
09/U//EVE	20908	Uhuru	Kenya		F	01/01/90	UGANDAN	COMPLEX	ARM	U0062	2007
09/U//EVE	20909	Vineyard	Martha		M	01/01/88	KENYAN	AFRICA	ARM	U1017	2008

***Table 1**: Admission List with PII – BirthDate, IndexNo, and RegNo are generalized*

Steps in the Data Privacy Procedure shown in Figure 1:
INPUT: Data from relation or schema
OUTPUT: Data privacy preserving published tabular dataset

1. Identify PII Attributes
2. Remove PII Attributes
3. Identify quasi-identifier attributes
4. Generalize or Suppress quasi-identifier attributes
5. Check that $k>1$ in tuples
6. Check for single values that cannot be grouped together to achieve $k>1$
7. If single values and outliers exist, Generalize or Suppress until k-anonymity at $k>1$
8. Check for utility
9. Publish tabular dataset

We borrowed from set theory notation to describe how we implemented the data privacy procedure on the Ugandan data set as follows:

- The original Ugandan published dataset included the following attributes, in which we let the following:
  - A = { *RegNo, StudentNo, Lname, Fname, Mname, Sex, BirthDate, Nationality, Hall, Program, IndexNo, Year* }, the relation *admission list* that included all attributes in the published dataset.
  - We let B = { *Lname, Fname, Mname, StudentNo, IndexNo, RegNo*}, the set of all PII attributes that we identified in the published dataset.
  - We let C = { *Nationality, Sex, BirthDate,*}, the set of all quasi-identifier attributes identified in the dataset.
  - We let *D={Hall, Program, Year}*, the set of all non-sensitive attributes.
  - *Lastly, we let E={ }*, the set of all sensitive attributes.
- Thus, we have $B \subset A$, $C \subset A$, $D \subset A$ and $E \subset A$;
  - *Therefore* $A = B \cup C \cup D \cup E$, *and* A ={ *B, C,*

D, E}.
- *By* removing PII, we get *A ={ C, D, E}.*
- The de-identification of the *Admission List* set involves a complement of the *PII* set: $(B)^c = U - B = A - B = C + D + E$. Therefore, we remained with the *quasi attributes, non-sensitive attributes, and sensitive attributes; w*here *U* is the universal set, which in this case is all the *Admission List attributes.*

- We suppressed or generalized the *quasi attributes:* suppress or generalize (*C*).
  - We then applied *k-anonymity*: *k-anonymity($(B)^c$).*
  - *Finally,* we ordered values of $(B)^c$.
  - If *k = 1*, we suppressed or generalized *C* until *k >1.*

Relational model view: For a formal relational model view implementation, we applied the following notation:
- we let π *<attribute list>*$^{(R)}$,
  - *w*here $\boldsymbol{\pi}$ is the projection or selecting of attributes from a relation (Table),
  - *<attribute list>* is the list of attributes from *Admission List*
  - , $^{(R)}$ is the relation from which we select attributes.

The original projection with all attributes is:
- π*<RegNo, StudentNo, Lname, Fname, Mname, Sex, BirthDate, Nationality, Hall, Program, IndexNo, Year* $>^{(Admission\ List)}$.
- The projection void of PII attributes is:
  - *To_Be_Published_List* ← π*< Sex, BirthDate, Nationality, Hall, Program, Year* $>^{(Admission\ List)}$.
- We apply *k-anonymity* to the list that is to be published:
  - *k-anonymity(To_Be_Published_List).*

7. Results

We generalized the *BirthDate* attribute to further prevent any reconstruction attacks by first developing a domain generalization hierarchy (DGH). We chose the DGH based on the oldest person in the dataset, and built our DGH to B_4 = {196*}, giving protection for the individuals born in 1967 [43], as shown in *Figure 2.*

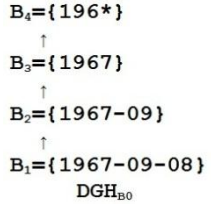

Figure 2*: Domain generalization hierarchy structure*

The SQL Implementation: We implemented data de-identification in SQL by creating a SQL View and doing SELECT on the view by choosing only attributes that remain in the *Admission List* after removing PII. We created SQL Views that are void of PII attributes:

```
CREATE VIEW V2 AS SELECT Sex,
BirthDate, Nationality, Hall,
Program, Year FROM
Admission_List;
```

Generalization: Utilizing the SQL functions, CREATE, SELECT, and UPDATE, we further generalized the *Program* attribute so as not to grant such information to a researcher. We generalized the *BirthDate* attribute to additionally prevent any reconstruction attacks.

Sex	BirthDate	Nationality	Hall	Program	Year
F	196*	UGANDAN	AFRICA	LIS	2008
F	196*	UGANDAN	MARY STUART	ARM	2008
F	196*	KENYAN	MARY STUART	BLE	2007
F	196*	UGANDAN	MARY STUART	LIS	2008
M	196*	UGANDAN		RAM	2007
F	196*	KENYAN	AFRICA	ARM	2008
F	196*	TANZANIA	MARY STUART	RAM	2007
M	196*	UGANDAN		BLE	2008
F	196*	UGANDAN	COMPLEX	ARM	2007
M	196*	TANZANIA	AFRICA	ARM	2008

Table 2: *Results after generalization and suppression*

MySQL implementation:

```
CREATE table V2_Generalize1
SELECT Sex, BirthDate,
Nationality, Hall, Program, Year
FROM V2;

UPDATE V2_Generalize1 set
BirthDate ='1950-99' WHERE
BirthDate BETWEEN 1950-01-01 AND
1999-12-31';
```

Suppression: In the case of achieving *k-anonymity*, we had to suppress some values that appeared once, yet still we had to ensure the utility of the data set, as too much suppression would kill the utility of the published dataset.

Sex	BirthDate	Nationality	Hall	Program	Year
F	196*	UGANDAN	AFRICA	LIS	2008
F	196*	UGANDAN	MARY STUART	ARM	2008
F	196*	KENYAN	MARY STUART	BLE	2007
F	196*	TANZANIA	MARY STUART	LIS	2008
M	196*	UGANDAN		RAM	2007
F	196*	KENYAN	AFRICA	ARM	2008
F	196*	TANZANIA	MARY STUART	RAM	2007
M	196*	UGANDAN		BLE	2008
F	196*	UGANDAN	COMPLEX	ARM	2007
M	196*	KENYAN	AFRICA	ARM	2008

Table 3: *Results after suppression, highlighted values to be further suppressed until k>1*

MySQL implementation:

```
UPDATE V2_Generalize1 set Hall
=' 'WHERE Hall ='Complex';
```

Check for *k-anonymity* that *k >1* by ordering data:

MySQL implementation:

```
SELECT Sex, BirthDate, Nationality, Hall, Program, Year FROM V2 ORDER BY Sex, Program, Hall;
```

k-anonymity achieved at *k>1*, where k is each value in the quasi attributes repeated at least *k >1* times.

Sex	BirthDate	Nationality	Hall	Program	Year
F	196*	UGANDAN	AFRICA	LIS	2008
F	196*	UGANDAN	MARY STUART	ARM	2008
F	196*	KENYAN	MARY STUART	BLE	
F	196*	TANZANIA	MARY STUART	LIS	
M	196*	UGANDAN		RAM	2007
F	196*	KENYAN	AFRICA	ARM	2008
F	196*	TANZANIA	MARY STUART	RAM	
M	196*	UGANDAN		BLE	2008
F	196*	UGANDAN		ARM	2007
M	196*	KENYAN	AFRICA	ARM	2008

Table 4: *Results after we achieve k-anonymity at k>1*

Removing names and student numbers entirely diminishes utility, in that the data becomes meaningless to students who simply want to view it to see if their names are on the university admission list. One way this problem can be dealt with is by publishing a list that includes the *student number* or *student names* while obscuring other PII data. However, in both scenarios, the issue of balancing data utility and data privacy remain quite challenging and demands tradeoffs [47].

8. Conclusion

We have made the case for the need to revamp Uganda's data privacy policy to encompass both private and government sectors on how to gather and disseminate data, and the need to implement data de-identification techniques. With the growth of data transaction in Uganda, there is a need for more research on how to implement privacy preserving data publishing and privacy preserving data mining methodologies tailored to the Ugandan context, with applications ranging from academia, government, health sector, and private sector. We have shown that with freely available open source technologies, some level of data privacy can be implemented on datasets from emerging markets. However, the problem of what PII constitutes in the emerging market nations still remains. Although no set of PII has been proposed in Uganda, we suggest that PII include any information that could specifically identify an individual in the Ugandan context. This could include: full names, face, fingerprints, handwriting, genetic data such as DNA, national ID number, driver's license number, passport number, credit and debit card numbers birth-date, birth place, village of residence, city of residence, county of residence, phone number, and student examination numbers. Applying the *k-anonymity* procedure might be practicable in the Ugandan context; however, achieving optimal privacy while maximizing utility continues to be an NP-hard problem, as data is lost through generalization and suppression process. Therefore more studies need to be done on various implementations of optimal data privacy tailored to Ugandan context; with consideration that PII differs in Uganda from other geographical locations.

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Effects of Innovation Characteristics and Emotional Attachment on Adoption of the Digital Magazine

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Abstract - *Research of digital publishing content has previously focused only the impact of its functionality or characteristics towards the intention to adopt the product. Over the years, with the advancement of information and communication technology and the adoption of various personal mobile device platforms, digital magazine adoption rates are soaring rapidly. Much of this phenomenon results from the acceptance of tablet computing devices. However, other additional factors contributing to the high adoption rate of digital magazine are ignored. This study investigates the effect of digital magazine innovation characteristics and the emotional attachment to paper magazines on the adoption of the digital magazines. The emotional attachment is found not to be a significant determinant factor both in terms of the intention to adopt and the frequency of use after adoption. Complexity and risk, and perceived inconvenience factors play important roles in the frequency of use after adoption.*

Keywords: Innovation, Emotional Attachment, Digital Magazine, Adoption, Tablet Computing Device

1 Introduction

Progress in information and communication technology (ICT) continually leads to changes in consumer lifestyle and also incessantly creates new opportunities for new products. The electronic book is one of such products that emerged from the advancement of the ICT. However, during the emerging stage when the technology was in its infancy, the e-book was adopted only by small groups of readers in educational and research areas [1]. The main reasons for low adoption rate stemmed from limited diffusion and adoption of reading devices and poor graphic quality. Therefore, the majority of the e-book research has focused on technical development of the graphic output quality [2, 3, 4, 5] and usage of the e-book in education [6, 7, 8].

In the 2000s, rapid development of the graphic quality and widespread diffusion of personal mobile devices has changed how consumers perceive and adopt digital media. Improvements in these technologies have provided consumers with more opportunities to use the e-books [9]. Application of digital publishing content has been stretched into other products such as novels, comic books, and particularly magazines.

As e-books become a part of lifestyle choice, adoption criteria of the digital publishing content no longer depends on the technical quality of the contents, or technological innovation of mobile devices alone. Digital magazines are of interest, with a double-digit growth rate globally and provide a huge opportunity for publishers in the digital content markets. However, by nature, magazine consumption is markedly different from book consumption. It is not a one-time purchase product. Buyers read it periodically or hold a subscription. Buyer's choices of magazines are highly related to their lifestyles and emotions. Therefore, other factors influencing digital magazine adoption must be explored and investigated in detail. Coupled with the fast adoption of personal mobile devices, this research question has become a significant and crucial pursuit. Tablet manufacturers and marketers need to find ways to maximize the monetizing of the digital revolution.

Past digital book and online newspaper studies showed that functional value is a main deciding factor for adoption [10]. Thus, it is interesting to investigate whether functional value remains the only factor affecting adoption of digital magazines. This study hypothesizes that innovation characteristics of digital magazines and emotional attachment to paper magazines are the determinant factors that lead to adoption of the digital magazine.

2 Literature review

Most digital book studies explored the attributes that influence the adoption of the product. Other studies focused on the diffusion of devices to read digital books, such as e-book readers [11, 12] and smartphones [11]. However, none of the studies tried to develop a model to investigate the factors affecting adoption of the innovation.

2.1 Innovation characteristics and innovation adoption

Past literature confirms that innovation characteristics affect adoption of new products. Roger (1983) suggested that these characteristics include relative advantage, compatibility, observability, trialability and complexity

[13]. As more studies paid attention to the topic, the concept of innovation characteristics was modified to include perceived risk [14, 15]. Recently, a more complex consumer decision process started to include characteristics related to the context of using the products, such as customization [16], volition [14, 17] and social advantage [17]. These in turn, increase depth in the construct of innovation characteristics. Flight et al. (2011) developed a measurement scale to evaluate how the customer perceives innovation in technology-based consumer durables [18]. The measurement scale has four dimensions including information, risk and communicability, complexity and relative advantage.

2.2 Technology acceptance model (TAM)

Technology acceptance model is another stream of research investigating factors affecting the adoption of innovation. Davis [19, 20] incorporated perceived ease of use and perceived usefulness into the TAM model. These factors have an impact on consumer preference towards technology and thus affect the intention to adopt the technology [21, 22].

Later study recognized that the emotional aspect of the products is another important criterion, thus the model was modified to include emotional attachment [23].

3 Conceptual model

It can be said that the TAM considers factors in a narrower focus and is more precise than the innovation characteristics concept. This is because the TAM explores relative advantage in more detail using perceived ease of use and perceived usefulness. Moreover, the TAM also includes the emotional attachment factor considered significant in fashion technology consumer products. However, the TAM ignores other innovation characteristics other than relative advantage.

This study is to recognize that both functionality and emotional values are involved in the consumer decision process. As a result, this study integrates the innovation characteristics with the TAM to predict the likelihood of the intention to adopt the digital magazine.

Thus, conceptual models are proposed as shown in Figures 1 and 2.

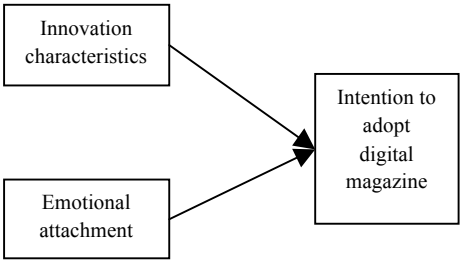

Figure 1 Conceptual model 1

Figure 1 shows the independent variables - innovation characteristics of the digital magazine and emotional attachment to the paper magazine. The dependent variable is intention to adopt the digital magazine.

Figure 2 shows the same independent variables as in Figure 1, but the dependent variable is extended to investigate a higher degree of intention to adopt by measuring frequency of use after adoption.

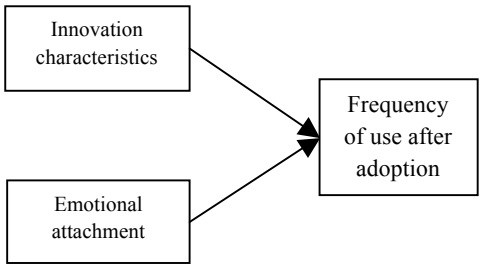

Figure 2 Conceptual model 2

4 Methodology

The samples of this study were drawn from a population 18-50 years old who generally read magazines, either paper magazines or digital magazines. Also, they must own a personal mobile device, i.e. smartphone, tablet, e-reader and others.

A questionnaire survey is used to collect data for analysis. The questionnaire consists of three parts. The first and second parts are the respondents' demographic profile and magazine reading behaviors. The third part consists of evaluation questions of how respondents perceive innovation characteristics of digital magazines, emotional attachment to paper magazines and intention to adopt and frequency of use after adoption. A five-point Likert scale is used for this study. The 46 questions in the third part were developed based on past studies of innovation characteristics [18] and emotional attachment to paper books [24]. It was later adjusted to fit within the context of the digital magazines by in-depth interviews with six samples.

5 Results

Total sample data were collected with an even distribution among gender, age and education level as shown in Table 1.

Table 1 The respondents' demographic profile

	Undergraduate and below		Graduate		Total
	Male	Female	Male	Female	
18-25 yr	27	28	25	25	105
26-35 yr	25	28	25	37	115
36-45 yr	17	27	15	27	86
46-50 yr	25	12	25	26	88
Total	94	95	90	115	394

The reliability coefficient (Cronbach's alpha) of the 46 questions of the innovation characteristics and emotional attachment measurement scale is 0.881. This shows that the measurement scale is reliable for use in further analysis.

To explore the construct of the newly developed measurement scale, a principal component analysis with varimax rotation method was applied. After eliminating nine items with cross loading between factors, the final results reveal that the remaining 37 items of the measurement scale can be grouped into eight factors. The KMO index of the analysis is 0.861. The Eigen value of the eighth factor is 1.076 and cumulative percentage of total variance explained is 65.277. The eight factors are complexity and risk, compatibility, emotional attachment, perceived ease of use, social value, communicability, observability, and perceived inconvenience as shown in Table 2.

Table 2 Construct of innovation characteristics and emotional attachment

Factor name	Number of items	Cronbach's alpha coefficient
Complexity and risk	7	0.888
Compatibility	8	0.840
Emotional attachment	6	0.876
Perceived ease of use	5	0.856
Social value	4	0.861
Communicability	3	0.687
Observability	2	0.735
Perceived inconvenience	2	0.608

Subsequently, two structural equation models were developed to investigate the impacts of innovation characteristics and emotional attachment on the adoption of digital magazines (model 1) and the frequency of use after adoption (model 2). The construct of independent variables in the models is based on the results from the exploratory factor analysis discussed above. The results of analysis are presented in Tables 3 and 4. The goodness of fit indices of the two analytical models are acceptable. All GFI, AGFI and CFI fit indices are above 0.700.

Factors affecting the adoption of digital magazines and the frequency of use after adoption are different. In the model 1, the factors that influence the adoption of digital magazines are compatibility (0.292), social value (0.268), communicability (0.244), perceived ease of use (0.147) and observability (0.099). However, emotional attachment, complexity and risk, and perceived inconvenience are not significant at the 0.05 p-value level.

On the other hand, in model 2, the factors that have impact on the frequency of use after adoption are compatibility (0.319), social value (0.201), perceived ease of use (0.186), communicability (0.181), complexity and risk (0.150), and perceived inconvenience (-0.108), while emotional attachment and observability are not significant at the 0.05 p-value level.

Table 3 Summary of structural equation model 1

Adoption of digital magazine		
Factor	**Standardized coefficient**	**p-value**
Complexity and risk	0.044	0.350
Communicability	0.244	***
Compatibility	0.292	***
Perceived ease of use	0.147	0.003
Emotional attachment	-0.067	0.155
Perceived inconvenience	-0.039	0.382
Observability	0.090	0.047
Social value	0.268	***
GFI	0.755	
AGFI	0.718	
CFI	0.799	
RMR	0.123	
RMSEA	0.080	

Table 4 Summary of structural equation model 2

Frequency of use after adoption		
Factor	**Standardized coefficient**	**p-value**
Complexity and risk	0.150	0.002
Communicability	0.181	***
Compatibility	0.319	***
Perceived ease of use	0.186	***
Emotional attachment	-0.035	0.461
Perceived inconvenience	-0.108	0.016
Observability	0.072	0.108
Social value	0.201	***
GFI	0.756	
AGFI	0.720	
CFI	0.800	
RMR	0.123	
RMSEA	0.079	

6 Discussions and conclusions

In the first model, the intention to adopt the digital magazines depends on compatibility, social value, communicability, perceived ease of use and observability factors. It is evident that the initial adoption of digital magazines is mainly based on innovation characteristic factors while the emotional attachment, complexity and risk and perceived inconvenience factors are not significant. This is because the digital magazines are related to consumer lifestyle and social interest. The adoption of the product is not perceived as risky. As the respondents own personal mobile devices, they are familiar with the technology and thus the complexity and perceived inconvenience factors are not regarded as a barrier to adopt the product. The emotional attachment factor likewise is not a determinant factor to adoption as the magazines are not regarded as collectible items like books. Therefore, it is logical for the emotional attachment factor to be excluded.

In the second model, a more in-depth analysis is extended into frequency of use after adoption. The determinant factors are compatibility, social value, perceived ease of use, communicability, complexity and risk and perceived inconvenience. This model looks into a longer-term of adoption that is highly useful for businesses to plan and market their products. Many

important factors are similar to the first model and share the same rationale. It is interesting to see that complexity and risk and perceived inconvenience factors are significant determinant factors only in the second model. The perceived inconvenience factor has a negative relationship with the frequency of use after adoption. The higher the perceived inconvenience, the lower the frequency of use after adoption. This can be explained that high perceived inconvenience will lead to low frequency of use after adoption. Marketers and businesses must provide convenience in ways for cross-referencing and comparison of multiple digital magazines to prevent perceived inconvenience. As for complexity and risk, this factor has a positive relationship with the frequency of use after adoption. It means that the higher the complexity, the higher the frequency of use after adoption. It is quite contrary to rationale. However, as the mobile application technology has improved and many digital magazines have become more complex, they are more interactive and have several new features for adopters to read the magazines more efficiently and effectively. For example, a drop-down menu, a photo slideshow and a scroll button have become common features. This implies that publishing houses cannot just convert print version periodicals into a digital version without added features and expect that the product will be adopted. In other words, consumers prefer, accept and expect digital magazine innovation even though the magazines may become more complex.

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Information System Planning Failures in Indian Telecommunication Industry

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ABSTRACT

There is industrialization, globalization and the intense competition in the market due to which business is rapidly changing. In order to get better competitive advantage, industry and managers are using Information system (IS). Most ISs are implemented with an expectation of being successful though there appears to be an increasing caseload of examples where systems go live and then have negative costs on the people who use them.
Most of the organizations are focusing on the success factors of the IS for the development and growth of the organization, though the failure factors are also equally important. The failure factors have been largely neglected, toned down and undermined. Therefore this problem has been undertaken to identify and analyse those factors with respect to time, industry and executive position. The objective of the paper is to deeply understand the failure and success factors for IS planning by examining the organizational environment of Indian telecommunication industry.
KEYWORDS-Information System Planning, IS, IS strategy; Critical Failure Factors (CFFs), Critical Success Factors (CSFs), Telecommunication.

1. INTRODUCTION

The information system supports an organization in fulfilling its business goals. As Information System (IS) has influenced the world today and there is lot of investments in IT but it is still not regarded as a formidable strategic resource. Therefore the practical implementation of the effective IT implementation, exploitation and assimilation is important and is the need an hour.
Information Systems have been given much more importance in business organizations especially in western countries & US. But the effectiveness of the IS is still not very sure. This is because of the absence of IT measures and IT success/ failure stories. As IT has not been exploited to its fullest extent so the tremendous potential is untapped and it should be effectively harnessed. The research literature regarding IS is largely theoretical and not empirical tested. Also it has been found that there are more studies on IS success factors and less literature available for IS failure factors. Most researches are highlighting the success factors and not the failure factors.
There has been tremendous thrust on such studies in US and western countries but such zeal is missing in our country due to certain factors like environment, politics, social setup, culture etc. Each country has its own setup therefore such studies of US and west may not be applicable or useful in our country. Most of the studies conducted focus themselves on the success factors and neglect failure factors. The study of the failures is equally important and yet not highlighted , therefore it is an important candidate of research.
Empirical study of the failure must be carried out in our country. In this research the focus will be on the factors contributing towards the IS failures. The thrust will be on the Indian industry.
Keeping in view the high importance of the subject and the existing gap in the research it is proposed to take up further research to the development of effective IS .

2. LITERATURE REVIEW

The review of IS literature suggests that for the past 15 years, the success and the failure of information systems have been major concern for the academics, practitioners, business consultants and research organizations.
A number of researchers and organizations throughout the world have been studying that why information systems do fail, [1] - [2].It has been identified the following critical IS failure factors:

Fear-based culture.	Political pressures.
Weak procurement. •	Poor training.
Technology focused.	Technical fix sought.
Development sites split.	Poor reporting structures
Poor consultation.	Project timetable slippage
Complexity	Inadequate testing
Leading edge system	Over commitment

Six major dimensions of IS viz. superior quality (the measure of IT itself), information quality (the measure of

information quality), information use (recipient consumption of IS output), user satisfaction (recipient response to use of IS output), individual impact (the impact of information on the behavior of the recipient) and organizational impact (the impact of information on organizational performance) had already been proposed [3] .

Cancellation of IS projects [4] are usually due to a combination of:

• Poorly stated project goals;
• Poor project team composition;
• Lack of project management and control;
• Little technical know-how;
• Poor technology base or infrastructure;
• Lack of senior management involvement.
• Escalating project cost and time of completion.

Some of the other elements of failure [5] identified were:

• Approaches to the conception of systems;
• IS development issues (e.g. user involvement);
• Systems planning;
• Organizational roles of IS professionals;
• Organizational politics;
• Organizational culture;
• Skill resources;
• Development practices (e.g. participation);

All the studies predict that during the past two decades, investment in Information technology and Information system have increased significantly in the organization. But the rate of failure remains quite high. Therefore an attempt is made to prepare the IS planning model for the prediction of the success or failure of the organization.

Critical Success Factors (CSFs) for IS are the few key areas in which things must go right for an organization to thrive. If results in these areas are inadequate or deficient, the organization's efforts will be without reward. Further, these mission-critical areas must be recognized and acted upon in an effective manner or it will not be possible to ensure success for a manager or an organization. Indeed, a logical conclusion and reasonable inference from this argument is that CSFs are areas of activity that should be receive constant and careful attention from management.

Successfully adopting IT depends on user acceptance and actual usage of the system .

3. OBJECTIVES AND SCOPE OF THE STUDY

- To study the causes of failures of ISs.
- To study the critical success factors of effective IS especially for the Indian industry.
- To develop a model of planning failure of IS.

The objective of study was to analyse the failure and success factors of Information System Planning and pinpoint the most important factors. Also, the study focuses on testing the relevance of the factors existing in literature in the Indian Telecom Industry.

In view of the certain constraints like time and money, the study was confined to the two organisations, namely, Punjab Communication Limited (PUNCOM), and Reliance Communication, Chandigarh (Reliance). These enterprises were selected because they are using Information Systems. The former one is using the domestic IS and has low business performance and is late in adopting IS where as the later one is using the international package of IS i.e Systems Applications and Products(SAP) for handing their business and the company have extremely good business performance, high employment generators and early adopters of IT with functional ISs. This industry is strategically and economically important due to high communication need and also India is the second largest mobile user country of the world.

Table 1 Sample distribution

Organisation	Management Level	Population	Sample	Actual Response	%age of response size
Puncom	Top Level	14	11	10	90.90
	Middle Level	20	14	13	92.85
	Lower Level	210	146	136	93.15
	Total	244	171	159	92.30
Reliance	Top Level	12	10	9	90
	Middle Level	42	32	29	90.62
	Lower Level	77	47	42	89.36.
	Total	131	89	80	89.88
	Grand Total	375	260	239	91.33

4.RESEARCH METHODOLOGY

4.1 Sampling scheme

The research involves the collection of data from the managers working at various levels within the selected enterprises. The total number of respondents in these enterprises, the sample size selection and application of the statistical techniques has been followed. The details of the research methodology adopted in this research are given below.

4.1.1 For the Organization

1 *Universe of study:* Telecommunication industry comprises of Reliance Communication, Vodafone, TataTeleservices, Idea, Bharti-Airtel, Bhart Sanchar Nigam Limited.

2 *Sample Selection*: Reliance Communication Chandigarh and Punjab Communication Ltd. (Puncom) Mohali.

4.1.2 For the Respondents

1 *Universe of study*: All managers working at the three levels of the selected organizations.

2 Sample Selection: A number of respondents based on proportional stratified sampling from all of these organizations had been selected. The respondents would be identified from various levels / business functions in each organization such as top management, IS management, functional heads, IS staff and users. The primary data had

been collected via questionnaires cum interviews with the selected respondents. Statistical Package for the Social Sciences (SPSS-20) statistical tool was used for the statistical analysis. The norms were formalised for the choice of respondents from the participating organisations on the basis of detailed discussions with a number of academicians, researchers and industrial experts. It was observed that increase in sample size will affect the results only marginally, whereas effort for it will be considerable. The sample size from a stratum was determined on the basis of the following criterion:
25% of the population where sample size > 100
50% of the population where sample size < 100.

4.2 Data collection tools

Primary data has been collected through a questionnaire-cum-interview method from the selected respondents. The questionnaire was designed based on the literature survey, and detailed discussion with many academicians, professionals and industry experts. As a result, a total of 09 dimensions consisting of a total of 32 factors were identified that have been shown in Table 3. The questionnaire was designed that was carefully pre-tested through subjecting it to the 15 respondents, before being administered to the selected respondents. To ensure the quality of the instrument the questionnaire was tested for reliability, content validity and sensitivity. The questionnaire chosen for the study was found reliable as Cronbach's alpha reliability of the scale used was more than 0.983, indicating the goodness of the scale measurements as shown in table 2.

Table 2 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.983	.978	32

Content validity of the questionnaire was tested through thorough discussions for comprehensiveness, depth and relevance to the selected organisations and the topic of study. The questionnaire was found to be comprehensive, appropriate and relevant to the study. The responses and the recommendations on the basis of the feedback were incorporated into the final questionnaire. Further, the sensitivity of the questionnaire was found good as the Likert scales were used to record the responses of the participants. The participants were both identified at random and selected based on professional contacts of the researchers. External resources based on industry experts along with a review of industry literature was also completed and used in order to gauge the validity of the participant's response.

4.3 Processing of data

The responses of the 239 employees of the selected organisations under study were recorded on five-point likert scale with scores ranging from 1 to 5. The valid responses were entered in Microsoft Excel software. Thus, this data formed was the basis for the corresponding files on the SPSS software. The mean scores of the managers of the three companies and those over the whole industry considering all the managers included in the study for each of the factor have been plotted in a graph that has been shown in Figure 1.

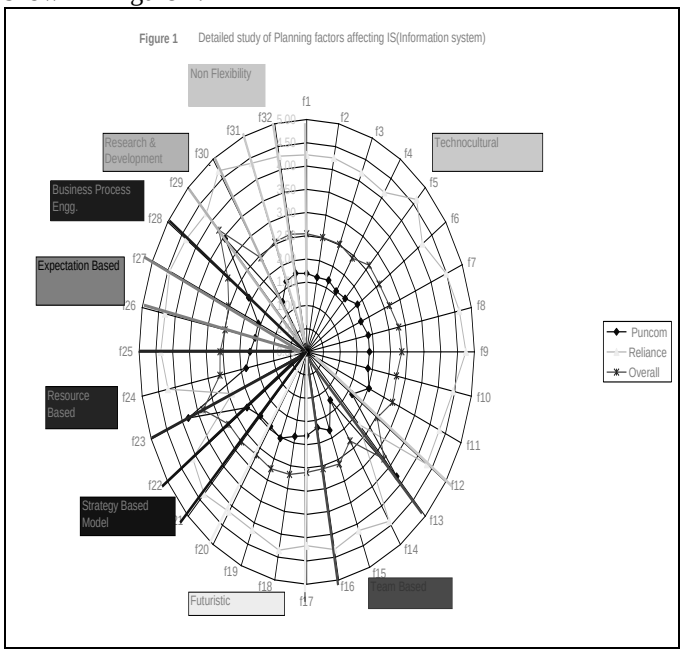

Figure 1 Detailed result of study (see online version for colors)

Table 3 Instrument for accessing alignment

S. No.	Dimension	Factors
1	Techno-Cultural	The availability of firm-wide communication network is essential for IS success IS (f1). The awareness of advanced technology helps in the Success of IS (f2) Freedom to the employees in contributing in decision making process is desired for the growth of the IS (f3) Integrated Database applications experience(is crucial factor for IS success (f4) Users recognizes the IS potential(f14)
2	Team Based	IS support Decision-making Process (f13) Easiness in the services offered by IS (f5) IS success is both directly and indirectly influenced by IS team communication skills, being mediated by user involvement and/or user attitude towards the IS. IS planned for the performance measurement of the employee (f6) Availability of integrated IS Applications around all functional areas (f7) Internal culture of the organization shares values and common goals for efficient & effective IS(f8) A sophistication in Authenticated Services (Digital Signatures) for the security of transaction data is essential feature of effective IS (f9) IS controls the processing of the information and the operations in the production life cycle(f10) IS support Mang. principles (f11) Competency of Technology of IS(f12) Support from Top Management for IS effectiveness (f15) Active involvement of steering committee (f16)

3	Futuristic	Top management can provide a long-term strategic vision, initiative, support, and a commitment to create a positive environment for innovation (f17) Clear value proposition planning for effective & efficient IS (f18) Active involvement needs to be transmitted throughout the organization at all levels to convince the IS department to give top priority to an IS (f19) Keep track of the strategic goals (f20)
4	Strategy Based Business Model	The business plan should propose the strategy & regarding cost benefits analysis, time, work and resources. Business objectives should be clearly stated regarding operations, implementation Bu. (f21) Supply-chain management software is important for the operations (f22)
5	Resource Based	IS employees' awareness, knowledge, understanding of advanced technology and methodology (f23) Top Management participation in the goal defining 7 project scheduling (f24) Organizations with an appropriate level of cross-functional and cross-business applications and telecommunications resources are capable to handle effective IS (f25)
6	Expectation Based	System specialists accept responsibility for system use (f26) Unrealistic expectation from IS by Top Management (f27)
7	Business Process Integration	The integration of online and offline strategies is must for effective IS (f28) Incompatibility of the features of the IS with the organization's business processes are not required at all. Efficient and Sufficient BPR required (f28)
8	Research & Development	Technology factors like security, scalability, stability, availability, speed of the system must be considered for the effective IS (f29) Marketing Research& Development practices availability (f30)
9	Non-Flexibility	Top management's rigidity and bureaucracy (f31) Telecommunication actual (f32)

5.ANALYSIS AND FINDING

The analysis has been made on the basis of the mean scores and the factor analysis techniques. The responses of the managers of the two companies differ significantly in terms of their mean scores. Among these companies, Reliance Communication Ltd. had been pioneer in planning full-fledged Information System (IS) with fully automated procedures, processes and practices. The Puncom had a function-wise domestic IS that is not well-integrated. IS is only being used as a support tool by the Puncom managers.

From Figure 1, it can be depicted that the managers of Reliance give maximum importance to the 'Resource Based and Team based' factors which leads to its IS planning success. However in Puncom the nonflexibility of the top management leads to its IS failure. Their unrealistic expectation also is the critical failure factors for Puncom.Their rigidity and bureaucracy leads to the failure of IS. However IS employees' awareness, knowledge, understanding of advanced technology and methodology is found to sufficient in Puncom. This high managerial expectations are prevalent in Puncom because the company has been the player among the public sector telecommunication and managers of the company strongly feel that tremendous improvement in IS functioning by introducing the global IS is required for the success of the organisation.

On the other hand, the managers of Reliance do not have such high aspirations as the company has already has full fledged Information System implemented. The global IS implemented in Reliance found to be efficient as it has a potential for the decision making process as shown in fig1. by mean scores.

5.1 Factor Analysis

Further analysis had been made on mean scores and factor analysis technique. The response of managers of two companies differs significantly in terms of their means scores. Among these companies Reliance has been sincere in planning fully fledged Information System with fully automated procedures processes and practices. Hence there averages are near or greater than 4 which shows that the variables identified are first planned and then executed in right order whereas in PUNCOM there is still a huge scope of improvement as PUNCOM had function wise IS that we're not well integrated.

The data collected for two companies to extract critical failure and success factors could he analysed using factor analysis.

The results for this analysis indicate that correlations among the factors were high and Bartlett's test of KMO value of sphericity was significant. See table 3

Table 4 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.978	
Bartlett's Test of Sphericity	Approx. Chi-Square	11345.292
	df	496
	Sig.	.000

The data were hence found suitable to conduct factor analysis. Principal component factor analysis was conducted for both the companies to identify the Principal factor.

It had used Principal Components as the extraction technique and rotation method was Varimax. Only factor with given value (Total Variance explained) more than 1 were included in final solutions. A factor loading is simple correlation between factors and all variable. It can be used to decide which variable belongs to these factors with which have the highest loading (neglecting negative sign).

Table 5: Total Variance Explained

	Initial eigenvalues							
Comp	Total	% of Variance	Cumm % of Var.	Total	% of Variance	Cum. %		
1	24.3	76.0	76.0	24.334	76.045	76.0	42.1	42.1

2	1.039	3.248	79.293	1.03	3.24	79.2	37.14	79.2
3	.725	2.265	81.558					
4	.521	1.628	83.185					
5	.505	1.577	84.763					
6	.476	1.197	86.260					
7	.390	1.217	87.477					
8	.338	1.055	88.532					
9	.301	.942	89.474					
10	.295	.921	90.396					
11	.268	.836	91.232					
12	.267	.833	92.064					
13	.241	.752	92.817					
14	.230	.719	93.536					
15	.218	.682	94.218					
16	.191	.596	94.813					
17	.188	.588	95.401					
18	.168	.525	95.926					
19	.153	.479	96.405					
20	.140	.439	96.844					
21	.127	.397	97.241					
22	.118	.368	97.609					
23	.113	.353	97.961					
24	.106	.332	98.893					
25	.098	.306	98.599					
26	.094	.292	98.892					
27	.078	.243	99.135					
28	.069	.216	99.351					
29	.063	.196	99.547					
30	.058	.183	99.730					
31	.051	.160	99.890					
32	.035	.110	10.000					

Extraction Method: Principal Component Analysis.

See Table 5, this process was used to find out all the constituent variable of each factor. It was seen from the total variance explained in table that only 02 components has been extracted along with the underlying factors loading more than 0.50 . It can be observed from Table 5 that these principal components explain 79.2% of the cumulative variance which means good factor analysis has been done. The factor analysis performed on 32 items under planning process resulted into extraction of 02 components for both the companies. Based on the content of each component they were suitably named. Factor analysis was asked to identify the critical factors that influence Information System planning at Puncom & Reliance.

Then the rotated component matrix had been calculated as shown in Table 6.The first and the second components have been shown in Tables 7 and 8, respectively. The factors mentioned in Table 7 & 8 are the very important for avoiding failures of Planning of IS.

In Table-7, the first principal component shows the important sub factors pertaining to team based planning of IS .The support from Top Management for effective IS is most important parameter and then followed by IS potential of the decision making process. The other important factor is that the users should recognizes the IS potential. In Table 8, the second principal component consists of the techno-culture, business process reengineering and research & development practices to be adopted. The most important parameter in second component is found to be that IS should according to the management principles and control. Also IS should be capable of giving freedom of decision making at different level of management. The results of factor analysis point out mainly two things. Firstly, on the basis of Table 7, user should recognises the IS potential otherwise IS fails, the top management involvement is must for IS success, unrealistic expectation from IS and the rigidity & bureaucracy of top management also leads to failure of IS. Secondly, on the basis of Table 8, better IS infrastructure and technology is important for IS success. Incompatibility of the features of the IS with the organization's business processes are not required at all. IS employees' awareness, knowledge, understanding of advanced technology and methodology is also the important factor for success of IS in Reliance. Top Management participation in defining the goals during planning phase leads to IS success in Reliance.

5.2 Findings

Study concludes that 32 factors influencing the failure and success of Information System planning at Puncom & Reliance

The variable were divided under different factors based on values in rotated component matrix (the higher values are taken) the division of variables into different factors are given in table-7 & 8.

The study also makes groups of important factors for failure & success of Information system (IS) planning by identifying key factors as shown by Rotated component Matrix .Since the grouping of variable were done on basis of data collected from managers, IS analyst, system analyst, system managers, IS consultant, the results of the study were also acceptable for all levels and would be acknowledged by Information system users. Based on the results obtained from above analysis following IS planning Model can be used to judge failure or success of IS planning at telecommunication companies

Table 6 Rotated Component Matrix[a]

	Component	
	1	2
Support actual	.870	.278
IS decision actual	.840	.396
Recognize actual	.831	.375
Vision actual	.796	.414
Responsibility actual	.794	.494
Business actual	.788	.466
Part. Actual	.767	.524
proposition actual	.749	.507
involvement actual	.704	.469
Expectation actual	-.695	-.554
Chain value actual	.693	.478
Steering commt. actual	.678	.622
IS employees awareness actual	.672	.662

Rigidity actual	-.641	-.417
Mang. Principles actual	.448	.753
Control actual	.505	.739
Freedom actual	.543	.732
Awareness actual	.508	.729
Technology IS actual	.097	.708
Perf. Measurement actual	.536	.705
Sophistication actual	.605	.701
Internal culture actual	.474	.700
R & D actual	.647	.697
Easiness service actual	.635	.691
Int. online actual	.567	.680
Strategies goal actual	.634	.679
Tech IS actual	.591	.670
Firm wide network actual	.644	.666
IS Application actual	.613	.660
Database application actual	.614	.660
Resource actual	.532	.650
Telecommunication actual	.524	.599
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.		
a. Rotation converged in 3 iterations.		

Table 7 Important sub objectives and associated factors (first component)

IS Strategic Planning Parameters responsible for IS failure/success (component 1)	
Resource Based	IS employees' awareness, knowledge, understanding of advanced technology and methodology (f23) Top Management participation in the goal defining & project scheduling (f24). Organizations with an appropriate level of cross-functional and cross-business applications and telecommunications resources are capable to handle effective IS (f25).
Team Based	Support from Top Management for IS effectiveness (f15) IS has a potential of the decision making process (f13). Users recognizes the IS potential(f14) Active involvement of steering committee (f16)
Futuristic	Top management can provide a long-term strategic vision, initiative, support, and a commitment to create a positive environment for innovation (f17). System specialists should accept the responsibility for system use (f26)
Strategy Based Business Model & Plan	The business plan should propose the strategy regarding cost benefits analysis, time, work and resources. Business objectives should be clearly stated regarding operations, implementation Bu.(f21) Clear value proposition planning for effective & efficient IS (f18) Active involvement needs to be transmitted throughout the organization at all levels to convince the IS department to give top priority to an IS (f19) Supply-chain management software is important for the operations(f22)
Expectation Based	Unrealistic expectation from IS by Top Management leads to failures (f27).
Non-Flexibility	Top management's rigidity and bureaucracy (f31) Telecommunication actual (f32).

Table 8 Information System Planning practices within the organization (Component 2)

Techno-Cultural	The availability of firm-wide communication network is essential for IS success IS (f1). The awareness of advanced technology helps in the Success of IS(f2) Freedom to the employees in contributing in decision making process is desired for the growth of the IS (f3) Integrated Database applications experience(is crucial factor for IS success (f4) Easiness in the services offered by IS (f5) IS planned for the performance. measurement of the employee (f6) Availability of integrated IS Applications around all functional areas (f7) Internal culture of the organization shares values and common goals for efficient & effective IS (f8) A sophistication in Authenticated Services (Digital Signatures) for the security of transaction data is essential feature of effective IS (f9) IS controls the processing of the information and the operations in the production life cycle (f10) IS support Mang. principles (f11) Competency of Technology of IS (f12)
Research & Development	Technology factors like security, scalability, stability, availability, speed of the system must be considered for the effective IS (f29) Marketing Research& Development practices availability (f30)
Business Process Integration	IS Keep track of the strategic goals (f20) The integration of online and offline strategies is must for effective IS. Incompatibility of the features of the IS with the organization's business processes are not required at all. Efficient and Sufficient BPR required (f28).

The list of key critical factors can be shown by communalities which basically provide handling for each individual variable. Then the models for planning the information system for the telecom industry can be generated in later stage.

Table 9 Communalities

	Initial	Extraction
Int. online actual	1.000	.784
Strategies goal actual	1.000	.863
Proposition actual	1.000	.818
Business actual	1.000	.838
Part. Actual	1.000	.862
Chain value actual	1.000	.708
vision actual	1.000	.806
Recognize actual	1.000	.831
IS Decision actual	1.000	.863
Support actual	1.000	.834
involvement actual	1.000	.716
Steering commt. actual	1.000	.847
Expectation actual	1.000	.791
R & D actual	1.000	.904
Tech IS actual	1.000	.798
Freedom actual	1.000	.831
Awareness actual	1.000	.790
Perf. measurement actual	1.000	.785
Internal culture actual	1.000	.715
Mang. Principles actual	1.000	.768
control actual	1.000	.801
Resource actual	1.000	.705
Rigidity actual	1.000	.584
Database application actual	1.000	.812
IS Application actual	1.000	.812
Firm wide network actual	1.000	.859

IS employees awareness actual	1.000	.890
Telecommunication actual	1.000	.634
Technology IS actual	1.000	.510
Responsibility actual	1.000	.875
Easiness service actual	1.000	.882
Sophistication actual	1.000	.857
Extraction Method: Principal Component Analysis.		

The IS planning model simples functionality of IS planning at Puncom & Reliance. The simplification of system makes easier to understand the IS requirements by using this model for all small medium size companies.

4. RECOMMENDATIONS

In the telecommunication industries IS play a vital role for the success or failure of the organization. It must be a part of the organization plan, so that the role of IS is for decision making and not just a support. The IS in the communication industry is successful only if the top management involvement & support otherwise it may become a failure. Therefore there is a need of team based IS planning model with a supportive management as a leader. Top management must provide a long-term strategic vision, initiative, support, and a commitment to create a positive environment for innovation. Clear value proposition planning is essential for effective & efficient IS. Active involvement of all the employees needs to be transmitted throughout the organization at all levels to convince the IS department to give top priority to an IS. Management should have to keep track of the strategic goals while planning for the IS. The surety of the effective IS lies in the presence of formal strategy planning. High Rigidity and bureaucracy of Top management leads to failure of IS. Flexibility is required for the success of IS. IS success/failure depends on the availability resources and infrastructure. Availability & retention of IS employees' having awareness, knowledge, understanding of advanced technology and methodology is important for the success of IS otherwise IS fails. The business plan should propose the strategy regarding cost benefits analysis, time, work and resources. Business objectives should be clearly stated regarding operations and implementation. The planning of Supply-chain management software is important for the operations of effective and efficient IS.

Top Management's Unrealistic expectation from IS leads to IS failures. System specialists and developers should accept responsibility for system use not merely its development is their concern.

Techno-Cultural planning factor play vital role in the failure and the success of the organization. The availability of firm-wide communication network is essential for IS success the availability and awareness of advanced technology helps in the success of IS. Freedom to the employees in contributing in decision making process is desired for the growth of the IS.IS failure/success is both directly and indirectly influenced by IS team communication skills, being mediated by user involvement and/or user attitude towards the IS. IS must be planned for the performance measurement of the employee. Nonavailability of integrated IS Applications around all functional areas leads to failure of IS. Internal culture of the organization must shares values and common goals for efficient & effective IS. Sophistication in Authenticated Services (Digital Signatures) for the security of transaction data is essential feature of effective IS planning otherwise failure. IS controls the processing of the information and the operations in the production life cycle. IS must support Management principles. The technology of IS should be competent for the global market. The research and development is crucial for effective and efficient IS. IS employees' awareness, knowledge, understanding of advanced technology and methodology? Technology factors like security, scalability, stability, availability, speed of the system must be considered for the effective IS... Good quality Business Process Reengineering is required for IS success. The integration of online and offline strategies is must for effective IS. Incompatibility of the features of the IS with the organization's business processes are not required at all. Efficient and Sufficient BPR required incompatibility of the features of the IS with the organization's business processes are not required at all

7. CONCLUSIONS

Our findings at the systems level will help the management in making the planning of IS effective at individual and organisational level. If the above concepts are implemented in their present ISs, the systems acceptance is very likely to improve because it would be based on how the future effective planning of IS is required for success of IS. The study has many implications for both academic and practice communities. The results are especially important to the organisations seeking standardisation of their ISs according to Indian culture and environment. Besides, the study is important as it is empirical and pertains to large sector industry of strategic planning importance having direct impact on the country's economy. Further, as there is a shortage of IS failure studies pertaining to the Indian industry and culture, the study can contribute significantly in evolving and conceptualising an effective IS planning model for IS in Indian Telecom industry.

Some of the important limitations of study were confinement to single industrial sector, fixed sized population evaluation, divergence from strict random sample selection, sticking to five point scales. The study has proposed CSSs & CFSs of IS planning factors in two large-sized organisations. However, the study can be carried out for a large sample or organisations across the industries. Further, it will be extremely useful if the suggested factors are incorporated in the ISs of the considered organisations. Also, the factors suggested in this article provide a macroscopic view, which should be further extended to include the information content at microscopic level. Besides, more such studies need to be carried out for the cross-culture and global perspective to make the IS Planning model robust and practical.

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Log Management and Retention in Corporate Environments

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Abstract - *As an increase in the amount of data breaches, hacking attempts and other malicious activities have harmed corporate environments, regulations have arisen to address the concerns of the public in regards to these events. As a result, corporations have to address the need for log management and data retention within their environments. This requires an abundance of resources and policies to ensure that the log data collected meet integrity standards and can be assured to be accurate. A review of (1) why log management and retention is important, (2) the barriers of good log management policies, types of log files, and (3) the future security concerns are surveyed to better understand the needs of the corporate environment.*

Keywords: log, corporate, hacking, policies

1 Introduction

As the migration of large corporations from the physical business space to the Internet has rapidly increased over the last few decades, a greater emphasis on creating accurate audit trails of ingress and egress communication traffic from these corporate environments has become more and more vital. In addition, Federal, State, and International regulations on the transmission of data have now served as warning for corporations to enact reliable policies which follow best security practices needed in the business field in regards to computers. Until recently, log management was held in the background of security concerns. The risk of log file mismanagement was greater as the amount of log files collected increased with the expansion of hardware and software used within computer environments. However, because of law and regulations enacted over the last fifteen years, corporations now have to focus resources to provide log management solutions within their environment.

This paper will first discuss the background of log management and corporate environments. It will then discuss what log management is and why it is necessary from a corporation's point of view to implement these policies using Federal, State and International law. The paper will then transition into a discussion of the similarities and differences between Windows log files and Syslog files. Finally, the paper will discuss how cloud computing will affect log management in the future and give conclusions on the topic.

2 Background

The Syslog protocol was first used in the 1980s in a sendmail application to remotely deliver log messages to a server [1] as a part of the Berkeley Software Distribution of UNIX [2]. This protocol was created to provide the ability to report system events. Since the introduction of the protocol, the formatting used for a Syslog is extensively used within the UNIX environment, as well as other open source and many proprietary software and hardware devices. Microsoft decided to differentiate from the Syslog format by using hexadecimal outputs to store their log messages. As a result of these formatting decisions, the Windows event logs and the logs produced in the Syslog method have significant styling, formatting and log collection methods.

3 The Corporate Environment

The scope and size of the corporate environment must be defined to adequately determine how log management should be used to collect and retain log data. The National Institute of Standards and Technology (NIST) describes recommendations which may be used by computer security personnel, such as program managers, computer security incident response teams, and other individuals who are responsible for log management [3]. The four major recommendations include establishing policies and procedures for log management, prioritizing log management throughout the organization, giving support to all staff with log management responsibilities, and establishing a standard operational process for log management [3].

Because many security incidents are not discovered until after a breach has occurred, log management, data retention and log analysis is vital to determine what has occurred and what can be done to reduce the risk of similar incidents occurring in the future [4].

4 What is Log Management?

Log management is the process in which auditing logs should be parsed, protected, and used within the corporate environment. Log management contains many facets including log retention, as well as log analysis and forensics [4]. Security system logging allows for corporations to hold to confidentiality, integrity and assurance (CIA) practices.

By becoming compliant, a corporation allows itself to guarantee that resources and tools are available to provide evidence to investigators when malicious incidents occur. Also, a log management policy allows for proactive monitoring of trends within an environment [4]. With the knowledge of these trends, corporations can determine if significant changes have arisen.

A log management policy allows for support for internal investigations, data which can be used for forensic investigations, baselines for normal activity within the environment, the ability to identify operational problems, perspective for malicious activity which originates from both internal and external threats, and the ability to meet Federal, State and International laws and regulations [4].

5 Regulations and Data Retention

According to Privacy Rights Clearinghouse, between 2005 and 2012 over 560,000,000 records have been breached [5]. Some of the largest breaches have included Hartford Life Insurance Company, TJX Stores, Sony Corporation of America and the Texas Comptroller's Office [5]. As a result of these data breaches, compliance boards and organizations have been created by both private and federal authorities. Some of the largest include the Payment Card Industry Data Security Standard (PCI-DSS), Sarbanes-Oxley Compliance (SOX), and the Health Insurance Portability and Accountability Act (HIPAA). To give an example of these regulations, the Occupational Safety and Health Administration (OSHA), requires that medical and other similar types of records must be retained for 30 years [6].

These standards and regulation increasingly demand for complete and accurate audit trails to be created in order for companies to be in compliance. For corporations, ensuring that their logging and auditing practices are up to date allows for quicker incident response, forensic investigations and incident responses to occur. Also, since security incidences may not be discovered for weeks or sometimes months after the initial breach has occurred, corporations must make sure that their log records are both secure and up to date [4].

Regulatory agencies and regulations such as PCI-DSS, SOX, and The Federal information Security Management Act of 2002 (FISMA) have required companies and organizations to monitor and audit log files which are created within their infrastructures [7][8][9]. Since the fines and fees for data lost can be tremendous, corporations must give considerate attention towards how they will implement log management and data retention into their environments. Knight recommends that log management and analysis must be used together to protect an environment [10].

6 Types of Log Files

Since many corporations have a mixture of Windows log sources and Syslog sources within their environment, an understanding of the similarities and differences of these logs is vital in log management for security personnel [11][12].

6.1 Windows Logs

During the transition to Windows Vista, Microsoft decided to transition away from the previous format and to include export of the logs into the more universally used .XML format compared to using hexadecimal format of prior Windows NT operating systems. Although there are many types of Windows Event Logs, most failures typically fall into the following categories [4][7][13]:

- *Information*: Occurs when an infrequent but significant event occurs, such as when a Microsoft SQL Server successfully loads.
- *Warning*: Reports a problem that is not significant at the time, but could escalate into a large problem in the future.
- *Error*: Notifies when a significant even has occurred.
- *Success Audit*: A type of security event which notifies that a successful action has occurred. Examples include successful user account logins, or a file being successfully opened.
- *Failure Audit*: A type of security event which notifies when a failed action has occurred. Examples of a failure audit include a failed user account login attempt.

The Windows NT log structure was initiated to allow for smaller log file sizes which can be quickly transferred from one location to another. Once a log is parsed by Windows Event Viewer or other software, it provides a detailed list of information. This event types allow a security personnel to locate why an incident may have taken place.

6.2 Windows Log Example

To show how a Windows Event Log looks like, Windows Security Event ID 4624 will be used. This event is a Success Audit indicating that an account has successfully logged on. We collected this data from a Windows 7 Home Premium Edition virtual machine named 'TEST-PC'. The parsed message appears below:

SubjectUserSid S-1-5-18
SubjectUserName TEST-PC$
SubjectDomainName WORKGROUP
SubjectLogonId 0x3e7
TargetUserSid S-1-5-21-3639450285-3132740584-3241638508-1000
TargetUserName TestUser
TargetDomainName TEST-PC
TargetLogonId 0x13adfdd
LogonType 7
LogonProcessName User32

AuthenticationPackageName Negotiate
WorkstationName TEST-PC
LogonGuid {00000000-0000-0000-0000-000000000000}
TransmittedServices -
LmPackageName -
KeyLength 0
ProcessId 0x230
ProcessName C:\Windows\System32\winlogon.exe
IpAddress 127.0.0.1
IpPort 0

This log message includes several data points which would be important for an investigation. There is a large amount of information you can obtain from this log file. First, the SubjectUserSid, S-1-5-18, is a well known security identifier (SID) which indicates that the computer used a service account for the logon [14]. The TargetUserSid is the target computer account that the logon was requested and granted. In this example, the target is the local computer.

The most important information related to this type of log is the LogonType, the LogonProcess and TargetLogonId. The LogonType is a hexadecimal code which explains the location in which the login attempt originated. In the example above, the reason for the failure was type 7, which is when the workstation is unlocked from the password protection screen [15]. Next, the User32 is the logon process which was started to initiate logon [16]. The User32 process is used for interactive logons, which is the logon screen which appears either after Windows 7 is started or when a user account is locked. Finally, TargetLogonId describes the target location in which the logon was granted. This value is a semi-unique value which is reset each time the workstation is restarted [15]. Therefore, this value can be used to track the actions of the user after they have logged into the workstation.

While log types differentiate based on event type, this method of investigation can be used to locate how and when events have occurred on a workstation.

6.3 Syslog

Most varieties of *nix and UNIX operating systems continue to use the Syslog as their primary logging type. Syslog data is a plaintext string which can then be tokenized by either a script or program to be human-readable. These logs are usually collected into several log files which are disbursed into several areas of the operating system. By default, RedHat/Fedora and Ubuntu/Debian systems generally place these files in the ~/var/log/messages directory [17]. Rainer Gerhards defines Syslog as being a non-standardized formatting system which allows log emitters to decide or configure which types of log messages will be produced [18].

Although there is not a standard format, Syslog is in general a fairly readable format. Since Syslog is free of formatting, scripts and parsers can be used to create easy to read reports. A 'Syslogger', a centralizing collector of Syslog data which is collected from configured devices within an environment, can be used to collect Syslog data [2][19]. When a corporation discusses bring in external products for their environments, each products should be compared to test the ability to provide accurate data, reliable results, and any other criteria the environment needs to provide evidence of their compliance to regulators and auditors [1]. Purcell discusses a case study which he created to compare correlation rule sets as well as other criteria which could be compared to other products [2]. Using methods such as this allows corporations to provide reliable evidences of what has occurred in their environment.

6.4 Syslog File Example

Since Syslogs are stored in plaintext, either a GUI system log viewer or accessing the /var/log/messages folder can be used to view the files. We collected this data from log messages originating from an Ubuntu 10.4 (Lucid Lynx) virtual machine using the method described by Gite [17]. The computer name for this account is 'testtoor'. This data can then be parsed into a more human-readable format, which is shown in Table I.

TABLE I
SYSLOG AUDIT FORMATTING

Date	System Name	Failure Type	Alert Type	Reason
Apr 01 07:44:12	testtoor	exim	ALERT	/var/log/exim4/paniclog has non-zero size, mail system possibly broken
April 10 10:00:12	testtoor	passwd	password	successfully changed

Since Syslogs are stored in plaintext, either a GUI system log viewer or accessing the /var/log/messages folder can be used to view the files. We collected this data from log messages originating from an Ubuntu 10.4 (Lucid Lynx) virtual machine using the method described by Gite [17]. The computer name for this account is 'testtoor'. This data can then be parsed into a more human-readable format, which is shown in Table I.

6.5 Comparison of Windows Log Files and Syslog

As mentioned previously, the differences between Windows Event Logs and Syslogs are extensive. To show these differences, Table II shows the differences between these log file types.

Windows event logs and Syslogs do have a few similarities. There are a few events which have similar wording, such as Alerts/Warning or password change notifications. Also, both types use files to store log events, as well as only allow administrative users to view the log directories by default.

TABLE II
DIFFERENCES BETWEEN SYSLOG AND WINDOWS LOG FILES

Differences	Log Types	
	Windows (NT Operating Systems)	**Syslog**
Location (Default)	%SystemRoot%\System32\Config	var/log/messages
Format	Hexadecimal, .xml	Plaintext
Format Standarized?	Yes	No
Used Elsewhere?	No (Microsoft Proprietary Systems)	Yes

7 Future Security Considerations

As with any management consideration within the technology environment, a need to discuss potential future obstacles which may cause additional implementation changes must be discussed. One of the more rapidly growing fields is the cloud computing. Cloud computing is the sharing of resources, hardware, and software as a means to provide services to a wider range of customers with a decrease in the amount of resources required by corporations and other organizations [20]. As a result, cloud computer log management may be implemented as a Software-as-a-Service (SaaS) instead of the traditional hardware techniques [20].

Although cloud computing will allow for greater ease in allowing for network resources to be pooled in a easier method, this change also effects more traditional businesses which are required to implement a logging solution. Cloud computing requires significant amounts of preparation before implementing a log management solution [20]. Challenges corporations may run into as they attempt to collect and retain log data which is collected from cloud environments must be discussed by a corporation's security personnel and corporate management before hardware and/or software solutions are implemented [20]. Also, corporations may need to consider a SaaS provider who may have applications which can be used to create a logging infrastructure for log file analysis.

8 Conclusion

Log management, collection, and reporting have become a significant part of business in the 21st century. As a greater number of corporations enter or expand their Internet market, rules and regulation will continue to expand the amount of auditing required to protect consumers. Both the Windows and UNIX environments have robust log creation infrastructure which allow for security personnel to locate potentially malicious activity.

As a greater emphasis for accurate log collection is pushed, corporations must strive to include better and more efficient log collection tools. These tools must include the ability to expand based on regulations, data retention requirements, and other considerations such as cloud computing. The process of constructing the framework of a log management and data retention policy cannot be ignored by organizations.

Because of the greater risk of proprietary data, employee data, and customer data being stolen, deleted or changed by both inside and outside threats, corporations must prepare themselves by thoroughly analysing the policies they have, as well as analysing the policies they may need to continue to be compliant and secure. Because of this, log management and data retention will be more and more relied upon as the secondary measure used to locate when a security incident has occurred as well as the forensic proof needed to show that a crime has been performed within a corporation's environment.

With all of these considerations to keep in mind, corporate security personnel must be knowledgeable of new standards within the field while continuing their education of log management, data retention, and log analysis practices. These personnel must also communicate these trends to management. When selecting a log management procedure, a holistic approach must be implemented. This includes employing personnel who are responsible for reviewing log data on a daily basis, regularly monitoring how this log data is stored, and making sure that log data is not lost due to changes within the organization or movement of the data to external sources.

Although log management is a difficult task, and one of many that a corporate environment must monitor, the rewards for keeping a complete log management system show that it is a necessity. If a corporation does not include a log management system, the risk of substantial financial lost due to malicious activity increases significantly. Therefore, log management is a vital component in the security practices used by corporate environments.

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Diffusion Innovation, Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology

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Abstract

In recent years, more and more people have various information technology products of their own such as e-Portfolio system, notebook, laptop, PDA, mobile phone etc. Valid measurement scales for predicting user acceptance of computers are in short supply. Most subjective measures used in practice are invalidated, and their relationship to system usage is unknown. The present research develops and validates new scales for three specific variables, perceived usefulness and perceived ease of use, diffusion innovation, which are hypothesized to be fundamental determinants of user acceptance. Therefore, this research, which chooses college student as subject, aims to meet students' urgent need to have a thorough information technology. This research utilizes Innovation Technology Acceptance Model (ITAM) to research college students' acceptability to information technology, and collect out data through questionnaire. Definitions for these three variables were used to develop scale items that were pretested for content validity and then tested for reliability and construct validity in three studies involving a total of 100 users and four application programs.The measures were refined and streamlined, resulting in six-item scales with perceived usefulness and information technology is plus (γ=0.96, p>0.1); that of perceived ease of use and information technology is plus (γ=0.16, p<0.1); that of compatibility and information technology is also plus (γ=0.15, p<0.1). Regression analysis suggest that perceived ease of use may actually be a causal antecedent to perceived usefulness, as opposed to a parallel, direct determinant of system usage. Implications are drawn for future research on user acceptance.

Keywords: User acceptance, User measurement, Technology Acceptance Model, Diffusion of Innovation Theory

1. Introduction

Telecommunication has gradually changed the way of people's lifestyle; traditional lifestyles and work mode have been superseded by the more flexible ones, such as mobile office, hotel, satellite office, work center etc. In the U.S., where it is first adopted by enterprises, telecommunication-based work mode is at present estimated

to be used by 25,000,000 work forces. While in Taiwan, telecommunication-based office is rather new, and is now adopted by enterprises such as HP, IBM, Xerox and CPC. Other enterprises such as Taiwan Business Consulting implements e-Office, while Sun building Flexible-Office. Several researches have been done on information technology, but few of them go further to discuss teenagers' intention of using the systems and how acceptable to them. Thus in this research we adopt ITAM to discuss and analyze the factors affecting teenagers' use of information technology. We take the students of N school as the object of study, using questionnaire to collect the data to study the factors influencing teenagers' intention of using information technology.

In the face of information-mobilization trend, the need of a well-developed information technology service is rather urgent. However, a systematic research project on information technology is not yet done, and this fact will leave the users and to-be users of it high-and –dry. In the light of this, our project, based on the Innovation Diffusion Theory of Rogers (1981), alongside with Technology Acceptance Model, will discuss "information technology" ─ a newly-arrived technique, with environmental, organizational and personal factors, respectively. Special attention will be paid on the practicum of information technology so as to satisfy the learning activity of individual, organization, or even the whole society. By doing so, we hope to establish a well-formed strategy that benefits school teaching and development, campus management.

The primary subject of the project is college student, and the focus of information technology will be on school subjects. Due to limited staff, funds, time, the willingness of the respondents etc., this study cannot adopt random sampling.The remainder of the study is organized as follows. Section 2 introduces the related literature. The concept ITAM is developed in Section 3. Section 4 presents the performance study. Section 5 discusses the issues and points out some future research plans.

2. Literature Review

2.1 Technology Acceptance Model

In the TAM model, Davis (1989) proposed that the influence of other variables on technology acceptance is mediated by two individual beliefs: perceived ease of use (PEOU) and perceived usefulness (PU). The actual system usage is determined by the

users' behavioral intention (BI), which is jointly determined by the users' attitudes towards using the system and their perceived usefulness of the system. In order to predict and explain teenagers' telecommunication technology using behavior, it is Theory of Reasoned Action (TRA) to make it suitable for situations of using information technology (Ajzen&Fishbein, 1980). The adapted theory, technology acceptance model (TAM), effectively simplifies TRA. It also focuses on analyzing variables influencing teenagers' orientation towards information technology and explaining it. Since TAM is based on TRA, it brings further TRA's hypothesis about individual behavior, presuming that individual behavior is a result of free will and careful consideration of possible consequences. However, TAM does not adopt the concept like "normative beliefs and motivation to comply" and "subjective norm". Instead, according to the concerning documents, it presumes that belief-attitude-intention is affected by "perceived usefulness" and "perceived ease of use".

The conciseness of TAM was generally approved of by scholars, but it is in fact insufficient for full understanding of teenagers' telecommunication technology using behavior if only discussing "normative beliefs and motivation to comply" and "subjective norm". If other variables are taken into account, the explanation would be easier. Therefore, in this research we adopt TAM and Theory of Diffusion of Innovation as a way to understand teenagers' orientation towards information technology.

2.2 Diffusion of Innovation

Rogers (1981) defines diffusion as "the process by which an innovation is communicated through certain channels among the members of a social system." Four vital factors are included in the definition: Innovation, communication channels, time and social system. In the process of diffusion, new information is constantly brought to potential users, so at different stages of the process, variables are different, too. At "knowledge" stage, the primary variables are decision unit. Decision unit refers to the prior experience of adopting innovation, problems confronted at present, needs for solution, and the attitude towards innovation of the potential user, as well as social norms and views towards the innovation. At "persuasion" stage, Rogers has five innovation perception features, and argues that "persuasion" stage is mainly affected by these five features. The five features are respectively Relative advantage, Compatibility, Complexity, Absorbability and Trialibility. TAM also lays much emphasis on similarity. Rogers defines similarity as something the innovators and

potential users share, for example goals, strategy, norms, beliefs and culture. Many research results indicate that between two or more units that share similar traits, diffusion of innovation processes at great speed, since they are most likely to share Relative advantage, Compatibility, Complexity, Operability and Trialibility. Rogers' model and innovation perception features are widely used by scholars, for example in information technology or telecommunication construction and development.

In Rogers' theory, primary variables influencing individual adopting innovation are Relative advantage, Compatibility, Complexity, Observability and Trialibility. "Relative advantage" is the same concept as "perceived usefulness" in TAM, while "Complexity" and "perceived ease of use" are two different extremes on the same scale. Trialibility is not included in information technology. Therefore, in this paper, we will only focus on "Compatibility".In this section some documents concerning TAM and Theory of Diffusion of Innovation will be discussed as a base for further analysis of variables influencing teenagers' orientation towards information technology.

3. Methodology

In this section we will elaborate on the research structure, research hypothesis, reliability examination and Structural Type Model. In this research we adopt TAM and Theory of Diffusion of Innovation to discuss and analyze the factors affecting teenagers' use of information technology. We take the students of school N as the object of study, use questionnaire to collect the data, and study the factors influencing teenagers' intention of using information technology. The Statistical Analysis Systems which been used in this project are SAS and LISREL. In the following, we will explain more about the hypothesis, questionnaire source, and methods of statistical analysis. The questionnaire is designed according to the documents and information technology environments. The data are shown in figure 1.

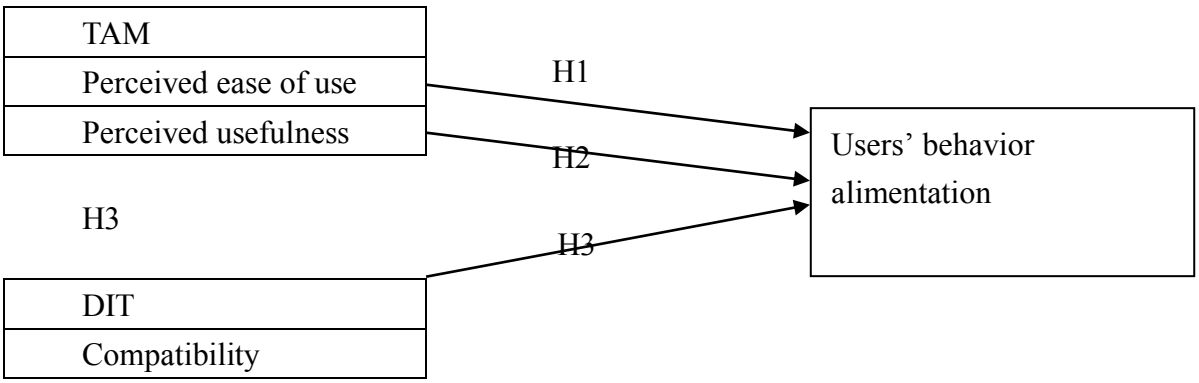

Fig 1. Innovation Technology Acceptance Model

As for research subject and research method, we distribute 100 questionnaires to teenage students who use information technology in school N, and retrieve 100 questionnaires.

The central theme of the above studies is that the design of an online course directly or indirectly affects learning efficiency. Therefore, in this research, we discuss the relationship between Online Course Design and Perceived Usefulness, Perceived Ease of Use, and Perceived Interaction individually. Every variable is scaled according to Likert Scale, from "strongly disagree" to "strongly agree". The research hypothesis is explained in the following:

H1. Online Course Design will positively affect the Perceived Usefulness of an information technology.
H2. Online Course Design will positively affect Perceived Ease of Use of an information technology.
H3. Online Course Design will positively affect Compatibility with an information technology.

In this project, Cronbach's α value is used to analyze reliability. The coefficient of reliability is as suggested by Hair (1998), sufficient if α value is above 0.6, so is it in researches in exploration stage. If α value is below 0.3, it should be deleted to maintain reliability. The α value of teenager using information technology is 0.8; perceived usefulness and compatibility 0.7, as shown in table1. In terms of individual item reliability, when Square Multiple Correlations is above 0.5, it is reliable. Reliability analysis of every aspect is shown in table 2.

Table1. Reliability examination

	Variable number	Cronbach's α
Users' behavioral intention	2	0.7
Perceived usefulness	3	0.8
Perceived ease of use	3	0.7
Compatibility	4	0.7

Table 2.Reliability analysis of every aspect

	Users' behavioral intention									
Variable	Y1	Y2								
Squared Multiple Correlations	0.385	**1.073**								
	Perceived usefulness			Perceived ease of use			Compatibility			
Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Squared Multiple Correlations	**0.585**	0.809	0.467	0.395	**0.695**	0.005	0.069	0.002	0.435	**0.680**

4. Experiments and Discussion

4.1 The Development and Construction of Structural Type Model

In this project we rely on LISREL (Joreskog&Sorbom, 1993) to examine research hypothesis. There are two major variables in LISREL analysis mode, which are observed variables and latent variable. Latent variable can be further divided into exogenous variable, represented by ξ, and endogenous variable, represented by η. Equation models can also be divided into two types: measurement model and structural equation model. Measurement model is used to define the relation between observed variable and latent variable, while structural equation model is used to represent relations between latent variables. LISREL can make precise inference about the intensity between variables. We use the statistics shown by ISREL to observe the cause-and-effect relation between the latent variables and observed variables.

In LISREL Scale, perceived usefulness, perceived ease of use and compatibility are exogenous variables. The coefficient between exogenous variable and observed variable is represented by Lambda X (λx). The using attitude of information technology is latent variable, and the coefficient between latent variable and observed variable is represented by Lambda Y (λy). Structural Type Model is the perceived usefulness, perceived ease of use and compatibility influence intensity of teenager's using information technology, represented by Gamma (λ). The theory model set in this project. The latent variables are marked by oval shaped line, while observed variables rectangle shaped lines.

4.2 Analysis Result

In terms of Structural Type Model, this project uses ($\chi 2$ /df), GFI, AGFI, NFI, NNFI, CFI and RMSR as indexes from which to judge if the model correspond to observed data. Since $\chi 2$ is highly sensible, we decide to use $\chi 2$ /df as evaluation index. AGFI is a value adapted from GFI, and they are used to explain the amount of variation. RMSR is used to evaluate unexplained variation rate. NFI (Bentler&Bonett, 1980), NNFI and CFI (Bentler, 1990) are used to evaluate this evaluation structure and Null model's improvement. As for the standard of the indexes, we adopt the judging indexes suggested by Henry and Lacker(1994) to see if the evaluation model is suitable, and it is shown in figure 2 that the overall suitability value of $\chi 2$ /df are both 1.2, RMSEA 0.0724, GFI 0.961, and AGFI 0.912, all of which are close to the ideal value. It means that the evaluation result correspond to the real situation. The indexes

and their minimum value are shown in table 3.

Table 3. Structural Type Model

Index	χ^2/df	RMSEA	GFI	NFI	AGFI
Value	48.98/35=1.2	0.0724	0.961	0.947	0.912
Threshold	<3	<0.08	>0.9	>0.9	>0.9

We can see from the path coefficient shown in table 4 that that of perceived usefulness and information technology is plus (γ_{11}=0.96, p>0.1); that of perceived ease of use and information technology is plus (γ_{11}=0.16, p<0.1); that of compatibility and information technology is also plus (γ_{11}=0.15, p<0.1). It is important to note that the indirect effect on attitude through perceived ease of use and Compatibility is significant. As a result, H2 and H3 are supported but H1 is rejected.

Table 4. Path coefficient

Path	Item	Path parameter a	t-value
γ_{11}	Online Course Design will positively affect the Perceived Usefulness of an information technology	0.96	4.36
γ_{12}	Online Course Design will positively affect Perceived Ease of Use of an information technology.	0.16	1.77*
γ_{13}	Online Course Design will positively affect Compatibility with an information technology.	0.15	2.48*

*p<0.1

5. Conclusions

The relation between perceived usefulness and information technology using attitude is positive, which means high perceived usefulness gives teenagers an incentive to use information technology.

This fact corresponds to what is recorded in the documents. It is probably because information technology helps teenagers communicate with each other at anytime and anywhere, thus having great influence on their using attitude. The relation between perceived ease of use and information technology is negative, meaning that high perceived ease of use cannot guarantee teenager's high willingness towards using information technology, which is against the documents. It is probably because the difficulty of operating or using information technology is not an obstacle intimidating teenagers. The relation between compatibility and information technology is negative,

meaning that high compatibility cannot guarantee teenager's high willingness towards using information technology, which is against the documents. It is probably because the functions teenagers use are limited, and so the compatibility is not so important to them. Further research will shed more light on the generality of these findings. Another limitation is that the usage measures employed were self-reported as opposed to objectively measured.

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TOEIC Multimedia Content Design Based on Usability

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Abstract - *Educational content design is rather complex because it includes both logical and emotional elements. In this paper we propose to take the usability principles in the content design and see how they can be used with the left and right side brain functions.*

Keywords: <Toeic>, <Usability>, <Eye-tracking>, <F-shaped pattern>, <Readability>

1 Introduction

Even using multimedia content, it is very difficult to get the student's attention when it comes to something educational[1]. Perhaps by using some usability such as the F-shaped scanning pattern, easy readability, and comic elements, we may more likely engage their interest.

The F-shaped pattern was found to be effective in reading multimedia content. This study was carried out by Jakob Nielsen[2], a pioneer in the field of usability. His eye tracking study on the reading habits of multimedia content users shows that they exhibited an F-shaped pattern when scanning multimedia content. A similar study[3] was conducted by Enquiro, a marketing firm, with eye-tolls, an eye-tracking research firm, whose study showed a similar pattern. The use of this F-shaped multimedia content increases the possibility of catching the student's eye.

Easy readability of text in educational content is crucial because it improves comprehension and enhances the likelihood that a student will continue reading to understand the course material. We consider font type, font-size, line spaces, background/foreground contrast, as well as word spacing.

Readability study[4] showed that text with no margins was read faster but with less comprehension. Text with proper margin setup helps students to pinpoint important content.

People normally read and write from left to right and top to bottom. This can be the reason why students spend a majority of their attention on the left side of multimedia contents (69% of the time) according to Nielsen' eye tracking study. For a user friendly interaction, we list test problems with related images and let the student check their answers visually. The right answer is marked by graphical "O" and the wrong answer is shown with graphical "X".

This paper elaborates on our efforts to satisfy the above usability principles. Chapter II of this paper describes the overall structural design required for such content, chapter III describes the implementation process, and chapter IV concludes with further considerations.

2 Overall Structural Design

The intro to the multimedia content welcomes you and shows a video. The first button leads you to the study mode where you can hear someone speaking slowly in detail about the question under study. In this mode, you can listen to both the explanation and answer. The second button leads you to the test mode where you can participate in an actual test.

The two modes shows 20 different questions identified by a specific icon image related to the question. When you choose one of them, you are then engaging in a specific problem. If desired, you can go back to the main menu and choose the study mode. When you are engaged in a problem, you can see the complimentary text by pressing the button "see text". When you finish, you are allowed to check a score immediately.

Once you have finished a problem in the test or study mode, you can move on to the next problem in one of three ways: to engage in the next or previous one problem, to engage in a problem selected randomly, or select a problem from the 20 icon images by yourself. If you are not satisfied with the score result in the test mode, you can go back to the study mode for a better understanding. When you have studied enough, you can go to the test mode immediately to check your achievement.

The study mode provides more question practices related to the problem. Students can learn how to ask about the topic dealt in the problem. The speaker reads the text with additional comments and then perhaps more readily understands the topic. The detailed flow chart of the content is shown in the following figure.

3 Implementation and Experiments

3.1 Intro

To grab the attention of students, we show cartoon character faces in the intro page. The students can choose their favorable character faces or can use a cartoon of their own

face. In Fig.2 we see 4 faces including two user's cartoon faces.

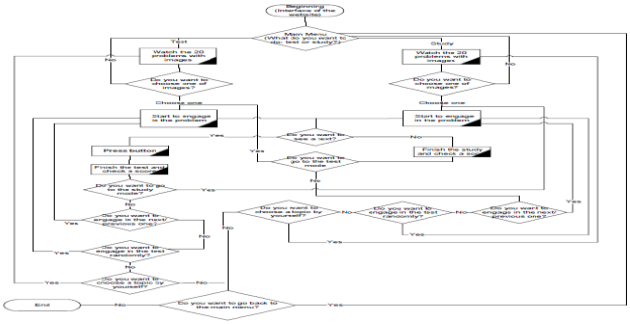

Fig.1 Flow Diagram of Content Pages

The page includes a video saying "Welcome to TOEIC Listening" and two image buttons, a study and a test button. By clicking the study button, the student can go into the study mode where explanatory listening material is provided with more practice questions. In the test mode, the student should solve the questions without any help, but the student can read the question text[5] if he is not confident in listening.

Fig.2 Intro Page

3.2 Two Test Pages

To satisfy the F-shaped content, we lay out the content as shown in Fig 3. But the video on the left side in this arrangement distracted student's attention and neglected the importance of the solving the question. So, we exchanged locations of the video and the question texts as show in Fig 4 with the text on and in Fig. 5 without the text.

This arrangement of text on the left might trigger the left side of student's brain more quickly[6,7,8] The arrangement of the video on the right side engages the right side of brain and students seem to be enjoying the pictures.

These two arrangements may accelerate the communicative channel circuits between the left logical process part of the brain and the right emotional part.

Fig. 3 A Page with video on the left

4 Conclusions and Further Considerations

Good visualizations for interface design are more than just good aesthetics. Good visualisations should be usable and useful to help students make sense of information or acquire insight from easier information handling.

Fig. 4 A Study Page

This paper suggests the use of an innovative user interface design for improved user interaction to achieve better educational effectiveness. The problem with designing an effective user interface however is how to coordinate in the interface design the logical educational material with the emotional fun part.

Fig.5 A Test Page

We propose to use the F-shaped pattern in the content design and arrange the logical elements such as text on the right side and the emotional elements such as image/video on the left for proper brain function. The TOEIC multimedia content shown here follows this guide and shows its effectiveness.

For the validity of this interface, we should go through a usability testing procedure. The procedure discovers if users can grasp what they need to do, and what is necessary to make the interface more useful.

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SESSION

LEARNING METHODS, TOOLS, AND RELATED ISSUES

Chair(s)

TBA

iBook learning experience: the challenge of teaching computer architecture to first year university students

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Abstract *- Tablets, mobiles and handheld computers such as the iPad / iPhone and similar platform technologies are transforming the ways in which we interact with technology. It is becoming easier for people from all backgrounds and age groups to assimilate information quickly, efficiently and to have a fun, entertaining and even educational experience. One such current and popular interactive learning experience is through the use of what is commonly known as an iBook. This research aims to explore how and if the iBooks Author application with its new and stimulating interaction and multimedia capabilities can be used to encourage and motivate first year university students into becoming active learners. The outcomes of this research will be evaluated on four key elements: motivation, experience, knowledge and reflection. This paper will document the early developmental stages of an iBook learning experience as well as present some of the initial research findings.*

Keywords: learning, experience, iBook, interactive, iPad

1 Introduction

Computer systems are everywhere and as end users the majority of our students in computer science are familiar and comfortable working with and using computers. However going beyond the keyboard and monitor, many students struggle to fully comprehend the mechanisms and the relationships that make a computer system function. As research highlights [1] [2] [3] the difficulties encountered by students studying computer architecture have been well recorded. [4] believes that without a solid understanding of computer architecture most computer science students will have a fragmentary knowledge of how a computer operates. In her paper 'A Case for Teaching Computer Architecture' she has identified a need for better pedagogical methods and tools to provide students with a balanced, well-informed view of the subject, and following from that, the ability to apply this understanding to problems that they might face in their professional life [4].

At the University of Glamorgan, the basic principles of computer architecture play a role in the core of most of computing modules. However, it has been a subject that has proved difficult for students to fully understand as is evident from their poor student performance, engagement and grades. Therefore, the aim of this research is to tackle/address some of the conceptual challenges surrounding the student's understanding of computer architecture. The work aims to explore new ways of interacting with a computer, to instigate new ways of thinking about how a computer works and in doing so to introduce new approaches for learning and teaching the core concepts of computer architecture. The key will lie in triggering the student's inner motivation for learning by offering engaging learning experiences. This paper aims to show the early elaboration stages of harnessing the innovative potential of mobile and handheld devices (and in particular, the new interactions they afford) to intrinsically motivate students to become active learners who seek to understand and learn. In detail, the paper will show initial investigations into what we mean by an iBook learning experience and then how we propose to use a Learning, Research and Development Framework [5] to create an iBook learning application. The overall focus is on the elaboration phase particularly the thoughts, feeling and impressions behind the planning of the iBook learning experience. This paper will present some of the initial research findings.

2 iBook and the learning experience

Understanding what constitutes a learning experience is the first step in designing and developing for an intended iBook learning experience. In this paper we would like to build up an understanding of what is meant by the term 'iBook learning experience' and how we might go about actually designing and developing for a holistic iBook learning experience.

The term 'experience' has been making a noise in the e-learning sphere for quite a while now. In fact, the last decade and a half has been about trying to make sense of the concept of experience: what is it? What does it mean for learning? It is generally now agreed that it is no longer considered sufficient to produce 'a computer system that is effective, flexible, learnable and satisfying to use … [but] it must now also be useful in the lives of those using it' [6]. When we look at the iBook, these applications are already transforming the way in which we assimilate and absorb information providing a greater level of accessibility to people on a global scale [7]. It

is true, we have moved on from using technology for just instrumental needs to now it being more about the subjective, situated, complex and dynamic encounter [8]. Computers have become something larger than usability or one of its components, such as satisfaction or attitude [6], it now touches into all spatial dimensions and senses [9]. Indeed, the Apple product (including the iBook) epitomizes this new ideology of experience driven technology so much so that over the last few years it has played a leading role in securing this truly revolutionary and innovative vein within computing. However, in terms of learning, it has only been in the last two years, that the iBook has started to take shape and to move slowly into the educational sphere. For example, some of the more successful iBooks are Alice in Wonderland which has been used to educate young children in classic storytelling [10] as well as the interactive iBook from Al Gore which aims to educate people on the damaging effects of Climate Change [11] illustrated in Figure 1. These books are described as inspiring creativity and hands-on learning with features that let students engage with content in interactive ways, find information in an instant, and access an entire library wherever they go [12]. These books have the potential to take learning to a whole new level, but it is only now that designers/developers are realizing this and are in a position to start to take the iBook serious as a means to enhancing and building our student's learning experiences.

Figure 1 Our Choice by Al Gore iBook

In fact, iBooks /Mobile devices are promoted as excellent interpersonal communication tools bringing the opportunity for students to interact with each other in order to resolve problems and to develop deeper understandings of complex concepts. One of the main advantages of the iBook would be its capacity to engage and stimulate students; it seems to afford a learning at-the-time-and-place that it is needed format, which could bring greater context and relevance to the learning. For designers and developers, it is important to understand the bigger picture (i.e. the relationship between the iBooks properties, the experiences that they provide and how these can be harnessed to create a contextualized learning experience). To understand this, a Learning, Research and Development Framework [5] will be used as guidance in the development of the iBook learning experience. This framework (see Figure 2 on next page) adopts a spiral model supporting a process that passes through a number of iterations. This is divided into four main phases: inception – determining scope and purpose of the project; elaboration – capture requirements and determining structure of the project, construction – building the experience and transition – dealing with production, installation and rollout of the project. These extensively cover the dimensions of experience design, educational research, instructional design, innovation development and methodology. As seen from the diagram, the framework places an equal importance on issues concerning the design of the experience (i.e. the learner and educator experiences) and how these could be represented by the designers, as on other forms of design.

For this paper, we will document some of the requirements in the elaboration phase for the development of the iBook. The paper will highlight some research undertaken with the target learners and in particular, their thoughts on an existing iBook technology and the potential for it to enhance the learning of a computing subject such as computer architecture. The main objective was to probe the learner's thoughts on the creation of multi-sensory experiences, different levels of interaction that might be used to create a iBook learning experience. In doing so, it attempted to identify some of the learner's requirements in terms of the curriculum area and how they perceive the iPad technology and its many interactions may be best utilised to achieve the expected learning outcomes. The framework is used to achieve a deep understanding of different dimensions of the possible iBook learning experiences through observing how target learners consider and might use the iPad technologies and its interactions.

2.1 Research methods

This study investigated first year computing student's main perceptions of the iBook technology and their reflections on its potential to enhance their own learning (i.e. the strengths and weaknesses of the technology and ultimately their opinion of its prospects for learning success). A total of 27 participants (20 male and 7 female) took part in the study. They were of different ages (18 - 47 years) and from computing backgrounds. They were shown a video clip of Al Gore's Our Choice, the first full-length interactive book for the iPad by Mike Matas [13]. The video demonstrated some new multi-touch interface features, in particular the 'pick up', 'explore', 'zoom out' and 'quickly browse' features. After watching the video clip the participants were asked to answer a short questionnaire to provide insight in their perceptions on such technology on the learning experience.

Figure 2 Learning, Research and Development Framework [5]

3 Results

From the data collected, it became apparent that the majority of participants (92%) had a positive view on the use of iBook technology – if used correctly, and accessible to all students –in a lab/ lecture. Moreover, that it has the potential to effectively teach a computing topic. One student (Participant 17) described it as the next level of interaction with several students' feeling that especially it's facility for interaction would enhance their learning. As we can see from Figure 3, the overall participant's response/attitude to the technology and its use in education was very positive.

Students used words like 'interactive', 'interesting', 'brilliant', 'helpful', 'useful', 'exciting' and 'fun' to describe the iBook technology. With only three students feeling it was 'expensive', 'waste of time' and 'redundant'.

Some of the responses from the questionnaire:

- '…useful way to interact with a book' (Participant 3)
- '…could be very useful – interactivity useful' (Participant 5)
- '…an interesting development that could lend to even easier access to information' (Participant 6)

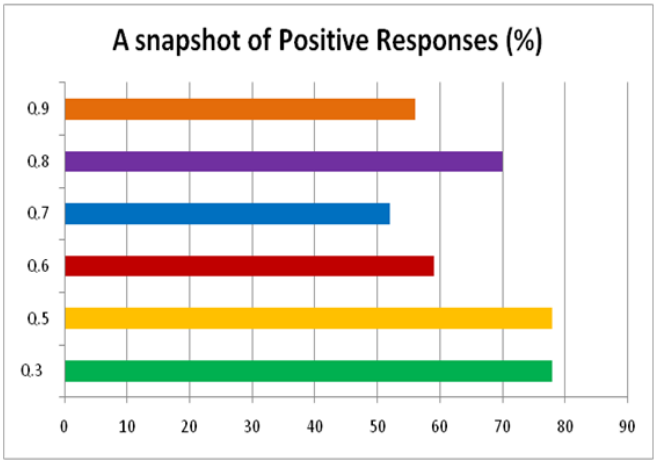

Figure 3 Snapshot of positive responses

- '…it's very interesting as it has a vast range of interaction and has unlimited capabilities' (Participant 13)
- '…very exciting and impressive' (Participant 14)
- '…looks fun and interactive' (Participant 15)

When asked how they perceived the technology could be used effectively to teach a computing topic, the majority of participants had positive views and shared some ideas, including:

- 'I think it would be good for guides such as code and web' (Participant 1)
- '…showing the construction of computers' (Participant 3)
- '…have animations of computer points or examples of code' (Participant 4)
- 'You could have inside of computer, interactive sites/code' (Participant 5)
- '…can lead to clearer understanding of complex computing concepts' (6)
- '… some computing elements could be simulated' (Participant 10)
- '… by having examples within the text that could be picked up so the student can see the creative process' (Participant 11)

Computing requires more visualisation and live demos to understand how things work and the iBook could enhance this' (Participant 20)

- '… lecture slides can be downloaded onto it and it is easy to flick through' (Participant 27)

However, when asked would using a range of interactions (i.e. shake, touch, gestures, camera, geo-location etc) help them to further understand complex concepts/ topics? Some students felt:

- 'Yes, it is easier to learn when interacting with elements of the topic' (Participant 16)
- 'Yes, more fun and imagination capturing, keeping interest, lots of computing subjects need more visualisation' (Participant 20)

Whilst others felt it might be a distraction from the learning and also annoying:

- 'I'm not sure as some people could find it annoying' (Participant 13)
- 'No it would distract me' (Participant 26)

Finally, when asked if they had any views on the potential of the interactions seen in the video to stimulate their curiosity and interest in learning about a new topic, several students (78%) felt that it would help them to learn about a new topic.

Responses included:

- '…keep attention. Explain specific parts, better show example' (Participant 5)
- ' …by granting greater access to more information' (Participant 6)
- 'Help us with understanding' (Participant 9)
- 'Makes you enthusiastic about the topic' (Participant 16)
- '…helpful, it can explain more, give you more understanding of the topic' (Participant 23)
- '…you can view the images in different sizes such as small and large which is good' (Participant 27)

4 Conclusion

This study has allowed us to identify some of the main perceptions of first year students on the iBook technology. More importantly, it has also given us an insight into why (and if) they think it might be an effective tool to teach a computing topic. In detail, it has highlighted the participant's thoughts on the important role of 'interaction' in their learning experience. Through interaction, several participants felt that the iBook technology has the potential to help them with the understanding of complex topics. In fact, interaction, motivation, engagement, enthusiasm, helpful for access to information, interesting and fun were all terms used when participants were discussing learning in conjunction with the iBook technology; with more detailed requirements – in relation to the teaching of computing – taking the form of animation, simulation, interactive guides, interactive text/code, scaling, visualization and demonstrations. In summary, these results have given us insight into how the participants perceive the use of the iBook and how it might enhance their own learning. These important insights (and particularly the detailed requirements identified) will feed into the construction phase and then the overall planning of the iBook learning experience.

4.1 Future work

The work documented in this paper is part of the Novel Learning project which is funded by the Centre for Excellence in Learning and Teaching (CELT) at the University of Glamorgan, South Wales, UK where the authors have won this year's Innovation in Learning and Teaching Grant award. The main aim of the project is to explore how emerging options for interaction with technology can be used to integrate an innovative learning application on handheld devices to stimulate students' curiosity and interest. In addition to inspire learning, particularly within the field of computer architecture - an important subject area in any computing discipline, one which has often been quite difficult for new computing students to understand. Future research will include investigations into how we might organize and present high quality multimedia content in real-time responses to students' interactions to enhance their understanding of

complex concepts. In detail, it will explore a wide range of interactions such as shake, touch, gestures, camera, geo-location etc in an attempt to cater for a range of senses such as sight, touch, hearing, etc. An iBook learning application will be developed and tested on first year university students. Evaluation will focus on four key elements: motivation, experience, knowledge and reflection.

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Teaching Hyperpersonal On-line Collaboration

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Abstract - *Educators need to prepare their students to professionally work in remote teams. This paper presents learning points from nine years of an inter-institutional project to teach students to collaborate in international teams. Considering the findings of Walther's [1,2] hyperpersonal perspective of on-line collaboration, the suggestions for educators are firstly to "make use of more time", i.e. to ensure the students use the benefits of nonsimultaneous communication, secondly to "value a word over a thousand pictures", i.e. to prevent automatic stereotyping which is unavoidable when people meet face-to-face, thirdly to "professionalize digital nativism", i.e. to make sure the students do not simply take their experience in informal on-line environments to a work setting but rather learn how to communicate on-line professionally.*

Keywords: Education, on-line collaboration, hyperpersonal perspective

1 Introduction

International on-line collaboration is becoming widespread in today's working life. The social processes in remote team-work provide intriguing challenges, since there is a need to cooperate without seeing the people that you are actually working with [3]. Yet preparing students for this challenge in something which is often not explicitly focused on by educators.

In approaching virtual team work, many educators as well as theorists base their suggestions on the "cues filtered out approaches" [4,5]. These focus on the information which is lost when teams communicate on-line rather than face-to-face: Facial expressions, tone of voice, physical appearance and attractiveness, gestures, use of space, touch, and smell are all missing. Cues filtered out theorists typically assume that the lack of these cues leads to problems forming well-defined impressions of the other team members and results in communication and collaboration which is not as good as it would be if it took place face-to-face.

Contrasting these "cues filtered out approaches", the "hyperpersonal perspective" by Joseph B. Walther [1,2] claims that precisely because of this lack of individuating information which is present in face-to-face exchanges, on-line collaboration can lead to better than personal, thus hyperpersonal, communication. This perspective has several implications for teaching students to collaborate in on-line teams [6]. Based on an inter-institutional project to teach students to professionally collaborate on-line, some suggestions will be outlined in this paper.

1.1 The Hyperpersonal Perspective of On-Line Collaboration

The hyperpersonal perspective is based on the social information processing model of on-line collaboration. It assumes that communicators using on-line channels are motivated to reduce interpersonal uncertainty, form impressions, and develop affinity in virtual collaboration just like individuals are in face-to-face situations [1,5,7,8]. In an on-line settings, people use the means available through computer-mediated communication for impression management and relationship building. Examples of these means are content, style, and timing of verbal messages on-line.

The hyperpersonal perspective shows that on-line interaction cannot only be as personal as face-to-face communication but actually achieve levels of sociality and cohesiveness on-line which could not – or not as rapidly – be achieved in a face-to-face situation. Walther [1,5] explains these observations by showing four types of media effects that occur *because* sender and receiver are not in a face-to-face situation. Not having the full range of communication cues leads to specific effects virtuality has on sender, receiver, channel and feedback in computer-mediated communication.

1.1.1 Sender: Selective Self-presentation

Walther shows that by selective self-presentation, people collaborating on-line have the opportunity to make a positive impression by presenting their most attractive characteristics, attributes, thoughts, and accomplishments without fear of contradiction from their physical appearance. Using

asynchronous communication media they can mindfully construct the breadth and the depth of their self-disclosure and the image of themselves they want to present without nonverbal leakage. They have the opportunity to allocate all their cognitive resources to their selective presentation of self and do not have to use cognitive resources for monitoring their appearance etc. Furthermore, they have the chance to edit the message which they want to send before it actually reaches the receiver.

1.1.2 Receiver: Overattribution of Similarity

Attributional processes are perceptions whereby people interpret why others are behaving the way they are and what they are really like. One basic effect which biases people's perception is the assumption that the actions someone takes reflect the personality of the person who did it. In on-line collaboration in which people have only the text that the other person has written, they have very little to go on. The only immediate basis for judgment is the message which one received. Yet having few cues does not keep the receiver from forming an image: The little information which is available gets more weight – and while the information being conveying by the message might be meager, there are often additional information which become more important, e.g. that the other person is part of the same team, is working towards the same goal, etc. So the receiver is likely to overattribute the information which he or she has and interpret in the sense that there is more similarity and create an idealized image of the sender.

1.1.3 Channel: Dis-Entrainment

Entrainment describes the necessity to synchronize behaviors guided towards different goals in a situation. Face-to-face situations stress entrainment, while asynchronous on-line communication gives the partners the opportunity to interact without having to attend to one another at the same time. With time constraints relaxed, the pressure to react to the partner's message is reduced. The sender can mindfully construct her or his message, knowing that the receiver can read it at a convenient time. The hyperpersonal perspective thus focuses on the benefits of asynchronous channels, i.e. sender and receiver can use it nonsimultaneously. The resulting dis-entrainment is advantageous when communicating across time zones or with different working hours, and it can help dealing with touchy issues and misunderstandings.

1.1.4 Feedback: Self-Fulfilling Prophecy

Self-fulfilling prophecy describes the tendency of a person to evoke a reaction from someone else which in turn confirms the anticipation which he or she had. The characteristics of the hyperpersonal perspective can amplify one another resulting in a self-fulfilling prophecy: The sender carefully presenting only those aspects of him- or herself which are advantageous in the situation is matched by a receiver who has a tendency to overattribute similarity and thus be positive towards the sender. The channel supports the process by giving the sender time for self-selecting what she or he reveals and the receiver time to create an idealized image of the partner. The self-fulfilling prophecy is triggered when this positive image is fed back to the partner and he or she begins acting even more in the direction of this positive image.

1.2 Teaching Students to Work in Virtual Teams

The inter-institutional project to teach computer-mediated communication between the University of Heilbronn, Germany, Dundalk Institute of Technology, Ireland and the University Transilvania of Brasov, Romania has been in operation for more than nine years [9, 10]. Students collaborate in remote teams. The international teams typically work on a software project which prepares students to work in and manage virtual software development. Benefits to the students include developing and improving group skills on-line. The students also learn to work as virtual teams and develop on-line project management skills. They gain experience in remote software development and develop their computer-mediated communication skills.

The coordination and structure of the project across the three institutes is organized at the start of the semester. A designated lab time is scheduled when all students are timetabled to be on-line at the same time. However students were required to organize additional on-line time. They use a group-ware platform for their on-line communication. Active participation on the platform is a pre-requisite to pass. Teams of four to six students are established, with each team consisting of students from Germany, Romania and Ireland. All on-line communication is in English.

The structure of the lab work is typically so that teams are given some reading/discussion exercises for the first two or three weeks. Then a larger project is defined and students have six weeks to complete it. During this assignment students will have project management responsibilities and development work to do. The teams are assessed and grades accumulated. Students get an individual grade for constructive participation and a grade for the overall team project.

2 Learning Points in Teaching On-line Collaboration

In evaluating the inter-institutional project to teach on-line collaboration and based on the hyperpersonal perspective of computer-mediated communication, the following learning points have been identified. Each learning point is presented

by first giving some background on the issue which is being addressed and then giving a suggestion of how to deal with this issue.

2.1 Make Use of More Time

2.1.1 Background of the Issue

Students rely on their experiences in face-to-face collaboration. In organizing their on-line work, they often try to take the face-to-face situation on-line instead of making use of the different means of communication that new technologies have to offer. The hyperpersonal perspective shows how to prevent some of the down-falls of face-to-face situations such as the need for immediate responses in synchronous communication and the resulting disadvantages for people not communicating in their native tongue. Or for people not able to type or write fast. The need to react right away in a social situation can put great stress on people, especially if English is their second, third or even forth language. When listening to other people and at the same time trying to prepare their own statement both activities are competing for cognitive resources thus both are not getting the maximum attention they could.

2.1.2 Suggestion for Teaching On-Line Collaboration

Based on the benefits of the hyperpersonal perspective, asynchronous, nonssimultaneous channels should be used instead of synchronous on-line communication technologies. Students can take their time presenting their statement and non-native speakers can take the time they need to put their thoughts into (English) words.

Since classes typically have a specific schedule and a set time, students tend to assume they should be having regular meetings using synchronous communication and have a tendency to neglect asynchronous communication. Our experience was that the students realize that because of the different timing in on-line communication [5] they were much less effective than they would be in a face-to-face meeting. But the conclusion to use asynchronous communication-systems did not come naturally to them and had to be build into the structure of the course to ensure that they experience the benefit of it.

2.2 Value a Word over a Thousand Pictures

2.2.1 Background of the Issue

The students typically like to get a visual impression of their team members. Thus they put photos on-line or ask their team members to do so. Yet these photos can activate stereotypes, especially if the teams are heterogeneous regarding gender, nationality, ethnic and cultural background. Thus by giving away these visual cues they do not make use of the advantages that the virtual collaboration can entail based on the hyperpersonal perspective.

Liking of a person is very much based on how attractive this person is an how much he or she is like myself. People's appearance thus can hinder constructive collaboration if the person is perceived as being physically unattractive or dissimilar to the person her- or himself. On-line collaboration can lead to a higher level of trust and liking each other if the participants do not see each other. Instead their sense of community can be built on having a common social identity by working on a project together.

2.2.2 Suggestion for Teaching On-Line Collaboration

Students should not put pictures of themselves on the on-line platform which they use for the class. They should also not link to other social communities where they have a profile presenting themselves. Forbidding them to do so will typically lead to reactance, so this should be avoided. But distributing pictures should not be encouraged and the instructors should not put pictures of themselves on the platform.

The groupware system used for the class should be mainly text-based and discourage using pictures. This approach is counter-intuitive to people, so implementing it can actually be difficult: Stereotypes are the way to find our way around the world, so not being able to rely on them can create discomfort. Plus: If somebody's appearance – either in real-life or in a picture – is attractive, this can be a strong driver of a positive attitude towards that person. Thus the suggestion of not putting pictures on-line improves the on-line-collaboration based on how dissimilar the students are to each other: If the group is very homogeneous, it could actually help to let them post pictures of themselves.

2.3 Professionalize Digital Nativism

2.3.1 Background of the Issue

As so-called digital natives, the students typically have extensive on-line experience. Often these social situations on-line were mostly informal meetings and not professional exchanges. Bringing the typical behavior of informal on-line communication to the on-line class can result in inadequate and unprofessional behavior. Especially with simultaneous media communicating without seeing the other team-members can lead to disinhibition and rude and thoughtless or overly intimate behavior.

2.3.2 Suggestion for Teaching On-Line Collaboration

In order to professionalize the communication students have to be presented with their real names and not nicknames. Ground rules for professional behavior on the platform should be agreed upon.

In our course we evaluate the chat logs and base the individual marks of the students on their active and constructive on-line participation. We inform the students about this beforehand, yet reading through the logs we have often found the students exposing themselves in quite embarrassing ways. Since our hypothesis was that they would not do so if at that time they were aware that the instructors were “watching”, we now frequently point to the fact that the logs will be read and will be the basis for their marks. This has improved the students’ impression-management drastically

3 Conclusions

Educators are faced with the necessity of preparing their students for a work-life in which on-line collaboration is likely to play an important role. In teaching students to work in remote teams, many educators as well as theorists rely on the "cues filtered out approaches": They focus on compensating the information that gets lost in remote collaboration, e.g. facial expressions, gestures, etc.

Contrasting these cues filtered out approaches, the "hyperpersonal perspective" claims that because of this lack of individuating information which is present in face-to-face exchanges, on-line collaboration can lead not to less, but to more personal, thus hyperpersonal, communication.

The hyperpersonal perspective of on-line collaboration offers insights in how the collaboration can be designed to be most effective. Going beyond the idea that on-line cooperation is lacking in terms of non-verbal communication, this approach shows how on-line communication and collaboration can be designed to actually be better than face-to-face interactions if certain conditions apply.

In considering the findings of the hyperpersonal perspective, educators can teach their students to create a productive remote team setting, in which the senders have a chance to present positive aspects of themselves, the receivers are motivated to perceive mainly the aspects of the sender which will lead to a better cooperation, the nonsimultaneous channel promotes this effect by dis-entrainment and feedback increases the enhanced and selective exchange leads to a self-fulfilling prophecy.

This paper presented three suggestions of how to put the findings of the hyperpersonal perspective into action in an educational setting: The first one is to "make use of more time", i.e. to ensure the students use the benefits of nonsimultaneous communication. The second one is to "value a word over a thousand pictures", i.e. to be aware and use the chances of not having the automatic stereotyping taking place which is unavoidable when people meet face-to-face. And the third one is to "professionalize digital nativism", i.e. to make sure the students do not simply take their extensive experience in informal on-line environments to a work setting but rather learn how to professionally communicate on-line.

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Effectiveness of SNS in Learning Support System with SNS and CMS Combined

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Abstract -*The use of learning support system using CMS and SNS can be expected to increase in future. The purposes of our study are to develop the learning support system using CMS and SNS, identify how subjects come to hold knowledge in common on SNS through social network analysis between users, and examine the effectiveness of SNS. Social network analysis of the experimental results between the learners (juniors) and the skilled instructors (seniors) who used the selected CMS software and SNS websites for 8 weeks proved the followings:*

・The learners have a small number of accesses at the time of starting to use the learning support system, but they will have the increased number of accesses if the advantages of this system are understood by themselves. Conversely speaking, it is necessary to introduce a mechanism that makes the learners forcedly access the SNS websites until they grasp the advantages of this system to give independent access because they have only a small number of accesses at the beginning.

・The learners read communication between the skilled fellow instructors, which was entered into the SNS websites, to master the experiences and knowhow in job search. Furthermore, the learners enter their own questions produced in communication

between the instructors into the Q&A column and obtain the answers from the instructors to cultivate a better understanding. The learners can also understand deeply the explicit knowledge to be mastered by using CMS when the fellow learners communicate with one another on SNS.

・Knowledge is transmitted with the experienced students as leaders. With usually casual communication between the experienced fellow students on SNS, the learners read the experienced students' opinions to gain extensive knowledge. This means that if the experienced students enter positively their own information into the threads, it will lead the learners to an effective state.

Key Words: Social Networking Service, e-Learning, Learning Effectiveness, Computer Supported Collaborative Learning, Knowledge Management

1. Introduction

In recent years, high-level technical knowledge has been requested in the information society in accordance with the change from low-variety high-volume to high-variety low-volume production [1]. This means that just creating human resources of high profound knowledge will improve company productivity.

Effective learning must be done to provide employees with high-level knowledge. For improvement of productivity in a company, they essentially need to master not only explicit knowledge presented in employee training but also informal knowledge including experience and intuition, i.e., tacit knowledge [2]. The use of e-learning is seen as an indispensable means to allow the employees to get smoothly the explicit knowledge and tacit knowledge in the current companies.

Recently, the most commonly used tool in e-learning was course management system (CMS) software and it is now introduced into various educational fields. In addition, social networking service (SNS) websites such as weblog and twitter have been spread to promote communication between users and the education field staff has also started to grope for a suitable method of using them.

In 2006, [3]Shinichi Sato et al. published the paper "Development of Learning Support System Using CMS and SNS" that describes an e-learning system for both day students and correspondence students who can have information in common and study with on-demand programs. Specifically, they aimed to support mutual learning among the students without discrimination between the day students and the correspondence students and finally created a good study environment to support their learning by using CMS and SNS. According to their study, entering the daily activities of students into the system linking CMS and SNS to keep communication can make them reflect on their actions and look back over the past, leading to the effective results that are expectable.

The use of learning support system using CMS and SNS can be expected to increase in future. The purposes of our study are to develop the learning support system using CMS and SNS, identify how subjects come to hold knowledge in common on SNS through social network analysis between users, and examine the effectiveness of SNS. When applying SNS to the learning support system, the transmission of knowledge is an important element in education and pregrasping the flow of knowledge in the learning process is very essential for making an educational plan.

2. Outline of Designed System

2.1 Designed System Platform

The learning support system designed in this study was to help junior students find their jobs, and we created CMS software to enable them to study questions about general common sense and synthetic personality inventory (SPI) in web-based training (WBT) system. Next, we developed a new system to allow the students to have in common the questions presented by inexperienced students in job hunting activities and the advice given by experienced students on SNS and transmit their experience and knowhow in job search, or tacit knowledge.

Moodle software and OpenPNE software were used for CMS and SNS, respectively. Apache Web server software, MySQL database management system and PHP language
processor were also installed to operate Moodle and OpenPNE. The server operating system was Windows Server 2003.

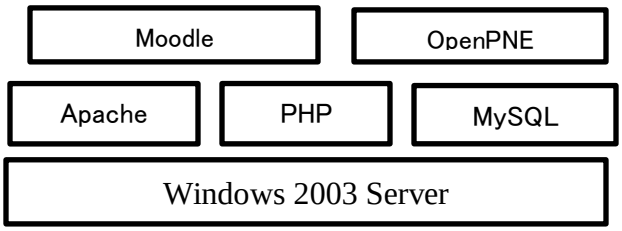

Fig.1 System platform image

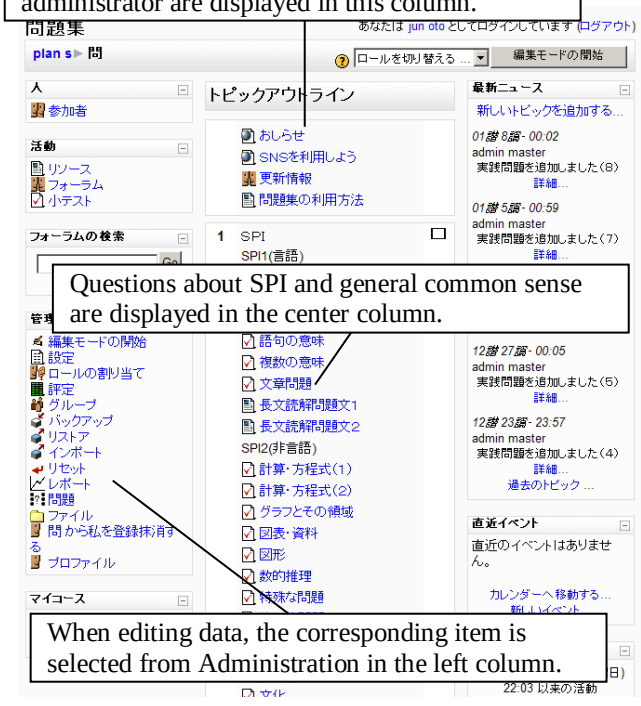

Fig.2 First screen of CMS

Fig.3 User's first screen of SNS

2.2 Designed System Platform

When editing data, the corresponding item is selected from Administration in the left column. A lot of subjects are displayed on the first screen of CMS. The students without administrator rights can obtain information described in a topic outline and study questions about SPI and others. On the other hand, an administrator can modify anything on a computer by clicking an "Administration" item in the left column or the "Edit Mode Start" button displayed at the top. (FIgure2)

2.3 Designed System Platform

When a user logs in SNS, his first web page is displayed on the screen. The latest information displays the updated diaries, blogs and comments of My Friends registered by the user. My Friend list, community list, calendar, and information to promote communication between users are also displayed at the same time. (FIgure2)

3. Social Network Analysis

Social network is a network to present the relation between decision-making entities in individuals or groups, for instance, in school class, interest club, company organization, business contract between companies and relationship between countries, and this network is considered to be a structure to show the relation between entities consisting of points and lines.

In graph theory, these points and lines are called nodes and edges, respectively. The graph theory perceives the network as a node-edge structure to study the related structure, and the graph is able to illustrate the relation between entities using the nodes and edges.

Social network among networks regards all social units (actors), which include individuals, companies and countries, as the nodes and refers to a structure that shows the mutual relation between the actors [4].

Social network analysis refers to the mathematical analysis of the social structure as a group of actors and is a study of the explanation of event happening that the actors relate. Hereupon, the event indicates the social event.

The graph theory creates the matrix (e.g., Table 1) to draw a graph. The first row and column of the matrix are given the actor (set "p"). When "p_i" and "p_j" are related to each other, the numeric value "1" is entered into the row and column elements (i, j), but otherwise the numeric value "0" is entered. However, the numeric value "0" is entered into the diagonal elements (i, i) that "p_i" and "p_j" are not related to each other. The matrix that the numeric values were entered in this way is called "sociomatrix". The sociomatrix can be classified into three type graphs: non-directed graph, directed graph and weighted graph, depending on the relation between entities.

3.1 Non Directed Graph

The relation between entities is set as follows: "I have met "p" directly". As a result, the relation from "p_i" to "p_j" is the same as that from "p_j" to "p_i". In other words, it means that the elements (i, j) and (j, i) of the sociomatrix have the same value. At this time, the graph is displayed with only an edge or the edge with arrows at both ends because no direction is produced. Such a graph is called "non-directed graph". The said sociomatrix becomes a symmetric matrix.

Tbl.1 ex. of Symmetric sociomatrix

	A	B	C	D	E
A	0	1	0	1	0
B	1	0	1	1	1
C	0	1	0	0	0
D	1	1	0	0	0
E	0	1	0	0	0

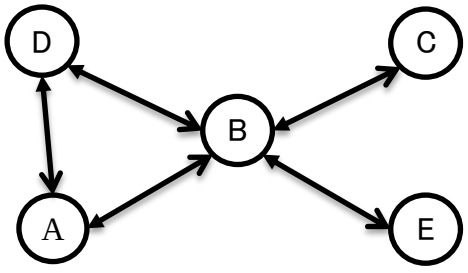

Fig.4 ex. of Non-directed graph

3.2 Directed Graph

The relation between entities is set as follows: "I know 'p' ". As a result, the relation from "p_i" to "p_j" may be different from that from "p_j" to "p_i" when only one of them knows the other. In other words, it means that the elements (i, j) and (j, i) of the sociomatrix do not always have the same value. At this time, the graph is displayed using the edge with an arrow at one end because its direction is

produced. Such a graph is called "directed graph". The said sociomatrix becomes asymmetric.

Tbl.2 ex. of Asymmetric sociomatrix

	A	B	C	D	E
A	0	1	0	1	0
B	1	0	0	1	1
C	0	1	0	0	0
D	1	0	0	0	0
E	0	0	0	0	0

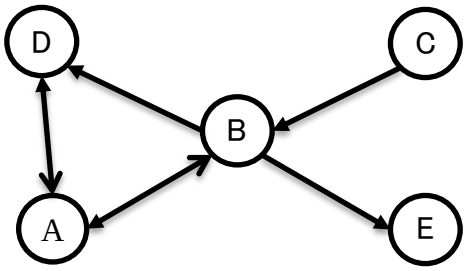

Fig.5 ex. of Directed graph

3.3 Weighted Graph

The sociomatrix can present not only the presence or absence of the relation between entities but also the strength of that. At this time, the numeric value to show the strength of the relation between entities is entered into the elements (i, j). The graph made like above is called "weighted graph". The weighted graph is used when the relation between entities is set to the number of telephone calls to/from "p" and the three-step evaluation in the reliability of "p". The weighted graph also gives the detailed social network and improves flexibility in the analysis method.

Tbl.3 ex. of Weighted sociomatrix

	A	B	C	D	E	F
A	0	3	0	2	0	0
B	3	0	2	2	1	0
C	0	2	0	0	0	0
D	2	2	0	0	0	0
E	0	1	0	0	0	0
F	0	0	0	0	0	0

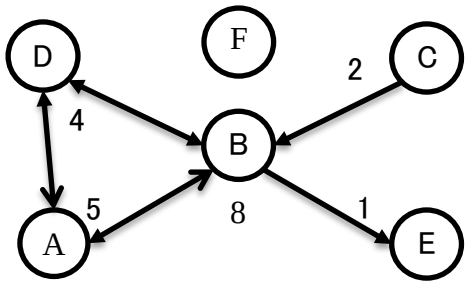

Fig.6 ex. of Weighted graph

4. Application Experiment of SNS and CMS

4.1 Purpose of Experiment

Through the social network analysis, we clarify how knowledge is transmitted to the subjects from which route in the learning support system using CMS and SNS.

4.2 Experimental Method

(1) Subjects

- The subjects shall be the students who are familiar with the operation of a personal computer (PC) in order to avoid the difference of PC operation skills between them.
- The purpose of learning shall be their job search.
- They shall operate a PC once or more per day unless something special happens to them.

From the above reasons, total 9 subjects in this study were selected: 5 juniors as learners and 4 seniors who had experienced the job hunting activities as advisers. These juniors and seniors belonged to the same seminar, but they met each other only one time at a social party held in May of last year.

(2) Theme

The experimental researchers monitored how the subjects use the CMS software and the SNS websites and led them to access the SNS websites one or more per week. They were able to make free use of the CMS software without compulsion. Because the theme of this study was the job search, the juniors lacked the experience of an interview for a job and the knowledge with knowhow other than the questions about the SPI and common sense. Therefore, we asked the seniors who had experienced the job hunting activities to instruct the juniors on the seniors' experiences and knowhow in job search on SNS.

(3) Experimental period
The 8-week experiment started on October 7, 2011.

4.3 Purpose of Experiment

The subjects are shown as follows: the juniors who have not experienced the job hunting activities as Ti (i = 1～5) and the seniors who have experienced that as Fi (i = 1～4). The number of accesses to websites for 8 weeks after the start of the experiments is described below.

Tbl.4 No. of accesses to SNS websites

ID	1st to 2nd weeks	3rd to 4th weeks	5th to 6th weeks	7th to 8th weeks	Total
T1	16	20	30	31	81
T2	10	30	22	20	82
T3	11	10	19	20	60
T4	3	16	21	26	66
T5	30	58	38	38	164
F1	23	30	32	35	120
F2	45	50	48	48	191
F3	28	12	26	25	91
F4	50	44	45	43	182
Total	200	270	281	286	1037

During the experimental period, the threads created by the subjects and the number of accesses to them are described below.

Tbl.5 List of threads on SNS

Thread	No. of accesses
Job search Q&A	84
Knowledge and interview tests preparation	85
Seniors chat	21
Information on social party	24
Electric power saving	63
Trial community to master the method of using SNS	3
The 1st environmental awareness improving activities	44

Table 6 shows the weighted sociomatrix based on the history of subjects' accesses.

Tbl.6 Weighted sociomatrix

ID	T1	T2	T3	T4	T5	F1	F2	F3	F4
T1	0	14	9	6	5	11	12	7	21
T2	8	0	4	3	7	7	21	11	17
T3	7	8	0	8	6	4	24	11	13
T4	4	7	6	0	15	11	19	7	13
T5	8	3	4	7	0	8	14	8	11
F1	4	3	3	8	9	0	19	21	21
F2	6	6	5	3	5	5	0	1	11
F3	5	6	11	8	6	13	21	0	7
F4	9	7	12	12	9	12	26	12	0

Table 7 shows the aggregated results of the number of accesses with the subjects classified into the juniors and seniors.

Tbl.7 No. of accesses by school year

Total number of accesses to/from the juniors	87
Total number of accesses to/from the seniors	143
Total number of accesses from the juniors to the seniors	187
Total number of accesses from the seniors to the juniors	91
Total number of all accesses	508

Figs. 7 and 8 show the results of accesses above in the social network graph. The size of nodes in a graph displays the weight vector and the largest weight node is drawn to be located at the center of a graph. Figs. 7 and 8 made each graph of the number of accesses to and from others, respectively.

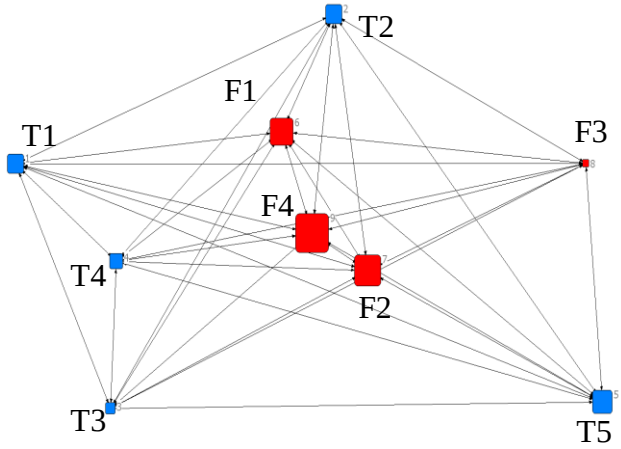

Fig. 7 Social network graph showing the number of accesses to others

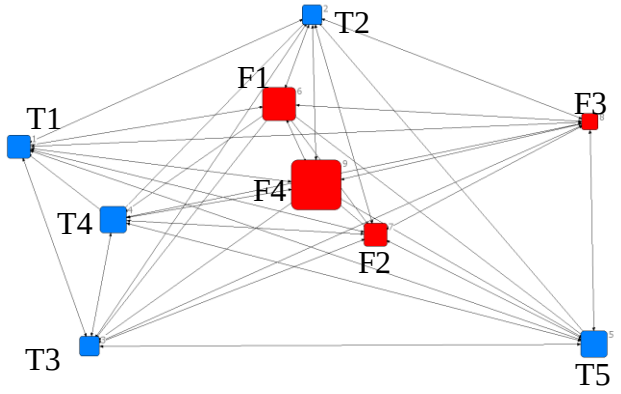

Fig. 8 Social network graph showing the number of accesses from others

4.4 Discussion

Table 4 shows that the number of accesses from the juniors as learners increased along the experimental period. However, the number of accesses from the seniors as advisers to instruct their experiences and knowhow in job search did not change during the experimental period. These results mean that the number of accesses from the juniors did not increase because they had the question whether our newly developed learning support system is beneficial to them in the early experimental period, but the number of accesses from the juniors would increase spontaneously if they understand this learning support system is beneficial to them. Consequently, making the users who want to obtain knowledge grasp our salutary learning support system will increase the number of accesses.

Tables 6 and 7 indicate that the seniors provided some themes on SNS and active communication was performed between them. The juniors took in seniors' experience and knowhow in job search through conversation between them and entered their questions into the threads such as Q&A. The seniors often answered the juniors' questions. In this learning support system, it can be said that the users who have not knowledge read the experience and knowhow in job search, or tacit knowledge entered and transmitted by others who hold such knowledge so that the former can ask the latter to respond directly to the questions in communication.

Tables 6 and 7 show that the fellow juniors often had a conversation about the main questions relating to the SPI and aptitude test. Thus, the fellow learners may be able to share the explicit knowledge and they put to practical use SNS as a support tool to communicate with one another.

According to Figs. 7 and 8, information is sent/received so as to revolve around the seniors who transmit their knowledge. When making a comparison between the number of accesses to others and the number of accesses from others, the seniors who send too much information get a large number of accesses from others. As a result, the seniors who often transmit their experience and knowhow have an increased number of accesses from the juniors. Therefore, the users designated as the transmitter of knowledge send information positively to bring the learners to a beneficial status, so that the number of accesses is surely enhanced.

5. Conclusion

The importance of e-learning system will increase much more than before in order to improve company productivity along with the regularization of knowledge-based society in future. This study applied the CMS software used generally as the current e-learning tool, together with the SNS websites groping for their practical use in the educational fields.

The learners can master the explicit knowledge by using CMS. Communicating with the skilled users on SNS makes it possible to obtain not only the explicit knowledge but also the skilled users' experience and knowhow, or tacit knowledge. This study is to find the effective transmission route of experience and knowhow, or tacit knowledge on SNS through social network analysis between users and to examine the effectiveness of SNS.

In order to accomplish the purpose of our study, we first developed a new learning support system to help the students find their jobs. We used Moodle software for CMS, constructed this learning support system to enable the students to master the explicit knowledge including SPI and general common sense, and provided free learning opportunities for the juniors who start the job search. Next, we used OpenPNE software for SNS and created the learning support system to send the experiences and knowhow in job search from the seniors to the juniors on SNS where the experienced former and the inexperienced latter in job hunting activities can communicate with one another.

Social network analysis of the experimental results between the learners (juniors) and the skilled instructors (seniors) who used the selected CMS software and SNS websites for 8 weeks proved the followings:

- The learners have a small number of accesses at the time of starting to use the learning support system, but they will have the increased number of accesses if the advantages of this system are understood by themselves. Conversely speaking, it is necessary to introduce a mechanism that makes the learners forcedly access the SNS websites until they grasp the advantages of this system to give independent access because they have only a small number of accesses at the beginning.

- The learners read communication between the skilled fellow instructors, which was entered into the SNS websites, to master the experiences and knowhow in job search. Furthermore, the learners enter their own questions produced in communication between the instructors into the Q&A column and obtain the answers from the instructors to cultivate a better understanding. The learners can also understand deeply the explicit knowledge to be mastered by using CMS when the fellow learners communicate with one another on SNS.
- Knowledge is transmitted with the experienced students as leaders. With usually casual communication between the experienced fellow students on SNS, the learners read the experienced students' opinions to gain extensive knowledge. This means that if the experienced students enter positively their own information into the threads, it will lead the learners to an effective state.

As described above, the effectiveness of SNS has proven to transmit the students' experience and knowhow in job search, or tacit knowledge. In a part of e-learning system, the skilled students use SNS as a daily communication tool, the learners who have little experience read communication described by the experienced students and ask them questions, and the experienced students transmit effectively the tacit knowledge to the inexperienced ones.

Finally, this paper proposes that e-learning system, including generally CMS, should be combined with SNS for optimum operation.

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$D^4 S^4$: A Four Dimensions Instructional Strategy for Web-based Learning

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Abstract - *Web-based education is facing a paradigm shift under the rapid development of information and communication technology. The new paradigm of learning requires special techniques of course design, special instructional models, and special methods of evaluation. This philosophical paper presents an adaptive instructional strategy for teaching and learning through the Web. The central theme of this strategy is that instructional strategies give instructors and students a conceptual as well as a practical mode of delivery from which to teach and learn. Considering and applying new instructional strategy can help instructors to understand the uses of pedagogical content knowledge, as well as to reflect the role of technological content knowledge that can be adapted and/or adopted in teaching in all educational levels.*

The main objective of this theoretical paper was to develop a holonomic instructional strategy for Web-based learning. This strategy is guided by the non-linear and interactive features of learning environments. The strategy is consisted of four dimensions: designing, developing, delving and distributing. In this instructional strategy, learning is holonomic and adaptive. Learning occurs in an open learning environment, in which instructors are designing a shared vision, developing a sharable e-learning task, delving students' learning through scaffolding and salvaging students' knowledge. The expected outcome of this instructional strategy is that each learner will develop a cognitive schema to be used to organize and construct knowledge and meaning in similar context of learning which may increase the generalizability, trustworthiness and transferability of learning.

Keywords: Web-based learning, instructional models, instructional strategies, adaptive learning, holonomic learning.

1. Theoretical Background

Educational systems are facing what is called "Paradigm Shift". This shift occurs when difficulties or anomalies begin to appear in the functioning of the existing paradigm, which cannot be handled adequately and when there is an alternative paradigm that will account for all that the original paradigm accounted for. This shift, in turn, offers real expectation for solving the major difficulties facing the current paradigm (Schuyler, 1997).

Educational practices through the ages have been shaped by the dominant forms of communication, and the transitions from one age to the next age have caused great anxiety among educators of the time (Thornburg, 1996). While communication was an important skill in the industrial age, it has become the most important skill during the current age – the digital age. Web-based learning began with a poor initial pedagogical model of e-learning, based on a behaviorist and page-turning approach to learning. The reality is that Web-based learning is becoming integrated into portals and work flows, even though it is not necessarily labeled as e-learning. The lines are increasingly blurred between learning and working, and many aspects of learning that occur online are not being measured as such (Driscoll, 2008).

The effects on and changes in the labor market mean that some jobs are declining in significance; others are growing in importance, and others still require completely new or different skills and competencies. The size of the workforce employed in the service and technology industries, where high-level education and skills are required, will increase while the demand for low-skilled workers will shrink. Many employees are likely to change jobs, and possibly even careers, several times during their working lives. The changing nature of labor market trends has significant implications for education in general, and learning specifically, implying the need to provide lifelong learning, continuing and recurrent business and vocational education, and continued upgrading of knowledge and skills. Information and communication technology in schools and universities may help students succeed when they enter the world of work because "technology learning environments mirror the

analytic, interpretive, creative, and expressive uses of information tools increasingly characteristic of sophisticated workplace settings" (Dede, 2000, p. 211).

Programs objectives should be developed to emphasize the basic work skills, life-long learning skills, and critical thinking skills for the digital generation. Currently, there is a growing demand for people who can use computer-based systems, multimedia-based systems, network-based systems, problem-solving skills, simulation-based software, and expert systems in personal life and career. Today's students live in a global-knowledge-based age. They deserve teachers whose practices embrace the best that technology can bring to learning (International Society for Technology in Education (ISTE), 2002).

Colletta (2002) reported that technology can support learning in five ways: (a) creating more exciting curricula, (b) providing tools for scaffolding, (c) providing opportunities for feedback, reflection, and revision; (d) expanding opportunities for teacher learning, and (e) providing for local and global communication. The National Research Council (NRC) has also reported that there are five ways that instructional technology can be used to help meet the challenges of establishing effective learning environments (NRC, 2001, p. 243):

1. Bringing real-world problems into classroom through the use of videos, demonstrations, simulations, and Internet connections to concrete data and working scientists.
2. Providing "scaffolding" support to augment what learners can do and explain about on their path to understanding. Scaffolding allows learners to participate in complex cognitive performances, such as scientific visualization and model-based learning, which is more difficult or impossible without technical support.
3. Increasing opportunities for learners to receive feedback from software tutors, teachers, and peers; to engage in reflection on their own learning processes; and to receive guidance toward progressive revisions that improve their learning and reasoning.
4. Building local and global communities of teachers, administrators, students, parents, and other interested learners or groups.
5. Expanding opportunities for teachers' learning.

Thus, this paper attempted to design a new instructional strategy based on the non-linear and interactive features of the digital learning and instruction through the Web. The premise of this new instructional strategy was based on the belief that adaptive learning environments are important medium in teaching and learning process and need to be integrated into Web-based instruction more than ever before. Adaptive learning environments introduce another source of knowledge, skills and values. The introduction of an adaptive and interactive source of learning means that instructors may spend less time presenting knowledge to groups of students and more time facilitating small groups work and guiding students to appropriate resources of curriculum. This shift will more likely involve a change in all instructional practices and delivery of Web-based education. This shift will also keep our learning from or with the Internet and the Web more molecularized and holonomic than ever before.

The holonomic concept is shifting Web-based learning environment from ordinary one into an adaptive and effective learning environment. According to NRC, effective learning environments are consisted of four basic components: (a) knowledge-centered wherein the emphasis is on understanding rather than remembering; (b) learner-centered, wherein individual learners' personal and cultural backgrounds and learning styles are valued; (c) community-centered, wherein learning activities are collaborative and foster a community of practice and inquiry that involves legitimate peripheral participation; and (d) assessment-centered, wherein formative assessment is used to make students' thinking visible to them and evaluations are performance-oriented (Rhodes, 2011, p. 2).

One of the most important measures taken to ensure quality of instruction is the use of instructional design models and strategies to meet the special requirements of teaching. Instructional design offers a framework for planning, developing, and evaluating instruction based on learner needs, content requirements and delivery methods.

2. Definition and Importance of Instructional Design

Reigeluth (1999) argues that instructional design theories are design oriented and offer probabilistic (as opposed to deterministic) methods to increase the possibility of attaining learning goals. He views instructional design as primarily a prescriptive enterprise aimed at a set of principles to be used to guide the development of optimal learning solutions. In this regard, Dick & Carey (2001) offer three major reasons for performing the principles of instructional design. The first reason is it focuses instruction on defined outcomes instead of offering good activities without any specific desired learning results. Secondly, it supports the connection between each component of instruction, especially the linkage between the instructional strategy and the desired learning outcomes. Instruction is thus focused on the skills and

knowledge to be taught to achieve the defined learning goals. The third reason is that it makes instruction empirical and replicable. Empirical means that instruction is defined in a way that its variables can be analyzed and the effect of each variable can be determined. Replicable implies that instruction is based on a systems approach, which can be repeated at another time or location with similar results. According to Gustafson & Branch (2002), the role of models in instructional development is to provide us with conceptual and communication tools that we can use to visualize, direct, and manage processes for generating episodes of guided learning; allow us to view both the linear and concurrent aspects of instructional development; and to allow us to select or develop appropriate operational tools.

Bailey & Hahn (1999) used a generic five instruction system design (ISD) approach, namely, "analysis, design, development, implementation, and evaluation," as the organizational framework to present their process model. They also, added several modifications compared to other systematic ISD models. These modifications were:

1. the addition of a team/ project definition step,
2. the addition of a vision and pedagogical philosophy,
3. the replacements of goal analysis and objectives with performance outcomes,
4. the addition of an interface design step,
5. the addition of an integration of communication tools step,
6. the early use of formative evaluation and usability testing, and
7. the longer phased implementation step (Bailey & Hahn, 1999, p. 302).

The uniqueness of the Bailey and Hahn's model is that it emphasizes: (a) the early vision and pedagogical step, (b) performance outcomes, (c) problem analysis instead of task analysis, and (d) the effective integration of communication tools. Unlike the traditional ISD models, the theoretical base of Bailey and Hahn's model was mainly constructivism. However, the Bailey and Hahn's model did not provide solutions for instruction through adaptive learning environments, such as the Internet and the Web environment. In this regard, Heide & Henderson (2001) reported that there are a number of important reasons for adaptive models of instruction:

1. our students live in a world of technology,
2. new technologies can enrich and expand learning, increase the productivity of teachers and students, and enhance their lives beyond the classroom,
3. research continually provides us with new information on how we learn and how technology can be of assistance in the teaching/learning process,
4. there is an ever-widening diversity of student needs in every classroom and these students have different learning preferences, and
5. the workplace demands a new repertoire of skills and competencies.

What shall we do when information is doubling every 73 days or less? One rational answer is to train students to learn how to learn and contribute to other students learning in an ever-changing society. In order to develop such a training model, we need to adopt a student-centered curriculum and materials where students can become adept to new information in light of their own needs based on their academic and culture background. (Gillani, 2003, p.4).

Many of current e-learning models could be characterized as e_3 –learning (e sub-three learning) (Merrill, 2008, p. 397):

- *Enervative*, which, rather than promoting skill acquisition, actually interferes with the learning that should occur.
- *Endless*, which leads to boredom by being too passive, devoid of interaction, allowing learners to disengage, thereby failing to gain the desired skill acquisition.
- *Empty*, which fails to implement those instructional strategies that have been found to be necessary for learning to occur and may be, at its worst, information alone-transferred to the Internet without appropriate demonstration, practice, feedback, learner guidance, or coaching.

In summary, the Internet and the Web are the driving force of the future of the educational delivery, in which the learners are allowed to choose and change not only the location and people, but also the time that learning takes place. The instructional environments became non-linear and concurrent than ever before. Therefore, it is questionable whether any new instructional strategy will support the non-linear and concurrent features of Web-based instruction and learning to educate our students to be life-long learners and successful contributors to other students learning. Such holonomic model will make student not only responsible for his own learning but also other students' learning as well.

Nowadays, students are learning in a technology-rich environment that is collaborative and knowledge building. Thus, technology-rich environment requires a special type of holonomic and adaptive instructional strategy. The main features and components that can be used to visualize, direct, and manage the process of

Web-based learning according to this new strategy are presented in the following section.

3. Pedagogical Philosophy

Constructivist and connectivist perspectives were adopted as a theoretical framework for this holonomic instructional strategy. Constructivism has a substantial impact on views pertaining to the conditions and instructional strategies essential to build and organize learners' knowledge. And connectivism has considerable views regarding how to contribute, delve and support other people learning. According to Gustafson & Branch (2002), the role of models in instructional development is to provide us with conceptual and communication tools that we can use to: (a) visualize, direct, and manage processes for generating episodes of guided learning; (b) allow us to view both the linear and concurrent aspects of instructional development; and (c) allow us to select or develop appropriate operational tools.

As the World Wide Web (WWW) and the Internet have become the common tools of instruction in the digital age, the linear features of the traditional models no longer fit or meet the "learning focused" instructional environment. Perhaps the most important of all implications is that much of the designing should be done by the learners while they are learning, with help from a computer system and/or the teacher and other students generating options. Web-based learning environment is providing creative solutions to qualify and quantify learning through the following strategies (Horton, 2008):

- Increasing knowledge by making it more accessible to people.
- Capturing knowledge by making it easier for people to record what they know.
- Refining knowledge so it is expressed in a way that's useful to others.
- Sharing knowledge, which involves making knowledge accessible, keeping knowledge chunks small and easy to find and quick to use and reusing knowledge.
- Applying knowledge-that is, acting on the messages in the content.

2.1 Pedagogical Assumptions

- With the rapid growth in computer technology and multimedia, instruction should be designed in a way that makes it subject to a sequence of quick tryout and revision cycles.
- Instruction should be a self-regulated process taking place through the learner who is motivated to explore problems and situations.
- In order for students to learn through the Web as a constructivist learning environment, the learning environment should be shifted to a learner-centered rather than teacher-centered environment.
- Students and teachers must enter into a collaboration or partnership with technology and multimedia to create a virtual community that supports the learning process.
- Computer technology and multimedia help in developing multiple perspectives through the learners' exposure to multiple points of view or resources.
- The variables that have more effect on learning than the teacher are the learners and the environment that produces learning.
- Learning and instruction in the digital age are characterized as self-regulated, self-paced, self-prescribed, collaborative and autonomous learning.
- Students in a Web-based environment are able to work at a pace consistent with their rate of learning, have more time for reflection, feel more in control of the learning process, and engage in more self-directed and independent learning (Thomson, 2010).

2.2 Pedagogical Principles

To engage learners in knowledge construction, facilitate tests of their understanding, and prompt reflection on the knowledge generation process, constructivists and connectivists recommend the creation and use of holonomic and adaptive learning environments. Such learning environments should:

- engage learners in activities authentic to the discipline in which they are learning,
- provide for collaboration and the opportunity to engage multiple perspectives on what is being learned,
- support learners in setting their goals and regulating their own learning, and
- encourage learners to reflect on what and how they are learning (Driscoll, 2002).

To enhance the knowledge base for the new strategy, the following two areas of constructivist design principles and practices were used as bases for the D^4 S^4 strategy. Those two practices are: Cognitive Apprenticeship (Collins, 1988) and Anchored Knowledge in Authentic Situations (Vanderbilt, 1993).

2.2.1 Cognitive Apprenticeship

Collins (1988) defined the value of the cognitive apprenticeship through a set of features to assist the design, implementation, and evaluation of technology integration in the learning environment. These features contain:

1. *situated learning*: learning knowledge and skills in context that reflects the way the knowledge and skills will be useful in real life;
2. *modeling and explaining*: showing how the process unfolds and providing reasons why it happens that way;
3. *coaching*: facing to observe students at work while providing hints or scaffolds for assistance when they need;
4. *reflection on performance*: students recalling their actions and analyzing their performance jointly;
5. *articulation*: assisting the students in explaining and thinking about their processes to become part of their knowledge base; and
6. *exploration*: encouraging students to try different methods and strategies to see the effects.

2.2.3 Anchored Knowledge in Authentic Situations

The Cognition and Technology Group at Vanderbilt (1993) has worked for several years to design, implement and evaluate classroom projects based on the principles of anchored instruction and situated learning. They produced realistic contexts to encourage the active construction of knowledge by the learner. These contexts were as authentic as possible by recreating situations that the learner could interface with in the real life situations. They named these scenarios "anchors" that would give a content-rich environment for exploration related to the needed topics and skills. This exploration was encouraged so the learner could visit and revisit specific areas as necessary for knowledge construction. As they progressed in their studies, they have created and implemented student generated, community–based projects that were distributed via telecommunications and two-way video conferencing. These projects continue to focus on situated learning environments developed by the learner in which to anchor the learning.

In addition, the new D^4 S^4 holonomic strategy of Web-based learning is guided by Merrill's e^3-learning (e to the third power learning) design themes. These three themes are: effective, efficient, and engaging (Merrill, 2008). The main dimensions of suggested D^4 S^4 strategy are presented in Figure 1.

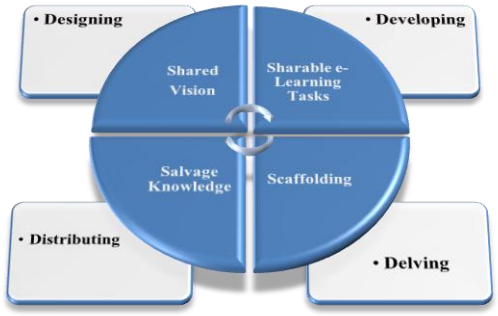

Figure 1. D^4 S^4 main dimensions

We may notice from Figure 1 that the D^4 S^4 strategy is an adaptive and evolving strategy in which both instructors and students are playing an integral role to qualify learning. In this new instructional strategy, learning is holonomic and vision-driven. Learning occurs in an open learning environment, in which instructors and learners are designing a shared vision, developing a sharable e-learning task, delving learning through scaffolding and distributing learning throughout salvaging knowledge.

According to this new instructional strategy, instructor is cognitive coach who is helping learners to do planning and reflecting conversation throughout their learning. These planning and reflecting conversations will support both individual and group learning functions among learners. They will maximize the probabilities of creative problem and task solutions that are needed for learning context or situation. The expected outcome of this process is that each learner will develop a cognitive schema to be used to organize knowledge in similar context of learning which may increase the generalizability, trustworthiness and transferability of learning functions. In D^4 S^4 instructional strategy, pedagogy must lead technology and information alone is not instruction. Table 1 presents instructors and students' role according to D^4 S^4 strategy.

Table 1.
Instructors and students' role according to D^4 S^4 strategy

Dimensions	Instructor Role	Student Role
D S^1	1. Selecting Web-based course materials 2. Stating goals and missions 3. Socialize learning 4. Shaping group dynamic regulations	1. Design a learning vision 2. Develop self-study action plan 3. Delve course goals, objectives, conditions 4. Distribute personal expectations to other learners
D S^2	1. Sequencing Web-course content 2. Stating learning tasks 3. Show how to do learning tasks 4. Standardize students' mission	1. Design individual and co-learning tasks 2. Develop self-generated ideas 3. Delve other students' ideas 4. Distribute common understanding (meaning making) of other learners' ideas
D S^3	1. Sort common ideas 2. Seriate students' work 3. Storm students' power through expanded activities 4. Stimulate students to organize well-structured knowledge	1. Design new lines of common understanding of course materials 2. Develop subsumption of new concepts 3. Delve new connected ideas 4. Distribute new well-structured knowledge with other students
D S^4	1. Symbolize structured knowledge 2. Summarize learning tasks/solutions 3. Shape holonomic understanding of course applications 4. Share a new revised vision	1. Design mind-maps for whole ideas and concepts getting from the course. 2. Develop connected ideas with other courses being taught (generalizability) 3. Delve organized knowledge for new meaning (building trustworthiness) 4. Distribute well-preparing values with other students (transferability of learning)

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KumuCloud: A Progress Report

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Abstract - *Within last year, we have developed an **e-learning portal**, called KumuCloud, (Kumu in Hawaiian language means "Teacher"). The main objective of this e-Learning Portal is to introduce a user friendly web based portal which helps the students to get high quality education material very quickly at anywhere and anytime, as well as make a bridge between inside and outside of the classroom via technology. We are hoping that by the next year this site will become a major source for any college student around the world to access course lecturer videos/ text/ slides on many different fields of study. This site could be a great course materials supplement for students. The supported video lectures/ text/ slides are selected through a review process and later are ranked by the users. The main benefit is: users can have access to the best open access materials which are collected from anywhere around the world. This paper presents the main components of this website.*

Keywords: Open Access, Mobile learning, Educational Site, Teachers in Cloud, KumuCloud

1 Introduction

Advances in processing speed, storage, networking, and intelligent software have brought computing into science, business and culture in ways that were barely imagined a few years ago. Much of this progress is due to advances in transistor technology. Today's transistor size is 22 *n*m which means: one blood cell covers 600 transistors; the width of a human hair covers 4,000 transistors; a transistor is 1/100 of the size of a silicon atom; and we can place 3 billion transistors on one penny. Given these advances in transistors, the new Intel Single Chip Cloud includes 48 processors connected via a 2D mesh network. Now, imagine what will happen in the next couple of years to fully implement today's technology in mobile phones. The mobile phones are already very fast in computation and advanced in multi-media. They play an important role in learning and teaching because they provide an environment for active learning and social interactions **anytime** and **anywhere**. With today's mobile phones, we can do many of the tasks we can do with our PCs. Moreover, they provide a more personalized and private environment for learning. Many students are intimidated when they are in a situation where others can see their screen (such as public-lab computers). Mobile phones are personally intimate; they are held close to the body and their screens are hidden from snooping eyes. They allow students to utilize videos, visualizations, interactive instructional materials, online homework, games, discussion groups/boards, demonstration projects, and many free applications, such as Smart Algebra, Space Time, etc.

Although the computational power and multi-media features of mobile phones have increased significantly in recent years, one may say that they are still limited by small screen size, non-ergonomic small keywords, and battery size. But again, even these limitations have not prevented them from becoming a great tool in student's learning across the globe. Moreover, the current technology is addressing these limitations and the developers are racing to overcome them. The small screen size could be overcome by projecting the display on a wall/desk or using a flexible film display that can be folded out as needed. The keyboard limitation can be overcome by projection keyboard, voice recognition, or cursive hand writing recognition.

Mobile phones are widely used over the world. In many countries, almost every person owns one mobile phone. In the U.S.A, by the end of 2009 there were 285,610,580 mobile phones which make about 91% of the population. The majority of students carry mobile phones wherever they go; they play, eat, and sleep with mobile phones. They are digital native and can text much faster than we can type. So we have to find effective ways to teach them what we would like them to learn by utilizing this technology. Dr. David Kennedy, Director of the Teaching and Learning Centre at Lingnan University, suggests that "We should leverage the technologies and applications in these devices and take advantage of the skills students already possess by building activities and resources around the devices they have 24/7." Presently there are thousands of instructional video lectures from YouTube that you can watch on your phone. For example, there are 40,000 videos on Algebra, 19,000 on Calculus, and 60,000 on Statistics. Sooner or later students will tap into these resources. If we do not know how to compete with the digital world, then we had better join it and start a new way of teaching.

There are many open access educational sites that provide free course materials, such as: ***Khan Academy*** (http://www.khanacademy.org/), ***arXiv.org*** (http://arxiv.org/), ***Open Learning Initiative*** (http://oli.web.cmu.edu/openlearning/), ***TED***

(http://www.ted.com/); and ***Academic Earth*** (http://academicearth.org/). However these sites have either limited resources for course development or are very specific toward one way of course delivery. To address these deficiencies, the KumuCloud site provides a hybrid environment for learning. In addition to top lectures from around the world, instructors can record their own lectures and make it available to students within an hour from the lecture time. With placing these videos on KumuCloud, students can review the lectures through their smart phones in addition to their desktops/laptops. They can also communicate with each other to discuss the lectures or project requirements.

2 KumuCloud

The main objective of the KumuCloud is to introduce a user-friendly web-based portal which helps the students to get high quality educational materials anywhere/anytime and in a timely manner, as well as make a bridge between inside and outside of the classroom via technology. They have remote access to the materials 24/7/365 hours from any place in the world. This access will help in situations where some students may have confusion regarding a topic after the class and while the professor is not available; some might miss a lecture and want to have access to the corresponding lessons or some may have an interest of an entirely different topic which they have never studied and would be able to access it via KumuCloud. The solution to all of these problems is an e-learning portal such as KumuCloud.

2.1 KumuCloud's Features

This section describes the main features of the KumuCloud. Figure 1 represents the home page for the site. The main component of this page is explained below.

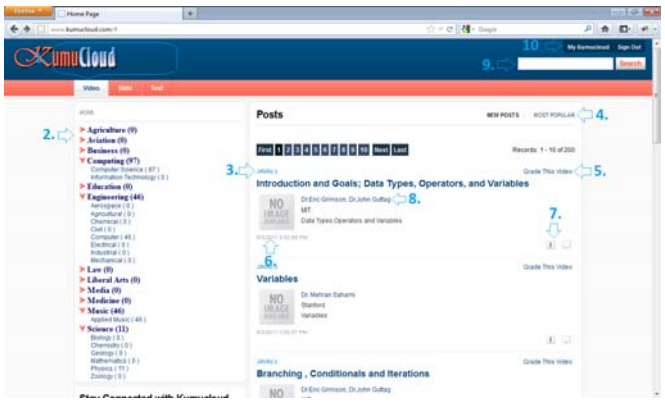

Figure 1. Home Page of KumuCloud

1)*Post Category*: Currently the portal focuses on three types of posts. They are: a) Video, b) Slide (e.g. PowerPoint presentation) and c) Text. These categories make it easier for searching through supported materials so that students can go directly to the targeted category and find the post they want. As it is described in a later section, these categories can also be linked with each other to allow user to switch between different media's for a particular subject.

2)*Post Navigation*: To get more precise posts on a specific area, site navigation can be very useful. KumuCloud supports a four step navigation system. Figure 2 represents the hierarchy of this navigation.

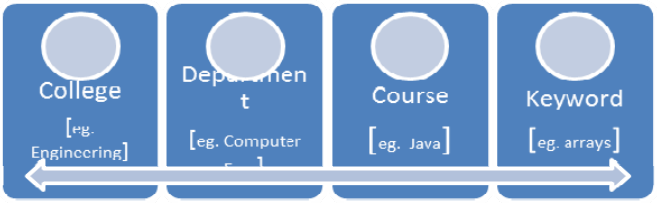

Figure 2. Navigation hierarchy

In Figure 2, we see that if a student wants to get material related to "Arrays" of Java programming language, they select the department of "Computer Engineering" from "College of Engineering" and then select "Java" from the list of the courses which will display the list of keywords/topics related to the java course. As soon as they choose "Arrays" from the list of keywords, they will get all the posts related to "Arrays". This navigation system is user-friendly and easy to understand as it represents the hierarchies that exist in most of the colleges/universities.

3)*Grade of the Post*: Grade represents the quality of the post. It is very important since it separates high-quality posts from poor-quality ones. So students can easily figure out which are the useful posts among thousands of posts. A very smart ranking algorithm has been used to sort the articles; this technique is discussed in detail in a later section of this article.

4)*Post Status*: Some users may be interested to see the more recent work on a topic rather than the earlier but popular ones. Alternatively, some might look for the most popular posts. Users can switch between these categories using these functionalities.

5)*Grade It*: Students can grade a post to keep it in the top ranking of the list. Ranking of the post is not dependent on the grade only; it depends on other factors, too, such as, number of views, number of shares and bookmarks, user comments, popularity, duration of the stay, age of the post, etc., but the grading will help the ranking system to make the decision.

6)*Upload Information*: This indicates when the post is originally uploaded and in the case of a video post, there is a preview image of the video to give some idea about the post to the users.

7)*Popularity of the Post*: It indicates the popularity of the post by showing the total number of views and the number of shared addresses through the social networks and comments.

8)*Post Information*: This section displays the name of the individual who uploaded the post and, in the case of a video, it shows the name of the playlist, if one exists.

9)*Search Engine*: This is a general search throughout the portal. Users can search by keywords, topic name, course name, department name, college name, uploader's name, etc. The search engine uses the indexing technique to display the result of the search which is extremely fast and convenient.

10) *Authentication*: Authentication is required to provide some user-friendly functionality, such as, displaying favorite lists, searching history, posting an item, commenting on a post, etc.

11) *Featured Posts:* Admin or portal moderator can mark a post as a featured post which will display at the bottom of the portal. There are six different areas like the Figure 3. Users can quickly look and pick up the article that they have interest.

Figure 3. Featured Post

Once a user has selected a particular department, a page will appear listing related topics/courses. The user can then select a particular topic within the possible choices. Figure 4 represents a sample page for a topic in the field of computing. The main features of this page are explained below.

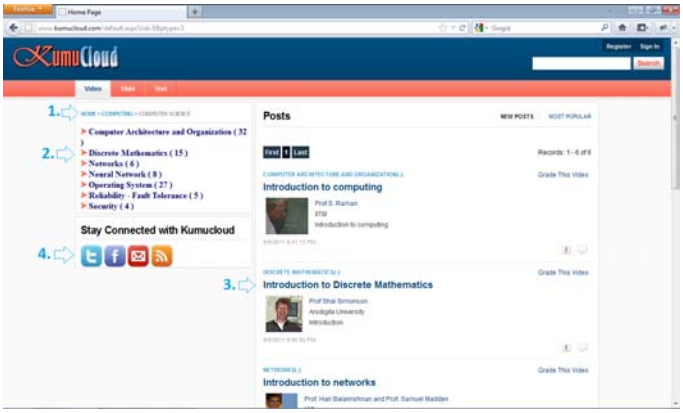

Figure 4. Listing of KumuCloud

1)*Breadcrumb*: Breadcrumb is a very useful feature. It tracks the navigation path and also helps the user to navigate back to the previous categories. Figure 4 shows posts list under "Computer Science" department. Clicking on "Computing" will redirect to the previous navigation and will show the list of all courses under "Computing".

2)List of Courses: As soon user selects a department, navigation menu displays the list of the courses under that specific department. Figure 4 shows seven courses under "Computer Science" department with total number of posts in each course.

3)*List of the Posts*: It displays the list of the posts based on the user's selections from the navigation menu.

4)*Share in the Community*: The user can share a high-quality post in their own community (e.g. Facebook, Twitter, MySpace, etc.) to notify others about it. It helps to spread the existence of new materials among people quickly.

When a course is selected, a page representing the videos corresponding to the selected course will be opened. Figure 5 represents a sample for this page. The main component of this page is explained below.

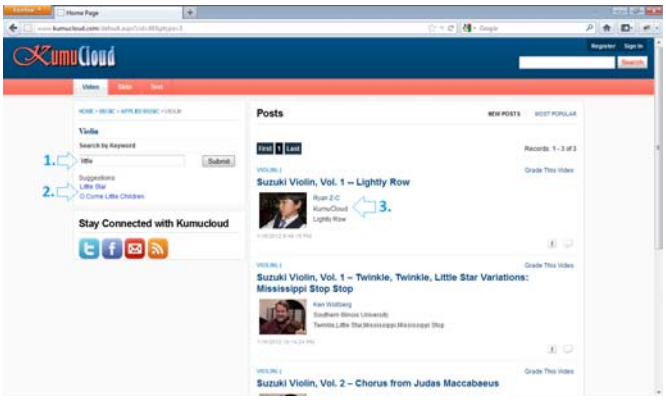

Figure: 5. Course Page

1)*Keywords/Areas*: There are many sections/areas/topics of each course. As soon as the user selects the course from the navigation, it displays the list of topics of the course which will filter the posts to get to the right post quickly. For example- in figure 5, we are searching with keyword "little" inside "Music > Applied Music > Violin".

2)*Keyword Suggestions*: Sometime it is really difficult to remember the exact keyword. Therefore it is difficult to find a particular post. Keyword suggestions module automatically search in the database for keywords while user type inside the "Search by Keyword" textbox and filter all the keywords that partially match with the entered text.

3)*Post Groups*: It is possible to group one or more post together. This is a very useful feature for the students who are looking to learn an entire course rather than a particular topic. When user select a school/department/course, by default the portal only displays the list of the groups rather than individual posts. One group can have more than 40 different posts. Individual posts can be found using "Search by Keyword" module.

When a video (or slide, text) is selected, a page representing the selected video will be opened. Figure 6 represents a sample for this page. The main component of this page is explained below.

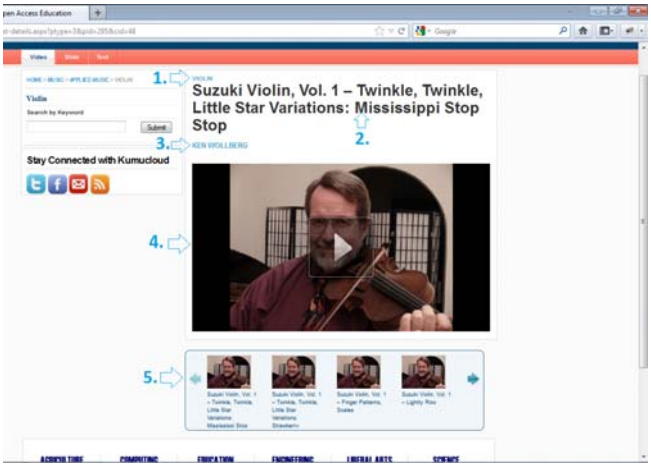

Figure 6. Detail Page of the Post

1)*Area*: Displays the area of the post which gives some idea of the purpose for the post to the user.

2)*Title of the Post*: It displays the title of the post.

3)*Author Name*: It displays the name of the author of the post.

4)*Main Content Area*: This is the description area. In the case of a video/presentation post, it displays a video player which streams the data to the user. In the case of a text post, this area contains the descriptive text of the post and links to download the file.

5)Related Videos: If the selected post is under a group then this section displays all other posts of the group. So that user can easily navigate to all the videos. For example, in case of java course it may display all the different lectures of java course. In figure 6, it is displaying all the videos related to "Suzuki Violin, Vol.1".

Sometime linking of different posts is very helpful to understand a topic for the student. Kumucloud have three different categories of posts: video, slide and text. Each of them can be linked with others. Figure 7 shows a window where a slide is linked with a video and text.

1)*Image of the Post*: It displays image of the post if there is any.

2)*Linked Posts*: If a post is linked with other posts then it displays different colors of bubbles here. Each color of bubbles has different meaning. A red bubble used for video. Similarly a green and blue bubble is used for text and slide, respectively. By clicking on the bubble, user can navigate to the linked post.

3)*File Links*: In case of slide and text post, this section will display the link of the file. User can view/download the file by clicking on the link.

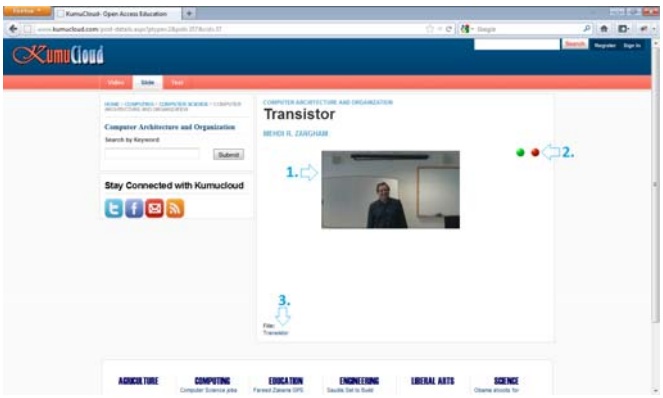

Figure 7. Linking of different posts

2.2 Ranking Technique

Ranking is very important since the number of new video/slide/text) posts are continually changing. It maintains the order of the posts in terms of their importance and relevance. In real life, we often rely on the opinion of our friends, colleagues, or experts when we have to choose between multiple options. Similarly, online users rely on the ranking system to choose a post among thousands of related posts. There are many ranking methods proposed in the literature. However, the majority of them are based on the mathematical calculations of the only "grades" given by the users. But there are some other factors along with the user's rates, such as the number of views, number of shares and bookmarks, user comments, popularity, duration of the stay, age of the post, etc., which need to be considered during the ranking computation. We follow the most popular "Bayesian theorem" to sort the posts. Bayesian theorem states in part that probabilities are rationally coherent degrees of belief, or a degree of belief in a proposition given a body of well specified information [1]. Below is the Bayesian formula which derives a rating based on the "believability" of the raw data [2]:

BayesianAverage=

$$\frac{(AvgNumberOfRatingForAll \times Average\ rating\ for\ all) + TotalRating}{(RateCount + AvgNumberOfRatingForAll)}$$

Where,
RateCount= the number of rating for a particular post
TotalRating= Sum of all rating given to a post
AvgNumberOfRatingForAll= Average number of rating for all book where RateCount>0
AvgRatingForAll= Average unweighted rating for all books where RateCount>0

We also consider the following factors to rank the posts:
➢ We impose weight for each view, share, rating, favorite, etc., to prioritize them. For example, assuming post **A** has 1000 views, 200 shares, and 300 rates, and post **B** has700

views, 300 shares, and 400 rates, using only flat calculation, post A might come before post B. But it is clear that post B is more popular than post A.

➢ It is normal that the older post will have more views, shares, rates, etc., than the newer one. In normal calculation, newer posts may never make it to the top of the list. To resolve this issue, we also consider the age of the post during the ranking.

Based on the above considerations, we calculate the total grading of a post. There are eight grades and each of them has a numerical range value (these ranges do not have constant values); the grades are A+, A, A-, B+, B, B-, C+, C. If two posts have the same grade then the post is sorted based on the number of views, shares, rates, etc.

3 Conclusions

In this paper, we have described the main components of KumuCloud website which is still under development. We are hoping that in near future, this site become a major source for any college student around the world to access course lecturer videos/ text/ slides on many different fields of study. Considering the progress in mobile learning throughout the world, this site may function as a great supplement, especially for underrepresented group. Among the differences between this site and the existing ones, there are three main differences that make the site more practical; these are 1) the materials are reviewed before they are published, 2) The materials are ranked based on the user ratings through an intelligent algorithm, and 3) The materials are not limited to some specific sources rather they are compiled from around the world.

4 References

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Research of Students' Learning Situation during Lecture in PC Room and Practical Use of MyPage

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Abstract - *Internetwork environment at university has been improved to supply often the lecture materials to students through websites. Along with such a tendency, the number of students who use personal computer (PC) has also increased during the lesson at university. Hereupon, we investigated whether the students would get high scores in tests when some limitations were imposed on the students' use of the PC during lecture and when they were not.*
We created the tool to check the students' learning situation and to grasp which student is performing the PC operations, which are not related to the ongoing lesson, during the lecture. Teaching assistant carrying the iPad was made to walk around the class during the lecture and collect data of the students. In addition, we developed "MyPage" that the students can be given access to their personal information including individual class absence/tardiness, lesson comprehension and question understanding level of them, and after using MyPage, we examined its effectiveness as a tool and its relationship with their attendance rate.

Key Words: use of websites, student's lesson attitude, limitations imposed on PC use

1. Introduction

Recently, the low-price and light-weight notebook computers have been produced, the internetwork environment has been improved on campus and in classroom, and the students have become able to connect easily their PCs to the Internet.

The lecture materials that have been prepared in printing papers and textbooks until now are increasingly stored on the web server visited by the students. Simultaneously, the number of students who use their own PC has increased during the lesson. By the looks of such students, however, a part of the students access web pages, which are not related to an ongoing lesson, send/receive e-mail messages, use the SNS or BBS for discussion, or play online animated games in spite of school.

The environment that allows the students to use the PC connected to the Internet in class is convenient to be able to access the detailed lecture materials and collect information on them, but there are various negative influences including the case that some students cannot concentrate on the lesson because they feel uneasy about the contents of e-mail messages, SNS or BBS.

Therefore, we supposed that the students can concentrate on the lecture contents with their learning efficiency kept high if they were prohibited from using the PC during their teacher's explanation. First, we surveyed the influence of the PC use on the arts students' learning efficiency when some limitations were imposed on the PC use during lecture and when they were not [1].

Furthermore, we investigated whether the science students would get high scores in tests when some limitations were imposed on the PC use during lecture and when they were not.

We updated the "System to Display Data of Students [2]" created in 2003 and developed the tool that can record data on the contents of each PC operated by the students during the lecture in the PC room by using the Apple iPad Tablet Computer. The teaching assistant (TA) carrying the iPad was made to walk around the class during the lecture and check the student performing the PC operations, which are not related to the ongoing lesson. This makes it possible for the teacher to understand how many students are

watching the PC screens, which are not related to the actual lesson, during the lecture.

We collected the students' personal information including individual class absence/tardiness and question understanding level and developed the tool that the students can be given access to their own learning situation on web page. This web page was created so that the students can enter their lesson comprehension or comments.

We designated this web page as "MyPage". The teachers can check all students' personal information on MyPage. After using MyPage for half a year, we examined its effectiveness as a tool and its relationship with the students' attendance rate.

2. Imposing of Limitations on Students' Use of PC

We conducted both pre-test and post-test for the students when some limitations were imposed on the students' use of the PC during the lecture and when they were not, in order to survey the changes in the students' test scores.

2.1 Research

We researched the lecture that the freshman science students used each desktop personal computer in an optional subject in the PC room.

The lecture style consists of the following steps: the teacher instructs the HTML grammar with web-based teaching materials for about 60 minutes and the students do exercises for 30 minutes. When this type of lecture was given three times, the pre-test was conducted before the 1st lecture and the post-test after the 3rd lecture as well (Fig. 1).

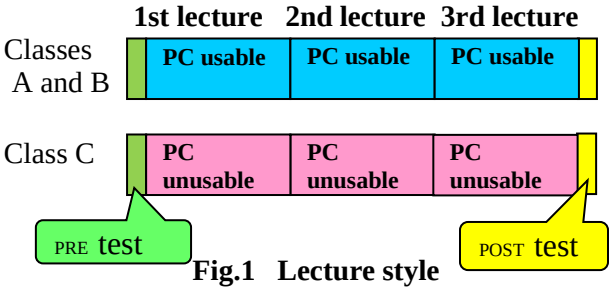


Fig.1 Lecture style

Class A (about 100 students) and Class B (about 110 students) were able to use each PC without limitations from the 1st to 3rd lecture, but Class C (about 130 students) were prohibited from using the PC from the 1st to 3rd lecture.

We conducted both pre-test and post-test for the class that the students' use of the PC was limited during the lecture and for the class that it was permitted, in order to analyze their learning efficiency (Table 1). Regression achievement score [3] shown in Table 3 is the compared value that the effect of pre-test is considered statistically. As a result of this research, there was no significant difference between both classes.

Table 1 Analysis results of students' learning efficiency

Class		PC usable	PC unusable
No. of subjects		210	127
PRE test	Average	0.79	0.96
	Standard deviation	1.47	1.78
POST test	Average	8.27	8.57
	Standard deviation	1.47	1.31
Regression achievement score	Average	−0.11	0.01
	Standard deviation	1.42	1.28

2.2 Analysis of Pre-test, Post-test and Questionnaire Investigation

We examined the results of questionnaire to ask the students "if you use the PC for something other than the lecture or not" and the pre- and post-tests.

As a result, there was a significant difference (significance level < 5%) between the students in the PC usable lecture, and the students who "use the PC for something other than the lecture" got higher scores in tests than other students who "do not use the PC for something other than the lecture".

It seems that because the students who "use the PC for something other than the lecture" can understand the lecture contents, to some degree, they may operate the PC with time on hand.

When we also examined the results of questionnaire to ask the students "if you should be prohibited" from using the PC during the lecture or not, it was proven that the students who think of their use of the PC that "should not be prohibited" got higher scores in tests than other students who think of their use of the PC that "should be prohibited", in the PC usable lecture.

3. Research of Students' Learning Situation during Lecture

We developed the tool to make the teaching assistant (TA) survey how the students are doing during the lecture. Fig. 2 shows the "System to Display Data of Students" created in 2003, which can display the classroom layout and the students' personal information as indicated below.

This system automatically displays the student seats in different colors in accordance with each individual student's learning situation including his/her class tardiness/absence and submission of reports, enabling a student who may have learning problems to be found out.

- Student's system login designation
- Student's name and sex
- Student's history of attendance (No. of class attendances/tardinesses)
- Student's learning report submission
- Student's system login time

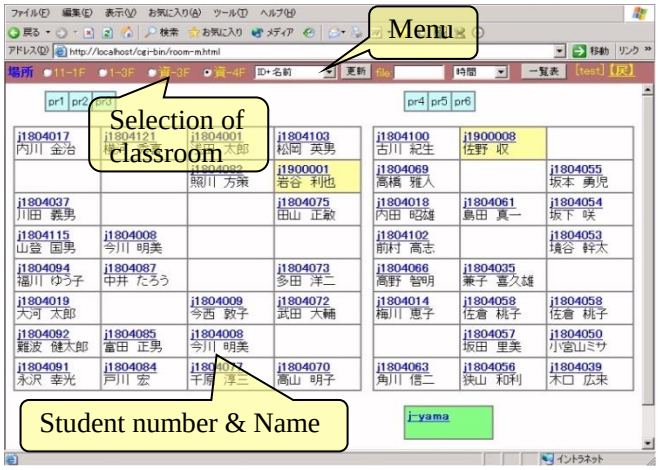


Fig. 2 System to display data of students

Fig. 3 shows a screen that we have newly created for the Apple iPad Tablet Computer after updating the "System to Display Data of Students". While using iPad, the TA can select the corresponding items from the pull-down menu on web page when a student is performing the PC operations, which are not related to the ongoing lesson, during the lecture.

The student's number, name and history of attendance can be displayed on the iPad screen when he/she logs in to the web server in the classroom.

During the lecture, the TA is made to walk around the class and use the iPad's touchscreen to select and record "Talking", "Sleeping", "PC operation relating to other lectures", "Game", "Access to animation" and "Access to SNS".

This TA's action allows the teacher to understand which student is performing the PC operations, which are not related to the ongoing lesson, during the lecture while accessing data stored in the "System to Display Data of Students" as shown in Fig. 2.

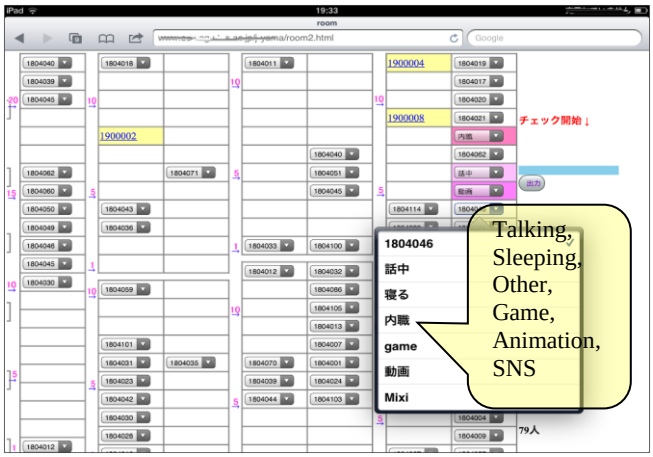


Fig. 3 iPad screen

4. Practical Use of MyPage

Fig. 4 shows our designated "MyPage" that the students can be given access to their own learning information. This page can display the following information:

- Display of student's system login/logout time
- Display of student's class absence/tardiness
- Display of student's level of understanding questions
- Display of student's PC operations not related to actual lesson (student's learning situation)
- Lesson comprehension (entered by student)

The students are able to enter their "Reasons for class tardiness/absence", "Lesson comprehension" and "Free description (impressions of lesson)" for each lecture. We used this tool to survey the students' opinions and the change of their class attendance in 2011. Figs. 5, 6 and 7 show each web page to which the teachers can be given access.

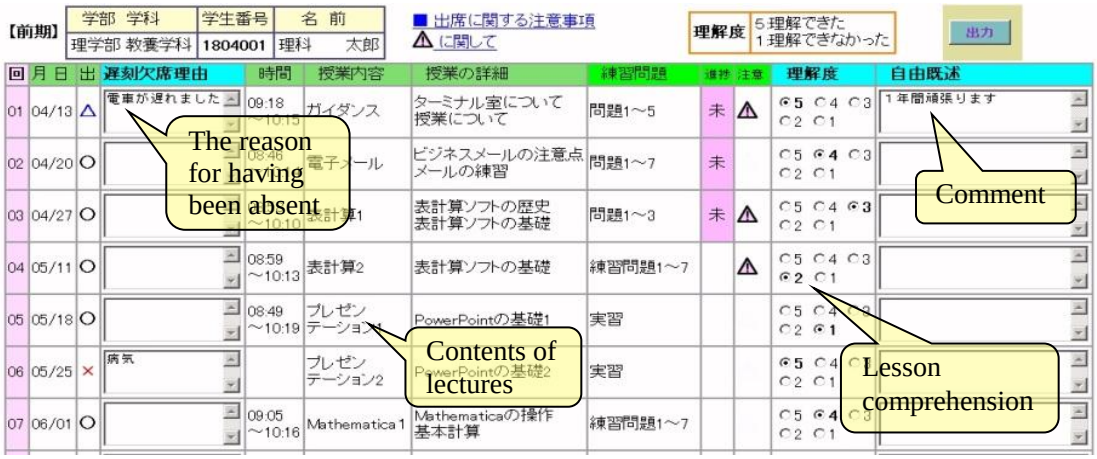


Fig. 4 MyPage screen for student

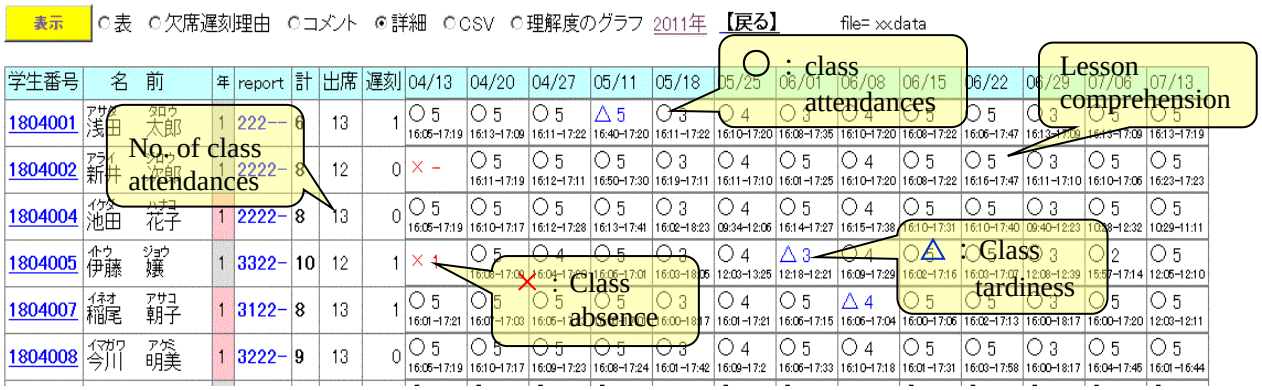


Fig. 5 Each individual student's detailed data (All data are fictitious.)

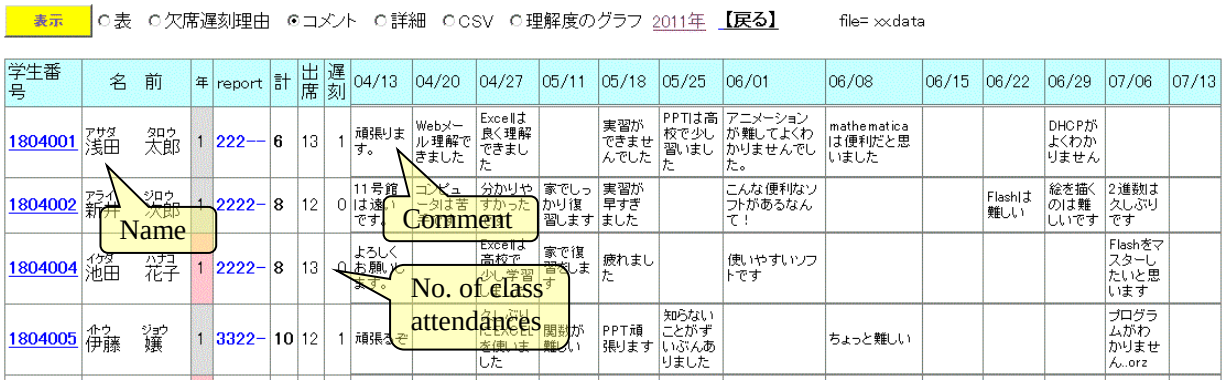


Fig. 6 Each individual student's impression of lessons

Fig. 5 indicates each individual student's detailed data including "Name", "Report score", "No. of class attendances", "Class tardiness/absence" and "Lesson comprehension". Fig. 6 displays each individual student's impression of lessons.

Fig. 7 graphs the students' comprehension in lessons and presents the five (5) levels of understanding with the green-colored zone set to the highest level.

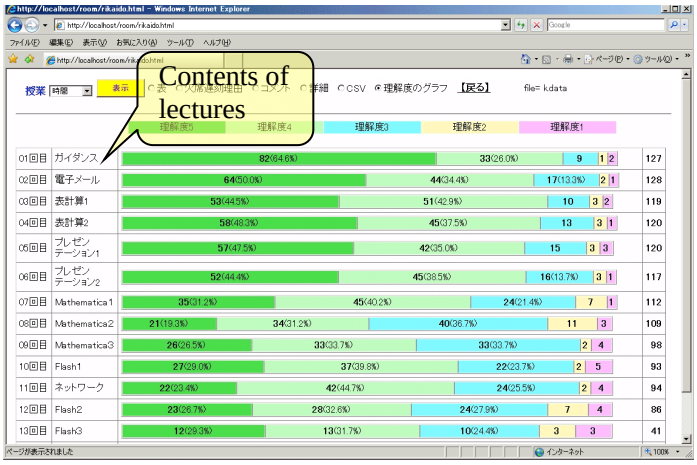


Fig. 7 Graph of students' comprehension in lessons

4.1 Results of Questionnaire about MyPage

We used MyPage for half a year and obtained information of MyPage by means of questionnaire. Tables 2 and 3 show the students' impressions of MyPage and the results of questionnaire on the necessity of MyPage, respectively. Half of the students answered "useful", but it cannot be said that the necessity of MyPage is so high for the students. Table 4 indicates the results of questionnaire on the understandability of MyPage display.

Table 2 Students' impressions of MyPage (Total 214 subjects)

Students who used MyPage	Great useful	31 subjects (14.5%)
	A little useful	79 subjects (36.9%)
	Little useful	60 subjects (28.0%)
Students who did not use MyPage		44 subjects (20.6%)

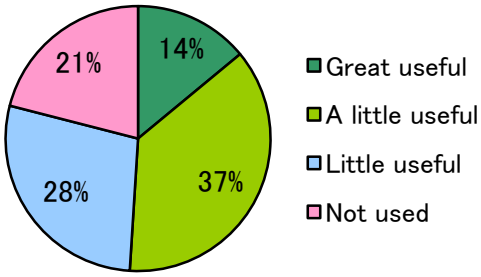


Table 3 Necessity of MyPage

Necessary	76 subjects (35.5%)
Yes and No	109 subjects (50.9%)
Unnecessary	29 subjects (13.6%)

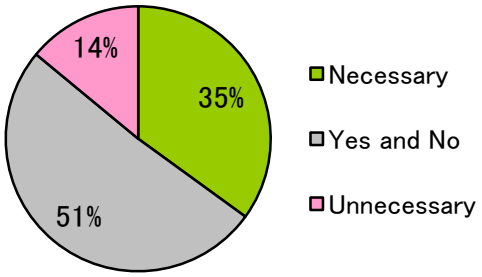
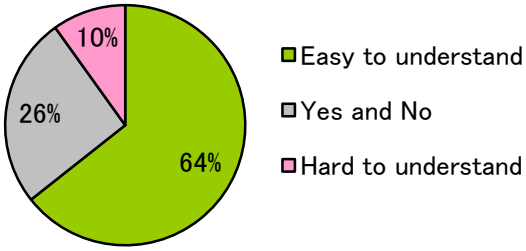


Table 4 Understandability of MyPage display

Easy to understand	136 subjects (63.6%)
Yes and No	56 subjects (26.2%)
Hard to understand	22 subjects (10.3%)



4.2 Relationship between Students' Use of MyPage and their Attendance Rate

The use of MyPage allows the students to grasp their class attendance/absence situation. Concerning the students' class tardiness/absence, they were made to enter their reasons for that. We compared the students' attendance rate between MyPage available class and MyPage unavailable class.

Table 5 indicates the comparison of students' attendance rate between the two classes with their class attendance (1), tardiness (0.7) and absence (0) set numerically.

When starting a lecture, however, the teacher explained to the students that their class attendance does not relate to their test scores.

Fig. 8 graphs the correlation between the students' attendance rate and the number of accesses to MyPage. This led to a small correlation between the students' attendance rate and the number of accesses to MyPage [4].

Table 5 Comparison between MyPage available class and MyPage unavailable class

	No. of subjects	Attendance rate
MyPage available class	260 subjects	0.93
MyPage unavailable class	133 subjects	0.77

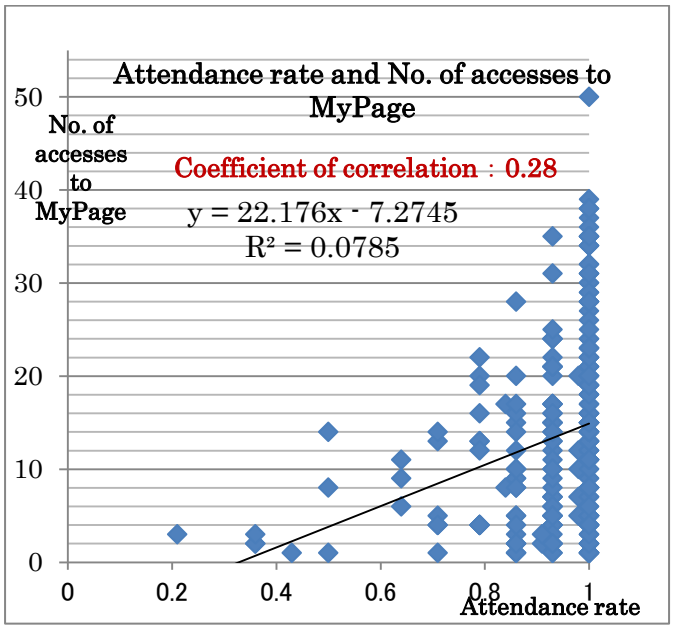


Fig. 8 Correlation between students' attendance rate and No. of accesses to MyPage

5. Conclusion and Future Research

We have supposed that the students will be able to concentrate on the lecture and get high scores in tests if they are prohibited from using the PC during the lecture.

However, the analysis results of pre-test, post-test and questionnaire investigation showed that there was no significant change in the test scores between the students even if they were prohibited from using the PC. It is considered that lazy students do not hear the teacher in the same state even if they are prohibited from using the PC and rather, these students have negative effects on other students who use the PC positively in class. It has been found that both arts students and science students have the almost same tendency.

In 2011, we researched the students' learning situation during lecture (Fig .9) and also developed "MyPage" that the students can be given access to their personal information including individual class absence/tardiness and lesson comprehension.

Fig. 9 Research of Students' Learning Situation during Lecture in PC Room

We made the students use MyPage for half a year and obtained information of MyPage by means of questionnaire. As a result, we realized that the students had not used MyPage as a convenient tool as we had expected. We are going to collect its detailed reasons and develop a tool useful for the students in future.

The teachers can check all students' personal information on MyPage and understand their comprehension levels in every lesson and their comments on the lecture contents.

Using MyPage enables a teacher to add an explanation of the lecture contents that the students have not been able to understand before, to the next lecture and to obtain effective information for giving an easy-to-understand lecture, for example, by modifying properly the students' progress in understanding the lecture.

When the students were tardy to or absent from classes, they were made to enter their reasons for that by use of MyPage. Because the use of MyPage allows the students to grasp their class attendance/absence situation, they were expected to increase their attendance rate.

They were also expected to have a good grip on the instructions that they had not understood, by entering their comments on the lectures. We compared the students' attendance rate between MyPage available class and MyPage unavailable class, which resulted in a small correlation between the students' attendance rate and the number of accesses to MyPage. Therefore, it can be expected that the use of MyPage will increase the students' attendance rate.

The situation of students' use of the PC during the lecture is changing year by year.

It is expectable that we will force the students themselves to have consciousness of their own actions and to use the PC effectively in class.

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A Progress Reporting System to Advance Experiential Learning and Administrate Student Activities

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Abstract – *Experiential learning, while an extremely valuable educational tool, can often be difficult to administrate and regulate. By introducing a system to track progress and activities, students are held accountable for their work and administrators are granted the ability to manage a large amount of students with a minimal amount of effort. This system demonstrates one such implementation where the emphasis is placed, not only on the efficiency of administration, but on the usability of the system and the experience for the student. Such an approach can serve to expedite system acceptance and enhance the user experience for all parties involved.*

Keywords: Web-based Management Tool, Student Activity Administration, Web Interfaces to Databases, Data Information Knowledge models, Education Management, User Centric Design

1 Introduction

Experiential learning can be an extremely effective educational tool in a wide variety of disciplines, Computer Science education included [1] [2]. Administrating this type of learning, however, can sometimes bring its own challenges. In many cases, students must meet instructor-imposed deadlines and provide detailed reports of their experiences.

Designed for the University of Central Florida (UCF)'s Programming Team, the system discussed in this paper is a solution to exactly that problem. The benefits of programming competitions as an educational tool are well documented [3]; however, this begs the question: Can the quality of experiential learning be enhanced through the use of technology?

Unlike many approaches that stress faculty as the primary user, this system is designed with students' behaviors and preferences held paramount. Through user centric interface design, dynamic report management, and clear completion feedback, this approach delivers a system that is intuitive for the student and yet still effective at progress management.

2 Evaluation of Needs

Each week, Programming Team members are required to enhance their abilities through a variety of different means. Anything from racing through TopCoder problems to researching new and innovative algorithms is considered fair game.

The life of a college student, though, is not without its distractions, and oftentimes team members find themselves missing deadlines or forgetting to complete assignments altogether. This type of behavior can not only be detrimental to the team's success but, more importantly, detrimental to the success and education of the individual student.

Ultimately the basic high-level requirements for the project began to take shape:

- Supplemental tool to track student activities
- Administrator-controlled user registration and team member authentication
- Tasks submitted on *Reports* which would have a dynamically set length (in days)
- Pronounced report notifications and reminders
- Administrative overrides for "locked" report periods
- Administrative tools for identifying students who regularly miss reporting their activities

3 Design

As a matter of convenience to in-house technical personnel, as well as to integrate with systems already in place, the PHP programming language was utilized in conjunction with the Joomla! content management system. By designing the application on top of a preexisting

framework, significant development time was saved that would have otherwise been spent on foundations such as user authentication and database abstraction.

Another such advantage to utilizing the Joomla! framework was seen in its inherent Model-View-Controller (MVC) based architecture. Very helpful for event driven applications [4], MVC architectures allow for effective abstraction in the high-level business logic of an application. Moreover, the MVC provides an increased degree of control when integrating object-oriented design principles [5].

Various other frameworks, such as Microsoft's ASP.NET MVC or ElissLab's CodeIgnitor, would have yielded comparable benefits.

3.1 High level design

The system has to cover several fundamental use cases: The completion and viewing of reports, the management of users, and the administration of the application.

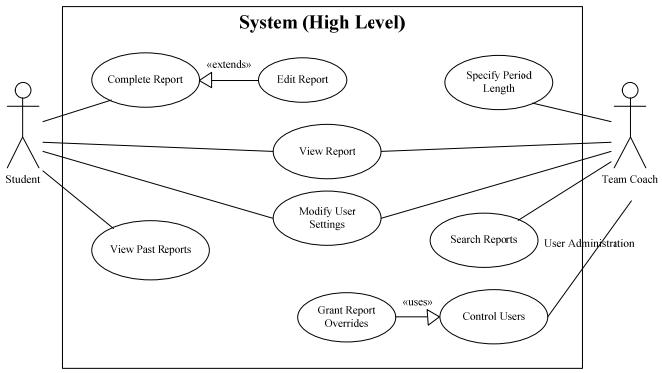

Figure 1 System Use Case Diagram

As seen in Figure 1, the primary actions of the system are carried out by two types of users: Students (for the purposes of this project *Team Members*) and Administrators (*Coaches*). This fact plays an important role during development, as database relations and object-oriented design will revolve around the concept of these user types as the primary actors.

Beyond simple use case scenarios, an important part of early design is to establish the user interface standards that will guide the development process. Often overlooked in specialized systems and academic applications, the look and feel of a system can have a drastic impact not only on the usability of the system but on the degree users choose to accept it [6] [7].

3.2 User Interface (UI) Design

An effective point in any design is the complete understanding of a system's target demographic. This understanding aids in effectively developing a system for the particular group being targeted. Development of an application for college students, for example, poses very different challenges than developing a system for the elderly.

By understanding the demographic, which in this instance is college students, design decisions were made which catered to an environment students are already comfortable with and accustomed to.

A brief evaluation of websites popular with this demographic (such as Facebook, Google, and Flickr) shows that the design elements chosen focus on clean and elegant displays with a pronounced degree of simplicity in design. Important UI elements typically invoke strong, bold colors while less important elements tend to be pale and blend easily into the background.

3.3 Database Design

The Joomla! framework offers database abstraction which allows for interaction with multiple database management systems. Given the needs of this specific implementation, the decision was made to utilize Joomla!'s default option of MySQL.

The Joomla! database design is very comprehensive, providing dozens of tables which control a wide array of options. While developing the database schema for the application (Figure 2 below) the `user` and `usergroup` tables were heavily relied upon for identification of the principal actors of our system.

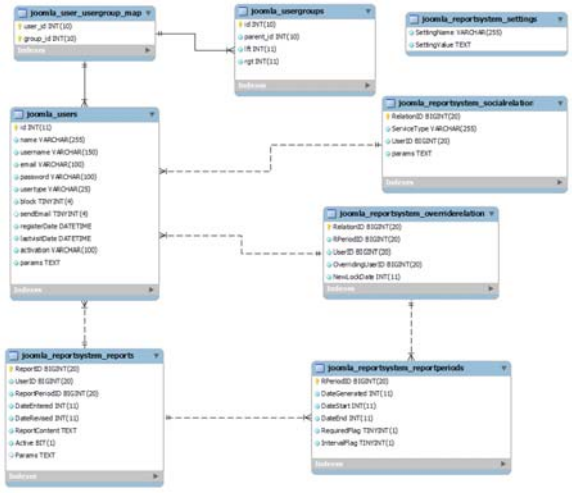

Figure 2 Database Design

As seen in the figure, an important component of this system which has not yet been discussed is the report period, `RPeriodID` and `ReportPeriodID`. The progress reports of this system are divided into time periods the length

of which are dynamically determined through the system's `settings` table.

After the report period has been created (discussed further in section 4.13), the identification number, or `RPeriodID`, is used to associate specific reports or report overrides to a progress report period. A design of this style allows for a single update made to the report period to be instantly carried through to all records which are associated with that period.

3.4 Authentication Design

Authentication in the system utilizes the Joomla! standard authentication paradigm with one notable addition. On each login, the usergroups of the authenticated user are retrieved and matched to known usergroups for administrators (*Coaches*) and students (*Team Members*) (Figure 3).

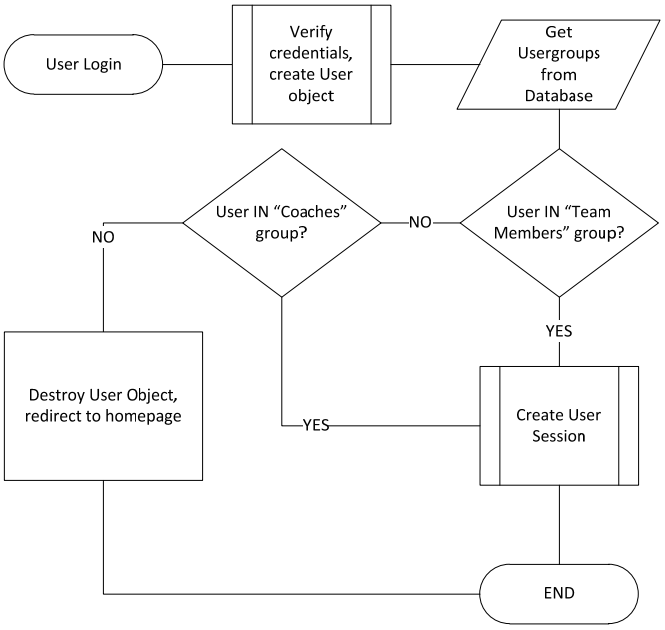

Figure 3 Authentication during user login

Users are placed into one of the two main usergroups by an administrative user of the system, which allows team coaches to restrict system access to only those explicitly authorized to view content.

3.5 Report Submission

There are four main states a report submission can occupy:

1. *Open* (unlocked, not submitted)
2. *Editable* (unlocked, submitted)
3. *Missed* (locked, not submitted)
4. *Complete* (locked, submitted)

Transitions between these states can occur either automatically (such as a user submitting a report which then becomes editable) or manually (such as an administrator re-opening a report for a student who failed to complete it) (Figure 4).

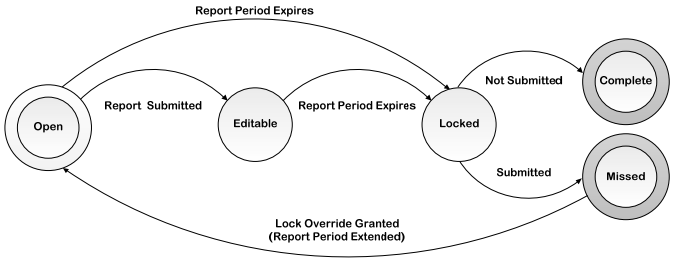

Figure 4 State flow diagram for report submission

3.6 Scheduled Task Design

Two very important features of the system, report period creation and dispatch of notifications, must be executed at consistent intervals in order to operate properly. Notifications, for example, are dispatched daily to students who have not yet completed a report which will be closing within the next 24 hours. If the notification dispatching service is not executed at least once daily these notifications will not be sent out, and students may very well miss their deadlines.

The design for the scheduled task system allows for individual components to be accessed or, if requested, all components may be executed in succession:

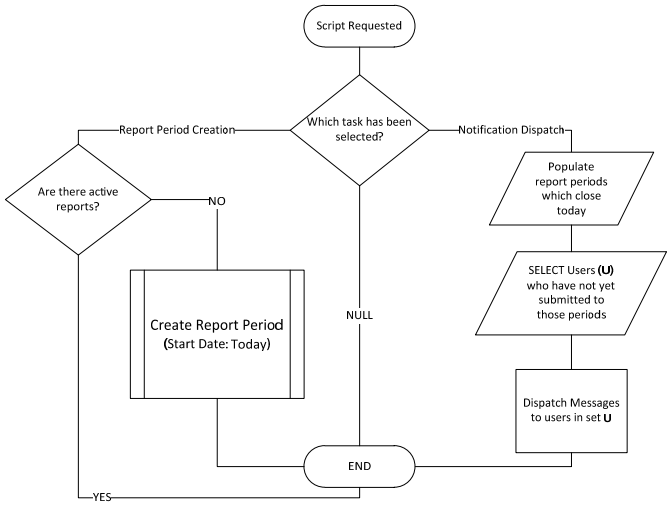

Figure 5 Scheduled Task execution

4 Implementation

The system implementation can be broken down into two main modes: the *Administrative Mode* and the *Student*

Mode. The following subsections will focus on these modes in the context of the most common use case scenarios encountered by the system.

4.1 Landing Page and User Login

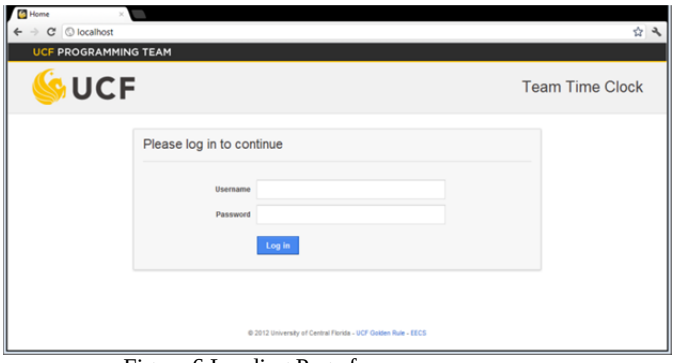

Figure 6 Landing Page for anonymous users

As seen in Figure 6, there is only one mode available for anonymous users: the ability to log in. Users who do not initiate a session are immediately redirected to the home page (Figure 7), while users who log in but are not in the proper authentication group (Figure 3) are presented with an error page (Figure 8).

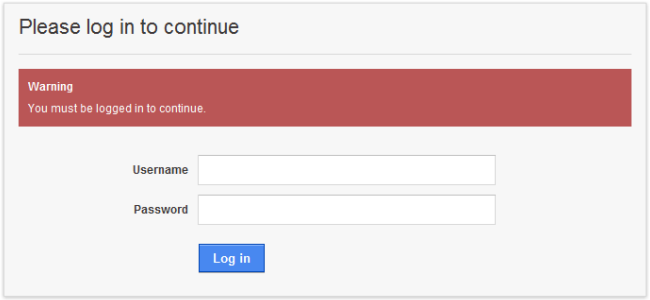

Figure 7 Error displayed to users during anonymous access

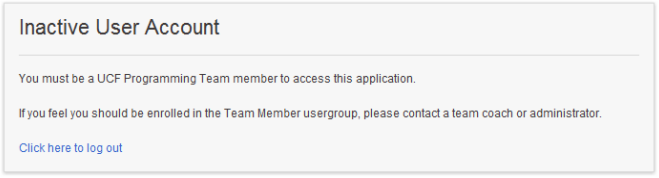

Figure 8 Error displayed to unauthorized user accounts

4.2 User Dashboard

The *Dashboard* is the primary landing page for the system. It provides essential information at the moment of login. For those in the *Team Members* usergroup, information regarding the most recent reports is displayed (Figure 9). For *Coaches*, summary statistics of the current and immediately prior report periods are displayed (Figure 10). For users matching both groups, both sets of data are available.

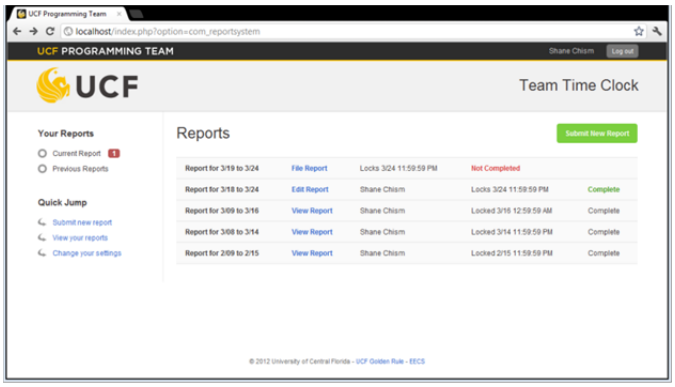

Figure 9 *Team Member* Dashboard interface

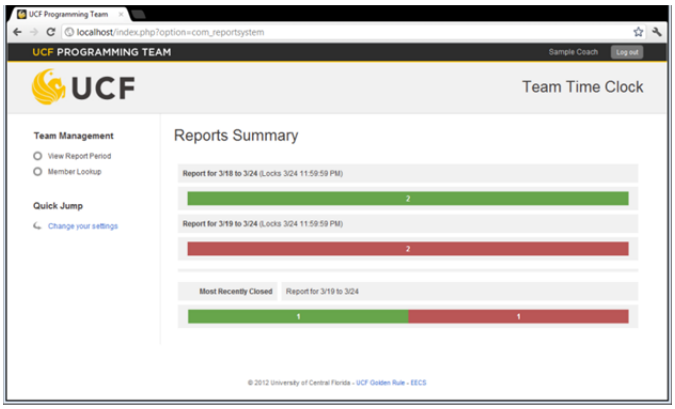

Figure 10 *Coach* Dashboard interface

4.3 Notifications Menu

Prominently displayed on every page for *Team Member* users is the "Current Report" button. This button displays a noticeable red square any time a report is due (Figure 11). In this square the user can easily see how many pending reports they have yet to complete. This approach encourages easy completion of reports which have been previously overlooked.

Figure 11 Two possible report status states

4.4 Reminder Notifications

As part of a scheduled task which is executed early each morning, the notification dispatching algorithm executes an SQL query which selects all users who have not yet submitted a report that will be closing within the next 24 hours. Once stored in memory, these records are then iterated over where the user's full name, e-mail address, and their missing report period(s) are passed into a mailer function.

The mailer function sends an HTML-styled e-mail to the user informing them of their need to submit a report and providing them a link where the report can be completed.

4.5 Report Completion and Editing

Team Member users can access the report completion page through a number of different elements: the *Current Reports* link, through the *Previous Reports* listing, or through the *User Dashboard*. After loading the report submission interface, controls are presented which allow the user to select the report they wish to submit to, as well as fields for entry of tasks and descriptions relevant to the period (Figure 12). By default, one activity log entry is displayed and the *Report Period* with the closest approaching deadline is selected.

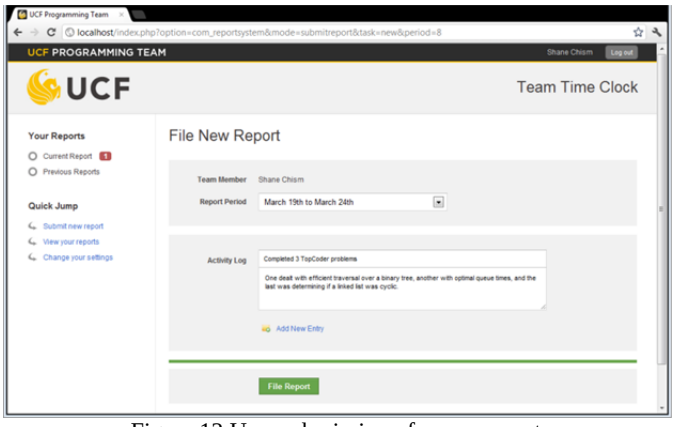

Figure 12 User submission of a new report

If a user wishes to add additional log entries to their report, they can simply select the "Add New Entry" dialog button and a new entry will appear on screen. Similarly, if the user wishes to delete an entry they simply click on the delete icon and, after a confirmation dialog (Figure 13), the entry disappears.

Figure 13 Entry deletion dialog

The option to edit a report is presented in both the *Previous Reports* interface as well as the *User Dashboard*. This mode is nearly identical to that of the report submission interface; however, in the edit report interface the option to select a report period is replaced with static text informing the user of the report period's time frame and lock date. As discussed earlier (see Figure 4), the edit interface can only be accessed if the target report period has not yet locked (or, consequently, has been overridden).

4.6 Viewing Reports

Viewing of a particular report is granted to administrative users as well as the report's original author. The *View Report* interface is accessed through links generated on the various interfaces where reports are listed. Dynamic loading of a specific report is done through the addition of the variable `repid` to the URI.

Attempts to access a report which does not exist, or the user is unauthorized to view, will result in the display of an error message.

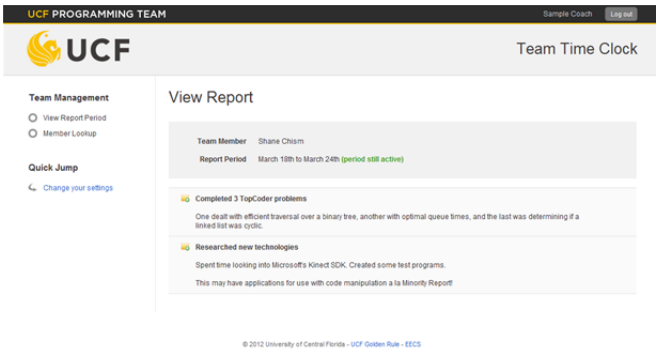

Figure 14 *View Report* interface

4.7 Viewing Previous Reports

It stands to reason that students may wish to access reports they have previously completed, either to edit the content or to view what they worked on during a previous report period. Additionally, until this point, no interface discussed shows users the specific reports they failed to complete during previous periods. The *Previous Reports* interface accomplishes all of these tasks (Figure 15).

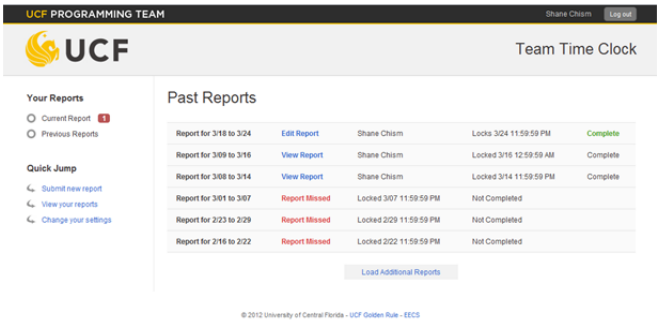

Figure 15 *Previous Reports* interface

4.8 User Settings Control

Available through the user settings page, any authorized user is permitted to modify their account e-mail address and/or their account password. For *Team Member* users, a color-coded graphic is presented allowing the user to see their performance at a glance (Figure 16). A green colored bar represents the completed reports, gray represents pending reports, and red represents missed reports.

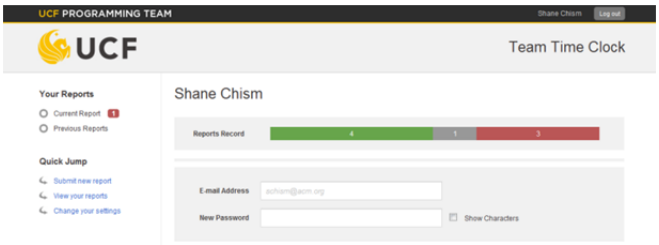

Figure 16 *User Settings* interface

4.9 Viewing Isolated Report Period

Administrator-Only Feature**.** Viewing a specific report period can be achieved either by clicking either on the "View Report Period" link or on one of the report period status graphics seen on the *Coach Dashboard* interface.

Once accessed, the *View Report Period* interface (Figure 17) provides several user interface components that allow an administrator to quickly see the status of the requested period.

Color-coded rectangles appear on the top of the page: Green rectangles indicate a user has completed a report, red rectangles indicate a user has not completed a report. Clicking on a green rectangle will immediately take the user to the portion of the page which contains that particular student's report.

Additionally, each report listing contains the report's full content, the time the report was last updated, and a link to the student's administrative page (this is discussed further in section 4.10).

To navigate to a different report period, the user can select the desired period from a dropdown box prominently displayed in the top right corner of the page. Once an option is selected, the page will automatically redirect to the desired period.

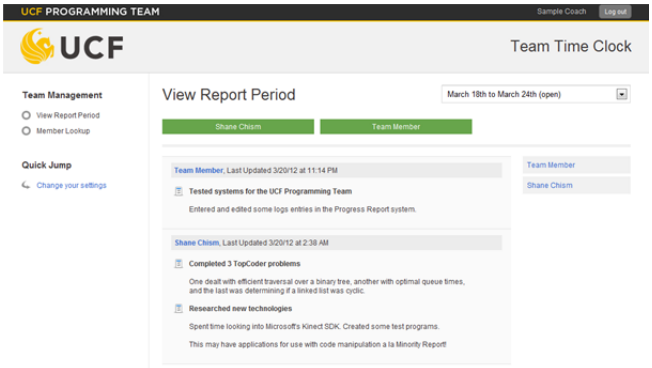

Figure 17 *View Report Period* interface

4.10 Viewing a Specific Member's Reports

Administrator-Only Feature**.** Similar in many respects to the *View Report Period* interface, this interface prominently displays a list of all report periods the *Team Member* has missed within the past six months. Additionally, this interface lists the report history for the user and provides a link where the administrator can view the report.

If a user has missed a report, in lieu of a viewing link, the administrator has the opportunity to grant an override (report period extension) to the user. If selected, the administrator must enter the number of days to extend the report period by. Report periods are extended on a user basis only, meaning an extension for a single user does not apply as an extension for all users.

4.11 Administrative Control of Users

Administrative control of users is achieved using the Joomla! default user administration system. With the sole exception of custom usergroups (*Team Members* and *Coaches*), this system was not modified. Additional information regarding Joomla! user administration, including resources for custom modification, is available in the official documentation [8].

4.12 User-Friendly Error Reporting

Implemented in the project's design was the idea that a quality system should not only execute expertly but fail gracefully. As such, wherever data is entered there exists client-side JavaScript code which is executed before the form is submitted. Should any error be present, this code will display an error message and highlight the offending field(s) (Figure 18).

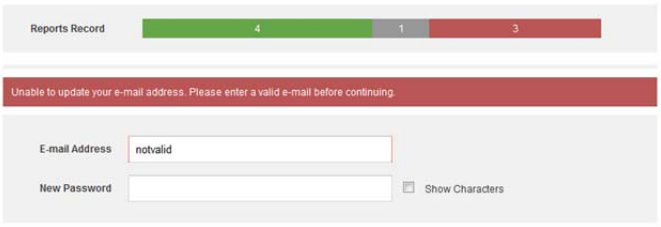

Figure 18 Sample error (from *User Settings* interface)

In the event that JavaScript is not enabled in the browser these features will be automatically disabled (or, more precisely, never enabled). All MVC components which process form data will include the same data integrity checks on the server side as are included on the client side. This enhances security and helps defend against cross-side scripting [9].

4.13 Scheduled Tasks

This specific implementation was designed for deployment on a Linux-based operating system. As such, the logical choice for scheduled task management proved to be a CRON job.

The CRON job created would access a specific page of the application every morning at 12:00 AM (Code 1). This task, as discussed earlier in section 3.6, determines the state of the system and executes operations as needed.

```
1  0 0 * * * /index.php?option=com_reportsystem& ↲
   mode=cron&task=all > log.txt
```

Code 1 CRON Job to execute every morning at 0:00:00

```
1  SUCCESS : New interval created beginning ↲
   1332043200 (03/18/12 12:00:00 AM) and ↲
   ending 1332644399 (03/24/12 11:59:59 PM).
2  Mailing operations completed. 0 ↲
   notification(s) were dispatched.
3  CRON Execution has been completed. 0 ↲
   error(s) were encountered.
```

Output 1 Output from sample CRON execution (7 day period)

The task this CRON job will execute is dictated by the `task` URI variable (Figure 5) which is mapped as follows:

- Task(`rperiod`): Execute Report Period updates
- Task(`notifications`): Dispatch pending notifications
- Task(`all`): Execute the above steps in succession

5 Future Opportunities

There are several ways this system can be upgraded to either enhance the user experience or provide more flexibility for system administrators.

5.1 University Integration

Most universities, UCF included, utilize some form of student identification number. During user registration, administrators could provide a student's University ID which the system would then be able to associate with a student's academic record. This integration opens opportunities for more comprehensive attendance tracking, academic evaluation, demographic analysis, and grade reporting.

5.2 Social Media Integration

Integration of social media into a system can be very difficult to do correctly. Social media that is too divergent from the system's intent may very well prove detrimental to the system's acceptance and performance.

For the purposes of the discussed implementation, a possible application of social technology could involve GitHub. A service such as GitHub would allow for automatic reporting when a student pushed code to a repository, along with in-line display of the relevant source code.

5.3 Report Feedback

While not applicable for our implementation, it stands to reason that instructors may wish to provide feedback to students based on their reports. This feature can be integrated seamlessly through the *View Report Period* and *View Report* interfaces. Automatic e-mail notification of instructor feedback would also be necessary.

6 Conclusion

While deployment of this system is still in its early stages, preliminary data regarding the efficiency and usability of the system is encouraging. Student feedback to the system's design and implementation is positive, while faculty members are seeing a drastic increase in efficiency over previously used systems.

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Design of Blended Learning with WBT in Higher Education

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Abstract - *The effectiveness of e-learning is being examined in higher education with the support of the advanced Information and Communication Technology (ICT) and the educational policy research. However, e-learning is not steadily becoming popular due to a large number of processes for creating the e-learning contents, the e-learning cost problems and the public's lack of understanding of the importance and necessity of e-learning. On the assumption that especially the students in regular day school programs will attend classes on campus, we cannot explain completely the importance and necessity of e-learning only under the time and space advantages that the students can learn whenever and wherever they want. Hereafter, we will report the practical use of "Blended Learning" combining the web based training (WBT) and the face-to-face class that could be a solution to the above problem.*

Keywords: blended learning, e-learning, WBT, department of library and information science, information equipment research

1 Introduction

The e-learning system has become popular in not only the business education and higher education but also the elementary/secondary education along with the most up-to-date ICT since the latter half of 1990s in the USA. In Japan as well as in the USA, the introduction of e-learning has been conducted rapidly since around 2000 on the occasion of the network infrastructure maintenance including Internet connection in the elementary/secondary education performed under the leadership of IT Strategy Headquarters of Japanese Government and the education system to approve credits in the lectures using the Internet, reformed by the University Council of Japan.

Furthermore, the effectiveness of e-learning is being examined to cope with an interest in lifelong education and knowledge management and the hard competition between universities caused by the decrease in the number of children.

While the progress of e-learning is now planned in higher education based on the educational policy research, the percentage of universities and junior colleges that use e-learning are 46.1% and 19.7%, respectively. Because the percentage of universities and junior colleges among them that approve credits are 28.8% and 5.8%, respectively [1], we assume that the corresponding lectures are not recognized as the formal ones and e-learning is used for supplementary teaching in the face-to-face class and for self-learning to obtain a qualification. Even in the university including some teachers who responded "we use e-learning", most of them are supposed to do so from their own personal viewpoint. There seems to be a lot of universities that have introduced the Learning Management System (LMS), created the e-learning contents in several classes and used them for supplementary teaching at the beginning, without having achieved the university-wide e-learning spread.

The obstructions to e-learning spread are summarized as follows: (1) a large number of processes for creating the e-learning contents and the e-learning cost problems and (2) the public's lack of understanding of the importance and necessity of e-learning [1]. Because the universities and graduate schools that the students can graduate from through e-learning only are limited to the correspondence students as the conventional model, it is easy to gain public understanding of the importance and necessity of e-learning introduction. However, it can easily become unclear how we should integrate e-learning into a curriculum for the students in regular day school programs. On the assumption that the students in regular day school programs will attend classes on campus, we cannot explain completely the importance and necessity of e-learning only under the time and space advantages that the students can learn whenever and wherever they want. In addition, we have not still succeeded in motivating the students to learn

continuously, which seems to be a major problem of open university, even with the conventional printed teaching materials and the newly developed e-learning system using multimedia technologies. The advantage of e-learning that the students can learn whenever and wherever they want is also regarded as its disadvantage that the students may not learn as well.

2 Blended Learning

Some researchers have already reported the practical use and effectiveness of blended learning in class [2][3][4]. At present, the e-learning materials are not used independently in education sites including the business education and higher education institutions, so that a new education system that e-learning is combined and used with group training in the classroom has been generalized. It can be said that blended learning is a learning method that has both the advantage of the face-to-face class between a teacher and students in group training and the advantage of e-learning that is free from the time and space limitations.

Before creating the class program in the face-to-face class, the teacher selects the proper teaching method from the lecture, exercise and discussion to enhance educational effectiveness in accordance with the learning contents. In the e-learning system, it is also possible to grasp the understanding levels of the students through the lecture in classroom learning and the drill and practice program or the tutorial exercise and to run a group discussion in the cooperative learning situation. However, a large number of processes for designing and creating the e-learning contents and the high cost of supporting them are required to try to produce the same learning effectiveness as the face-to-face class by introducing the above elements into e-learning.

Recently, blended learning that makes useful the characteristics of e-learning and face-to-face class and blends both of them has attracted a great deal of attention. Blended learning could be a solution to a large number of processes for creating the e-learning contents and the e-learning cost problems that are considered to be the obstructions to e-learning spread.

The e-learning contents should be created mainly to allow the students to acquire basic knowledge using the images and videos as multimedia objects and the drill and practice questions or the tutorial questions. The students will be able to have higher learning effectiveness by deepening the acquired basic knowledge while the teacher runs a group discussion or asks the students some questions in the face-to-face class.

3 Development of Blended Learning

3.1 Framework of Blended Learning

Our university's standard formula for 2 units of credits is 15 times x 90 min. of instructional time in a regular lecture class. In blended learning designed in this paper, we framed and used 10-time asynchronous learning with WBT and 5-time synchronous learning that corresponds to the face-to-face class. The class program was created by separating the knowledge acquirement part suitable for the WBT from the question/group-discussion part suitable for the face-to-face class. Our university has already prepared the "System

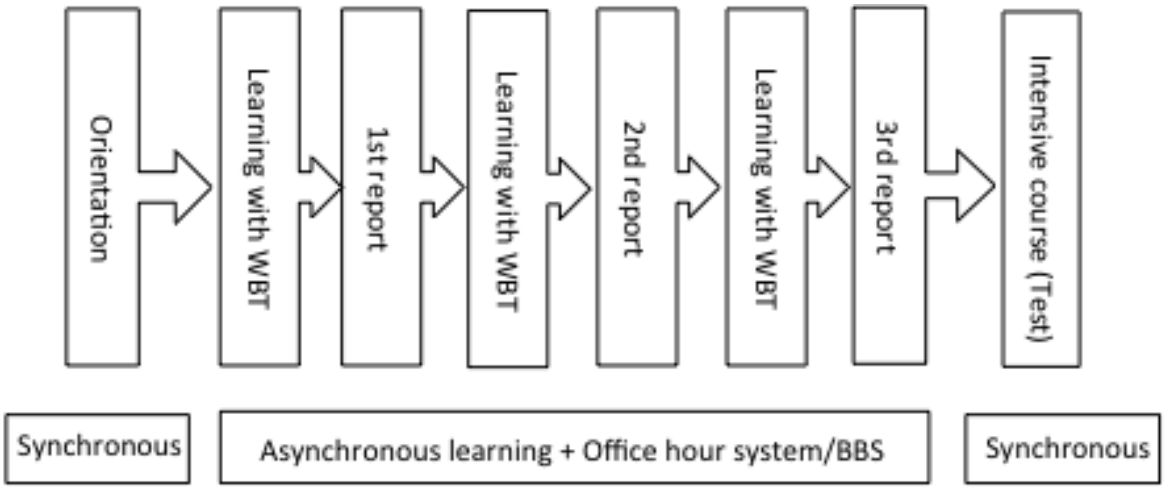

Fig. 1 Framework of blended learning

to Display Data of Students" that various functions such as the bulletin board system (BBS) are integrated, but the learning management for each student's history of accessing the e-learning contents and each student's score of questions cannot be carried out on the information system because the LMS is not introduced. In order to check the students' learning contents, we determined that the students should submit a report 3 times before taking an intensive course as shown in Fig. 1. Concerning the students' questions about the WBT materials, the subject teachers and the media education center's staff answered their questions about the learning contents and those about the method of using the WBT materials on the BBS and teacher's office hour system, respectively.

3.2 Preparation of WBT Materials

When the class scene is imaged and recorded, the actual class may be filmed directly in a classroom, or a temporary class may be filmed in a studio. In blended learning, it is supposed that higher learning effectiveness will be produced by creating the class contents that meet the characteristics of synchronous and asynchronous classes. For this reason, it is not appropriate that the conventional face-to-face class filmed is used as the WBT materials. Therefore, the subject teachers have prepared the WBT materials using a presentation software program (Microsoft PowerPoint) at the beginning, and they have also filmed the WBT materials completely in a studio.

As described above, the serious obstructions to e-learning spread are a large number of processes for creating the e-learning contents and the e-learning cost problems. When asking a contractor to film the actual class in a classroom or a temporary class in a studio, we must generally pay a heavy cost. Because an unnecessary part must be cut out from the actually filmed image and the editing tasks including video insertion is indispensable, we will have to pay really additional costs. In this study, the learning materials were displayed on the PC screen and the WBT materials were prepared using the general-use, in-home appliances that can be mixed with a videoed image of teacher, so that a low cost was needed for the imaging devices. However, only one imaging staff had to perform a task in the studio for switching the PC screen with the image of teacher and recording the teacher's voice. With a large number of processes for preparing the WBT materials, the editing tasks took approximately three times as long as the class

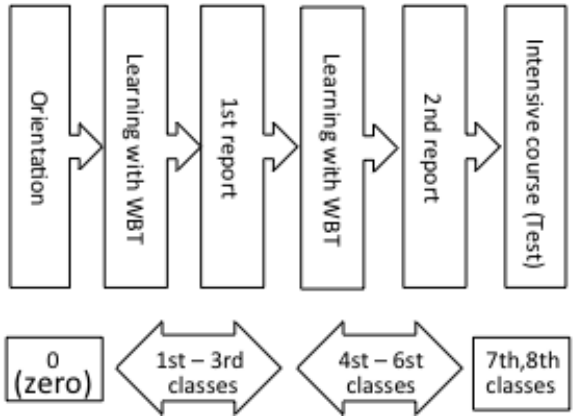

Fig. 2 Framework of "Information Equipment Research"

time. However, a newly developed class recording method has been introduced to enable only one subject teacher to record and edit the class by controlling simultaneously the PC screen and the web camera image of teacher with video capture software. The class recording devices consist of low-price video capture software, personal computer and web camera only, which are very easy to operate, and they enhance effectiveness of both the cost and the number of processes.

3.3 Practical Use of Blended Learning in "Information Equipment Research"

The "Information Equipment Research" in the Department of Library and Information Science of our university is a subject to approve 1 unit of credit. The above "framework of blended learning" is to approve 2 units of credits, but with the same basic policy employed, we framed and used 6-time asynchronous learning with WBT and 2-time synchronous learning that corresponds to the face-to-face class as shown in Fig. 2. We made the students submit a report 2 times before taking an intensive course and maintained bidirectional flow based on the teacher's office hour system and the BBS during learning with WBT.

We put in order the relationship between library and information equipment and the components of information equipment including the personal computer as the main element as shown in Fig. 3 and created the class program of "Information Equipment Research" (Table 1). We entered the approx. 10-min library tour program in the class No. 1. by taking advantage of the WBT. This program is planned to make the students confirm the information equipment used in the library and

Table 1 "Information Equipment Research" class program

No.	Class Title	Class Contents	Subject Report
1	Library and information equipment	・Outline of subject/Lecture contents ・Library and information equipment (Library tour)	
2	Mechanism of PC	・Information display ・Data processing	
3	PC hardware	・PC configuration ・CPU and memory	1st subject report submission
4	Auxiliary storage	・Magnetic disk (hardware disk, floppy disk) ・Auxiliary mass storage (CD, DVD, etc.)	
5	Peripheral equipment	・Input device ・Display unit/Printer	

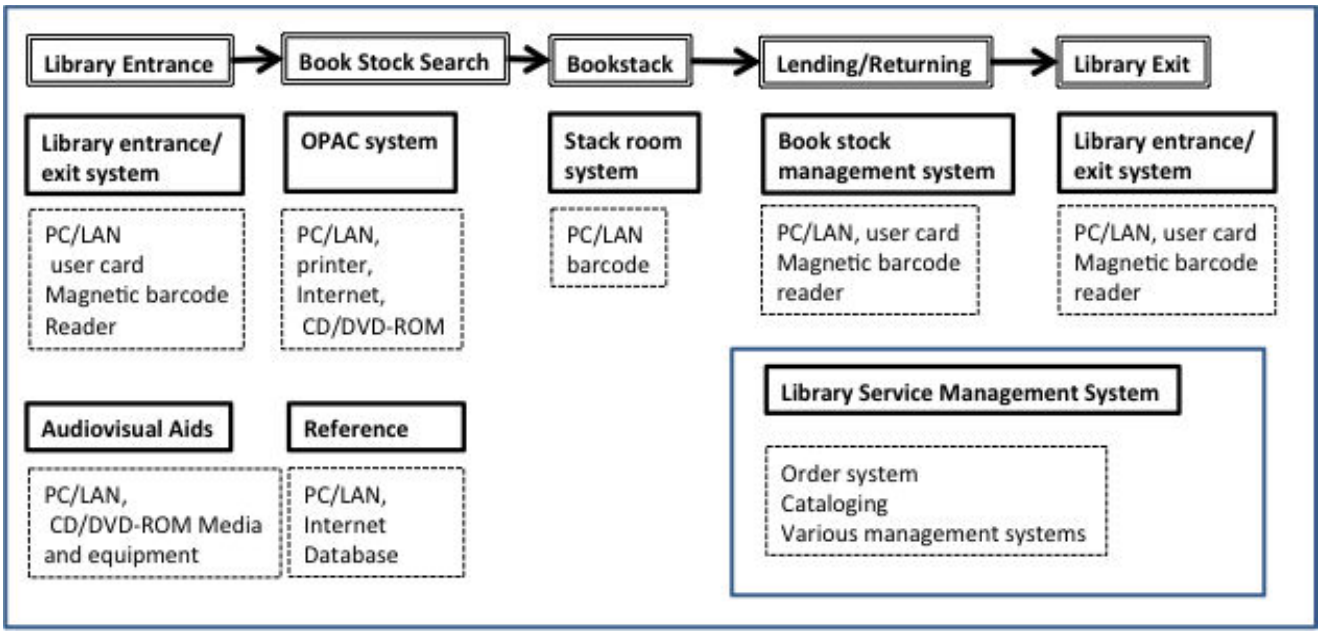

Fig. 3 Relationship between library and information equipment

the learning contents in the lectures, feel the information equipment more familiar, and continue their subsequent learning.

Fig. 4 shows the images of WBT materials. The left and right sides of a screen display the teacher image or streaming image and the static image of

learning materials created using PowerPoint, respectively. Because the WBT materials stored in the campus server can be used on not only the PC on the Net but also the PC that has downloaded a

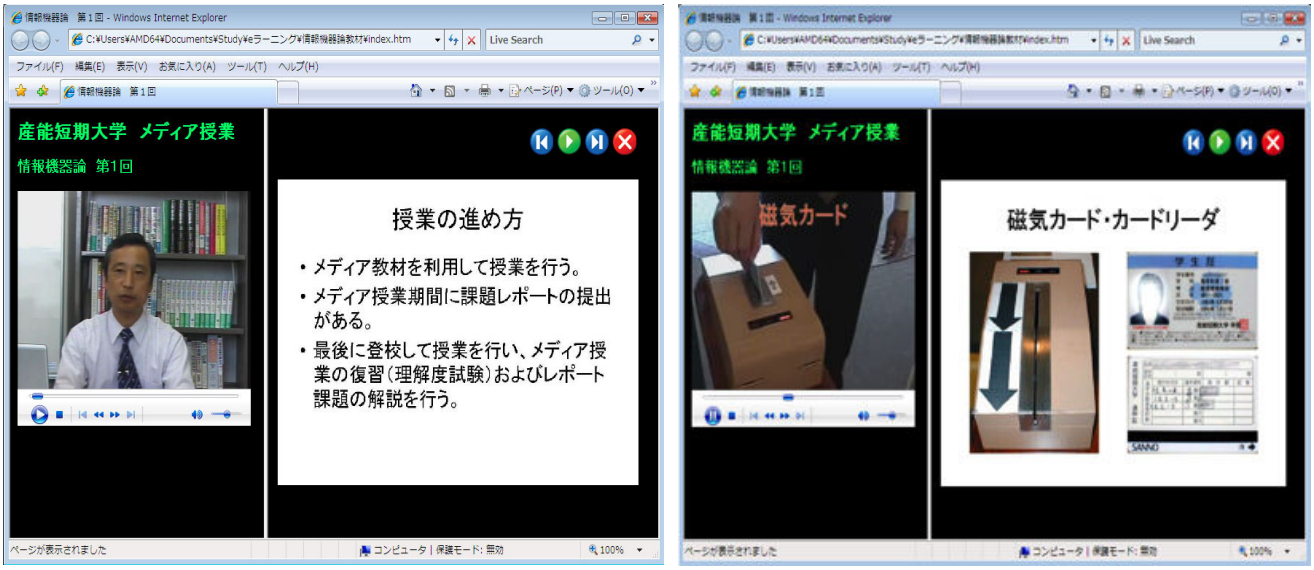

Fig. 4 Image of WBT materials

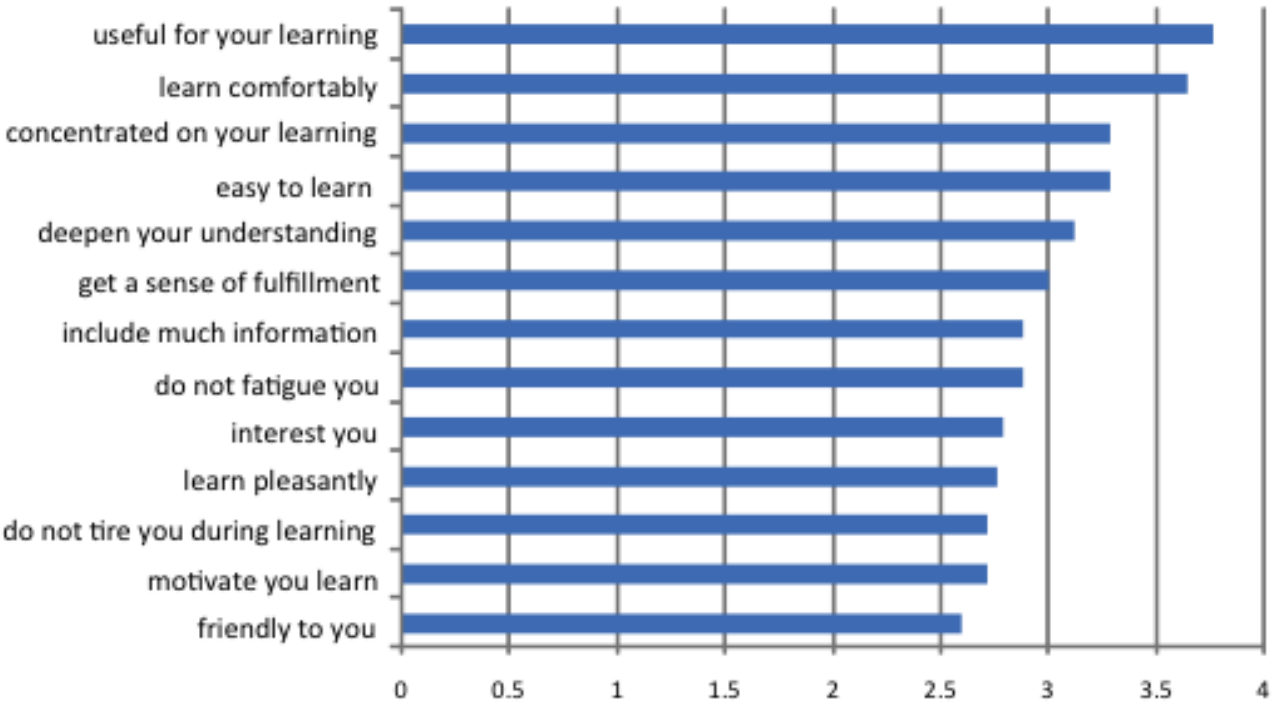

Fig. 5 Results of questionnaire investigation carried out for students (N = 26)

file of the WBT materials from the Net, this increases freedom of time and space in learning to the students.

3.4 Assessment Given by Students

We carried out the questionnaire investigation on learning with the WBT materials for the students (N = 26) taking lectures on the "Information Equipment Research". Thirteen (13) questions were put to the students and their 5-level answers were made to each question as follows: "I think so" is 5; "I think so a little" is 4; "Yes and No" is 3; "I think so little" is 2; and "I do not think so" is 1.

Although the reliability of this questionnaire investigation is not so high due to a small amount of data, it may be possible to grasp the students' learning tendency. Fig. 5 shows the results of this questionnaire investigation. The mean value of all questions was 3.03. The high-score questions are more than 3.5, asking the students if "the WBT materials are useful for your learning" and "the WBT materials can be used to learn comfortably". These students seem to praise the characteristics of e-learning that they can learn whenever and wherever they want if the PC is available.

On the contrary, the low-score questions ask the students if "the WBT materials are friendly to you", "the WBT materials motivate you learn", and "the WBT materials do not tire you during learning". These questions indicate that it is hard for each student to continue learning by himself in spite of the advantage that he can learn whenever and wherever he wants if the PC is available. The questions asking the students if " the WBT materials can be used to learn pleasantly" and "the WBT materials interest you" are also low score in the same way. Because each student must learn by himself on the PC as well as above, it is considered that he is not motivated enough to learn. The question asking the students if "the WBT materials do not fatigue you" is also low score, and this always becomes a problem in learning on the PC using the web image. It is necessary to examine the design of screen to prevent the students from being fatigued.

4 Conclusion

We surveyed the advanced e-learning in higher education and explained completely the effectiveness of "Blended Learning" that could be a solution to a large number of processes for creating the e-learning contents and the e-learning cost problems, which are the obstructions to e-learning spread for the students in regular day school programs, and to the public's lack of understanding of the importance and necessity of e-learning. We developed the framework of blended learning by using practically the BBS and teacher's office hour system and making the students submit the subject reports, without introducing the LMS. Based on this framework, we created the WBT materials to conduct the class program of the "Information Equipment Research" in the Department of Library and Information Science.

Because the students seem to feel relaxed in learning with WBT at their own pace and also to have a monotonous sense from the results of our questionnaire investigation, we must develop the interactive teaching materials that not only we supply one-sided information to the students but also they can do something to us. In addition, the question asking the students if "the WBT materials do not fatigue you" is a low score, and this always becomes a problem in learning on the PC using the web image. This status indicates that we must examine the design of screen or interface to prevent the students from being fatigued or bored.

Our university's standard formula for 1 unit of credit is required to keep 45-hour instructional time (in a subject of study to lecture, 15-hour class in classroom and 30-hour learning outside classroom). Thus, blended learning is also effective as a means of allowing the unit of credit to be approved by applying learning with WBT to learning outside the classroom.

Furthermore, blended learning can enhance the learning effectiveness by changing flexibly the rate of blending between leaning with WBT and face-to-face class according to the characteristics of classes such as the knowledge acquirement, exercise and discussion. We are going to introduce the LMS to check each student's history of learning contents, use practically the LMS as a means of allowing the unit of credit to be approved in not only the subjects of study to lecture but also those to exercise, and develop more effective blended learning in future.

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A CSCL Model for Educational Multiplayer Games

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Abstract - *Teaching computer programming to novices has always posed a major challenge to educators. Many novices acquire basic programming skills but they are unable to utilize them in a meaningful way to solve non-routine problems. As a result, they do not achieve any level of programming fluency. Collaboration has been identified as a useful tool to help overcome this problem if utilized at the right times during the programming/problem solving process. This paper presents a model for a synchronous gaming CSCL (Computer Supported Collaborative Learning) application aimed at improving problem-solving skill. The model addresses some major issues in CSCL such as unequal participation among group members, increasing argumentative discussion and promoting positive interdependence and individual accountability. A game, Collaborative Online Problem Solving (COPS), which was developed using this model, is presented. COPS aims to improve the problem-solving skill of novice programmers, by requiring them to collaboratively build program flowcharts.*

Keywords: CSCL, collaborative learning, problem solving, programming, educational game, metacognition

1 Introduction

Learning to program is a difficult process for many students; this is reflected in the high failure rates in introductory programming courses around the world. In Trinidad and Tobago, and by extension the Caribbean region, secondary school students write the Caribbean Secondary Education Certificate (CSEC) Information Technology exam. This syllabus contains two sections on problem solving and programming in Pascal and annual reports produced by CXC (Caribbean Examination Council) have continuously indicated the difficulties faced by students with these two sections. This is especially worrying since programming lies at the core of information technology and increasing attention has been given to producing students who are considered fluent in information technology, most recently highlighted in [1]. In [2] and [3], the authors identify low problem solving skill as one of the main reasons for this high failure rate. The results presented in [4] also highlight the designing of a program to solve a particular task as a major difficulty faced by novice programmers. Computer Supported Collaborative Learning (CSCL) has been identified as one of the most promising innovations to improve teaching and learning with the help of modern information and communication technology [5] since it aims to enhance learning by combining computer support and collaborative learning [6]. This paper proposes the design of an online multiplayer game, COPS (**C**ollaborative **O**nline **P**roblem **S**olving), which utilizes CSCL principles to assist students with their problem solving and program design by strengthening their problem solving ability. Most of the successful CSCL systems have employed the use of existing technologies such as forums, whiteboards, learning managements systems and shared workspaces asynchronously but COPS encourages synchronous collaboration between learners. COPS is developed based on a model which we introduce for a synchronous gaming CSCL application. It addresses major issues in CSCL such as unequal participation among group members, increasing argumentative discussion, promoting positive interdependence and individual accountability.

2 Background Review

2.1 Collaborative Learning and Programming

Collaborative learning is an instruction method in which students work in groups toward a common academic goal [7]. Some of the major achievements of collaborative learning as described by [8] include (1) Motivation since the students are driven by a reward or goal and they recognize that they can only achieve their goals if the other members of the group succeed. (2) Social Cohesion implies that the students may actually care about the other members of their group. (3) Development since each member will be exposed to the different abilities and viewpoints of the individuals in the group and (4) Cognitive Elaboration since each member of the group will be required to explain their solutions in a social context and they benefit from having to provide their explanations.

In [9], the following criteria are presented for tasks which are deemed applicable to collaborative learning;

- The task is complex or conceptual
- Problem Solving is desired
- Divergent thinking or creativity is desired
- Mastery or retention is important
- Quality of performance is expected
- Higher level reasoning strategies and critical thinking are needed

All of the above criteria clearly apply to computer programming and real world applications of programming are indeed collaborative. In [10], the following five critical attributes for successful collaborative learning are given;

1. Common Task or learning activity
2. Small group learning
3. Co-operative behavior
4. Positive Interdependence
5. Individual Accountability and responsibility

The author in [11] used the above framework to analyze the pair programming pedagogy and concludes that pair programming is a model for collaborative learning. Pair programming research has had many successes including higher quality programs being written [12], decreased time to complete programs [12], and improved performance on exams.

An experiment conducted in [13] also concluded that collaboration is an important pedagogy to use in teaching computer science and in performing java programming, their experiment investigated the influence of collaboration through pair programming and groups of three or four students. Collaboration was deemed to be most important in the 'brainstorming and formulating the problem' step of the programming process. This result follows with research that the major cause of students' failure in introductory programming is the lack of basic problem solving skill [2]. The author in [14] describes three basic attributes which are required by a successful problem solver; basic skill / cognition which can be thought of as individual learning objectives; metaskill / metacognition which refer to knowing when and how to use the basic skills and motivation.

2.2 Computer Supported Collaborative Learning

Computer supported collaborative learning (CSCL) aims to improve the collaborative learning experience by utilizing the rapidly evolving technology available to students in the classroom. Originally, collaborative learning was mainly adopted in classroom based environments which required face to face interaction between students and lecturers but web based implementations of CSCL eliminates the need for this physical interaction. Although there has been an abundance of research in collaboration and programming in the pair programming pedagogy, there is still the opportunity for exploration of CSCL and programming. The turtle graph system [15] uses collaboration to help teach recursion and has shown considerable success. A study involving the KnowCat system [19] concluded that some students' metacognitive skills increased after using a CSCL environment and that the use of CSCL systems can enhance the development of metacognitive learning processes. Findings from [4] show that novice programmers prefer practical programming sessions and collaborating with lecturers or other students and this indicates that a CSCL application of programming can be very successful.

2.3 Using Games to Teach Programming

In [17], the authors argue that traditional teaching of computer science education is not well suited to millennial students and they suggest that collaborative educational games can make the experience better for both students and educators. A work in progress attempt at a CSCL video game is given in [18] and the authors in [19] agree that the principles of CSCL and problem solving can be applied to multi-player games. Most recently, [20] agrees that online multiplayer games are an attractive and useful avenue for developing educational games. The use of games to teach introductory computer science and computer programming is well documented [21]. A game environment is described as one in which the concepts that emerge from interacting with it are created by the goal [22]; the authors recognize the highly abstract nature of core programming concepts and suggests that games which are successful at teaching programming are those which causes the learner to develop and understand concepts from the content of the game as a consequence of its system and interface. Traditional learning approaches using computer support have always utilized user or learner centered design since the learner is identified as the main component but since we are dealing with a group of students and not an individual, [23] recommends that we utilize task or activity centered design principles and this is easily achieved by the use of a game which is designed around completing the objectives of the game.

3 Game Design

3.1 Overview

In [3], the authors present a six step model which describes the computer programming / problem solving process; formulating the problem, planning the solution, designing the solution, translation, testing and delivery. The first three steps are those which present the toughest task for novices since it requires the problem solving ability which they lack. Two common tools which are used during these steps are pseudocode and flowcharts. Pseudocode is a notation for programming which uses a combination of semi-structured programming structures and verbal instructions. Flowcharts are a visual representation of program flow using a combination of arrows and symbols to represent the actions and sequence of the program. An experiment conducted in [24] overwhelmingly indicated that students preferred flowcharts to pseudocode for understanding algorithms.

A web-based multiplayer game, COPS (Collaborative Online Problem Solving) has been developed which would allow students to collaboratively solve flowchart puzzle based problems. Flowcharts were chosen because they depict the sequence of the program as well as the actions; these actions are the basic skills / cognition which programmers require and the sequence of the flowchart represents the metaskill / metacognition which show how the basic skills are used in a

meaningful way to solve a problem. However, the use of pseudocode is very important in helping students translate their solution into program code and as such pseudocode was utilized throughout the game to provide a guide for the players while solving the problem. Fig. 1 gives a screenshot of the COPS prototype. The area in the middle represents the playing area where players build the flowchart using the pieces from the container in the bottom right.

The target users of COPS are secondary school students (ages 13-17) and as such, a web based implementation was chosen because of the increasing familiarity of adolescents with online multiplayer games such as World of Warcraft. This implementation would also allow the students to collaborate outside of the classroom where they may be more comfortable and express themselves more freely. Like other online multiplayer games, COPS forces synchronous communication and this will encourage higher communication activity between players [25] which is essential for knowledge construction in CSCL.

3.2 Gameplay

COPS requires a group of between two to four players/students. The group will be required to create a flowchart to solve a given problem within a specified time. The game will have three levels; beginner, intermediate and expert. At the beginner level, the students will be given all the pieces of the flowchart (symbol and text within symbol) required to solve the problem and they simply have to build the flowchart like a jigsaw puzzle placing the pieces in the correct order. At the intermediate level, the students will be given the flowchart in incorrect order like a scrambled picture and they will be required to re-arrange the pieces to form the correct flowchart. At the expert level, the student will be given the flowchart symbols and the text for the symbols separately and the students will be required to match the text to the correct symbol and build the flowchart. Additionally, the students will be given extra symbols and text which do not form part of the solution.

4 CSCL Gaming Application Model

COPS has been developed using a model which we propose that takes into account the research found in the literature about CSCL. The model identifies the attributes of the game design that should be incorporated to make a successful CSCL environment for teaching problem solving and program design. A notable feature of this model, shown in Fig. 2 is the encouraging of collaboration between the learners, as opposed to cooperation. Using this model, each learner does not work on individual parts of the problem; instead the entire group works on the problem synchronously. The model describes the necessary input components for the game: leaner task, leaner groups, and game design and characteristics. A scripted game cycle is then given in which the group is forced to collaborate after a user action which leads to group actions. The game then updates to provide system feedback in response to the user and group actions and also guide the players towards achieving the task. Finally the game must provide output to both the learner and the educator. The learner should have accomplished some level of mastery of the skills learnt throughout the game. The educator will be provided with data regarding the individual and group performance, collaboration and participation. This data is important to allow the educator to refine the learning process to continuously produce better results. We will discuss this model from the perspective of the COPS multiplayer game.

4.1 Learning Task

Each task in COPS targets a specific skill such as read/write, selection or iteration. This approach is necessary to ensure that the students master these skills so they will be able to utilize them in a more meaningful way to solve other non – routine problems. For example, in the beginner level, the students will be instructed on which iteration structure to use such as 'while' or 'for' loop but in the advanced levels, they will simply be asked to solve the problem.

4.2 Learner Groups

Each group contains between two to four students who are familiar with each other and can interchangeably play within different groups. The players are expected to be novices who are at the same programming competency level. All members of the group will be working on the same puzzle simultaneously. The game has a chat facility to help facilitate communication. Puzzles have traditionally been attempted collaboratively and real world programming is a collaborative process.

4.3 Participation and Argument

In [26], the importance of equal participation by all members of the group and argumentative discussion in the collaborative leaning process is highlighted. The lack of dialogue between the members of the group in CSCL is documented in [27] and we expect to see these problems since it is prevalent in group work where certain members of the group take full responsibility and other members do not participate. These problems were addressed in the game through multiple features. Firstly, the turn based design of COPS ensures that each member of the group participates in the problem solving process, when a user makes a move; the other members of the group are polled by the game asking if everyone agrees.

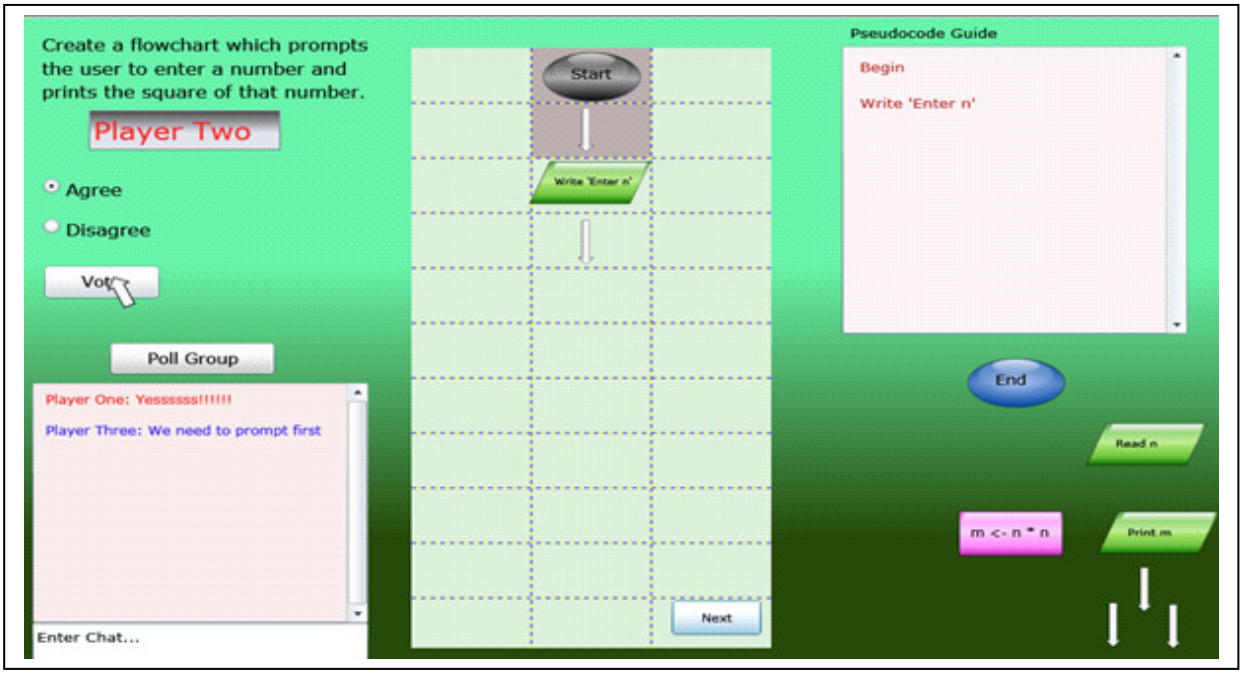

Figure 1. Screenshot of COPS

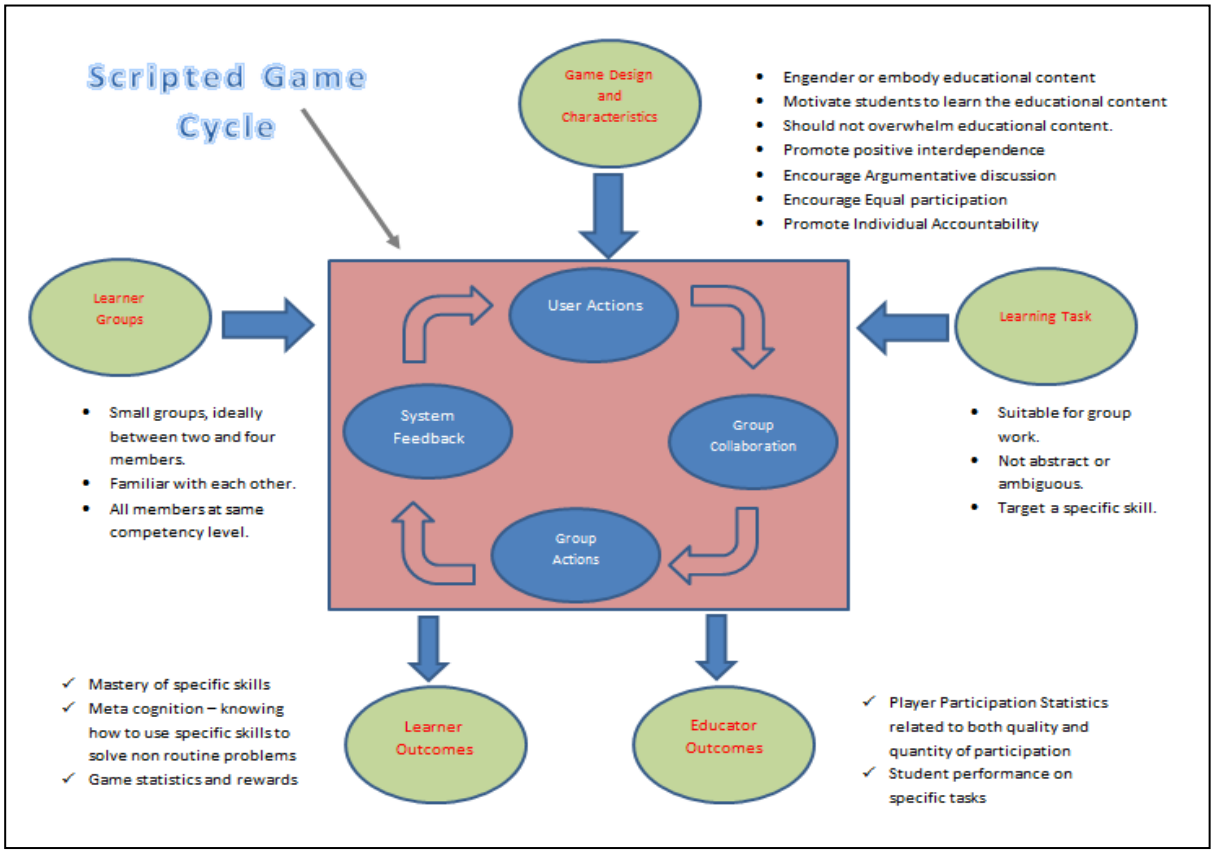

Figure 2. Model describing a gaming application of CSCL.

If the poll receives a positive result, the move is allowed else the game rejects the move and the game moves to the next player. To avoid cases of split votes, the player who made the move automatically receives a higher weighted positive vote than the other players. Additionally, when it is a player's turn, they can choose to undo previous moves before making their own move. The turn based design also lets students know that in order to solve the puzzle and win the game, every member of the team must succeed as well; this is referred to as positive interdependence. This forces the group to care about the decisions and learning process of each other.

This component of COPS which polls the members of the group will not only encourage greater participation by all group members but it will also encourage argumentative discussion between the players using the game's chat facility and the undoing of previous players' moves. Each player must convince their group members of their decision if the entire team is to succeed therefore; each member of the group becomes accountable for their decisions. In [29], the authors recognize that each member of the group's participation can be measured by counting the number of chat entries made but the epistemic value of the member's contribution cannot be easily obtained from the chat logs. The epistemic dimension is not concerned with the quantity of participation but the content and value of the member's discussion related to solving the puzzle. The result of the player polls and the tracking of undoing of previous player's moves (both correct and incorrect undoing) provide a better opportunity to measure the epistemic contribution. COPS keeps track of this data and it can be used by educators to improve the learning of students.

4.4 Coordination and Guidance

In [28], the author recognizes the importance of proper coordination in CSCL environments to ensure that the individual efforts of the group members contribute to the learning task. This coordination is usually provided by the technology itself acting as a mediator by providing chat facilities and shared workspaces but COPS takes a more interactive approach. It is expected that the entire group may get stuck at a certain step and this can be dangerous to the learning process. To help prevent this scenario, pseudocode matching the flowchart solution being constructed will be automatically generated; the students will be able to view the pseudocode version of their solution and more easily recognize where they have gone wrong in their solution. Another aspect of the game which will guide the learner's process is an accuracy indicator for the puzzle solution; when the group has placed a portion of the puzzle in the correct sequence, that portion will change color and players will not be able to alter any of the pieces within that portion.

4.5 Motivation and Positive Interdependence

The authors in [29] highlight the importance of motivation in computer programming courses due the uniquely demanding requirements of learning to program and motivation has also been identified as crucial to a problem solver. The use of games to provide motivation in learning and programming is well documented in [2] and therefore the game based design of COPS will provide motivation to students. In COPS, the players are only rewarded when the entire group succeeds and all members of the group are rewarded equally. This will motivate the individual members to do their best and also encourage and help the other members of the group to do their best; this also promotes positive interdependence. Additionally in COPS, the group will be provided with a target number of moves in which to complete the puzzle and if they do, the entire group will receive bonus points. This feature of the game is intended to motivate the players to collaborate more with their peers to ensure that the best possible moves are made throughout the game. Additionally, COPS maintains the individual score for each player for all games played (possibly with different groups). The current highest score is displayed so players can set themselves the goal of becoming or maintaining the lead in the game. This encourages them to play the game often, thereby achieving greater learning.

5 Future Works

The model presented has satisfied the attributes of successful CSCL and is tailored towards improving problem solving skill. COPS has been designed to improve the problem solving ability of novice programmers but innovative ways must be developed to evaluate students after the collaboration has concluded. Another single player game is being developed which will evaluate students based on the learning tasks used throughout COPS. This game will also be designed to help students master their coding skill within a specific programming language. However, it will still be necessary to have formal evaluation exercises such as classroom examinations to measure the student's improvement against their expected competency level.

6 Conclusion

Low problem solving skill has been identified as one of the main contributors to the difficulties faced by novice programmers. Collaboration, if utilized at the right times during the programming/problem solving process can help solve this problem as evident in research performed in pair programming. CSCL provides an avenue for enhancing this collaborative learning through the use of technology. In this paper, a model integrating the various elements of CSCL was

presented. The multiplayer game, COPS, that was described adheres to the principles of collaborative learning and provides the cognition, metacognition and most importantly the motivation which is required by successful problem solvers in the programming domain. The various attributes of COPS were designed to force collaboration within a group in an effort to solve a problem while motivating them to ensure that the entire group succeeds since their own success lies within the success of the group. The use of games like COPS has become necessary to appeal to millennial students and help them become better problem solvers and programmers. The CSCL model presented can be applied to any subject domain in which collaborative learning is applicable and problem solving is desired.

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The Role of Mobile Technology and Social Media in Mobile Learning: A Literature Review

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Abstract- *Mobile technology will play a big role in transforming science fiction into reality and provide vast universal learning opportunities. An individual can utilize the internet to build a self-directed learning plan that integrates collaborating with experts and peers throughout social networks and access to many learning resources. Online communities support knowledge exchange and this kind of environments present now and will continue to extend and develop with new and innovative ideas generated in groups of individuals in the same wave. These communities will be incredible places for people to learn and grow. Mobile technologies have attracted the attention of researchers and educators through their potential as learning tools that support and enhance the learning experience. This paper attempts to makes a contribution towards understanding how can learners gain from mobile technologies and social networks in formal and informal learning***.**

Keywords*:* Mobile Learning; m-learning; Mobile Technology; Social Network; Informal Learning.

1 Introduction

Since Tim O'Reilly (2005) announced for the very first time the term Web 2.0 and has demonstrated a new way to deal with the World Wide Web; a radically transform occurred. Nowadays, the expression Web 2.0 is used to describe applications that distinguish themselves from the earlier generations of applications by a number of principles. The motivation of active participation separates Web 2.0 based learning from traditional Web 1.0 learning. For example, in traditional learning management systems, users read web pages and solve exercises but cannot contribute; as well the social interactions are restricted to forums. The power of Web 2.0 together with the social aspect captured by the 'harnessing of the power of the crowds'; these two principles are the most observable and the most analyzed and studied by pedagogical research [1]. As Stephen Downes states, "the Web was shifting from being a medium, in which information was transmitted and consumed, into being a platform, in which content was created, shared, remixed, repurposed, and passed along"; he emphasizes the constructivist nature of these principles and distinguishes the delivered learning of learning management systems with the learner-centered activities generated by Web 2.0 applications [2].

Due to the extensive use of wireless technologies and the high rates of mobile device adapted, online learning is transforming from desktop computers to mobile devices. Mobile communication technology is considered to be effective in promoting learner motivation and encouraging interaction between learners and instructors as well as among peers in online learning environments. In addition, the capabilities of Web 2.0 tools and services, such as Blogs and Wikis, allow distributing and storing of information facilitated by provided user-friendly interfaces. One characteristic of Web 2.0 services is their values are increased as more people using them. In the case of traditional static website, it does not get better as more people visited it because its contents are statically presented; while with Web 2.0 sites, visitors maintain the site's information, either by constructing the site or piece of it, or by activities used for adapting its content [1].

The use of Internet and Web 2.0 applications are growing rapidly, especially amongst younger generations. In addition, by using Web 2.0 instead of consuming static web pages, learners of today become active by sharing their opinions using different technologies on the Web. Currently, web applications such as Facebook, Twitter, Wikipedia, YouTube, etc. appear to have become part of everyday life and help us to interact, share and contribute to a worldwide universal community. Since Web 2.0 are using for teaching and learning purposes, Stephen Downes named it "e-Learning 2.0" [2]. Consequently, social networks such as Facebook, Twitter, Wikis, Blogs and Podcasts have turned out to be very useful tools that preserve teaching and learning to be more effective.

This paper addresses the benefits of using mobile technology in appropriate contexts. The following sections include a relevant background followed by a review of literature aimed to understand how students can gain from

mobile technologies and social networks in formal and informal learning.

2 Background

2.1 Learning

Learning is the acquirement of new, or the adaptation of existing knowledge, behaviors, and skills. Learning may take place as a part of training, education, or certified development program, however it also occurs informally and socially among peers, or in a casual way. It may be oriented by objectives, aided by motivations, or as a result from more complex activities such as games participation, that is "Learning is a social process that occurs through interpersonal interaction within a cooperative context. Individuals, working together, construct shared understandings and knowledge." [3]

In general, learning can be divided into formal learning, and informal learning. Formal learning takes place in education and training organizations, leading to recognized certificates and qualifications. Informal learning is a natural addition of everyday life. Unlike formal, informal learning is not necessarily intentional learning, and so may well not be recognized even by individuals themselves as contributing to their knowledge and skills. According to the vocational training policy terminology [4], informal learning is: "Learning resulting from daily activities related to work, family or leisure. It is not organized or structured (in terms of objectives, time or learning support). It is in most cases unintentional from the learner's perspective. It typically does not lead to certification." Informal learning, also known as self-directed learning, and since it is more natural, it is accepted and gives a user more flexibility in deciding when, where and what to learn. In fact, most learning occurs as such unstructured processes and is not directed by learning experts. According to surveys taken in USA in 2006, 75% of organizational learning is informal [5]. Furthermore, Informal learning relates with collaborative learning, which supports communication between learners, communities of learners and other forms of shared knowledge creation and sharing.

2.2 Electronic Learning and Mobile Learning

Electronic learning or (e-learning) is not a new concept, but often used to describe many different situations. The predecessor to e-learning was online learning. Online learning was widely talked about in the late 1990's and consisted of using network technology to design, deliver, select, administer and extend learning [6]. Basically, e-learning is a process in which we use electronic technology and internet as medium to access educational applications. The importance of e-learning is being a crucial support mechanism for educational institutions to enhance the performance of their students and teachers, as well as useful for organizations to enhance the performance of their employees.

On the other hand, Mobile learning, also known as m-learning, started from 1970s and extends broadly in 2000s. Although it has a close association with e-learning, it is diverse in the use of mobile technologies. M-learning allows students to learn with mobile devices or portable technologies without location restriction. That is to say, m-learning is a logical extension of e-learning with the potential to promote expanding to be available anywhere and anytime [7].

2.3 Defining Mobile Learning

The term Mobile Learning, or simply 'm-learning', has grown up along with the growth of mobile technology. Although related to e-learning and distance education, it is distinct in its focus on learning with mobile devices. One definition of mobile learning by O'Malley et al (2003) is, "any sort of [technology enhanced] learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies" [8]. Whereas Ally (2009) believes, "Mobile learning through use of the technology of wireless mobile devices allows people to access learning resources anywhere, anytime and any device. Accordingly, learners can manage what they want to learn and from where they want to learn. Mobile Learning provide to all humans the right to access learning resources to increase their value of life in spite of where they live, their background, and their status."[9]

While first definition focused on learning that happens when the learner is not at a fixed or predetermined location, the second has promoted m-learning to be "anywhere, anytime and any device". Further definitions are focused on utilizing learning using mobile technology since "mlearning has attracted a great deal of attention from researchers in different disciplines who have realized the potential to apply mobile technologies to enhance learning" [10]. Obviously, the platforms and devices existing now are more flexible and portable. The providing of unlimited access to content makes m-learning more convenient and valuable. As so the latest devices are designed to be 'always connected' to Internet, and along with the use of 'cloud computing', unlimited amounts of content directly available to vast numbers of users.

Since 2010, the iPad and iPad-like tablets represent another game change in m-learning. We realized that early smartphones were not really well suited for traditional curriculum delivery, but rather for information delivery and performance support. As well, laptops have the issues of

weight and battery life. Beyond doubt, the latest tablets and ideas of 'always on', 'the app', 'the cloud', and 'Application Store' make mobile learners always motivated by the unlimited educational resources. In this paper, we will apply simple definition for m-learning: m-learning is a ubiquitous and self-directed learning activity, occurring during the use of a mobile device which is supported by an appropriate mobile platform, application and a pedagogical approach.

2.4 The shift towards Mobile Learning

The vision of mobile learning presented by the majority of authors currently writing in this field seeks to enable "anywhere, anytime, and any device" portable and personalized learning. The current movement towards mobile learning was identified by Wagner (2005) as she predicted that mobile learning will be the trend of future education which allows learners to have different and rich learning experience. Moreover, Wagner (2005) assumes that, when using m-learning in appropriate contexts, it will facilitate communication, creativity and collaboration; therefore, "the success of mobile learning will ultimately revolve around a mosaic of rich converged experiences. These experiences will rest, in turn, on a foundation of converged network and device technologies, wireless services, rights management, content management, search management, and transactional processing power." [11].

While coming across the variation between e-learning and m-learning, some researchers raised their concerns towards more pedagogical contexts. For example, a study conducted by Sharma & Kitchens (2004) shows that e-learning focuses on texts and graphics based instructions, while m-learning give emphasis to voice, graphics and animation based instruction. They also pointed out that e-learning usually occurs in home, classroom or labs using a computer, however, m-learning allows learning to happen everywhere using mobile devices [12]. Since the experiences provided by mobile learning include portable and personalized learning experience which enable learner to learn "anytime, anywhere and any device" this can be perceived also a revolution of "just-in-time" and "just-for-me" information delivery [11].

The benefits of m-learning have features for both formal and informal learning environments that support self-directed and experiential learning through facilitating community work. Despite the fact that these benefits are remarkable, it is important to know that m-learning also face challenges for educators and learners in a similar way. Indeed, "The challenge for the educators and technology developers of the future will be to find a way to ensure that this new learning is highly situated, personal, collaborative and long term; in other words, truly learner-centred learning." [13]. On the other hand, the ubiquitous of the smartphones and later of tablets are driving the interest in m-learning. While mobile devices are familiar, reachable, and connecting learners all the time, and along with the innovation of new mobile devices such as smartphones, tablets and wireless network technology, m-learning has been broadly adopted in many educational organizations as informational practice.

Nowadays, the educational environment is moving toward mobile learning, seeing that numbers of schools that are ready to offer courses using mobile technology are increasing. Therefore, the m-learning approach would require alteration in pedagogy, educational roles, curricular content and classroom practices [12]. On the other hand, the combination of mobile devices into the course outline needs a change in teaching approaches and strategies. A survey conducted by Corbeil and Valdés-Corbeil (2007) for instance, with instructors to find out among other things their readiness to move from e-learning to m-learning; the majority of participants stated that they were ready, although they were not yet integrating mobile technologies into their teaching activities [14]. This rise of new educational structure, weather from a pedagogical or a technical point of view; has resulted in a quest for new learning methodologies and frameworks. These transforms involve everybody "Since the scope of the change exceeds personal and interpersonal learning activities to include larger scale organizational and societal change, additional theories are needed to explain change, to plan interventions and to develop policies" [15].

2.5 The changes in learners' characteristics

Today's students are described to be digitally literate as they used to live and learn in a digital environment. They tend to be 'always on', or with communication with friends and classmates all the time through a combination of cell phones, instant messaging (IM) and emails. Mobility is another feature of today's students, either physically or virtually, in which they tend to be community-oriented.

The changing dynamics of learners and their characteristics have been discussed by several researches. According to Sheahan (2005), we can currently specify differences between the capabilities and preferences of Generation X and later generations [16]. Furthermore, Oblinger (2004) addresses the unique characteristics of the "millennial student" as being: digitally literate; always on; mobile; experimental; and community-oriented. "A new generation of students is entering higher education a group called the 'Millennial' or the 'Net Generation' were born in or after 1982 and exhibit different characteristics than siblings who are just a few years older" [17]. According to Sheahan, "technology and gadgets are critical to the way these newer generations define themselves", thus Generation Y and beyond are especially positive towards adoption of new technology [16].

3 Mobile Technologies and Learning

With the advent of mobile communication technologies, Mobile Learning (m-learning) is relatively new type of learning which allows people to learn across context and without restriction of location. M-learning is now perceived as the extension of e-learning with the added value of enabling learning anywhere and anytime. It is found that the latest mobile technologies and Web 2.0 applications are grown rapidly to support m-learning as proven in many successful cases. The literature review presented here reveals some of the current trends of mobile technology as well as identifies several key areas of Mobile Learning endeavors by means of online communities and social networking.

3.1 Current trends in Mobile Technology

Nowadays, when we think about mobile learning, we think about smartphones and tablets. The latest release of the iPad and similar tablets is a milestone in mobile technology, and has created a major shift in education. In 2010, when the iPad came, universities and schools began to see the iPad as the device that would move classroom education to the digital age. Even though mobile devices of all kinds have played an important role in the mobile learning, educational apps offered mobile learning the required push needed to move from concept to classrooms.

According to Tim Cook (2011), the CEO of Apple, "Last quarter, we sold more iPads in K-12 than we did Macs. To do that in just five quarters is absolutely shocking. We never would have predicted this". In actual fact, the arrival of the iPhone has maximized the industry of smartphone apps. For instance, iTunes alone now sells over 500,000 apps. Schools have already started implementing mobile learning projects using iPhones, iPad and educational apps in order to extend student's learning environment and engage them on the devices. It can truthfully be said that, the availability of well designed educational apps in Apple App Store, has made unbelievable opportunity for the mobile learning for all ages. Along with a lot of provided authoring tools, educators feel that tablets will change education because they can facilitate lessons design and assist the achieving of educational objectives.

In 2007, Apple created iTunes U service to manage, distribute, and control access to educational audio and video contents and PDF files for students within a college or university as well as the broader Internet. The member institutions are given their own iTunes U site that makes use of Apple's iTunes Store infrastructure [18]. Several studies have stated that lecture podcasts lead to a better and more effective learning. For instance, McKinney et al. (2009) examined the effectiveness of podcasts on the basis of a lecture. The test participants used iTunes U for download educational podcasts and use them on their iPod Touch devices. They obtained significantly better results than the group who physically attended. The best examination results were achieved by the students who took notes and listened to the recording several times [19]. Moreover, Fietze (2010) has performed a survey aimed to describe students' usage behavior and their assessment of podcasting. He mainly surveyed students with no experience in the use of podcasts. The primary intention of the students is to prepare ahead of written examinations. The survey revealed that more than half of the students consider the chance to use podcasts to be no substitute for attending lectures. Fietze also identifies the success factors of lecture podcasts, and provide evidence that podcasts helped to understand the contents of lectures better and more effectively. Once more, students who do not use lecture podcasts state that they have difficulties in learning [20].

There are many features that make the iPad a very powerful learning device. Firstly, the usability of the touch screen of the iPad has extended Human Computer Interaction (HCI) in a way that emulated human gestures. It enables intuitive touch to interact to get straight into the action. Secondly, the iPad does not enable users to read from several sources at the same time on a single screen through windows; while this perceived as a drawback, however as a learning tool, the iPad's flat interface reduces elements of interruption and potentially enhances user orientation to a specific task and educators often prefer mobile devices without distracting features like messaging and phone calls. Another feature is using iPad as book reader, as many students might buy the iPad for its e-reader capabilities alone.

Nowadays, educators are emphasizing the need for learning to be self-directed and collaborative. Mobile phones and digital whiteboards add a level of interactivity, but not a lot of computing power, and a laptop is not always convenient especially for students of small ages. Moreover, the shift from open web browsing to specialized apps was a practical improvement driven by the Apple model of mobile computing. The iPad influence this trend by providing personalized choice of content which is a huge benefit for learners.

3.2 Social Networking

According to Tim Berners-Lee, "The basic idea of the Web is that of information space through which people can communicate, but communicate in a special way: communicate by sharing their knowledge in a pool. The idea was not just that it should be a big browsing medium. The idea was that everybody would be putting their ideas in, as well as taking them out." Since then social networks and social communities are growing rapidly as they aim to connect individuals with similar interests to make their life

style better. Stephen Downes also declared that "Web 2.0 is an attitude not a technology. This means there is no technological revolution, it is a social revolution" [2].

Social Network can be defined as a tool that allows people to communicate their opinions online. A social network consists of users who collaborate and share, using the Internet, which brings about online communities. The motivation that drive a user belongs to social networks is the need to share and meet others with a similar domain of interests. Simultaneously, group effort is an excellent way of reaching information and knowledge. Furthermore, social networks are type of virtual community that has grown to be an essential component of recent culture. Nowadays, social networking services have been widely adopted by billions of users all over the world. The trend today is to be in close communication with others through Twitter, MySpace, Facebook and other social networking services. The extensive use of Facebook is not only due to its popularity; but also by the support from various mobile devices equipped with web browsers, and some are even equipped with dedicated application software exclusively for accessing Facebook, such as iPhone, iPad, and many Android devices. The support of Facebook by these mobile devices promotes the use of Facebook for educational purposes. However, unlimited access to information exchange can involve some risks, for example, there is a possibility that a social network is flooded with unneeded information, and to avoid this, or at least to limit the possibility of reaching poor data, rating and annotating shared resources were introduced [21].

3.3 Pedagogy in Social Networking

Much of the literature on mobile learning emphasizes the effectiveness of mobile technology joined by social networks in creating real learning opportunities, at the same time social networking websites have grown to be integrated into the people way of thinking, acting and communicating to each other. The integration of mobile Web 2.0 social tools built for smartphones can facilitate social constructivist pedagogies [15]. Cochrane and Bateman (2010) provide guidelines for implementing m-learning built on the foundation of four years of running mobile learning project that was aimed to evaluate pedagogical affordances of mobile Web 2.0 tools. The students feedback illustrate that mobile Web 2.0 pedagogical affordances have transformed pedagogy and facilitated student engagement in a variety of course contexts [22]. Furthermore, a research on the use of social networking tools in m-learning environments was carried out by Corbeil and Corbeil (2010) derive that social networking applications are beneficial for constructing dynamic and participatory m-learning environments that can engage learners to be active creators and consumers of learning materials. In addition, they found evidence that social networks support steady and shared communication between the learners, the educators and the content [23].

The social environment is changing as a result of supporting of social networking by mobile technologies. According to Siemens (2004), as the social environment changes, learning needs of the student changes, and instructional methods must changes as well, because "Learning needs and theories that describe learning principles and processes should be reflective of underlying social environments." [24]. As a result, powerful structure for learning starts to emerge. An integration of ideas happens as local learners participating in different virtual communities carry ideas back and forth between those communities and their local ones [25].

3.4 Microblogging and Mobile Learning

Microblogging is a further friendly form of mobile social networking. Learning of a foreign language presents an example of applying connectivism theory [26] seeing that learning is an activity that happens in a social environment. In the traditional educational system teaching usually means the knowledge is transferred from the educator to the learner, rather than the active participation. Thus, the active practicing outside the classes often did not take place. In addition, the students often were too shy or faced the lack of vocabulary when they were talking to their teachers. In fact, Microblogging social networks can come over all these barriers, and facilitate learning of foreign language due to the large community of users in which the learners can observe communication of native speakers and practice by communicating with them. Ullrich et al. (2008) describe one of the first uses of microblogging for language learning. Their research aimed to address how to enhance the students' active participation for English learning as a second language. The researchers prompted the students to create accounts in Twitter to follow each other, and then the students were told to post at least seven tweets per week and to read the tweets from the other students. Before the experiment, the students did not find the time to practice English; but with Twitter, they had the free choice of time for doing so. The researchers observed the communication of the community and ran a final questionnaire with the participants showing that the introduction of Twitter motivated the active participations of students given that 94% of the students stated that they felt their English had improved. Besides, about 50% of the students felt comfortable enough to communicate with native speakers. In view of the fact that Twitter is an open community where messages read by non friends as well, so the students were got in touch with outer users among them native speakers of English [1].

Moreover, microblogging can be used for enhancing in-class discussions. In large classes the teaching options is often limited to lecturing, which is not the best teaching

technique. The Twitter experiment at the U.T. Dallas clearly reveals how Twitter could be used as an improvement to traditional discussion formats and to enhance student participation comparing with pure lecture-style classes [27].

3.5 Wikis and Mobile Learning

Wikis create a unique situation where learners are not writing to communicate with their teacher like in a traditional learning environment but students are rather writing to communicate with their peers [28]. The responsible use of a wiki helps shift the responsibility from the teacher to the learner. This shift has the potential to make learning more orientated and self-directed. Wikis also potentially offer those who are not comfortable with speaking in front of the class an opportunity to participate and voice their opinions online [29]. The collaborative dimension of wikis allows students to work together to build, create, and develop content on the web, giving them a sense of how writing can be performed in collaboration. Besides, wikis can be used in project development with peer review, as a group authoring tool to track a group project, to collect data for a class project, for teacher evaluation, and for tracking research groups. Whereas a greater sense of knowledge sharing is achieved, then community is developed and communication amongst the users is improved [30].

The literature reveals that published material relating to wikis in education mostly seek to promote positive elements of use [28] [30] [29]. A study conducted by Laughton (2011) to find out whether a wiki can be used as an alternative to a learning content management system (LCMS) proved that the wiki could be considered as a useful alternative to a LCMS. The LCMS was favored over the wiki on a number of aspects but features of the wiki made it ideal to enhance collaboration amongst learners which makes it an ideal tool to support learners to learn from their peers [28].

4 Conclusions

Students from different ages have been one of the earliest and most active groups of computer users as many of them grew up with computers as an integral part of their learning experiences. Nowadays, cell phones are a very important part of the field known as Mobile Technology, which includes cell phones, smartphones, tablets such as iPads, and many other devices.

The review of literature mentioned earlier makes a contribution towards understanding how students can gain from mobile technologies and social networks in formal and informal learning. Mobile technology has unlimited potentials for education, social networking, and personal productivity. The Internet accessibility and data capabilities of the mobile devices expand traditional classroom borders and move the classroom outside of the sense of location and time. Since, social presence is an important factor of community construction; mobile devices allow people to share information to increase their social presence regardless of their location or time. With these technologies, people are able to contribute to their online presence at any time. The very mobility of mobile technology allows learners to roam and discover ideas freely without restriction and to manage knowledge wherever they are. In spite of the benefits of using mobile technology in appropriate contexts, the majority of educational institutions have yet to include mobile technology as a fundamental part of educational syllabus. However, mobile technology is quietly gaining a place among educators as an effective tool for bringing communities of students together on the way to empower collaborative learning.

In conclusion, mobile technology has the potential to change learning and teaching as we have known it. The use of this technology is capable to transform students to become informal learners for a lifetime and without doubt, education stands on the edge of change brought about by mobile technology.

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Exploring Students' Cognitive Process in Game-based Learning Environment by Eye Tracking

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Abstract - *Game-based learning has been proposed and developed for years; however, its effectiveness is still open with inconsistent findings. This study attempted to explore students' visual attention distributions in game-based learning environment by using eye-tracking techniques. An online game, Talking Island, designed to enhance elementary students' English ability was used for eye-tracking experiments. Subjects were twenty 3rd graders in Taiwan. During the experiment, subjects played the game for 20 minutes individually and their eye movements was tracked and recorded by a MobileEye eye-tracker. After the experiment, a vocabulary test was used to evaluate students' learning. Percentage of fixation duration and percentage of viewing time were analyzed by T-tests and effect sizes between genders and between different performance groups. Heat maps and fixation sequences were further observed for each subject. Results showed that overall students can focus on learning-related elements in this game. Findings will be discussed in detail in the conference.*

Keywords: game-based learning, eye tracking, human-computer interaction, user studies, cognitive process

1 Background

Researchers have been devoted to develop game-based learning environments and design related contents for years; however, the effectiveness of game-based learning is still open with inconsistent findings. Most of the prior studies evaluating digital game-based learning use self-reported questionnaires to survey students' acceptances of technology or use log-files to analyze interactions between learners and computer systems. Self-reported questionnaires are usually conducted before or after the learning process; and log-files can only record students' responding behaviors during the learning process. Neither survey nor log data can reveal learners' cognitive process during this specific learning context. For example, how students pay attention to the digital contents or mind-tools designed in game-based learning environments is still unknown.

The eye tracking technique has been typically adopted to examine human visual attention based on the eye-mind assumption [1]. In general, eye fixation location reflects attention and eye fixation duration reflects processing difficulty and amount of attention (the longer the information is fixated, the more complex it is or the deeper it is processed). Specifically, fixation duration varies on types of information (e.g. texts or graphics) and types of tasks (e.g. reading or problem solving). Furthermore, fixation locations and duration reflect the individuals' reading strategies and prior knowledge or experience [2]. Besides, scan path patterns exhibit individuals' cognitive strategies utilized in goal-oriented tasks [3]. The eye-tracking method has been successfully applied in research fields including reading [4] and information processing (for a detailed review, see [5]), arithmetic problem solving [6], human-computer interactions [7] and emergent literacy [8]. In sum, eye-tracking studies thus far have provided some insights on how students pay attention to read texts, view graphics or solve math problems. However, little study has been conducted to explore how students learn in a game-based learning environment, especially the distributions and shifts of students' attentions.

2 Purpose

With the rapid development of eye-tracking techniques, researchers can observe more deeply about learners' cognitive process in digital learning environments, such as the visual attention distributions on designed digital contents. This poster will demonstrate a pilot study attempting to explore students' visual attention allocations in a game-based learning environment by using eye-tracking techniques. Research questions focus on how students pay their attention to the interface design in a game-based learning environment. For example, how many percentages of time do students spend on viewing learning-related elements in such a learning environment? Do boys and girls pay different attentions to different elements designed in game-based learning interfaces? Do successful learners and unsuccessful learners show different attention distributions on screen when they learn via a game-based learning environment? A mixed method including eye-tracking techniques is proposed and used in this study to answer the above research questions.

3 Method

An online game, Talking Island, designed to enhance elementary students' English speaking abilities has been used for conducting an eye-tracking experiment in this pilot study. Participants of the experiment are twenty 3rd graders in Taiwan. All of them have at least two-year English learning experience in elementary schools. In this game, participants need to talk to other online players or virtual players in English in order to finish tasks and then gain scores and energy to explore a virtual New York Island. Students can freely explore anywhere in any scene of the game by clicking a mouse. Also, a microphone is provided for students to respond with particular targeted English vocabularies or sentences and the system will promptly provide adapted feedbacks for individuals. For the interface design, the game provides four tools for learning supports: a map, a chat room, useful tools and score information, which are statically shown in four corners on screen. Sometimes, when a specific vocabulary is popped out for students to practice pronunciation, another window with the vocabulary will be shown in the center of the screen. The more practices of English vocabularies, the higher scores and more energy the learners can gain for fighting others and successfully exploring the virtual island.

All twenty subjects passed the eye-tracking calibrations and participated in an eye-tracking experiment individually. In the experiment, each participant was asked to learn English through playing this game for 20 minutes. Wearing with the ASL MobileEye eye-tracker just like a goggle on face, participants were free to move their heads during the whole experiment. With sampling rates of 60Hz for the eye-camera and 30 Hz for the scene camera, MobileEye tracked and recorded all gaze points allocated on screen (i.e. visual attention allocations) by each subject while playing the game. The process of experiment including all the interactions between the participants and computers such as mouse paths and speaking voices were videotaped for further observation. The vocabularies shown for practicing speaking for individual participant were monitored and recorded by researchers. After the experiment, a corresponding vocabulary test including pronunciation was used to evaluate students' learning retention through the game playing. Students' English scores of the last semester and prior English learning experience were also collected before experiments.

Regarding the eye-tracking data, several areas or windows on screen were defined Areas of Interests (AOIs) by using GazeTracker software. Each area was defined as either *related* AOI or *unrelated* AOI representing *learning-related elements* (such as vocabulary windows, maps, scores) or *learning-unrelated elements* (such as chat rooms, fighting tools). The two types of AOIs were then served as bases of statistical analyses for eye-tracking data. In this study, eye-tracking indices including *percentage of total fixation duration* and *percentage of total viewing time* were used to indicate participants' visual attention distributions on screen. Therefore, the two indicators were calculated for and compared between related AOIs and unrelated AOIs. T-tests with effect sizes calculations were used to examine possible differences between boys and girls as well as between high performance and low performance groups. Furthermore, a heat map and a scan path output from GazeTracker will be used to further analyze each participant's visual attention distribution and fixation sequence on the game-based learning interface.

Figure 1. The subject's gaze point (the cross point of two red lines) was allocated on the target sentences (the white window in the center of screen)

4 Preliminary Result

Currently, the study is still under data collection and data analyses. The preliminary data shows that most of the students can gaze on or pay attention to the learning-related elements designed in the game-based learning environment. For example, Figure 1 shows that the participant's gaze point was allocated on the target sentence for practicing English speaking. The cross point of the two red lines indicates a gaze location; and the white window in the center of the screen shows a popped out English sentence for practicing (i.e., a learning element designed in the game-based learning environment). Detailed statistical results and findings will be demonstrated and discussed in the conference poster presentation.

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A Curriculum & Support Model for a 100% Online Professional Masters in Applied Computer Science

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Abstract - *The Department of Computer Science at the University of West Georgia offers a professional Master of Science in Applied Computer Science program that enables individuals with a bachelor's in any discipline the opportunity to gain skills and knowledge needed to re-tool & re-equip for a career in IT. Recently, this program was transformed to a 100% online program with a revised and updated curriculum focused on software design & development integrated with professional practices and team-based project experiences. The 36-hour program uses a cohort matriculation model and can be completed in two years. This poster will describe the curriculum model and support infrastructure used to deliver this program.*

Keywords: Online education, learning tools and strategies, e-learning design and methodologies, computer science curriculum, virtual learning environments

1 Background

The Department of Computer Science at the University of West Georgia has offered a professional, career-oriented Master of Science in Applied Computer Science program since 2002. From its inception, the program aims to provide any individual holding a bachelor's degree in any discipline the knowledge and skills needed to seek employment in the computing and information technology industry. The program has been very successful and numerous students with undergraduate backgrounds in various disciplines as well as varied career backgrounds have obtained successful positions in information technology. Although successful, enrollment was reaching a plateau at approximately 25 students. In 2010, the department evaluated the program and determined that the most advantageous way to encourage growth would be to make a transition to 100% online delivery. To achieve this goal, we developed a streamlined and updated curriculum and leveraged current faculty and staff as well as an existing stable and robust support infrastructure to address the challenges of offering a fully online program.

2 Program Curriculum

The program's curriculum focuses on software design and development and ancillary knowledge areas, with integration of professional practices and teamwork through two project experiences. Students begin the program with two semesters taking courses in program construction and web technologies. These courses establish a foundation for writing software and working with both client and server-side web applications, after which they participate in the first of two project experiences designed to integrate knowledge and skills across these courses with teamwork and professional practices. At this level, their participation in the project is closely directed and supervised. Next, the students continue with two semesters of coursework in database systems and software development where they learn about the practice of designing and developing software, as well as the mechanics of programming and working with databases. They conclude the program with a final comprehensive project experience where they integrate knowledge and skills attained in the program with teamwork and professional practices through the implementation of a significant software project. Their participation in the project at this level is much more independent, and they are expected to take on more leadership responsibility within the project team.

3 Support Infrastructure

A stable and robust support infrastructure is a critical component to a successful online program. There are many additional concerns and challenges when delivering a program online, including: support for learner-learner and learner-instructor interactions; meeting student expectations for getting help and support; fostering a sense of community among students and faculty in the program; providing effective tools and media for asynchronous and synchronous communication as well as delivery of course materials; and availability of professional support and tools and for faculty to develop and maintain course content. To provide essential asynchronous communication, interaction, and delivery of course material we use the Moodle open source learning management system, which is hosted internally by the department. We are long time users of Moodle and have had the opportunity to gain significant experience with the system and find it to be an excellent tool for supporting traditional LMS functionality. To address the need for synchronous communication among students and faculty, we utilize Blackboard IM, an academic-centric instant messaging platform that integrates with Moodle. Blackboard IM allows students and faculty to meet online and provides a number of useful tools to facilitate online teaching and learning. Together, the Moodle + Blackboard IM platform has enabled us to provide a comprehensive virtual learning environment to support the program while also providing the medium to

support a sense of community among online students and faculty.

The faculty is supported by professional academic support staff who are responsible for the program's technology infrastructure and also assist in identifying and implementing effective tools and resources for developing and delivery course content. In addition to the tools in Moodle, other software tools such as Camtasia Studio and ScreenSteps are utilized to author instructional materials. Finally, we provide peer-tutoring services and dedicated teaching assistants for each online class. Upper-level undergraduate and graduate computer science students staff these services, and in addition to assisting the faculty they also provide support for online students outside of "business hours" (e.g., evenings and weekends) to accommodate varied needs and work schedules.

CORRELATION BETWEEN STUDENT'S LEARNING INTEREST BY USING AUDIOVISUAL MEDIA WITH THE RESULT OF PHYSICS STUDY

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Abstract *- The purpose of this research is to know the correlation between student's learning interest by using audiovisual media with the result of physics study. This research has been done at Public High school (SMAN 112) in Jakarta-Indonesia in May 2011, semester II, year 2010/2011. The object of the research was class ten (X-7) with 38 students. This research is using the quantitative research method. Research instruments that has been used are a questionnaire and a test for physics in a multiple choice setting. Validity test to collect data student's learning interest uses the Pearson Product Moment for continuous instruments and uses Point Biserial for discrete instruments. Reliability test is counted by Alpha Cronbach formula for continuous instruments and uses Kruder&Richardson (KR-20) for discrete instruments. Normality test of data has been executed with the Chi Square test. Hypothesis test result is* r_{count} *get 0,532; determination coefficient 0,283 and correlation significant test uses t-test; the result is* $t_{count} > t_{table}$ *or 3,773 > 1,684 in significant level 0,05 and df = 36. So, based on t-test* H_0 *rejected and accept* H_1*, it means this research get significant correlation between student's learning interest by using audiovisual media with the result of physics study. The result of this research shows that there is significant correlation between student's learning interest by using audiovisual media with the result of physics study.*

Keywords: Student's Interest in Physics learning, Audiovisual Media

1. Introduction

CD ROM is one of the products from Information Communication Technology (ICT). The use of Information Technology and multimedia has shown an effective and funny physics learning that requires students activity. The ability of ICT and multimedia in extended message has a large value. In education, ICT and multimedia had changed the paradigm of showing the learning material to students. Computer Assisted Instruction (CAI) not only can help the teacher in teaching, but can also facilitate the learning process.

The investigated problem in this research is as follows: "What is the influence of student's learning interest by using audiovisual media in the form of CD ROM towards physics learning result?".

Results from this research are useful for: Alleviate teachers of shown the learning material. Alleviate students in understand learning material as learning supplement. Increasing student's interest and motivation in learning physics. It can be used as a source of physics learning. It is a challenging and funny learning source.

2. Theory Framework

2.1 Learn Interest Essence

Interest is something which can increase someone's passion and causing someone use his time, energy, and wealth for his fun of the object (Rath and Merill, 1996: p.69). So, interest as motivation of showing individual's attention is to pleasant or interest of the object and people will try more active with the object.

Winkle said that learning is one of the physical activities which takes place in active interaction between subject and environment with results in the changing in understanding of knowledge, skill and attitude, where the changing is constant relatively and useful (Winkle, 1996: p. 53).

The definition of learning interest are the attraction feelings and powers which are pushed from inside of somebody by giving attention to an attractive object or activity in the learning process.

2.2 Learning Media Essence

In learning process, the media which are used for accelerating learning the communication is known as "Instructional Educative Media". Instructional educative media is a means of communication in the learning process in the form of hardware or software. It wants to

achieve an instructional process and results in effectiveness and efficiency and also can reach instructional purpose easily (Rohani, 1997: p.2)

The definition of learning media is all the tools which are used by teacher as information extending media in teaching and learning process to obtain an effective and efficient learning result and also alleviate in reaching the optimal aim of learning for students.

2.3 Audio-visual Media Essence: CD ROM

Audio-visual media are modern instructional media which are appropriate in this century (Development science and technology). This media covers all the media which can be seen and can be heard (Rohani, 1997: p.97). According to Prof. Mark Moore as be picked by Howard Hussock, this media (CD ROM) fundamentally would change the way of student's thinking about how to solve a problem (Hussock , 1996: p.36).

Definition of learning media in form of CD ROM is a media which is designed as a data storage tool used as an attractive learning media which help teachers to show the learning material and learning supplement for students. This media can facilitate the learning process autonomously.

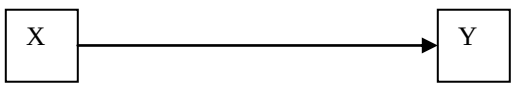
2.4 Physics Learning Result Essence

Learning result is all the abilities and results through teaching and learning process in school, obviously with scores and or values which measure the learning result test (Brigss, 1979: 145). Understanding of physics is equivalent to understanding how this world is acting. Physics science is the base science of knowledge, laws and theories in physics which explain how this nature works at basic level (Wolfson and Passachof, 1995: 3).

Definition of physics learning result is student's abilities (in the form of his knowledge), attitude and skills after following the physics learning process.

3. Research Method

The method which is used in this research is the quantitative Research Method. The research's paradigm is shown in the picture below:



X : The influence of student learning interest by using audio-visual media

Y : Physics learning results

In the Quantitative Research Method for the correlation, there are: The reliability test using Alpha Cronbach and Kruder&Richardson-20 Formula. Instrument Validity test uses Pearson Product Moment and Point Biserial Formula. We execute an Homogenity test and Normality test, where the Hypothesis test uses the SPSS Program (Sudijono, Anas, 2005: p.185).

3.1 Population and Sample

Target Population are all students in SMAN 112 Jakarta. The sample in this research are 38 students in X-7 forming the sampling class. Sampling method has used probability sample as proportionate stratified random sampling. Examination of difficulty level in every question by using formula as follows:

$I = B/N$ I : Difficulty level.

B : Number of students with correct answer .

N : Number of students who did the test.

Criterion which we use: The smaller the obtained index, the more difficult the question or the larger the obtained index, the easier the question.

3.2 Research steps

Planning, observation, interviewing and giving the test for sampling class. Test validity for the lesson of atomic structure. Make the learning software use Macromedia-Flash and Video from Youtube which is contained the atomic structure material in form of CD ROM. Try out test for the program which has been finished by the students. Test of reliability, normality and homogeneity then test of the hypothesis by SPSS Program.

4. Research Result

Based on calculation, obtained value of t_{count}=3,773. And t_{table}=1,684 for level of signification 0,05 at degree of freedom=36. If t_{count} consulted with t_{table} or $t_{count} > t_{table}$ or 3,773 > 1,684; refusing H_0 and accepting H_1 means that there is a significant influence between student's learning interest by using audio-visual media towards physics learning result.

Result of this research has shown that student's learning interest by using audio-visual media in learning process is one of the factors which can increase student's physics learning result.

5. Conclusion, Implication and Suggestion

5.1 Conclusion

Based on the research result, we can conclude that there is a significant influence between student's learning interest in using audio-visual media towards physics' learning result. We observed that correlation is linear. It means that the movement of one variable will follow by another.

Level of contribution of variable x (student's learning interest with the use of audio-visual media) towards variable y (physics' learning result) is 28.3%. It is shown that determinant coefficient price is equal to 0,283.

Louise

Although this research has shown that there is a significant influence between student's learning interest by using audio-visual media towards physics' learning result, it does not mean that only the student's learning interest variable give rise to the physics' learning result, because there are other factors that could influence the student's physics learning result such as learning environment condition, student's motivation, teacher interest level, etc.

5.2 Implication

The result from this research give indication to teachers to determine their learning strategy exactly in raising up the quality of teaching and learning process. But it's better to choose the media which can attract the student's attention, concordant with the learning material, and make them interested for the rest of their life.

The result from this research can be used as one of the optional ways to develop physics' learning quality, because the use of CD ROM media is an enabled form for learning effectiveness and fun physics learning pattern. Beside supporting the teachers in teaching, this media can also facilitate the learning process.

5.3 Suggestion

In physics learning, it's better to use learning media which can make the learning result optimal. The teacher must have the capability in operating the computer, teachers should understand computer programs as learning media ; so the computer can be a partner in designing the learning material. In doing next research, it's better to concordant the instrument with the capability of location in learning process. Students have to be more active and creative in learning process, so it will create an attracting learning process in the class.

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LENSOO – Collaborative Learning and Social Networking Platform for Continuing Education

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Abstract

The landscape of e-learning continues to evolve with the advent of social networking technologies. There is a significant shift in learning paradigms. Active asynchronous learning with community and expert support is something that enterprises are looking at for training their employees, customers, and partners. Enterprises are embracing social media inspired organization models for cross-functional collaboration which in turn necessitates appropriate collaborative learning paradigms and frameworks.

The paper presents a new collaborative learning and social networking platform which supports both asynchronous and synchronous learning. Other features of the platform include automatic creation of learning communities, study groups, ask an expert, and social networking and collaboration.

Keywords: e-learning, collaboration, active learning, social networking, learning marketplace, ask an expert, study group, and live sessions.

1. Active Learning

One of the significant advances in education is the pioneering work done in the 1950s by Bloom and others and the subsequent publication of Blooms Taxonomy of educational objectives which provides a classification of learning objectives [Bloom 1956]. The cognitive domain of the proposed taxonomy included a classification of levels of learning going from "knowledge" at the bottom of the pyramid to "evaluation" at the top. Higher the level greater the learning and application of knowledge gained. A modified version of this was proposed in 2001 [Anderson and Krathwohl 2001]. We use this model as a basis to show our perspective of "Active Learning" as depicted n Figure 1.

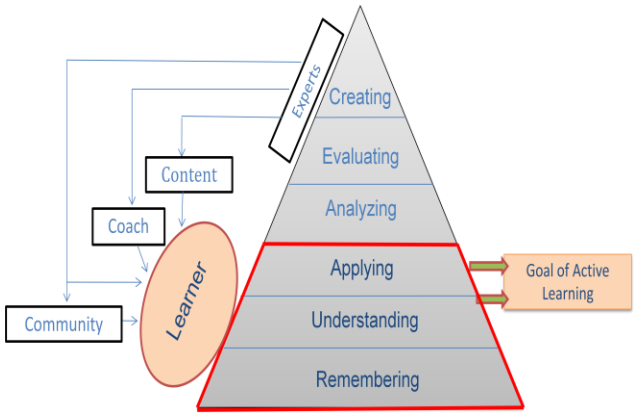

Figure 1: Active Learning Perspective

The learner has access to content, community, and experts (content experts as well as domain experts who are depicted as coach in Figure 1). From a continuing education perspective in the industry where the emphasis is on acquiring new job sills, the goal of active learning is the first three layers in Figure 1: Remembering, Understanding, and Applying. In essence what we emphasize is skills that are applied to a job/task. In today's work environment, there is constant and accelerated evolution of new technologies, processes, and paradigms and it becomes imperative for workforce to focus on continuing education to keep themselves current and employable. In this context it is also imperative that they learn at a much rapid pace and this is where collaborative learning will make a significant positive impact in our opinion.

2. The Lensoo Platform

Roles

The platform was visualized as a way to facilitate active learning. In addition, it was visualized as a marketplace where experts can monetize their knowledge and skills, and publishers can sell their content. In essence, the platform supports the following Roles:

- Learner

  Purchases courses in the marketplace and learns with support from community and experts

- Expert

  Content experts who are associated with a course and Domain experts who are associated with a subject domain. Learner has access to them while learning for a price. A publisher assigns experts to content while a domain expert is not tied to any course per se.

- Instructor

  Instructors are associated with live online classes. A publisher of content assigns instructors to live courses

- Publisher

  Anyone who wants to publish courses in the marketplace have to sign up as publisher. A publisher assigns content expert for a course when it is uploaded and sets the expert session price.

Process

Everyone has to sign up as a member and by default every member gets the role of "Learner". There is a separate sign up for Experts and Publishers. Learners who wish to learn browse the marketplace and select a course. They review the data sheet before they purchase. This data sheet will have information about the course, the reviews, etc. Once purchased, the course is deposited in "Learners Vault". It is a dashboard where learners keep track of all their courses.

Experts are members who sign up as experts in their specialty. When a publisher uploads content, he can specify any of these experts as "Content Experts". When learners seek expert help, they will have an opportunity to review the expert's rating, charges etc. before they select them. The "Experts Vault" is a dashboard that allows experts to keep track of the courses that that they are assigned to as experts

Publishers are those members who sign up for this role in order to publish their courses. They have the option of either publishing in the open marketplace or make it a 'private" course to which they invite learners. In the process of uploading their content for private audience, they also specify the email addresses of the participants and the Lensoo back end system will automatically send out invitation to those email addresses. The publishers also specify the experts associated with the content along with the expert session price.

Community and Collaboration

Our vision is to build a go to place for collaborative learning and formation of learning communities. Toward this goal, we have developed a set of features that allows for creation of learning communities. In addition, Lensoo allows users to form their own collaboration with others, either for searching for individual members or browsing for members in the various learning categories. Once users form these connections they are shown in an integrated

"Chat" window. For the purpose of this paper, we will focus on our concept of "Group" that allows for automatic creation of learning communities.

Group

Group fundamentally signifies a learning community. Every learning category in the marketplace has its own group created automatically in the community. When a learner purchase a course in the marketplace, that results in them being added to the learning community associated with the subject area. The learners will have an option of opting out of the group through their dashboard. Additionally, the group feature could be used by users of the lensoo community to start their interests based groups.

The Learners Window

The Learners Window reflects our vision and is depicted in Figure 2.

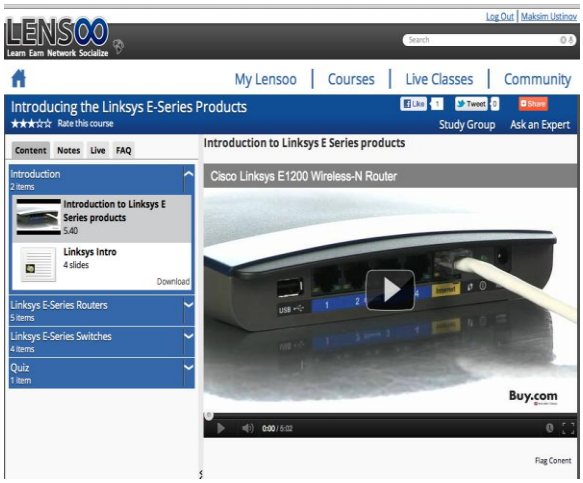

Figure 2: Learners Window

Key design features that distinguish Lensoo from other systems are the integration of "Notes", "FAQ" (Frequently Asked Questions), "Study Group", and "Ask an Expert" into one learners window. The "notes" feature allows learners to take notes while viewing the contents. These notes are time stamped and when a learner clicks on them it will take them to the module where the notes were taken. The FAQ allows for inclusion of additional material related to content for the benefit of learner. The "Study Group" consists of only those who subscription is current. It provides a mechanism for learners to engage in active interactive discussion while learning and these discussions are persistent as they are saved in the learners vault. The Ask-an-Expert feature allows a learner to select from a list of experts associated with course/subject domain. It opens a live online session with integrated audio and video, a shared, interactive white board, and a chat window. This allows for active discussion between the learners and experts.

Integrated into the learners window is the concept of 'Live Sessions". If the publishers schedule live sessions as part of the content upload process, the upcoming live sessions will show up in this window. In essence, the learner's window provides both synchronous and asynchronous learning. This is where the Lensoo platform demonstrates simplicity as well as elegance in active learning through collaboration.

3. Lensoo User Experience in Pictures

The pictures below show the key screens for a variety of features available to users of the platform. A detailed overview of these can be found at http://www.lensoo.com.

Learner

Figure 3 depicts a learner's vault where a learner keeps track of all his learning. In addition, they keep track of their chat connections and the learning groups that they belong to.

Figure 3: Learners Vault

Publisher

Figure 4 depicts the content upload interface for a publisher. Any user who wants to upload content in the marketplace has to sign up as a publisher. The content can be either "public" (shown in the marketplace) or "private" (visible to only invited users). In addition, this is the interface through which a publisher uploads content files, sets the price for a course, assigns experts and their price, and uploads FAQ and Quiz if any.

Community

Figure 5 depicts the "Forums" feature of Community. Here users can participate in discussion forums associated with learning categories.

Groups

Figure 6 depicts the groups feature. Here one can see the members of the group and participate in group discussions and collaboration. One unique element of this feature is the "always on" live session that group members could join. This feature also enables virtual project team rooms where they can share documents and collaborate.

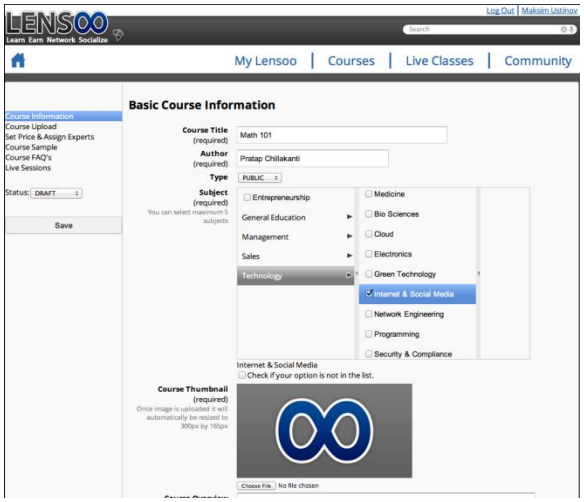

Figure 4: Content Upload Interface

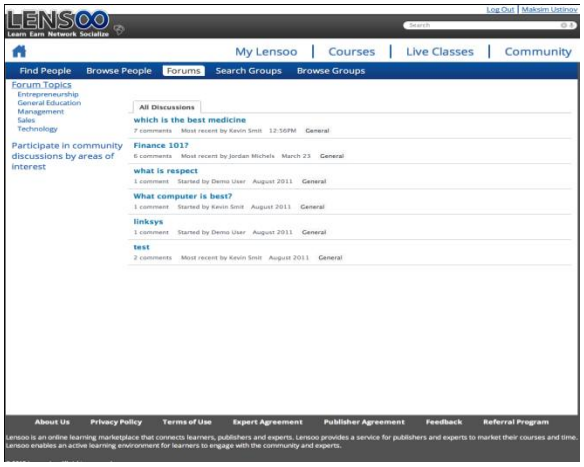

Figure 5: Community Forums

Live Class

The unique element of this feature is the integrated study group during the entire run of a live class with multiple sessions as depicted in Figure 7.

Ask an Expert

Figure 8 depicts a live session with an expert. In the learner's window when a user clicks on "Ask and Expert", it will lead to this session with an expert.

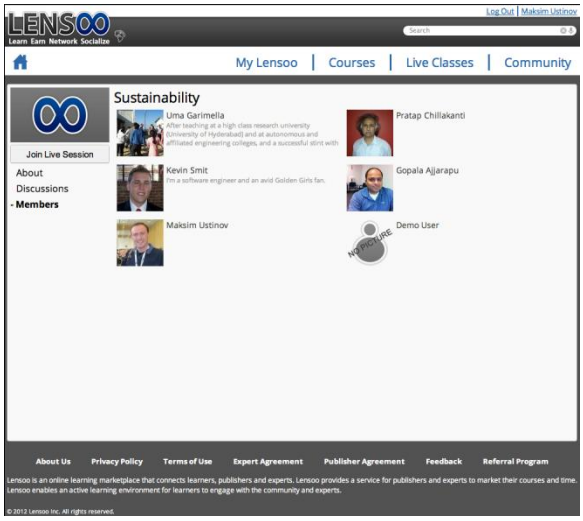

Figure 6: Groups with Live Session

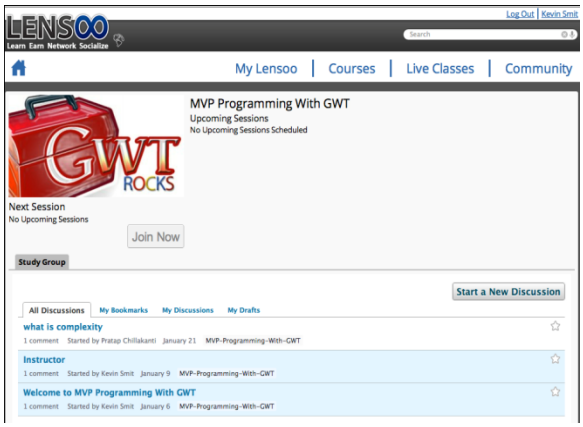

Figure 7: Live Class with Study Group

4. Comparative Analysis

As part of our effort in the design and development of Lensoo collaborative learning platform, we have investigated other platform including open source learning focused platforms. Figure 9 (on page 6) shows a snapshot of feature comparison between our platform and other platforms. We believe that we were able to capture the essence of collaborative learning in a simple and elegant platform.

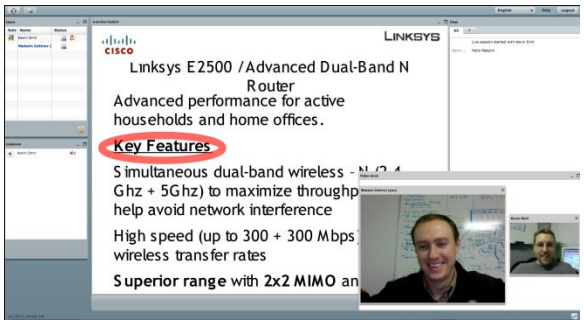

Figure 8: Live Session with an Expert

5. Conclusions & Further Research

The platform presented here is in the context of our ongoing research in transdisciplinary collaboration. Today's social media driven enterprise systems can essentially be characterized as transdisciplinary systems at an abstract level [Chillakanti 2011, Ertas 2010]. Collaborative learning is an integral component of any transdisciplinary effort in research and development. These transdisciplinary teams must be all trained in a common set of processes, methods, and tools in order to establish a common terminology among all participants.

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Table 1: Comparative Analysis

		Lensoo	Adobe Connect	Moodle	Blackboard	Microsoft SharePoint
Learner						
	Self-paced learning	Yes	Yes	Yes	Yes	Yes
	Integrated Study Group	Yes	No	Yes	Yes	No
	Learner's Vault	Yes	No	Yes	No	No
	Personal Dashboard	Yes	No	Yes	Yes	
	Learning Community	Yes	Yes-on adobe site	No		
	Integrated Assessments	Yes	Yes	Yes		Yes
	Forums	Yes	No	Yes	Discussion groups	Discussion forums
	Rate and review	Yes		No	No	Can rate files, articles, documents; not instructors.
Expert						
	Signup of experts to support learner	Yes	No	No	No	No
	Virtual live multimedia session with Learners	Yes	No	Yes	No	No
	Expertise monetizable?	Yes	No	No	No	No
	Rated by community?	Yes	No	No	No	No
	Expert dashboard	Yes	No	No	No	No
	Collaborating with others	Yes	No	No	No	No
Publisher	Self Service Course Upload	Yes	Yes	Yes	No	Yes
	Set course price	Yes		Yes	No	No
	Specify experts for courses	Yes	No	No	No	No
	Collaborate with other publishers	Yes		No	No	No
	Schedule live online classes	Yes	Yes	Yes	No	No
	Assign instructors to a live online class	Yes		Yes	No	No
	Scheduling private courses	Yes		Yes	No	No
	Scheduling private online classes	Yes		Yes	No	No

Life-Like Animated Virtual Tutor Embedded Learning Module

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Abstract - *In order to engage students in their learning experience, a life-like animated virtual tutor enhanced learning module that control learning interactions with students was presented in this paper. This module is designed to presents scientific lectures to students in optimal ways through narrated animations and to provide interactive support to students as they learn science expositions, and to assess and train comprehension through question-answer dialogs with a life-like animated virtual tutor. Results show that animated virtual tutor with life-like facial expressions and head movements has great impact on student's impressions and engagement in the learning process.*

Keywords: Life-Like, Animated virtual Tutor, Computer Animation, Learning Module

1 Introduction

In recent years, converging evidence indicates that learning gains can be achieved by designing computer programs that use pedagogical agents that foster social agency [1][2][3][4][5][6]. Research has shown that learning programs with well designed animated pedagogical agents engage and motivate students, produce greater reported satisfaction and enjoyment by students, and produce greater learning gains than programs without these agents.

In this paper, we have 1) developed procedures for producing head and face movements during speech by a virtual Pedagogical agent by combining different voice recordings, different facial expressions and different head movement patterns, and 2) we have conducted investigations that suggest virtual animated tutor that produce natural head movements and appropriate facial expressions while narrating a scientific topic produce much more positive user experiences than virtual tutors that lack these behaviors.

2 Related Work

Much prior research has focused on understanding the nature of gestures during speech communication. This research has shown that gestures are universal, interpretable and idiosyncratic. For example, at the McNeil lab at the University of Chicago, David McNeil and his colleagues have spent over two decades analyzing the relationship between speech and gesture through careful analysis of videos of individuals communicating with each other. They have concluded that spontaneous gestures occur universally, are generated almost exclusively during speech, that gestures and speech are synchronous and have a constant relationship in time, and that gesture and speech are semantically and pragmatically coexpressive—that is, they are aspects of a single underlying process. "My argument, in a nutshell, is that gestures are an integral part of language as much as are words, phrases, and sentences—gesture and language are one system." [7].

Given that gestures are an integral component of speech, "tightly intertwined with spoken language in time, meaning and function," but are also idiosyncratic, it is problematical and perhaps infeasible to develop a set of rules for predicting or generating gestures from text or speech. However, given that gestures, including head movements and facial expression, are the physical manifestation of ideas that are also represented in the discourse and acoustic structure of speech, it should be possible to learn statistical relationships between these linguistic structures and the head and facial behaviors that accompany speech production.

During daily conversations, meaning is communicated by both speakers and listeners in parallel both within and across auditory and visual channels. In the auditory speech signal, meaning is communicated through movements of the articulators to produce an acoustic phonetic representation of words that carry meaning, and through changes in fundamental frequency and amplitude that communicate emphasis, emotional states (excitement, anger) and other shades of meaning (e.g., sarcasm). Speakers also produce visual information through movements of the lips, tongue and jaw that complements and enhances the acoustic phonetic information in the auditory signal, especially in noisy environments. In addition, rigid head movements (e.g., vertical and horizontal head nods indicating agreement and disagreement, moving the head sideways and up to indicate thinking, etc.) are combined with a wide variety of facial expressions to communicate emotions and other communicative states during speech [8]. We note that listeners in conversations also produce a range of auditory behaviors, head movements and facial expressions which are processed by the speaker and often affect the content and flow of the conversation. The tight and meaningful integration of

communicative gestures during speech production is a remarkable feat of human communication that seems even more remarkable when it is considered that speech production, head and face movements and movements of the torso, arms and hands are controlled by different cortical mechanisms and muscle groups, each with their corresponding temporal constraints.

In the context of this research, the key point is that auditory and visual components of speech production by the head and face provide critically important information about the message being produced. In the context of speech communication by a lifelike computer character in learning contexts, communication should be more interesting, believable and meaningful when it is accompanied by the full range of auditory and visual behaviors used in daily interactions.

We also believe that comprehension of speech produced by a lifelike computer character with accurate visual speech and simultaneous expressive head and face movements will produce better comprehension and learning than listening to the auditory message alone. The ultimate goal is to develop a fully automatic approach for generating these believable and contextually appropriate head and face behaviors and demonstrate that children and adults find these agents more engaging, believable and are more effective tutors.

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3 Methods

The main objective of this research is to investigate the role of facial expressions and head movements produced by a lifelike animated character to indicate important information in a scientific topic or the emotions of the characters in a topic. The experiments we designed will manipulate head movements and facial emotions of a virtual tutor corresponding to intervals of speech that were either emphasized or provided with emotional expression by the tutor's voice. We will analyze videotapes of subjects who are listening to and looking at the tutor narrating a scientific topic to measure how attentive the subject is to the tutor, and use questionnaires to measure the subjects' impressions of how believable, credible and human-like the subjects believe the virtual tutor to be. We will also have subjects take quiz afterward to test both the comprehension and spontaneous recollection of the content. We hypothesize that scientific lectures in which the virtual tutor emulates natural head movements and emotions will produce increased engagement by subjects, produce more positive ratings of the animated virtual tutor and lead to better comprehension of the lectures.

3.1 Scientific Lectures Development

We first developed a series of scientific lectures for the animated virtual tutor to present. Then the scientific lectures were rehearsed and recorded by an expert human tutor with instructions to communicate the indicated emotions while narrating the lecture or producing dialogs between the characters. We videotaped the real human tutor recording the lecture in order to analyze the head movements and facial expressions; these analyses will inform the head movements and facial expressions of the virtual tutor in the experiments.

3.2 Manipulating Voice, Facial Expressions and Head Movements of the Virtual Agent

Voice: The human voice is a remarkable instrument. The words we produce in everyday conversations are often enhanced by features of voice that communicate emotions (e.g., joy, surprise, fear, anger, disgust and sadness), moods (excitement, impatience, boredom) and other communicative functions (e.g., sarcasm). In our studies, we manipulated the voice of the virtual tutor by having a professional voice talent rehearse and then produce two narrations of the scientific lectures, one in a normal "reading mode" and the other in a more theatrical "conversational mode. We recorded each of these narrations for use in different scientific lectures. We note that the visual speech produced by the virtual tutor, that is, the movements of the lips, tongue and jaw was animated independently for the two recordings. Each recording was transcribed phonetically and the resulting time-aligned phonetic transcription was used to generate the visual speech for each scientific lecture, synchronized with the auditory signal.

Facial Expressions: In the scientific lectures we prepared for our initial investigation, the six basic emotions of the virtual tutor known as sadness joy, anger, fear, surprise and disgust were developed. In our investigation, the virtual tutor either did or did not produce the six of the emotions shown in Figure 1 at appropriate times when narrating the science lectures. The emotions were designed in collaboration with Erika Rosenberg, an expert in the field of facial display emotions [9][10].

Figure 1: Six basic emotions of the animated virtual tutor: sadness, joy, anger, fear, surprise and disgust

Head Movements: In our experiment, we compared two head movement conditions produced by the animated virtual tutor: one is no head movements during speech; the other one is having the head movements of the virtual tutor mimic the head movements of the real human tutor. This was done using a video annotation system that produced parameters that were used to program the movements of the virtual tutor.

3.3 Experimental Conditions

To study how facial expressions and head movements influence the student learning experience and learning outcomes with the animated virtual tutor, three animation conditions of the animated tutor were created and used to instruct the same scientific lecture (learning material). Each condition differs from each other with respect to the expression and animation levels:

1. Fully Animated: the animated tutor is fully animated and realistically expressive. We used the annotated videos of the real expert tutor to create the facial animations so the animated tutor behaves just like the real expert tutor.
2. Partially Animated: the animated tutor is limited to only audio expression and head movements, the facial expressions are muted.
3. Muted: the animated tutor has its head and voice expression completely muted; a static version of the virtual tutor.

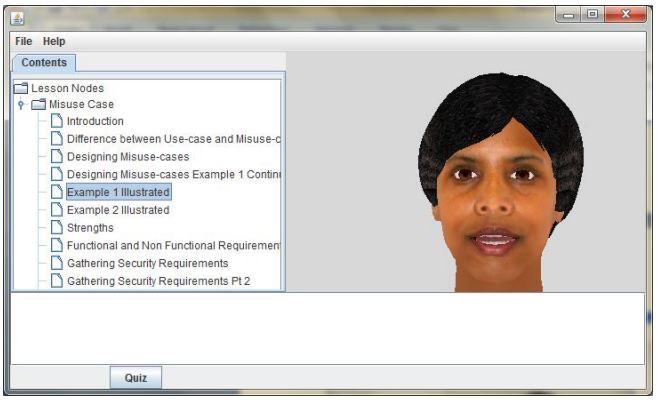

Figure 2: Animated virtual tutor interface (lecture mode)

3.4 Subject Testing Results

90 College students were participated in the evaluation of the animated virtual tutor. In the subject testing, the student is presented with a lecture specified by the animated tutor, as well topics to be covered in that lecture. Topics covered in the different lecture vary based on the type of instruction specified, but may include introduction to the lecture, explanation of terms related to the lecture topic, various examples to further explain concepts. Some of these examples contain different media like static images to illustrate a concept or provide a visual cue of an object or video media to demonstrate how tasks are to be completed. Based on the subtopic selected by the student, only information pertinent to that subtopic is displayed. Students are allowed to view and review material based on the subtopic covered so as to allow them the opportunity to re-explore certain aspects of the subtopic not fully understood.

Following each lecture, quizzes are made available to test the students' comprehension and retention of the lecture (Figure 3). The quiz mode test students on information covered in each lecture. The quizzes are cumulative.

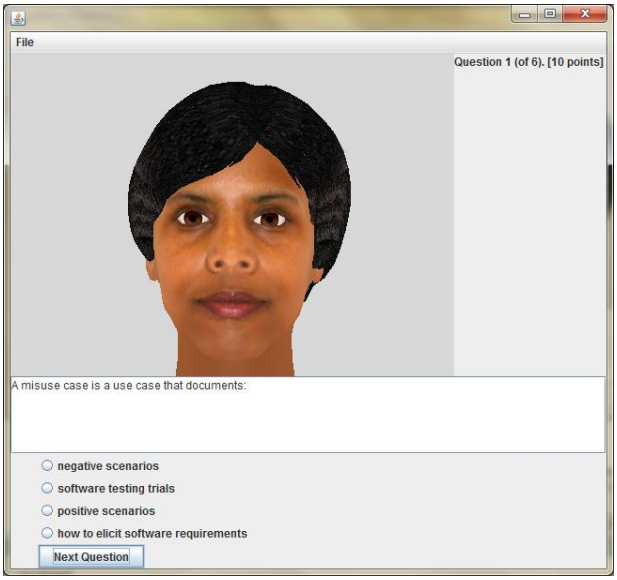

Figure 3: Animated virtual tutor interface (quiz mode)

These 90 students were separated into three groups (30 each) with the same scientific lectures presented by the virtual tutor but with different combinations of voice, face and head movements (Fully animated condition, partially animated condition and Muted condition).

After the test, students were given a questionnaire to rate the animated virtual tutor in terms of 12 related aspects including 1) Story telling ability 2) Overall rating 3) Interest 4) Believable 5) Effective delivery 6) Convincing 7) Voice face match 8) Hold attention 9) Contribution 10) Desirability 11) Comprehension 12) How emotional of the tutor . Results showed (See Figure 4) that facial expressions and head movements had great impact on student's impressions of and engagement with the virtual tutor, who was given the highest ratings on all dimensions. Unfortunately, no differences in comprehension were obtained across conditions because the quiz questions we designed were too simple, so subjects produced correct answers to all of the comprehension questions. We plan to replicate this study with more complex

learning materials and quiz questions for college students in different comprehension level.

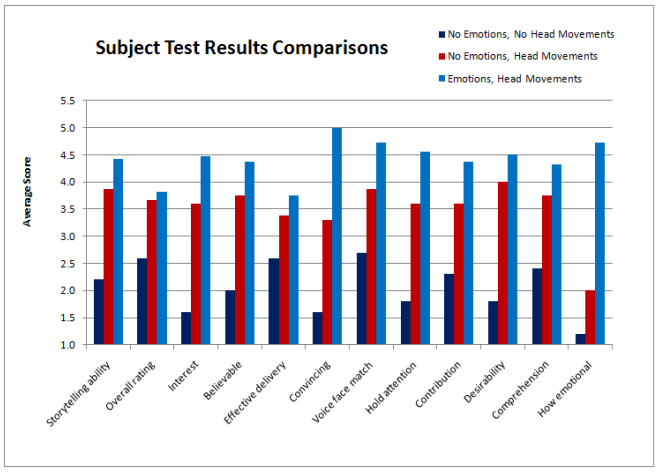

Figure 4: Subject Test Results Comparisions

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4 Discussion

Progress in our exploratory research has been hindered by the amount of time and effort required to create animation sequences for the virtual tutor that accurately modeled the behaviors of the real human tutor. One of the great potential directions of this research will be the development and demonstration of a research methodology and tools that facilitate design and testing of animated virtual tutors' behaviors in learning tasks.

5 Conclusions

In Summary, We developed an animated virtual tutor to evaluate how the facial expressions and head movements contribute to learning experiences and learning outcomes. Results showed that facial expressions and head movements have great impact on student's impressions and engagement with the virtual animated tutor.

This research has significant impact on individuals and society by providing more efficient and effective computer interfaces. The development of animated virtual tutor that behave like sensitive and effective teachers will have untold impact on quality of life for many individuals. Computer-based learning and tutoring systems with life-like animated tutor provide unprecedented opportunities for millions of individuals to benefit from accessible and inexpensive tutoring, distance learning systems.

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SESSION

E-GOVERNMENT, E-BUSINESS, and E-COMMERCE

Chair(s)

TBA

Municipal E-Government Security: Insights from Municipalities in Orange County, California

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Abstract - *Electronic government (e-government) is a field of growing interest to government agencies and researchers alike. Despite the many obvious benefits that e-government offers, government agencies face numerous obstacles and challenges with their e-government initiatives. Information security issues are frequently cited as one of those more difficult issues to address. Even though awareness of information security issues exists, the majority of e-government research still does not address many of these concerns. This is even more apparent at the municipal government level where publications dealing specifically with these smaller levels of government are extremely limited.*

This paper seeks to increase the focus of security in municipal government initiatives. This is accomplished by providing a preview of an in-progress case study of municipal government within Orange County, California. The case study focuses on analyzing the gap between federal and municipal e-government security.

Keywords: e-government, electronic government, e-local government, municipal

1 Introduction

Electronic government or e-government is the name given to the variety of online and web services that are provided by government entities to better serve the public. In the United States e-government can be witnessed at all levels of government: federal, state and local. Government agencies, much like their business counterparts leverage web technology and online services to reduce operating costs and enhance productivity. Recently, reductions in government funding have spawned a renewed interest in increasing efficiency by utilizing self-service e-government solutions by agencies of all sizes.

Government organizations are typically criticized for being slow adopters of new technology. However, despite this common stereotype many government agencies at all levels have made large strides in employing e-government technologies to provide better service to their constituents [1]. At the federal level the United States Department of Education allows students to submit their Free Application for Federal Student Aid (FAFSA). In California, citizens can check the status of their tax refund, make a payment on their taxes and view their state tax balance. Local municipalities are no exception in this regard. Many municipalities provide a variety of online services to their residents for items such as: applying for employment, applying for building permits, paying utility bills or acquiring a business license.

This vast array of online and web based services are only a few examples of e-government. The types of service provided by e-government vary from locality and the level of government offering the service. However, irrespective of size, the general trend of utilizing e-government and recognizing its versatility to serve the public is evident at all levels of government [2]. For citizens, they are empowered with the capability of interacting with their government entity from the convenience of their residence. This saves long waiting times in line or on hold waiting to speak to a representative [3]. At a first pass, all these e-government services may seem like a win-win for both government and citizens.

However, increased exposure also increases the security risks for agencies. From a security standpoint increases in identify theft, terrorist attacks, sabotage and security breaches have brought the importance of information security to the forefront [4]. The key issue though is while large federal and state agencies are provided with regulation and oversight the smaller municipal levels of government are left with virtually no such oversight or guidance.

This research paper seeks to shed light on the information security practices and resources of municipal government entities through a descriptive case study of municipalities within Orange County, California. The County of Orange is home to 34 incorporated cities of varying size and demographics. This county provides an adequate spread between cities which will allow the findings and contributions of this research to be applicable in other instances.

2 Literature Review

A literature review has been performed to stress the importance of information security within e-government solutions. Articles were retrieved for review from popular

online research databases including: ABI/INFORM, ProQuest, eBSCO Host, ACM Library and InfoSECURITY. The literature search yielded a high-number of results such as articles, journals and other abstracts. The search was further refined using these criteria:

- Primary research focus of e-government
- Discussed e-government use, implementation or its effects
- Excluded papers dealing strictly with e-voting systems

In searching relevant literature an even distribution of publications was noted among business/public administration disciplines and information systems related outlets. The dispersion of e-government literature throughout varies publication outlets suggests that this topic is multi-disciplinary in nature. It also indicates the need to analyze this phenomenon utilizing instruments from different disciplines.
Reports on e-government indicate an increased proliferation at all levels of government. Estimates suggest that at the federal level only, the United States spent in excess of $2 billion in 2006 for e-government related activities [5]. Furthermore, publication of e-government research has occurred in both the public administration and information systems disciplines. In reviewing e-government literature and related publications these general themes were noted:

1. **e-Government Frameworks**: [5-14]
2. **Classifications of e-Government**: [10, 15, 16]
3. **Types of services offered**: [10, 17]
4. **Legislation concerning e-Government**: [4, 17]
5. **Common barriers to e-Government**: [18, 19]
6. **Citizens' trust and confidence in e-Government**: [3, 20-23]
7. **Security concerns of e-Government solutions**: [24-27]

The complexity of e-government is described by some using a three stage model: initiation, infusion and customization. While others use a model that focuses on communication as: one-way communication, two-way communication, exchanges and portals [5].

However, others classify e-government as a comparison to the more established and related discipline of e-commerce. In classifying e-commerce transactions these terms are frequently used to describe the types of transactions: business-to-customer (B2C), business-to-business (B2B), business-to-employee (B2E) and customer-to-business (C2B). In comparison, e-government transactions can also be expressed in this same context as: government-to-citizen (G2C), government-to-employee (G2E) and government-to-government (G2G) [28]. In this context, government can interact with citizens, employees, and even other governmental institutions in an analogous manner as e-commerce [22].

Moon classifies e-government in two distinct categories: financial and non-financial transactions (2005). Financial transactions include activities such as: paying for taxes, fines, licenses, utilities and citations. However non-financial transactions include a large list of items including: services requests, records requests/searches, maps, permit renewals, program registration and communication with elected officials. This evidence demonstrates the numerous uses for e-government and the trend to expand such offerings

Collaboration and information sharing between government agencies was another prevalent occurrence at all levels of government. It is interesting to note that businesses utilizing e-commerce technologies were observed to typically shy away from information sharing as compared to the public sector [29]. One of the key deterrents in information sharing in governments agencies is a byproduct of incompatible legacy systems. The larger the agency the more problematic it becomes to stay current with technology and modernize legacy systems [30]. As such, e-government has also been used with the aspiration of solving this situation with the expectation that G2G transactions can be accomplished via such avenues despite more direct sharing methods.

There are numerous benefits for using e-government for citizen communication and also for intergovernmental transactions; however such initiatives face many barriers and obstacles. Barriers can be classified into the following three categories: political, financial or technological [19]. Of primary interest are those that are technological in nature. In some cases, there is no existing platform to perform a customized e-government service and developing such a service would be too cost restrictive. Other limitations reside not with the governmental institution, but on occasion with a given community's demographics as it relates to their access to technology. Implementing a service that would have limited or no usage would not be well advised.

The literature review yielded a large collection of e-government related publications. Nevertheless, the majority of the articles did not have a primary focus of information security. One of the reasons for this is that approximately half of such articles were published in business, management or public administration journals. Therefore, these publications focused on managerial issues and approaches for implementation. Others touched on barriers for implementation and frameworks to define or classify such e-government initiatives [31]. The remainder of publications were found in the information systems (IS) outlets. Regrettably, even works published in IS channels, did not fully address the need for e-government security, especially at the municipal government level.

Security however, was not an unknown factor. Most articles touched on the topic of security, however not extensively enough to define a framework for addressing security implications of e-government. Instead, security was simply mentioned as an obstacle or as a factor to consider when seeking to implement such a system [28]. Frequently, security was often left last because to its complex implementation within the e-government arena. The paradox is that management often seemed to think that security obstacles were the easiest to overcome [32]. For that reason, many initiatives often saw setbacks and delays. Security concerns were often not addressed and realized until the final steps of an implementation [33].

These findings suggest a need for an increased focus on information security within the e-government research field. Much of the existing research tends to focus on the larger federal and state agencies and often neglect the important role that local government plays in communities [34]. As such, future research should seek to understand the limitations of smaller municipal government agencies to ascertain how they can still achieve and maintain a reasonable degree of e-government security given their more limited resources.

3 Case Study of E-Government in Orange County, CA

This section discusses a current and in progress case study that is being conducted as part of a dissertation research project. This descriptive case study will examine e-government operations within all municipalities of Orange County, California. This county has 34 incorporated cities which will be included as part of the study. The county has cities of varying sizes which will provide the generalizability of findings to other potential cities of similar demographics.

The case study will address (3) three key research questions:

- What level of e-government security do municipalities currently have when benchmarked to federal e-government security requirements?
- Why are municipalities not fully compliant with federal e-government security requirements?
- How can municipal agencies reach a federal level of e-government security?

Municipalities will be benchmarked and studied using the requirements set forth by E-Government Act of 2002: Security Protocols to Protect Information (*E-Government Security Act of 2002, 207(f)(1)(b)(iv)*). This act applies directly to federal agencies which can achieve compliance by adhering to the guidelines of the NIST (National Institute of Standards and Technology) Special Publication 800-44: Guidelines for Securing Public Web Servers.

Specifically, NIST SP 800-44 provides a series of 7 security checklists which federal agencies can use to assess their level of compliance. These checklists are as follows:

- Checklist 1 - Planning and Managing Web Servers
- Checklist 2 - Securing the Web Server Operating System
- Checklist 3 - Securing the Web Server
- Checklist 4 - Securing Web Content
- Checklist 5 - Using Authentication and Encryption Technologies for Web Servers
- Checklist 6 - Implementing a Secure Network Infrastructure
- Checklist 7 - Administering the Web Server

While municipal government agencies are not required to adhere to these security requirements, the research project will investigate which of these requirements municipal government entities are compliant with and how they can become more compliant. Table 1 shown below, provides a list of all cities within Orange County along with related information and demographics. Population data was obtained from the most recent 2010 United States Census. Budgetary information was obtained for the 2011-2012 fiscal year as reported on each agency's public website.

Table 1

City Name	Population (U.S. Census 2010)	Website	E-Government Services	Budget Fiscal Year 2011-12
Aliso Viejo	47,823	Yes	Yes	$ 13,440,955.00
Anaheim	336,265	Yes	Yes	$ 1,305,839,186.00
Brea	39,282	Yes	Yes	$ 84,671,801.00
Buena Park	80,530	Yes	Yes	$ 121,963,350.00
Costa Mesa	109,960	Yes	Yes	$ 94,650,182.00
Cypress	47,802	Yes	Yes	$ 33,129,770.00
Dana Point	33,351	Yes	Yes	$ 27,367,550.00
Fountain Valley	55,313	Yes	Yes	$ 33,863,160.00
Fullerton	135,161	Yes	Yes	$ 193,200,000.00
Garden Grove	170,883	Yes	Yes	$ 88,950,000.00
Huntington Beach	189,992	Yes	Yes	$ 183,547,977.00
Irvine	212,375	Yes	Yes	$ 136,206,801.00
Laguna Beach	60,239	Yes	Yes	$ 64,322,200.00
Laguna Hills	15,568	Yes	Yes	$ 35,650,191.00
Laguna Niguel	22,723	Yes	Yes	$ 41,043,398.00
Laguna Woods	30,344	Yes	Yes	$ 7,569,992.00
La Habra	62,979	Yes	Yes	$ 33,564,360.00
Lake Forest	16,192	Yes	Yes	$ 33,798,900.00
La Palma	77,264	Yes	Yes	$ 13,432,204.00
Los Alamitos	11,449	Yes	Yes	$ 15,629,823.00
Mission Viejo	93,305	Yes	Yes	$ 90,150,514.00
Newport Beach	85,186	Yes	Yes	$ 148,955,783.00
Orange	136,416	Yes	Yes	$ 170,949,929.00
Placentia	50,533	Yes	Yes	$ 57,654,595.00
Rancho Santa Margarita	47,853	Yes	Yes	$ 17,206,488.00
San Clemente	63,522	Yes	Yes	$ 114,343,420.00
San Juan Capistrano	34,593	Yes	Yes	$ 58,757,473.00
Santa Ana	324,528	Yes	Yes	$ 459,361,890.00
Seal Beach	24,168	Yes	Yes	$ 60,662,300.00
Stanton	38,186	Yes	Yes	$ 22,446,727.00
Tustin	75,540	Yes	Yes	$ 143,631,002.00
Villa Park	5,812	Yes	Yes	$ 3,934,000.00
Westminster	89,701	Yes	No	$ 127,712,077.00
Yorba Linda	64,234	Yes	Yes	$ 110,581,212.00

The total population served by these 34 incorporated cities almost reaches 3 million residents. As such, the degree of e-government security in place by these municipalities affects a large population. As would be expected, all 34 municipalities had at minimum of an official municipal website maintained and controlled by that agency. A website in itself is the first step towards e-government as it allows a government agency

to provide at minimum read-only information to its citizens. Additionally, the majority of these municipalities had one or more e-government offerings.

As a matter of illustration, Figures 1 to 3 below provide a visual overview of the variety of online services used by three municipalities within Orange County. Each of these municipalities provides one or more online e-government services to their constituents.

Figure 1 shows the online services provided by the City of Anaheim. Such services include the ability to pay utility bills online, apply for employment, initiative building permits and register for community services classes.

Figure 2 displays the City of Brea. This city allows citizens to pay their water utility bill, review previous payments and retrieve account statement via this e-government service.

Figure 3 provides an overview of City of Cypress. Using their e-government service, individuals can search for and apply for employment opportunities online.

Figure 1 – City of Anaheim Online Services

Figure 2 – City of Brea: Online Water Utility E-Pay

Figure 3 - City of Cypress: Online Services

4 Contributions and Insights

This case study upon completion will provide substantial contributions to both research theory and practice.

Practical Contributions

This case study will use the foundation provided by the NIST SP800-44 publication to analyze the capacity and resources of municipal government agencies. The NIST document as a tested instrument provides a baseline of security expectations for e-government services. However, this document was designed to be used by federal agencies. The landscape of municipal government agencies is far different from that of its federal counterparts. As such, this study will reveal these compliance gaps and also demonstrate the applicability this document in the realm of municipal government.

Theoretical Contributions

The chief contribution to theory will be furnishing the answers to the three research questions proposed by this study. A theoretical model will be developed which will address the issues brought forth by these research questions. The intention is that this theoretical model will provide a window into the state of e-government security. It will analyze why municipal government security varies from federal e-government requirements. It will contain quantitative and qualitative evidence demonstrating why such issues exist and also suggest potential remedies.

5 Conclusion

The initial research and findings of this case study show a need to focus on e-government security at the municipal level. It also demonstrates that limited guidance is provided to municipal agencies for e-government security. Municipal government however is actively engaging in the use and implementation of new e-government offerings. Many of these services collect confidential citizen information which if comprised could present a serious security concern and could also affect the trust and reputation of such organizations.

The county of Orange, California provides a diverse research environment in which to perform a descriptive case study to explore the state of e-government security. The county of Orange serves approximately 3 million residents many of which frequently use the e-government services offered by their local municipalities. Each of the 34 incorporated municipalities has at minimum a public facing website. Additionally, the majority of these agencies offer one or more e-government services to their residents.

Therefore, a call for further research in municipal e-government security is made. Upon completion, this case study will provide many insights and research directions, many more research avenues still exist. The need for a specific model for municipal e-government exits. Additionally, if the NIST SP 800-44 publication is applicable to municipal agencies, a distilled version is needed to address the more limited set of resources that these agencies have.

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Effects of Computational Mechanism Design in User Evaluation System

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***Abstract*—This paper describes the survey on electronic commerce and proposes a new user evaluation methods based on multi-criteria based rating system. In recent years, number of e-commerce users is increasing and a lot of untruthful trades are occurred. Although most of electronic commerce sites provide user evaluation systems, each user does not know the real item and the trading partner's behavior in actual. In some cases, sellers do not lose a chance to sell the item because of lack of their and their items information. On the other hands, buyers sometimes can not make a decision to choose trading partner because the evaluation rating is not good, although electronic commerce site is looking good. To solve these problems, we propose a new evaluation system where sellers can set up and define the evaluation criteria and electronic commerce system evaluates sellers based on their behavior. We conducted some experiments with situation changing and show the result of simulation on the passage of sellers evaluations. Contributions of this research include providing basic concept of computational mechanism design in user evaluation system and showing experiment result where our proposed mechanism is employed.**

I. Introduction

Since around 2000, the Internet-based e-commerce is widely spread and some e-commerce sites are popular for buyers. Also, the academic researches on electronic commerce contributes to realize safe and rational trades. [1][2][3]. A lot of theoretical research contributions have been appearing, and also some have been focusing on systems to be used practically [4][5][6]. Matsuo et al. proposed a new mechanism to reduce an incentive of untruthful bidding with theoretical analysis on trading in volume discount-based auctions [7][8].

In this few years, researches regarding trader's evaluation are becoming popular to make validity and reliability in evaluation systems. The contribution of evaluation mechanism researches can be applied to automatic trading support.

Kobayashi et al. proposed an effective evaluation model to evaluate users using trading relationship and its network. Online auction sites are regarded as network structures and confidential relationship is evaluated by the strength of network connected with each user. Also, Kobayashi et al conducted an experiment and analyzed the effectiveness of their proposed evaluation method, which is applied from web-page evaluation algorithm [9]. Usui pointed out that evaluation system gives a certain effect of market revitalization [11]. The market size becomes bigger, if the evaluation system is provided in the market. One of well-known auction sites eBay.com employs multiple attribute-based evaluation mechanism to enable users get useful information. The attributes include delivery speed, communication with buyer, and so on [22].

However, in these systems, the evaluation between users is not objective and the trade makes an symmetric information problem like that the amount of information in which buyer has are less than the information in which seller has. Thus, in this paper, we give a new concept of e-commerce evaluation method to reduce asymmetric and incomplete information between buyers and sellers. Former half of this paper, we give a preliminary discussion with survey about e-commerce features. Then, we give some explanations about our proposed concept in which sellers can define the evaluation criteria based on items and their confidence on trade. After that, we propose a new mechanism design that is implemented into the evaluation system in electronic commerce. Then, we give a result of simulation using our proposed mechanism. The contributions of our research are including to make a safe and secure e-commerce environment, reliable society in e-commerce, and to give a theory of mechanism design in evaluation system.

II. Survey

We conducted small survey to clarify features of electronic commerce. We asked 30 people who are belonging and specializing information science in our university. All of them have an experiment of trading on e-commerce. Also, twenty five users usually see the seller evaluation before they make a decision to trade with the seller. Table I shows their thought about inconvenience of e-commerce. Others in the table contain out of stock, long shipping dates, expensive shipping fee, many garbage of packaging box, no option of shipping company, and so on. Most of people think some possibilities of inexpediences because they cannot see real items and cannot know seller's true identity. This means that electronic commerce websites should prepare and provide more concrete and credibility information about items and sellers.

Secondly, we surveyed about the multi-criteria based evaluation. Table II shows that the appropriate number of evaluation criteria when they buy. Most of people think that the appropriate number of criteria are 5-6 to know items and sellers concretely in the seller evaluation site.

TABLE I
SURVEY 1

Questions	Number (multiple answers allowed)
Actual/real items and traders cannot be seen.	20
I am afraid of fraud.	15
To much bothers to trade (like making a credit card and signing up).	6
Others	5

TABLE II
SURVEY 2

Number of Evaluation Criteria	Number of answer
1	1
2	0
3	5
4	5
5	20
6	10
7	3
8	5
9	0
10	6

Table III shows survey in which buyers need more concrete information depending on the item categories. From this result of survey, the seller evaluation system should provide the function in which the multiple evaluation criteria are provided based on the categories.

TABLE III
SURVEY 3

Category	Number of answer (multiple answers allowed)
Home electronics	55
Food	27
Car / Automobile	44
Bicycle	18
Fashion	34
Jewelry goods	16
Books / Magazines	15
Furniture	32
Stationery	5
Others	3

III. PRELIMINARY DISCUSSIONS

A. Existing Evaluation Systems

Yahoo! [12], Rakuten [13] and Bidders [14] are popular Internet auction sites in Japan. In their system, users can input their evaluation including total/synthetic evaluation and evaluation by free description. Users can know the latest result of evaluation and make decision by viewing whether trading partner is active or not.

Seller may gain evaluation score by many trades with same person, such as his/her friend. However, in a lot of e-auction systems, when a seller trades with same buyer, total score is not reflected after second trade. Namely, only new trades with different traders can be reflected in the total score.

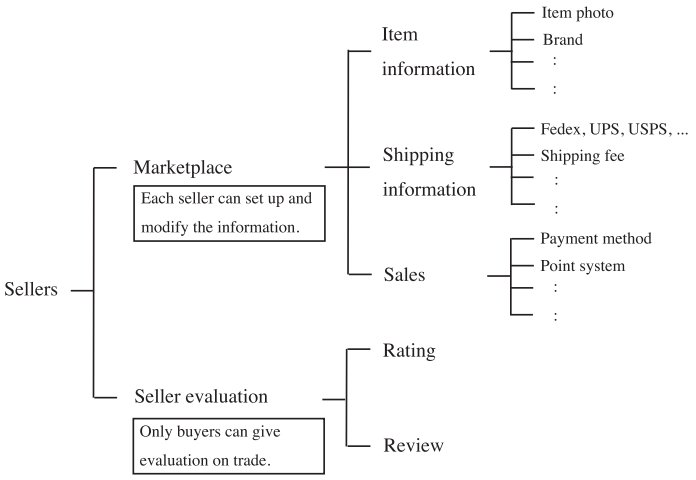

Fig. 1. Property of Existing Evaluation System

Buyer may deliberately give a bad/poor evaluation for sellers. In existing e-auction systems, a pair of seller and buyer evaluates by mutual evaluation. Thus, each trader takes care on evaluation.

Although existing evaluation systems have these features, buyers can never perfect information about sellers and items with incomplete and asymmetric information. A lot of causes of criminal acts are set up by these problems on information.

B. Feature of Existing Evaluation Systems

There are roughly two types of synthetic evaluation system employing the point-addition scoring method like Yahoo! auctions and point-average scoring method like Rakuten [12] [13]. On the other hands, there are multiple attribute-based evaluation systems like eBay auctions, Bidders, and Wanted auctions [14][22][23].

The evaluation system in eBay employs four attributes-based five scoring evaluation model, including "Item as described", "Communication", "Shipping time", and "Shipping and handling charges". Each total score is calculated by average-rating method. However, the evaluated items are limited in eBay system, and it also is difficult to reduce the incomplete information for users. Further, criteria are not clarified and included in the system, and each buyer also has a different feeling and impression even in same trade process.

The evaluation system in Wanted auctions includes both simple evaluation method and detailed evaluation method. Simple evaluation method is almost same with the evaluation process in Yahoo! auctions. Namely, synthetic evaluation and comments are input by traders. The detailed evaluation method has an advantage to reduce incomplete information for users. However, most of traders use the simple evaluation method. And also, the detailed evaluation method has a problem where the evaluation criteria is ambiguous. The result of evaluation is almost same with user evaluation system in eBay.

C. Mechanism Design

D. Incomplete Information

In the Internet-based auction, buyers view items information and sellers information based on only displayed information on the web browser. Buyers cannot perfectly know the actual information by the Internet until they receive purchased items. These situations put out incomplete information, such as every existing electronic commerce web site. On another hand, in an e-marketplace, differences of quantity and quality of information between sellers and buyers are huge issue for them. These situations put out the problem on asymmetric information. Web-based marketplace has more asymmetric information than actual marketplaces. In the actual marketplaces, buyers can view items from multiple aspects, sometimes touch and pick up them. Thus, they make sure the material, quality, size, and several other information. On the other hands, when users try to buy items on the electronic marketplace, they cannot touch and pick up items. Further, they just look at some pictures taken by sellers. Some sellers are good faith and honesty, but others may hide a scuff on the item and do not provide adverse information. It makes unfair trades. It is very important for buyers to be filled the gap of information between them and sellers. When there are above unfair issues on the trades, buyers sometimes fails their decision making to select items. This means that buyers' utilities are decreased by unfair information provision.

E. Computational Mechanism Design

To make an optimal society, mechanism design research is regarded as one of important research area in microeconomics research. Also, it is applied to make an optimal market, business model, and some other commercial activities. However, even though the invented mechanism is clear to solve the problem, the mechanism normally becomes complicated and complex. Although the mechanism has power to solve the problem, it is very difficult to apply to real world because citizens cannot easily understand the mechanism. In some cases, when the mechanism is employed in the marketplace, buyers and sellers need some pre-knowledge about economics and complicated trading procedure. In order to solve this problem, computational mechanism design is regarded as one of a promising field to make an optimal condition, even though sellers and buyers do not have good knowledge of economics. Also, in some situations, the optimal condition is dynamically change because the multiple types of agents join in the marketplace and they have a lot of properties. Mathematically, it is similar with dynamic systems like what the fixed point is changes with time pass in differential equation. Figure 2 shows the concept of the situation where the fixed point is changes. In the computational mechanism design in electronic commerce, the fixed point is monitored/predicted based on trading data, situation and condition, and all data used in past tradings.

IV. Evaluation mechanism

This section describes some conditions of the evaluation system and a mechanism employed by the system.

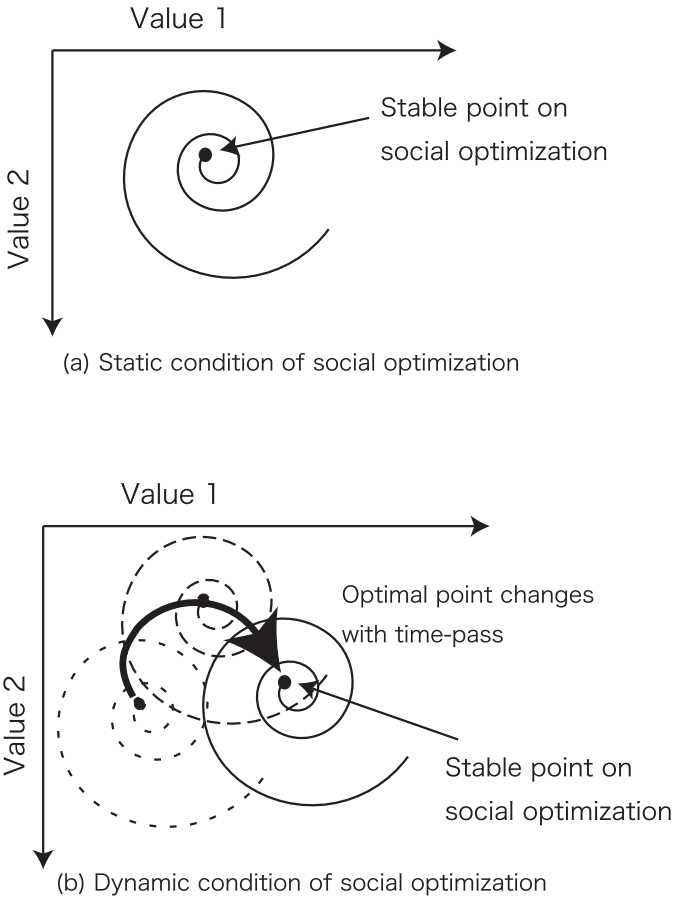

Fig. 2. Fixed Point Changes Dynamically

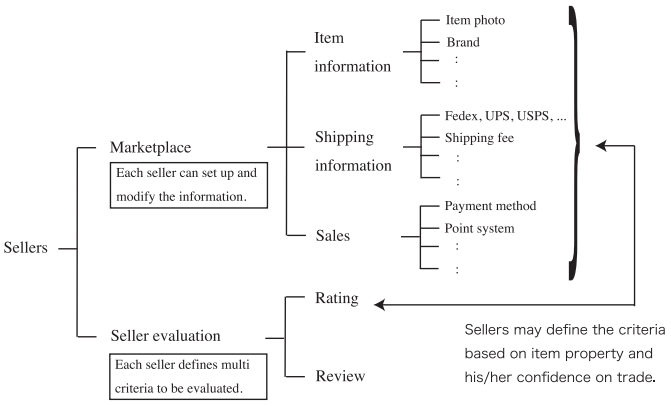

Fig. 3. Key Concept of the Proposed Issue

A. Conditions and protocols

We show some conditions and a protocol of the evaluation system. Let $N = \{s_1, \ldots, s_m, b_1, b_2, \ldots, b_n\}$ be a set of sellers and buyers of the electronic commerce, where each s_j shows a seller and each b_i shows a buyer, and $A = \{a_1, \ldots, a_k\}$ be a set of agents, which adjust the mechanism at each and calculate the evaluation. Hence, there are $N \cup A$ players in the electronic commerce. The evaluation system

has a set of evaluation items denoted by $E = \{e_1, ..., e_\ell\}$, each item's upper $u_{e_t}(\in \Re)$ and lower bound $l_{e_t}(\in \Re)$ and a calculation method for computing the evaluation.

We consider single seller and single buyer case for showing our protocol. First of all, the seller s choices a set of appropriate evaluation items $E^s \subseteq E$ for an own selling goods. Second the buyer b is able to evaluate the seller s and input it to the evaluation system when the buyer b took the goods. Also the evaluation system puts on among time from a transaction termination time to giving scores for each evaluation item by the buyer b. The buyer b scores to each evaluation item e_t given by the seller s among the value from upper u_{e_t} to lower bound l_{e_t} subjectively, that is, whether each evaluation item e_t influence to make a decision of purchasing in evaluation phase. In this phase, the evaluation system gives a weight to each evaluation item e_t, which shows believability of the item. The weight is calculated by an average score of every past buyers' evaluation scores.

B. Evaluation mechanism

Our objective of making an evaluation mechanism is to have an incentive for the seller to open more correct information of his/herself. The mechanism employs credit history method for not only providing useful subjective information to the buyers but also providing some objective information like a transaction result. The credit history is, generally, a credit record institution for credit card users of USA. The credit history works the following scheme:

- When the credit card user uses the credit card continuously or does not fall behind in his/her payment, the credit history point is increasing.
- When the credit card user falls his/her payment or does not use his/her credit card continuously, the credit history point is decreasing.

Our mechanism uses this scheme, and we describe our mechanism as follows.

[mechanism 1] Each seller s_j is given his/her evaluation by each agent a_ℓ and buyer b_i.
[mechanism 2] The buyer b_i is able to report an impression of the goods compared with before purchasing and after receiving the goods. Also the buyer is able to report a difference between a process written on the webpage and actual process.
[mechanism 3] The interval of purchasing time and evaluation reporting time is able to influence the seller s_j's rating, particularly, it is able to influence the evaluation of transportation time.
[mechanism 4] The agent a_ℓ gives some additional evaluation points to the seller s_j by number of evaluation items indicated by the seller s_j.
[mechanism 5] The system is able to give some weight for separating evaluation items between important and not in the transaction before the buyer b_i scores the evaluation.
[mechanism 6] The system evaluates some similar evaluation items, which is not specify in this trading, depending on the case of trading.
[mechanism 7] The agent a_ℓ adjusts the evaluation point by using credit history.
[mechanism 8] The agent a_ℓ calculates a total evaluation point of the seller s_j.

V. Efficiency of the mechanism

We evaluate our above mechanisms' efficiency by some computational experiences, simulations and incentive analyses. In this section we show some fundamental observations. **Mechanism 1** in our mechanism is able to control that the seller s_j increases own total evaluation value by making fictional buyer, where every buyers and sellers do not know how to calculate the total evaluation value. **Mechanism 2** requires a fairness to the buyer's evaluation. In the existing electronic commerce, the buyer report ambiguous evaluation, the evaluation is not fair unless the impression of the seller is not same among the buyers. **Mechanism 3** controls a reliability of the evaluation items. If the buyer scores to the evaluation items after a long time, then the impression of the purchased goods is decreasing. Hence, the evaluation system employs the mechanism 3 as a penalty for delaying evaluation of the buyer. **Mechanism 4** works for the sellers to encourage opening information. It means the evaluation system has an incentive that the seller provides more evaluation items to the buyers, when the system announces the additional point is given by the number of opening information. Also if the administrator of the electronic commerce evaluates the number of evaluation items is too many for the buyer, the system restricts the evaluation items such that it satisfies a maximum total additional point. This mechanism has another advantage. The most hopeful seller's strategy of increasing his/her point is to increase the evaluation items and to improve his/her weak point. This mechanism has a function that the seller tries to improve his/her weak point in this mean. **Mechanism 5** is able to eliminate idle evaluation items for the selling goods. For example, if the seller choices "Is this goods fresh?" as one of evaluation item in the sale category, the goods is already categorized Sale, therefore the seller's choice is idle evaluation in this case. This problem is able to be solved by the buyer put a weight on the important evaluation item. **Mechanism 6** controls that the seller choices a lot of redundant evaluation items for increasing his/her evaluation value. For example, suppose that the seller describes some foreign countries on the introduction of the goods and this goods is actually made by a foreign country. Then the two evaluation items "Does the introduction accord with actual goods?" and "Is the goods made by domestic?" are redundant. **Mechanism 7** means that the system evaluates the seller who gets a positive point continuously. That is an evaluation of continuously application. We consider that the total point of the seller is only calculated by the average value given by the buyers. Even if the seller is evaluated by negative evaluation after he/she got many positive evaluation, the high level positive evaluation lacquers the negative evaluation. This mechanism requires that a high level seller tries to trade maturely. It means

that the mechanism provides a negative incentive for false trading. **Mechanism 8** tries not to occur a disadvantage for the sellers by the agent changes the total evaluation value with respect to each market character by using some control value. We have been confirmed that the ratio of successful trading is changed significantly by types of buyers in the experience which verifies the effectiveness of decision making of purchasing by considering the evaluation value of the seller.

VI. Incentive Making

A. Evaluation from the System by Information Disclosure

Our proposed model is based on number of disclosure of information. Multiple attributes to evaluate are prepared and a seller selects attributes based on his/her strengths. If he/she is good at packing, he/she can choose the ”Package” as the evaluated attribute. On the other hand, if he/she does not want to disclose his weakness, he/she can omit the attribute to be evaluated. To design a desirable mechanism in evaluation, we set a control value based on number of information disclosure. When a seller changes five attributes from four attributes to be evaluated, the system gives an incentive points to the seller. Namely, if the seller discloses more attributes, the incentive points are given in proportion. Thus, he/she sets up a lot of attributes to get many incentive points. And also, incomplete information reduce from the shopping site. However, if he/she does so, he/she needs to be careful in each activity on a trade.

if a seller provides an item's information by pictures and explanation, a risk on trade is decreased [20][21].

B. Evaluation from the System by Cumulative Extra Point

Here, we define an experience value based on the cumulative number of trades for each seller. In existing evaluation systems, the score/rating of evaluation is calculated simple cumulative trading experience. For example, when a seller has 30 positive rating without any negative rating and he/she gets a positive rating in a subsequent trade, his/her score becomes 31 rating. However, we propose an appreciate model for outstanding sellers. The outline of the model is that the system gives an extra point for a seller who continues a lot of trading without negative rating from buyers. On the other hands, once he/she gets a negative point, the cumulative number goes back to the start. For example, when a seller has cumulative 100 positive rating without any negative rating and he/she gets a positive rating in a subsequent trade, the system give some extra score automatically. Thus, the marketplace positions outstanding sellers apart from the rest.

VII. Experiment

In this section, we show the result of experiments regarding the rating of seller evaluation after tradings. The purpose of this experiment is the effects of evaluation from the system. In this experiment, extra points based on the number of disclosed information and credit history are considered. Rate of extra point is changed and the effect of trading condition is investigated.

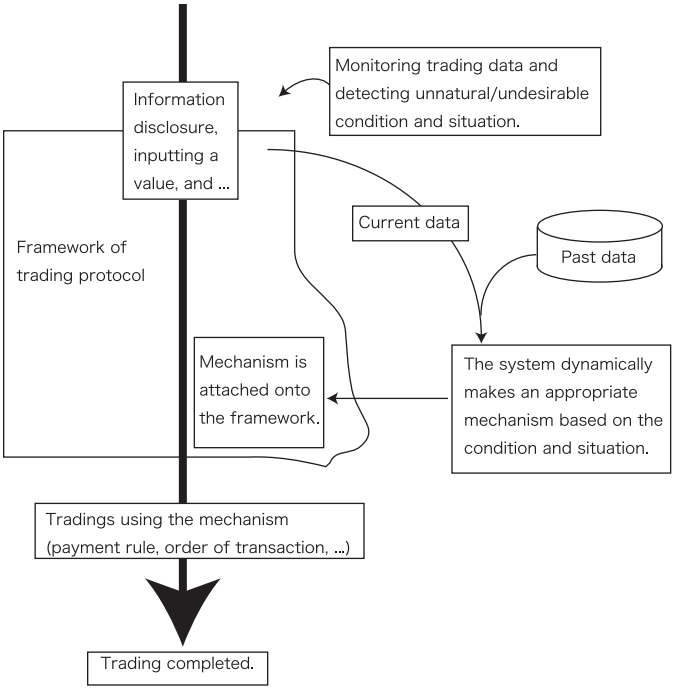

Fig. 4. Computational Mechanism Design

From this experiment, the result is used to make an optimal condition of tradings. Namely, the goal and future work of this research is to adjust the appropriate rate of extra point. Figure 4 shows the process of tradings and making a mechanism. Our experiment is basic contribution in a mechanism design phase.

A. Trading Passage

B. Setting

Normally, the number of evaluation criteria should be discussed based on the number of categories and items. However, simply, in this experiment, we assume that the number of evaluation criteria is between 1 to 10. We assume the buyers can give evaluation rating between 1 to 5. Extra point from the system is added between 1 to 5 based on number of disclosed information and credit history. When the system gives the maximum point to the seller who has maximum point from buyers, his total point becomes 10. In this experiment, we give the following rule when the buyer make a decision to buy the item.

1. Item's price
2. Amount of disclosed information (item information, shipping service, and sales)
3. Evaluation information (rating from past buyers and extra point based on number of evaluation criteria and credit history from the system)

Regarding the item's price, each buyer has a budget to buy the item. When the price is higher than the budget, he/she never makes a decision to buy the item.

Regarding the number of information disclosure, the amount of description and photo and several other information are considered. Particularly, in our experiment, we employ the shipping and sales in addition to item information. Each seller has characteristics about the e-commerce management. In our experiment, we assume three information disclosure levels. Because there are three attributes of information disclosure (item information, shipping service, and sales), there are twenty seven combinations of levels of information disclosure. If the level of information disclosure is high (namely, a lot of information is shown), such sellers have a big chance to be chosen by seller.

Regarding the evaluation information, in our experiment, each extra point of number of evaluation criteria and credit history is given between 1 to 3. When number of criteria is between 1 and 2, the extra point is 0. When number of criteria is between 3 and 4, the extra point is 1.5. When number of criteria is over 5, the extra point is 3. Regarding extra point by the credit history, when the seller has positive rating from buyers in recent 11 tradings, he/she gets 0.3 extra point. The example of extra point on credit history is shown in the Table IV. If the total extra point becomes over 5, the actual extra point to be given is 5.

TABLE IV
EXTRA POINT ON CREDIT HISTORY

Recent successful trades	Extra point
11	0.3
12	0.6
13	0.9
14	1.2
15	1.5
16	1.8
17	2.1
18	2.4
19	2.7
20	3
:	3

Each buyer has a decision making rule to choose a seller and to buy the item. Even though there are a lot of sellers whose condition is met to buy the item, the buyer choose only one appropriate seller.

After purchasing, each buyer evaluates the seller and gives a rating. Evaluation value given by the buyer is based on the difference between the item's price and his/her budget. Also, It is related with the factor of decision making. If the difference between the budget and item's price becomes positively large, evaluation value becomes high trend. Also, the amount of information disclosure is large, evaluation value becomes high trend. On other cases, buyers give negative rating on some probabilities.

C. Result of Experiments

In this paper, we show experiment results of the three cases of maximum extra point shown in Table V. In the marketplace, two hundred buyers and nine sellers exist. Each seller is dealing in thirty items. When the items are sold out, he/she finishes his/her sales. The result of experiment is shown in Figure 5, 6, and 7. Vertical axis shows the average of total evaluation value and horizontal axis shows the process of trades (maximum 30).

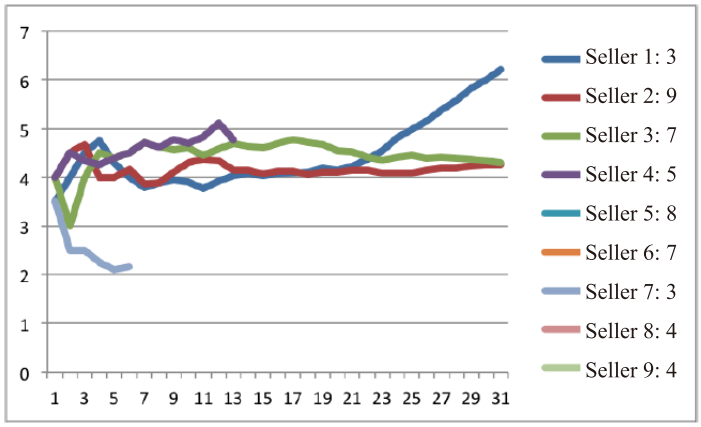

Fig. 5. Experiment Result 1

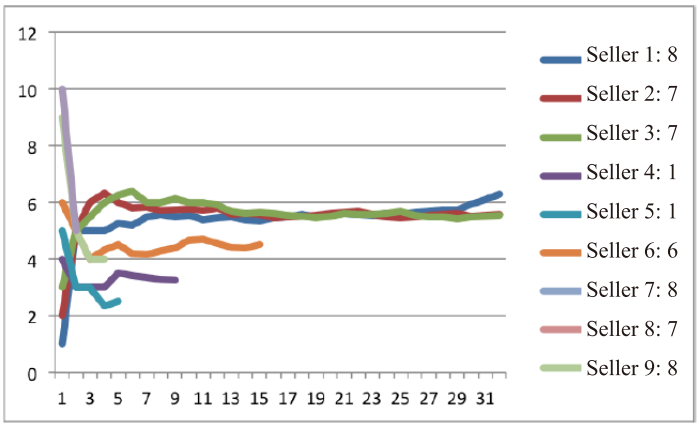

Fig. 6. Experiment Result 2

nine sellers are shown as respectively $\{s_1, s_2, \ldots, s_10\}$. Right description in the graph shows the number of evaluation criteria (number of information disclosure) defined at random.

TABLE V
CASES

Experiments	Number of evaluation criteria	credit history
Experiment 1	1	2
Experiment 2	2	2
Experiment 3	3	1

VIII. RELATED WORK

Researches on the evaluation system in online auction system are very popular and a lot of contributions are published [16]. Kobayashi analyzed the evaluation mechanism on the Internet auctions by considering as a network structure, that is, the relationship is constructed between buyers and sellers [15]. The contribution proposes a new evaluation model of

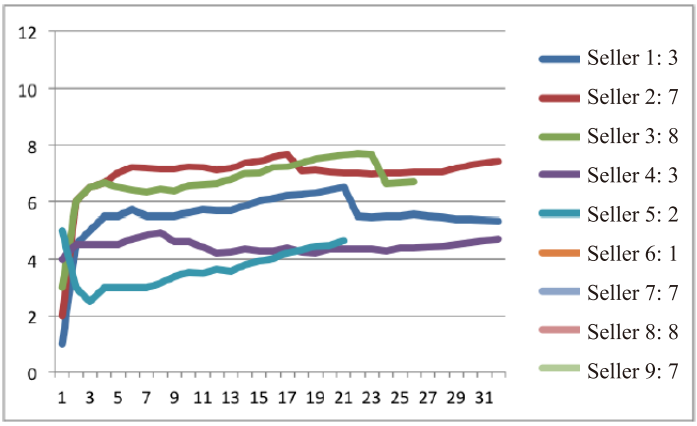

Fig. 7. Experiment Result 3

network structure instead of the evaluation on trades by sellers and buyers. Further, in the contribution [16], he implemented the evaluation system with the evaluation algorithm of web page. It also analyzed through the experiments to make sure of effectiveness.

Ming analyzed the evaluation method of online auction to take in exponential smoothing[17]. It analyzed to avoid the cheating because a bad evaluation wields large impact on seller's evaluation to give a lot of weight the last evaluation. It is a large effect to have a lot of weight when seller resort to cheating for buyer in trade.

Ito analyzed the Internet auction protocol to permit the Pareto efficient distribution[19]. It shows that the protocol can admeasure according to goods quality made a honest declaration by specialist when there are a lot of asymmetric information and some specialist in the Internet auction.

IX. Conclusion

In this paper, we clarified the essential problem of electronic commerce through our survey and showed the one of promising method to solve the problem using computational mechanism design. In the computational mechanism design, computers control a certain value or adjust mechanism automatically to make an optimal situation. This paper showed a new mechanism design in user evaluation system and the system needs to adjust/control the mechanism and values through background simulation during trading between buyers and sellers. We also showed eight segmentations of our proposed mechanism and explained their properties. In the experiment, we clarify what our proposed mechanism effects in the trading. Specially, we focused on the passages of sellers evaluation rating in thirty trading opportunity. Some sellers can have a chance to trade with buyer continuously. However, even though seller's item price is lower than the other sellers' items, he/she sometimes loses a chance subsequently to trade because of less disclosed information.

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A Model of Information Technology Strategic Plan for the Government Sector

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Abstract - *Information Technology (IT) is strategic for organization management, although many companies lack IT governance and planning, skilled people, defined and institutionalized methods and procedures, internal controls and indicators, as well as agreements service levels and information security, legality, and economy. In this scenario, one needs a minimum of organization and control in the use of resources to boost technical and administrative efficiency, with a focus on IT governance. An Information Technology Strategic Plan (ITSP) aims at discovering the resources and IT in an organization, to direct the technological and information architecture to its strategic objectives. The Brazilian Government issued a Normative Instruction (NI04) for public organizations to develop IT Strategic Plans so that they can purchase products and services. In order to help organizations develop, control and manage their ITSPs, a model was created that defines a set of auxiliary steps in the construction of the ITSP. Throughout this article we present a ITSP development and management model, its evaluation, and our conclusions after that.*

Keywords: Government, Strategic Planning, Information Technology Strategic Plan (ITSP)

1 Introduction

Over the years, many public and private organizations have had their areas of Information Technology undervalued, generally confined to the supporting role. [1]

Typically, organizations use their technological resources on a very poor level of planning where IT decisions are taken in an isolated way, for different reasons and by different people in their structures. [2] [9]

Still, according to [2], as a consequence of this scenario, we experience the following situations: Discontinuity of projects by constantly changing priorities and objectives, or need to attend to emergency situations, especially those arising from decisions by individual managers; Bad design of computational and human resources for the Information Technology unit; Information systems deployed without adequate regard to compliance requirements, creating more problems than solutions; Lack of motivation of the professionals involved in the process and leaders who often decide to reduce investments in technology.

Nevertheless, IT strategic planning is still placed in the background and, to reverse this, it is necessary to develop a plan that allows the combination of strategic guidelines and organizational intelligence with IT actions. [10][11]

There are several models for the development of ITSP, including the model proposed by the Microsoft called Microsoft Methodology Consulting Service (MCS) which is based on technical recommendations of COBIT, and developed jointly with partners who specialize in this practice. 5 This model is divided into five phases where each phase has activities related to its responsibility. The first phase deals with the generation of the IT strategic plan, the second includes a survey of IT necssity, the third phase consists in mapping the desired situation, the fourth is responsible for preparing the strategic plan for IT, already the fifth stage is the implementation and monitoring of ITSP.5

The proposed model by 5, considers that the development of ITSP consists on three steps. The first step is the preparation which is elaborated throughout the framework to create a ITSP, the second step is to diagnose the current situation, where the organ has an exact notion of your stage, and the necessity are raised The final step is the planning of the desired situation which is the time of elaborating the ITSP. 5

In Brazil, the Department of Planning, Budget and Management (MPBM) issued a Normative Instruction (NI04) stating that the acquisition of IT (Products and Services) is preceded by an Information Technology Strategic Plan (ITSP). [3] [8]

The Information Technology Strategic Plan - ITSP provides a complete view of the current environment and

Information Technology, according to current and future needs, and allows direct information architecture and technology aligned with the strategic objectives of the institution. [4]

The Information Technology Strategic Plan consists primarily of knowledge of its resources (services, Business Processes, Information Systems, Infrastructure, and Technology) from an analysis based on the purpose of the organization, definition and planning of a strategy to IT evolution. An administration concerned about the ITSP is a company that uses modern principles of rationality, consistency and quality, creating a policy for success. [5] [7]

Looking to improve the construction process and its monitoring of the ITSP, an idea rose to develop a model to provide direction, control and monitor the development of ITSPs and after their production, to allow an effective management and monitoring.

2 Model

The objective of this model is to define a set of steps that can help IT managers in the Federal Administration in the construction, monitoring, and management of its Information Technology Strategic Plan - ITSP. In the following sections we will detail the development and management of ITSP. [6]

The model of design and construction of an ITSP was split into two parts:

1. Preparation, comprising the steps of Preparation, Diagnosis, and Planning (Actions and Risks);

2. Management and Control.

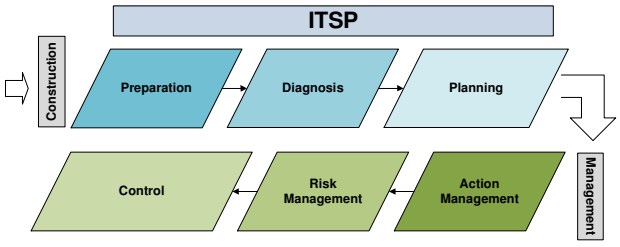

Figure 1 - Model for ITSP Preparation and Management

2.1 ITSP Construction Model

The Model for the Development of the Information and Technology Strategic Plan aims at establishing a simple and succinct ITSPs construction, serving as a tool to aid in the diagnosis, planning and management of IT resources and processes in an agency or entity. Below we detail the steps that make up the development model for the ITSP. [6]

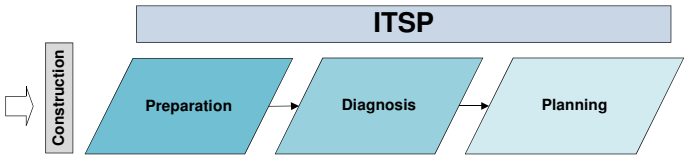

Figure 2 - ITSP Preparation Model

2.1.1 Preparation Stage

Before starting the actual development of the ITSP, one should observe the following tasks that make up the first stage of developing the ITSP, which is the preparation stage:

- Defining a validity period for the ITSP;
- Defining the scope;
- Defining the construction team and participants in the ITSP;
- Defining the methodology;
- Defining the mission and vision of the institution;
- Defining the documents used as references;
- Aligning the ITSP with the documents of the agency.

The alignment of the ITSP with other planning instruments is to make them compatible, listing requirements already contained in them to prevent inconsistencies and unnecessary expenses, and to boost efficiency.

2.1.2 Diagnostic Stage

The next stage of the ITSP Construction Model is the diagnostic stage, in which the current situation of the body and IT Needs to be attended to are identified. Please note that in the previous stage only the needs that were included in these documents rise to the fore. It is at the stage of diagnosis that we raised all the needs or demands that must be attended to.

The diagnostic stage seeks to identify internal or external needs that the IT area has to meet. One should remember to include the needs raised during the alignment. The assessment of the needs can be done through questionnaires, interviews, appraisals, a history of the inventories, amongst others.

The following tasks comprise the diagnostic stage of IT:

- Raising the current IT situation in the body;
- Identifying the requirements to be met;
- Evaluating the services provided;
- Inventories;
- Filling of evaluation forms and interviews with deadlines for replies;
- Evaluating the services provided.

The evaluation of services aims at contributing to the improvement of services and giving the IT manager a management tool to make decisions. It is suggested to evaluate both contracted services such as those performed by its own IT area; Diagnosing people. Diagnosing people is to identify HR needs and IT training.

2.1.3 Planning Stage

Planning should be done from the diagnosis. The planning stage is the most important. It is the time of defining what will be done and what the priorities are. For this it is important to have at hand objective criteria on which to base decisions and never fail to record the reasons for divergent decisions on such criteria.

At this stage, for each requirement a priority has to be set and one or more actions for meeting it. These actions may involve the contracting of services, acquisition of equipment or the use of one's own resources, including human, for its development.

The following tasks comprise the diagnostic stage of IT:

- Defining actions to be taken to meet the needs;
- Defining the mode execution for the actions;
- Action planning. Identify, for each requirement listed in the previous stage, your priority goals and actions needed to achieve the goals;
- People planning. Identifying HR needs arising from activities not addressed in the planning of execution;
- Execution Planning. Seeks to identify the human and budgetary resources necessary to carry out the planned action to meet the needs, and estimate the deadlines for start and completion of the actions.

2.2 ITSP Management Model

The management model has three stages, Actions Management, Risk Management, and Monitoring, the latter being responsible for managing the other stages. The management of an ITSP should be planned so as to facilitate its monitoring and execution.

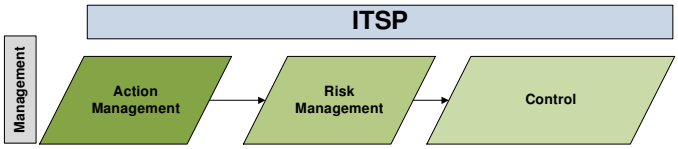

Figure 3 - ITSP Management Model

2.2.1 Action Management

In the Actions Management Stage one needs to identify, for each action, its guardian, its replacement guardian, the terms, and the risks. At this stage the planning is done for the monitoring and implementing the actions set out in the ITSP. The preparation of the action management plan can be made by observing the following tasks:

- For each action, identify a person responsible and a substitute;
- For each action, set out start and completion deadlines the Execution Plan;
- For each action, a plan can be made separately, a document of which will be referred to as "detailing" of the action;
- For each action, list the estimated budget resources for its development.

2.2.2 Risk Management

Planning Risk Management is the identification of each action, the main risks that could result from their full or partial non-performance. For each risk identified, one should set one or more preventive measures and contingency plan, as well as their caretakers. For an effective monitoring identification of action, time, responsible human resources involved, type, and value budget. It is necessary to create control points through indicators.

2.2.3 Monitoring Stage

The ITSP establishes a set of Strategic Objectives and Strategic Guidelines aimed at directing IT management. To achieve this new IT management position, we established a set of actions to be conducted by the Strategic Guidelines and by the associated Strategic Objectives.

ITSP monitoring is based on the execution of these actions, to establish a relationship with the Objectives and Strategic Guidelines. The advice from Action Planning monitors the progress of actions in which the information is obtained from the actual start and finish projects.

2.2.3.1 Metrics to monitor the ITSP actions

The metrics of the actions will be used to evaluate the progress of the ITSP. The goal is to guide ITSP development to achieve the goals set by the institution in adapting their strategies for IT.

The metrics are defined based on the following schedule parameters:

- Percent Complete (%) = Display value after completion of the project or values calculated from actual start date and Actual End of project;
- Variation of Completion (Days) = Conclusion - Conclusion Baseline;
- Variation of Begin (Days) = Begin - Begin Baseline;
- Variation of Duration (Days) = Duration - Baseline Duration.

The analysis of Variation in Start and End can be done with the following parameters:

- If Variation of Completion and Variation of Begin is larger than zero it means that there were delays in projects that make up the guidelines;
- If Variation of Completion and Variation of Begin is less than zero it means that there was an anticipation of the projects that make up the guidelines;
- If the Variation of Completion is greater than zero and Variation of Begin is less than zero it means that more time has been spent for projects that make up the guidelines;
- If the Variation of Completion is less than zero and Variation of Begin is larger than zero, it means that less time was spent for projects that make up the guidelines.
- If the dispersion is concentrated in the quadrant in which the variation of completion is less than zero, it indicates better performance in project development;
- Variation of the Duration indicates how much time was spent, whether more or less, in the development of a project.

It is information that supplements the Variation of Completion and Begin.

Analyses of length variation can be:

- If the Variation of Duration is greater than zero, it indicates that more time was spent developing the project;
- If the Variation of Duration is less than zero, it indicates that less time was spent developing the project.

The metric is defined for this Percent Complete (%) that indicates how a strategic direction has been met, and the execution of the guidelines indicates how a Strategic Objective is met.

3 Evaluation (Case Study)

This section presents a brief assessment to demonstrate how the model can provide improvements in the process to create and manage an Information Technology Strategic Plan in government institutions. The example used in this paper is adapted from a Brazilian Government organization which we call institution X.

3.1 Strengths

Employees engaged in work, tech staff with high degree of technological expertise, interest of the institution in

adapting its technology direction to facilitate goals, experienced employees, strong technological structure very good work environment, reference in technology, despite the loss of professionals, employees who believe in the company, training for professionals, expertise in the business of government, ability to overcome challenges and win.

3.2 Weaknesses (needs)

Lack of uniformity in IT standards, failure to plan mid and long-term technology in government changes, lack of staff to meet IT demands, insufficient processes, documentation, and workflows, dispersion of resources at the front desk, making it difficult, lack of technological forecasting, no ownership and no project cost estimate to allow a comparison between doing the work internally or outsourcing it, lack of tools for more productive work (hardware and software).

4 Conclusions

The Information Technology Strategic Plan (ITSP) aims to guide an organization in the use of their information technology resources, leading to focus on continuous improvement processes of governance. An institution that has prepared her ITSP is based on principles of rationality, economy, uniformity and standardization, creating the technological basis for the deployment with enhanced efficiency and effectiveness of public policies.

The lack of planning for IT can cause an insufficient understanding of the external and internal environment of the organization and emerging technologies that can add value to customer services. This situation can drive to inadequate investment in IT, considering meeting the necessity of the organization to overcome its challenges. In fact, ITSP is a strategic tool to direct and manage information technology resources in alignment with the strategic priorities of the organization's business.

It's important highlight the dynamism of strategic planning due to the fact of the instability of technology environments, which are constantly evolving. Thus, the ITSP should be reviewed annually in order to the strategies are aligned with organizational mission, considering the action of the organ, as well as issues relating to the evolution of technology.

The development of an ITSP brings many benefits, such as a complete view of the Information Technology environment, more accurate decision-making, focus on the needs of end-affairs of the institution, amongst others. In addition, the work done in evaluating the model allowed the following benefits:

- A set of information that allows a consistent view of the IT environment in the institution;
- Enabling interaction between different areas in the institution and other units in aligning objectives and efforts to IT development;
- Creation of an initial portfolio of programs (projects) to guide consolidated investments in IT, and therefore its growth and evolution.

With the implementation of this model, government institutions will have a foundation to start if one does not have it, the construction of an enterprise architecture that will boost the accomplishment of its mission to attain specific goals. As such, enterprise architecture increasingly makes investments in IT reliable and compliant with the strategic needs of the institution.

4.1 Acknowledgement

We should like to thank institution X for allowing us to evaluate the proposed model and provide support for possible evolution and improvement.

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E-GOVERNMENT SERVICES and USER EXPECTATIONS

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Abstract – *In this paper we make considerations of the opportunities that Web 2.0 tools can offer in providing user-centric services that can be personalized and integrated in the users' proximity. The social media application based models of public service delivery that are developed by government agencies in co-production with third parties certainly could have the potential to better meet user needs and, accordingly, to be adopted by at significantly high proportion of today's online citizens. After having illustrated the user needs and the experiment conducted by the Division of General Society explains how 2.0 applications and service-oriented methodologies can improve the understandability and use of applications eGov*

Keywords: e-governement, service oriented aapplications, human interface

1 Introduction

This study provides a future vision of e-Government service provision that is based on a life events approach, user expectations, key Web 2.0 enablers, and a service-oriented architecture paradigm. [23]

Today‘s developments in online service provision, particularly in the private sector, reflect a rapidly changing environment in which services are increasingly user-oriented and draw on new opportunities and collaborative approaches. Important trends are observed in the use of Web 2.0 tools: they are under continuous development and deployment in ways that provide innovative interactive online applications. These developments have given rise to a significant uptake of new services based on platforms like social networks and new approaches such as crowd-sourcing, rich content, blogging, and social bookmarking.

The opportunities that Web 2.0 tools can offer are immense in providing user-centric services that can be personalized and integrated in the users‘ proximity (whether in their own homes or “on the go”). The integration and mashing-up of these services is an important driver for the continued improvement of new, easy-to-use, online services.

The availability of these tools and techniques offers public services, or e-Government services, an important opportunity to create more value for society as a whole[12]. These gains, as well as costs, were explored in a general way in this study and costing, more specifically, in terms of the proposed architecture and platform. The desk research carried out during the first phase of this study demonstrated that the development of Gov 2.0, and the use of Web 2.0 in e-Government service provision, is still at an early stage.

Life events are important events or “stages in a citizen's life, such as school, marriage, or buying a property” [14]. They can be packaged so that the work of multiple government agencies are concentrated “around a subject that makes sense to the citizen” [14]

Web 2.0 is associated with Web applications that facilitate interactive information-sharing and collaboration on the World Wide Web. It is based on the notion of connectivity and user-centered design. It facilitates large-scale participation and collaboration in terms of creating, editing, ranking and distributing content[3]. By its very nature, Web 2.0, is composed of many hybrid forms, tools, and technologies. Web 2.0 is not an aim in its own right, but is a set of tools that can be used to address the needs and behaviors of users of online services.

Gov 2.0 has been described as: “making use of web 2.0 technologies … to interact with citizens and provide government services” ([1]. This study shows that the term Gov 2.0 is based on a combination of social computing (Web 2.0), public service value, and governance, institutional, and organizational trends that open up government services[11]. Trends in this direction indicate public policy shifts towards openness and transparency, engagement with citizens, and the release of non-sensitive public sector information (PSI) and third party collaboration.

2 User needs and behaviour

In 2010 experiments were conducted for a study commissioned by the Directorate General for Information Society in relation to the solution of everyday problems. [9]

One hundred and thirty persons participated in the experiment, which they were given an hour to complete. Each person was provided with four scenarios. All the

individuals were asked to think themselves into the fictitious situation. The scenarios described four different life events: all took place in a cross-border context. The experiment's purpose was to identify the ways in which people approach a life event and how they navigate and use the available online sources to find appropriate solutions. The four examples of life events used in the experiment involved: experiencing the theft of identity papers abroad, preparing to study abroad, preparing a long-term stay abroad, or dealing with a pandemic threat when travelling.

The users used two types of search strategy to find information: a) when confronted with one of these four life events, the individuals involved in the experiment tended to segregate the separate actions, tasks, and information they needed related to the life event and approached the issue at hand in a 'disaggregated' way; b) when they searched for the information, they followed two different strategies.

When using a single strategy, the users looked solely at government portals (portal-only) or they relied entirely on a search engine (search-only). When they used a mixed strategy, it meant that they started with a government portal and ended up by searching using a search engine or vice versa.[13,16]

Single strategies (i.e., portal-only and search-only) were the most effective; the mixed strategies are concerned the "search-then-portal" took considerably longer; and the least effective strategy was portal-then-search. Indeed, a significant proportion of those users who started with government portals perceived the portal as not effective in providing the information they needed and had to change towards the use of an open search method.

Users who were pointed towards government portals took significantly longer to find the right information.

Lastly, users found their questions answered significantly faster by searching on private sector sites and Wikipedia rather than on government sites.

These findings may indicate two trends: first, the information provided on the tested government portals is difficult to find and, second, navigation through established paths on government portals is not necessarily optimal when users in a trial setting are trying to find the very targeted information that is needed in relation to a specific life event. Hence, information provision is not optimized so that users can find it quickly by following different navigation paths. Two lessons can be drawn here from the private sector, and both provide leanings for government services:

First, online stores offer a "mystery shopping" approach. This approach facilitates a disaggregated search approach and thereby produces relevant results and links to related topics. Such an approach involves using a range of Web 2.0 and Web 3.0 strategies: Web 3.0 indicates a shift towards a form of guide, based on artificial intelligence [20] incorporating semantic web (i.e., the meaning of data), personalization (e.g. iGoogle), intelligent search, and behavioral advertising. The Web 2.0 strategies would involve the use of recommender and reputation systems; user testimonials and feedback facilities; and linking to social networking and data sharing sites. The Web 3.0 initiatives would use the Semantic Web, the "web of linked data"; complex search mechanisms; and personalized browser technologies.[24]

Second, more and more services are offered as separate modular elements that can be integrated and re-used in new or other online services. Generally, such a move towards tailored service provision would require governments to shift from a more closed, monolithic manner of service provision towards a more modular, open or atomic way of providing information and services. The toolset provided by Web 2.0 and Web 3.0 techniques is particularly aimed at enabling exactly this type of approach: it could facilitate a move away from monolithic e-Government towards what this study terms an "atomic e-Government" model.

3 Future scenarios of Life Event cases

Based on these findings, the four life event scenarios for future e Government services were developed which integrate different Web 2.0 tools. They provide a future vision of service provision in which third party involvement plays an important role. These four scenarios were translated into visual mock-ups that served to introduce potential users to this new approach to service provision based on life events. They involve a combination of services, both government and private, that are each linked to a single life event and are provided in a single application. This approach shows the potential for re-use of e Government services [4,5] The four scenarios are:

1. **Stolen valuables abroad**: A mobile-based application that provides an integrated approach to service provision associated with the life event of a person having their valuables stolen while abroad;
2. **Studying abroad**: A social network platform-based application that provides an integrated approach to service provision associated with the life event of studying abroad;
3. **Working abroad**: A social network platform-based application that provides an integrated approach to service provision associated with the life event of working abroad;
4. **Pandemic flu**: A multi-channel based application that provides an integrated and crowd-sourcing approach to service provision associated with the life event of experiencing the possibility a pandemic flu threat while planning to travel abroad.

4 What users really want and what are their needs

In general, the benefits of adopting new Gov 2.0 based applications were time savings, flexibility, convenience, simplified service delivery and being better informed. The most important feature of these Web 2.0 applications is the fact that a person can handle all the necessary formalities by using a single application. Although user needs differ from one application to another, the most essential features of such a service perceived by the survey respondents related either to user service friendliness or to convenient information provision.[8,9]

Personalization and pro-activity were high on people‘s list of requirements whereas multi-channel access seemed less essential. .

As far as future conditions for the development of Gov 2.0 are concerned, more than half of the people in the sample target groups were convinced that public agencies should collaborate with private actors to enable better information and service delivery. There was a strong belief that – in order to develop new user-oriented service applications – public agencies will have to open up and exchange their data with other public and private actors. At the same time, according to at least one out of three respondents, third party involvement in the development and provision of public service delivery applications implies increased privacy risks.

Many people stated that government agencies should make use of social media platforms more actively, and other people was convinced that information posted by fellow Internet users is more useful than official government web applications.[18,21]

According to the platform analysis, new Web 2.0 based models of public service delivery that are developed by government agencies in co-production with third parties certainly have the potential to better meet user needs and, accordingly, to be adopted by a significantly high proportion of today’s online citizens.

Given the potential offered by these new scenarios, it is important that their development can be made possible. However, this begs the question of what needs to be in place to make this new service provision a reality in the future.

In the cited experiment study, interviews were therefore conducted with a group of stakeholders such as experts in online e-Government service delivery, public sector actors, and different private sector players.

These stakeholders identified a number of key enablers that would be needed to facilitate the future vision of service provision. The enablers identified include such elements as opening up public data, providing accessible and re-usable public services within a service-oriented architecture, and enabling an appropriate legal framework and standards.

Government plays an essential role in facilitating the creation of these prerequisite underlying elements. Doing so would also involve addressing some of the most important obstacles to the development of the proposed scenarios: back-office integration and interoperability in the public sector not only within single countries but also across borders6. In other words, interoperability is an essential enabler of such future e-Government services. [7]

A business model is also important. The development of new services based on re-usable public services and data by private sector also requires a clear economic incentive. Facilitating a low threshold to the actual access and use of public services to create new value-added services is important to make this a reality.

It is expected that public demand for Web 2.0-enabled services that provide the complete handling of a “life event” or action will arise in the near future.

By leading by example, government should aim to develop basic, re-usable, services that are both attractive for the private sector to build on and end-users to take up.

Enabling such a development may lead to more user demand for these services, build up greater political commitment, and showcase a clear business case in which the private sector can collaborate.

5 Service-oriented architecture: a key enabler

The service-oriented architecture is the main approach that would enable a shift towards Gov 2.0 and the re-use of online e-Government services. The study therefore went on to investigate in some depth the benefits of service-oriented architecture and a possible target service architecture. [15,19,22]

Service-oriented architecture is particularly suited to help government agencies deal with the obstacles that currently inhibit their service provision. A number of benefits are evident. The architecture can help governments to implement new systems that enable them to modernize their business architecture, integrate agency service delivery, and share information across organizational boundaries. They will also be enabled to reduce costs by consolidating redundant application functionality.

Service-oriented architecture re-uses application functionality which allows governments to leverage existing applications. In a service-oriented architecture, services are loosely coupled with each other: this enables rapid restructuring and reconfiguration of business processes and leads to more business agility. Applications that are service-oriented are developed and delivered faster than in traditional application development projects. This is due to a variety of factors, including the sharing of services and service composition, and the wrapping of the functionality of legacy assets to provide them through web services.

When considering the implementation of service-oriented architecture and enhanced collaboration between the public and private sectors, four possibilities exist.

Providing a service registry at a International level: One of the key components in the architecture is dynamic service discovery. A service registry enables the re-use and discovery of services.

Providing services by local authorities: in order to enable local authorities to develop re-usable services, a global vision, principles, methodology and standards in a reference framework is needed.

Providing open standards at a global level: an essential aspect of service-oriented architecture is that it is composed of services that can be re-used, extended, recombined or orchestrated to deliver the required functionalities. Open standards can ensure the re-use, combination and orchestration of the existing and future services in this architecture. Open standards could be defined on a global level to ensure these essential aspects of service-oriented architecture. [2,6]

Better collaboration between the public and private sectors: Governments cannot provide every potential service that citizens might need. However, by putting key services in place, governments can then partially outsource the provisioning of services to private entities. By making these two moves, governments can focus on their own priorities. This would enable the private sector to provide end services to citizens that are composed of both public and private services. Such a move will help make considerable progress towards the notion of the government as a one-stop-shop.

A possible roadmap for migrating to a service-oriented architecture is of strategic importance in terms of planning future possible directions.

The roadmap may include an envisioning phase in which the vision, the principles, the standards, the methods are set and tested. Three alternatives could be suggested for this phase: describing and implementing a finite set of life events, government as a platform, and dynamic public service mediation.

When the vision and a tested – and agreed – set of principles, methods and standards could are formalized, an implementation phase could start. It would consist of the installation of the platform, developing and providing services, marketing these services, and evaluating and adjusting the vision, methods and standards.

6 Conclusions

As a final reflection, the paper offers some conclusions with regard to the future role of life events; the benefits that can come from a shift towards Gov 2.0 – a Web 2.0 approach to service provision based on life events; and some preliminary observations with regard to cost effectiveness.

Life events can offer an appropriate and effective way of structuring services for citizens. These services would be more firmly oriented towards people‘s lifetime needs. The ways of doing this involve the use of different technologies and channels for service delivery, the re-use of public sector information and services, and enabling different options for the provision of core services. As a result, public agencies, third parties, intermediaries, and end-users – indeed, citizens themselves – could become engaged much more collaboratively in producing, combining, embedding, re-packaging and delivering a variety of core services. This is implicitly a more Gov 2.0 approach.

Shifts towards Gov 2.0 are already underway: it could be even more firmly based on service provision via a service-oriented architecture. It is clear from the outline of the benefits that arise from the proposed new means of service delivery and the expectations of users that a move in this direction is inevitable. Not only do users expect such services to be developed but the services will also enable public agencies as well as third parties to create important added-value for society as whole.

To enable this type of service delivery in the near future requires a clear commitment to put the key enablers in place and to agree on a clear common vision. Government plays an essential role in facilitating the creation of these prerequisite underlying elements and tackling the major obstacles.

An adaptation of the Gov 2.0 life events model to government services can reflect both the expectations of users, and resolve a number of the challenges that surround public service provision (for awareness of such challenges, see for example, the Council of the European Union, 2009, and the Fifth Ministerial e-Government Conference 2009).

Costs and gains

Gov 2.0 is conceived as a means of making government services more responsive and effective and, in parallel, enabling them to “slim down”; this trend complements the directions taken by other organizations and their use of Web 2.0 technologies, a shift which is transforming both the economy and people‘s lives. In addition, Gov 2.0 offers the possibility to “unlock the immense economic and social value of information and other content held by governments to serve as a precompetitive platform for innovation” (e-Government task force, 2010, page xii).[17]

In the paper has been highlighted what a shift towards a more modular approach to life events in a Web 2.0 context might mean. It identified clear gains, such as: higher responsiveness to the expectations and needs of citizens as and when they require certain services; fulfillment of policy mandates and coordination on their accomplishment; greater transparency; greater collaboration and cooperation across services, between government and third parties, and between citizens and their government. . The study explored in some detail the potential costing with regard

to life events, platforms, and dynamic public services mediation. A rigorous and in-depth cost-benefit analysis was not undertaken, but should certainly be considered for future possible application.

Three broad possibilities with regard to costing were identified in view of establishing the future scenarios: First, when implementing a finite set of life events, development costs are stable over time; investment costs are assumed to be reduced over time. Second, the implementation of government as a platform, requires higher investment upfront due to the installation of the platform; the development costs are reduced over time as private initiatives will gradually take over the development. Third, dynamic public services mediation requires a very high investment budget upfront; over time, however, the development cost would be lower due to the re-usability of the semantic services.

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4-LIFE-Model: An Approach for a Government-with-You Strategy

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Abstract - *The growing importance of terms like transparency and openness in public administrations on the one hand, and the growing popularity of social media platforms on the other hand are facts that cannot be ignored. They build the basis of a modern citizen-oriented public administration allowing bidirectional communication between government and citizens. But, just the availability of ICT in general or social media in particular does not help. For a good quality of E-Service the design of a government's internet portal is the crucial factor. To support this design process the 4-LIFE-Model has been developed. The model is the backbone of an expert system that can be used by a town council, for example. Information about population structure, citizen needs, regulatory requirements, or the attributes of certain Web2.0 tools are vital parts of the mandatory knowledge base. The 4-LIFE-Model and its projection to an expert system will be explained in this paper.*

Keywords: E-Government Strategy; E-Democracy; Public Administrations; Survey; 4-LIFE-Model

1 Introduction

Openness and transparency are becoming increasingly important for administrations on all levels. Social networking and social media play an essential role in the everyday life of citizens. Their importance and influence in government structures is therefore obvious. We will experience the regular appearance of new communication channels, offering new, more and hopefully better levels of service. According to recent statistics, "Facebook" has more than 845 million active users and is used on a daily basis for information searches and communication by many of them [1]. It has been particularly noted in recent times that companies are taking advantage of these platforms through an increased involvement of social networks in Corporate Communication Strategies [2]. Public administrations, however, currently lack the conditions, strategies and structures to address these Web2.0 technologies and establish forward-looking and modern communication and information channels. They still reflect industrial-age organizational thinking [3]. The E-Government process enables the integration of Web2.0 technologies and provides public administrations with a large potential for cost savings and synergies.

2 Paradigm Shift

The relationship between citizens and public administrations is undergoing a remarkable transformation. The paradigm shift from a traditional "government-to-you" relationship towards a forward-looking and interactive "government-with-you" relationship must be recognized, accepted and internalized by government decision makers in order to ensure a citizen-oriented and citizen-centered management policy [4]. Dialogue and interaction combined with a high degree of transparency are key factors in this process.

The service portfolio of municipalities and cities requires a targeted and tailor-made approach to the needs of individual users, leading to a more efficient allocation of resources. Although this implies cost savings for the government, economic factors and cost reasons should not, however, be the main motivation. They should rather be considered a side effect of a citizen-centered administration, which accepts the citizen as an equal partner and facilitates mutual exchange of information and transfer of knowledge [5].

3 The SWING Research Project

The "SWING" (SWiss INnovation @ e-Government) project was launched against the background of the increasing importance of ICT as an integral partner in administrative processes and the availability and general widespread public use of Web2.0 technology [6]. The objective of SWING is the availability of high-quality E-Services to enhance the Swiss information society and thereby encourage the integration of sectors of the community less inclined towards ICT. The research is based on the described paradigm shift.

The "government-with-you" relationship implies high-quality E-Services tailored to meet citizens' specific municipal needs. A multidimensional approach is necessary to fulfill this requirement. SWING therefore examines issues of portal design and the implementation of Web2.0 technology into the E-Government process. This includes not only an inventory of social media in general, but more specifically, the implementation of appropriate strategies by public authorities. E-Government strategies in Swiss municipalities and cities were analyzed with an

initial data collection. This analysis then formed the basis for further considerations on portal design from the perspective of service users, taking Swiss-specific factors into account [7].

4 Lack of E-Government Strategies in Swiss Municipalities and Cities

The examination of the multiform interaction of public authorities, their employees and the assumed Swiss-specific factors required a complex primary data collection aimed at providing an accurate picture of the current provision of citizens' services by public administrations. 824 Swiss public administrations were contacted by e-mail and asked to complete an online survey with a runtime from 08/24/2011 to 09/30/2011. The response rate was rounded to 13%. In this paper the authors present the results globally, adapted to an international context. The majority of the surveyed public administrations, rounded to 85%, offer electronic services on their websites. 70% of the survey group provides e-mail and e-mail-based services, such as newsletters (53.6%) or standardized feedback forms (49.1%). Embedded E-Government-portals, such as the portals developed based on the Swiss eCH-0049 standard [8], are available in 31.8% of our surveyed group.

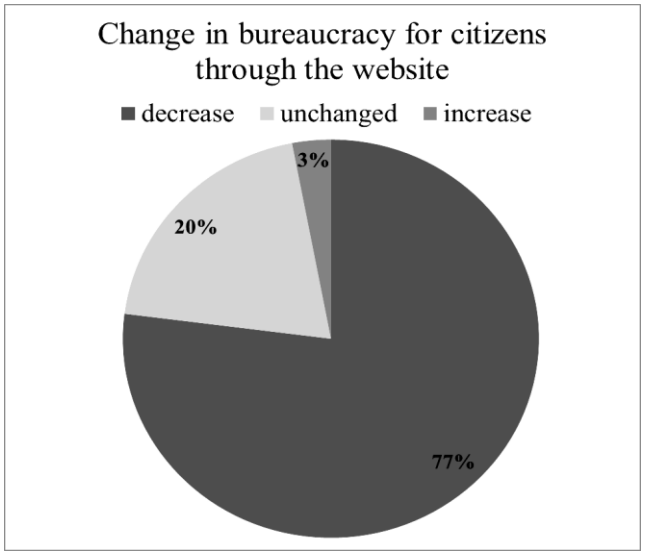

Figure 1 - Estimation of change in bureaucracy (n:110)
Source compiled by the author

Only a small percentage of responses indicated an extended website service offer including Web2.0 technologies, with relatively little use of forums (12.7%), social networks (10%) and blogs (4.5%) among the participants, although the majority of the surveyed administrations see a benefit in social networking and the use of social media.
Figure 1 and Figure 2 show estimates by the surveyed public administrations regarding changes to bureaucracy through their website and the perceived benefits of social networks.

Another interesting point is the discrepancy between (a) authorities that have a profile in a social network and (b) those that have their social network profile actually linked to their official website. As mentioned, 10% of the websites have a link to their social-network profile,

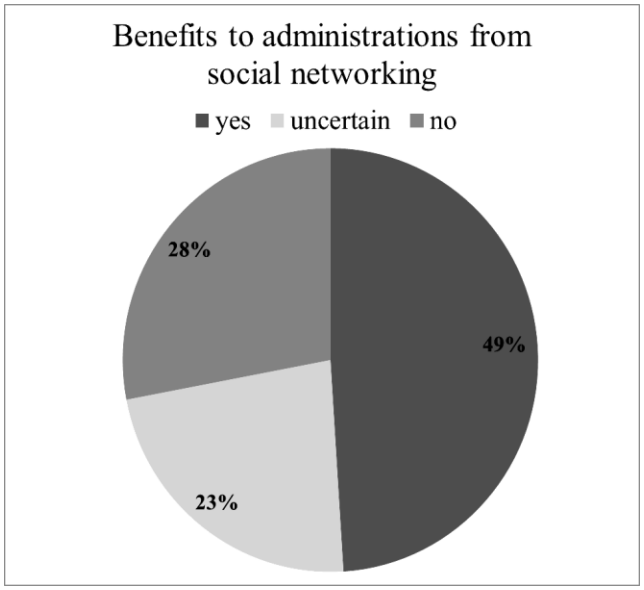

Figure 2 - Estimation of benefits (n:110)
Source compiled by the author

whereas 26% of the authorities affirm that they have a social network profile. This fact could be interpreted as a strategic shortcoming and poor use of resources. More than two thirds, however, have no profile in any social network, and half of this group has no Web2.0 project as part of their long-term planning.

This fact is discouraging, because the implementation of social networks by companies shows how successful it can be as an information and coordination channel. Social networks are well accepted in public life, even among the staff of public authorities, with 82% of the respondents participating in at least one social network. According to the survey, this bias can be traced back to the main obstacles and challenges concerning appropriate forms of communication and the definition of a strategy or approach for the use of Web2.0 technologies. Reasons due to legal or security issues were negligible, which is surprising, considering the importance of data protection, and this should be interpreted as a lack of awareness concerning security matters. Sensitivity towards the risks inherent in Web2.0 and those concerning reputation could be handled through detailed and anchored Social Media Guidelines [9].

5 The 4-LIFE Model

The 4-LIFE-Model, an acronym for L(lively)I(interactive)F(flexible)E(electronic), uses the Swiss eCH-0049 portal design standard, which is based and structured on real life situations, rather than internal processes and responsibilities, and is geared towards practical utility [10]. The standardization is part of a federal business process management (BPM) approach [11]. The model focuses on citizens and ensures optimum implementation of Web2.0 technologies. It also supports service portals architects in the process of activating

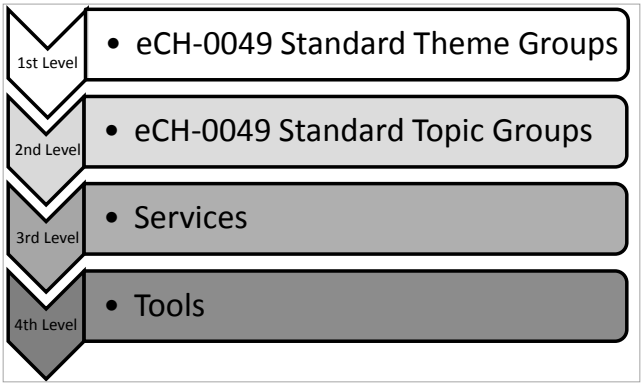

Figure 3 - Schematic Structure of the 4-LIFE-Model
Source compiled by the author

Web2.0 tools (e.g. VoIP, Blogs, Wiki) for interactions between public administrations and citizens as service recipients. The model is structured into four hierarchical levels (see Figure 3) which adapt the themes and topic groups of the Swiss eCH-0049 standard, supplementing and enlarging the design around the "Services" area of the portal. This 3rd hierarchical level is structured to include any service that could be requested by citizens. The services providing links to the public administration can be categorized as follows:

• E-Services
• E-Participation
• E-Voting
• E-Collaboration
• E-Discussion
• Contact

E-Services is understood as including everything in the field of digitized E-Government processes and documents, which are provided and managed by a corresponding document server tool. All requested forms are supplied in digital form to the service users through this tool. An important part of the E-Government process is E-Democracy. This grants citizens entitled to E-Participation, E-Voting, E-Collaboration and E-Discussion extended rights of co-determination and promotes active participation in the decision-making processes of public administrations.

Since the approach of the SWING project is focused on citizen's needs, the area of E-Democracy is given special attention. When users are involved in the planning and decision making processes of public administration, this is generally referred to as participation; if ICTs are involved in the participatory process, then it is referred to as E-Participation. The term E-Voting refers to the use of ICT in elections and votes aimed at decision making [12]. E-Collaboration describes the internet-based, networked collaboration of several people in a virtual team. In this context, citizens work together on an issue and seek a community driven solution. The public administration must make it own contribution and actively promote collaborative work in this process as part of a virtual team. Lastly, the "Services" area of the portal includes E-Discussion. Discussions are held in this area, with active management of proposal and complaints organized and controlled by the public authority. The "Service" area is supported by tools, which provide the medium for the desired activity. A tool is to be understood as any analog and digital instrument, of interaction between public administrations and citizens. The "Contact" area is omnipresent and contains traditional communication channels such as phone, fax and mail, as well as the capacity to support new channels such as VoIP and instant messengers.

This 4th hierarchical level ("tool"-area) includes the following media:
• Document Server
• SMS Voting
• Webpoll
• Wiki
• Blog
• Forum
• RSS Feed
• Social Media Platform
• Video Platform
• Photo Platform
• ...

The list of tools is open and without specific reference to special Web2.0 technology providers. This allows a continuous and dynamic extension and therefore the capacity to adapt to new technologies and trends. Figure 4 shows the entire model structure based on the standard Swiss eCH-0049 "Personal" theme, with the "Sport" topic group highlighted. If a citizen has specific living conditions that can be assigned to the "Personal" theme group and the subgroup "Sport", it is assumed that he/she has concerns (e.g. the desire to participate, express and share opinions, and fill in application forms) which can be addressed through these service area features.

Firstly, this could involve a traditional request or application form, which is managed by the document

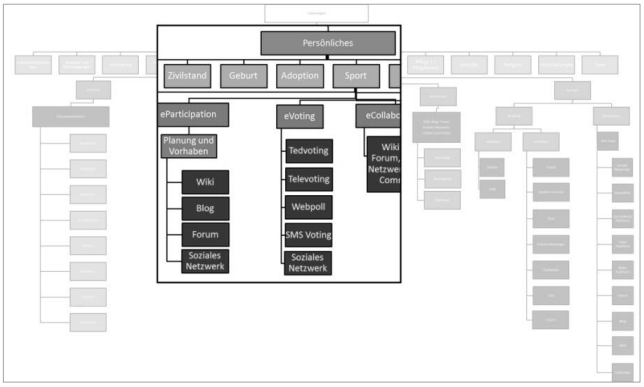

Figure 4 - Structure of the 4-LIFE-Model
Source compiled by the author

server tool. Secondly, the user could have an interest in active interaction with the public administration. This could be expressed through participation in decision-making or elections, co-operation in the creation of a joint solution, or guiding a discussion. The service user may also wish to be contacted. These tools are either activated in the process or remain inactive, depending on the service requested by the user. If a certain issue mainly involves users less inclined towards Web2.0 services, such as the 55+ age group (the study conducted by Forrester indicates that the user behavior of this age group is averse towards Web2.0 technologies [13]), it is recommended not to integrate or activate Web2.0 technologies. For amenable users, however, Web2.0 technologies should be incorporated in the process [10].

6 How to use the 4-LIFE-Model in Reality?

The main purpose of the 4-LIFE Model is to recommend specific social media tools to any public authority or governmental institution in order to fulfill the needs of the citizens. To be able to recommend the correct use of social media tools, two main questions have to be answered:

(1) What are the basic conditions for extending the traditional portal design (document server and contact/communication channels) to include elements of E-Democracy?

(2) Which Web2.0 technology tools should be implemented and activated in the particular E-Democracy elements?

To adopt a citizen-focused approach, data on the internet and on Web2.0 technology use by citizens in specific life situations should be obtained from secondary research (e.g. the Social Technographics profile tool – Forrester; Sinus-Milieus [14]). To answer the two main questions, a program will be set up based on the axioms of an expert-system. It is therefore important to determine the rules (established by public administration experts) by which the system decides in a first selection process which elements of E-Democracy are implemented on the portal. In the second selection process tools which are best suited to meeting the requirements (set by iimt social media experts), among E-Participation, E-Voting and E-Collaboration and E-Discussion are allocated to the "Service" area elements. The program raises questions which need to be answered by a public administration expert. It then automatically evaluates the answers and selects the appropriate tools, according to a process of elimination. The program mainly provides support and assistance for informed and pondered decision about which tools should be activated on the E-Government portal.

Making things more tangible the following example should serve: The "Service" area elements "Document Server" and "Contact" area are always integrated on the portal structure

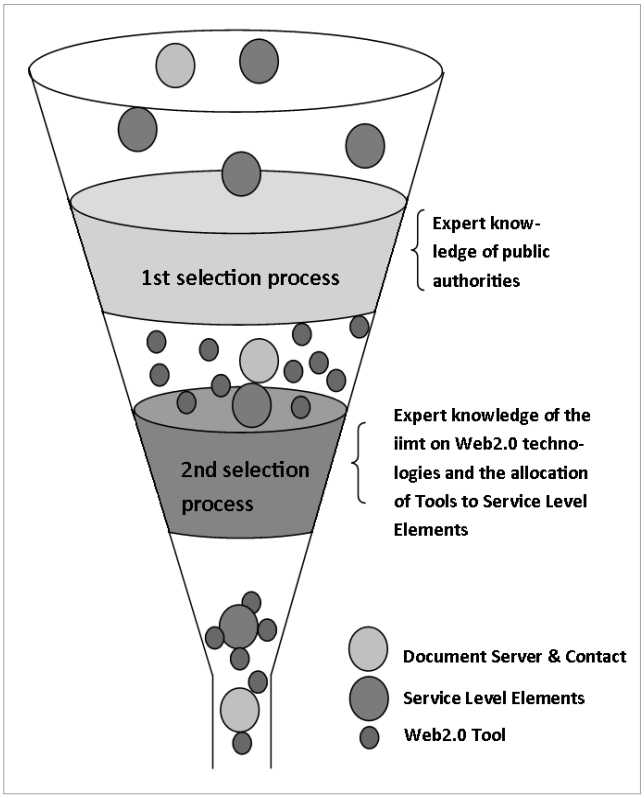

Figure 5 - Selection Structure of the 4-LIFE-Model Expert System
Source compiled by the author

and are not affected by the selection processes. The allocation of supporting Web2.0 tools (e.g. VoIP, Chatterbot, Instant Messenger) to the element Contact is done by the second selection process. Whether all elements of E-Democracy are activated depends for example on the catchment area of the municipality and the financial and

human resources. In the example of Figure 5 only one "Service" area element passes the first selection process. This element, for instance E-Voting, is allocated with Web2.0 technology tools which support the E-Voting basic idea. Reasonable Web2.0 tools allocated by the second selection process are SMS Voting, Tedvoting, Webpoll and Social Networks. The 4-LIFE-Model and its corresponding expert system allow a standardized activation of "Service" area elements on the public authority portals and guarantee a homogeneous portal design allover Switzerland. Furthermore, it conserves financial and human resources and thus safes costs and reduces risks of unreflected use of Web2.0 technology.

7 Conclusions

A modern citizen-oriented public administration must allow bidirectional communication between government and citizens. Thus administrative procedures are going through a period of transition. The E-Government process offers the possibility to bring the relationship with service users, i.e. the citizen, towards a new era. The integration of Web2.0 technologies into website and portal design ensure citizen-oriented and citizen-centered administrative processes. We have shown that the elaborated 4-LIFE-Model supports the design process and builds the backbone of the presented expert system. The on-going evaluation process of our approach together with government representatives is very encouraging.

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Experience based Recommendation System for E-Governance

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Abstract *- The cornerstone for the success of e-governance systems is the all-encompassing participation of citizens in every aspect of governance. Towards this end, current research has focused on developing user-centric systems that respond adaptively to changing behavioral patterns, thus encouraging higher levels of participation from across the spectrum of the populace. The experience based recommendation system proposed in this paper analyzes web logs using web usage mining techniques. Based on the information collected, the system dynamically computes the interactivity level of a user and the frequency of accessed pages. These two parameters for all the users are stored in a multidimensional data structure called trie. Our system effectively uses experience of previous users to provide better recommendation to naïve users. We formulate a new metric that encapsulates the overall interactivity level of a user by using a set of predefined interactive web-page components that are classified according to the level of interactive action they spur and the time spent by the user. The algorithm traverses the trie to recommend a desired set of pages. Results demonstrate a user-sensitive system that guides new as well as experienced users appropriately*.

Keywords: Online recommendation system, interactivity level, pattern trie, frequency of web page access, e-governance systems

1 Introduction

E-Governance provides a single web portal that integrates all services of a system so as to utilize them conveniently through remote access by tapping the power of web technology [1]. With such ready access to information, its best possible presentation and the interface quality becomes an important. This is a highly user-centric quality parameter where the challenge lies in catering to a wide and diverse user-base. In order to ensure widespread participation in e-governance systems, the presentation sub-system must automatically adapt to the individual preferences of each user. Web usage mining techniques discover patterns of online behavior of users from web logs that are maintained at servers. The aim is to discover users' interests and preferences and utilize this information to fine tune user interfaces and suggest the most appropriate browsing paths.

Literature describes the applicability of web usage mining to recommendation systems in e-commerce [3] and web TV [4]. The existing models focus on mining the navigation patterns of users [5, 6] in order to represent their online preferences. However, as the number of active and web-savvy e-governance users continues to grow, we need to incorporate more behavioral indicators in order to distinguish the abilities and objectives of different users and categorize them suitably. This realization motivates us to develop a dynamically adaptive recommendation system for e-governance portals that is sensitive to not only the navigation patterns of users but also their interactivity levels and feedbacks.

2 Prior Work

User interface quality is an important issue in developing e-governance systems. In [1], the authors propose a layered architectural design approach for e-governance systems with separate layers for user access, e-government functions, e-business and infrastructure. This facilitates flexible user-interface design but still does not address the issue of adaptable interface design.

Web mining for improving user-interface quality: We look at the possibility of mining users' web usage pattern [5, 6] in order to create adaptable interfaces. In [2], the authors demonstrate the use of pre-processing web usages such as time stamp, time duration and navigation path for web mining applications such as knowledge discovery. Similarly, the parallelizable algorithm proposed in [5] identifies frequent patterns from preprocessed web logs. Techniques for finding user preferences automatically have also been utilized in online recommendation systems. For example, the Web TV recommendation system [4] conducts content based and collaborative filtering to find users' preference.

Techniques for online web-page access: The work in [9] focuses on improving frequent pattern tree generation algorithm by constructing a bidirectional tree, FP^+ using previous transactions stored in a database. It uses a minimum support value to decrease the number of candidate item sets. This system has high space complexity and tree may not fit into the memory in case of large database.

Sequential pattern mining: The authors in [10] use layer coded breadth-first linked web access pattern tree. It finds a relation between various entities stored in a sequential database. Technique used in this paper, requires a separate linked list to maintain a sequence of web pages. This introduces traversal over head.

Frequent Pattern Mining: The model in [13] explores frequent item sets in a transaction. It maintains a header table at root node of the pattern tree which stores a frequent item and an empty link in its each entry. This model applies breadth first search algorithm on pattern tree twice to generate frequent patterns recursively. Storage of frequent items in a compact and efficient data structure is an innovative idea of

authors which provide a convenient way to trace the usual behavior of users. This model scans the pattern tree twice which adds to the time complexity. Inclusion of each entry in header table requires additional space which may become difficult to manage in case of large number of users.

Enterprise Recommendation system: Techniques of Pattern mining enhances the quality of interface design by providing knowledge about behavioral aspects of various categories of users. Using this knowledge the system can give a suitable recommendation to each category of users. Author in [15] propose an enterprise proxy web usage mining, EPWUM recommendation system for web users. This model recommends frequently visited pages to an active user. It provides the recommendation using World Wide Web behavioral patterns of a user which makes it website independent. The authors apply incremental filtering algorithm to automatically categorize new pages uploaded on server. It can work effectively not only with increase in number of users but also with changing interest of web users.

In [14], the authors store a series of accessed URLs and their corresponding support values in a pattern tree. It gives recommendations by part-matching the series stored in the pattern tree with the series of URLs accessed so far in the current session. Our approach varies sharply from this approach as we use *interactivity level* as well as *feedback* from users in addition to their navigational patterns. This allows more user-specific recommendations and allows a better resolution for differentiating different categories of online users. We also use a decay constant to consider most recent interest of users. We store patterns of all users in a single trie which significantly use experience of other users in giving recommendation to naïve users. Our system also continually adjusts the recommendation system by dynamically evaluating its correctness vis-à-vis the actual decisions taken by a user.

3 Proposed Work

3.1 The Trie Data Structure for Page Access Pattern Mining:

URL Accesses: There is a website given by a document W comprising a fixed set of one or more page(s): W = {a,b,c…}.A user U accesses a website document W on different occasions. Each occasion is a session S_i of continuous interaction between the website and the user. During each session S_i, the user accesses a series of URLs that are strewn across several pages of the website document W. The access pattern of the user during session S_i is expressed as a series of URL access events $AP_i=\{u_{i,1},\ldots,u_{i,k},\ldots,u_{i,nAP(i)}\}$.

Page Access Patterns: Let $Page(u_{i,k})$ be the page on which the specified URL is present. For a given AP_i, the corresponding sequence of pages accessed, called Page Access Pattern PAP_i, is $PAP_i=\{Page(u_{i,1}),..,Page(u_{i,k}),..,Page(u_{i,nAP(i)})\}$, exemplified as {a,b,d,f…..} etc.

Access Sequence: Capturing the experience of a user during different sessions, we get a series AS of different page access patterns: AS = $\{\{PAP_1-\},..,\{PAP_i\},\ldots,\{PAP_{nAS}\}\}$. In essence, SA gives the complete website experience of a user collected over multiple sessions. Table1 shows a Sequence of Accesses comprising a set of 7 Page Access Patterns: 'abcde' to 'abcdea'.

Trie construction for access sequence: The data collected in AS, i.e. the sequence of access patterns of a user during different sessions, is stored in an efficient data structure called Trie [18]. Each node of the Trie stores just one page of a full access pattern. Trie is a multiway tree we use here to store pages of a series of pages defined over a set {a,b,c….}in a sequence of web accesses. Its node is defined as:

```
Trie_Node{
    Accessed_Page: Page;          //Page accessed Page(u_{i,k}). Page is enumerated data type.
    End_of_pattern: Boolean;      //Indicates the end of a PAP_i in one session
    Freq_across_sessions: int;    //Number of sessions in which the page sequence has been accessed
    Node_Children: vector <Node*>; //Multiway branches leading to more pages of the patterns
};
```

Thus, each node of the Trie itself is another Trie. In this system, each node stores

(i) A slice of several overlapping page- access-patterns that occurred till that level.

(ii) A field that records the number of sessions during which the pattern up till that level has been accessed. Each sub sequence of pages s-PAP is a subset of any of the PAPs accessed so far. For example the subsequence 'abcde' is a subset of PAP_1 as well as PAP_7. The Frequency_across_Sessions of a sub sequence gives the number of sessions during which that sub sequence of pages has been accessed. Thus, since s-PAP abcde has been accessed in both PAP_1 as well as PAP_7, therefore Frequency_across_Sessions(abcde) = 2.

(iii) A marker indicating the end of a specific pattern.

(iv) A pointer to a Trie of children nodes. The system keeps updating the Frequency of access across different sessions as a user encounters the same page sequence during multiple sessions. Figure 1 shows the pattern Trie that has been constructed for the Access Sequence given in Table 1.

We prefer trie to the tree data structure because it is very efficient for capturing dynamic web experience that entails insertion, deletion and finding in equal measures.Time complexity for insertion, deletion and searching in worst case of these operations is O(m) where m is depth of the trie. In trees it is O(m log n) where m is depth of a tree and n is number of elements in a tree. Trie uses special symbol such as (*) to mark end of a pattern. Trees do not have such

end markers. Pattern trie is space efficient as it shares nodes for common subsequences.

The pseudocode in Figure 1 describes the algorithm to construct the Trie for a specific user's access sequence.

```
Algorithm Trie_AS_Construction (
  Input:
     AS: vector of  Page-Access-Pattern PAP
  Output:
     PT(AS): Trie
)
Begin
     Delete obsolete sequences from AS where time duration > Decay constant
  1.  Create Root_Node = NULL.
  2.  For each (PAP_i) where PAP_i ε AS  and i = 1 .. nAS do
      Begin
        2.1 Set Current_Node pointer p to Root_Node
            p = &Root_node.
        2.2 For each Page(u_i,k) ε PAP_i and k = 1..nAP_i do
            2.2.1 If p has a child node with Page(u_i,k) as
                  Accessed_Page then
                  -Set Freq_across_Sessions of the
                  child node as maximum of
                  Freq_across_Session of p and the
                  child.
                  -Set p to this child node.
                Else
                  -Create a new Child_Node for p with
                  Accessed_Page=Page(u_i,k)and
                  Freq_across_Sessions set equal to that of
                  p.
                  -Set p equal to the newly created
                  node.
                Endif.
            2.2.2 if Page(u_i,k) = nAP(i) then
                  Set End_of_Pattern = True.
              End for-do (Step 2.2)
        End for-do (Step 2.1).
  3. Return PT
End.
```

Figure:1 Algorithm for constructing and maintaining a Trie for a sequence of page access patterns

Table:1 Session IDs and corresponding access sequences

Session ID	AS
121	abcde
122	abdec
123	acab
124	adcab
125	bcde
126	aebde
127	abcdea
128	ae
129	cbea

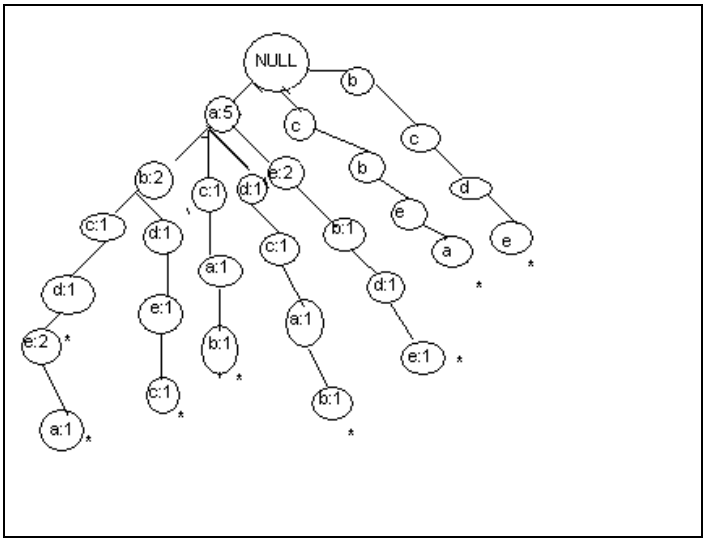

Figure:2 Pattern Trie corresponding to table 1

3.2 The User Centric Recommendation System:

Giving Recommendation to a User:

Current Sequence: There is a user U, who starts accessing a series of pages in a new session S_i with their specific URLs. We store this series of pages in a vector, CS. |CS| denotes the number of pages accessed so far in the new session. We store history of series of pages accessed by various users in different sessions, AS in a database, DB. Support vector, SV of each page updates automatically in database with increase in frequency of access of a page in an access sequence. Short_Length is a minimum threshold value of |CS| below which our algorithm does not give any recommendation.

Long_Length is maximum threshold value of |CS| which our algorithm considers for recommendation.

The algorithm in figure 3, compares number of pages accessed so far in current sequence,|CS| to Short_Length. It calls algorithm of pattern trie construction, as in figure1. When |CS| exceeds long_Length, it reduces |CS| by deleting initial pages from CS. This algorithm compares each page of a series captured in new session to pages stored at nodes of a trie. Once the page of CS matches to page of AS, stored in trie, it recommends the page(s) stored at children nodes of a trie arranged in decreasing order of their SV.

The algorithm proposed in figure.3 recommends a set of pages, RP of user's interest. It analyzes implicit information such as navigation pattern, feedback from user and interactivity level of users using web usage mining techniques. It predetermines pages of users' interest.

Feedback: We implicitly trace feedback of users to focus on their changing interest. Our system automatically updates positive and negative feedback. It increments positive feedback, P_F of the page recommended if a user accesses it. On the other hand, it increments negative feedback, N_F of all other recommended pages which the user does not access. The page for which negative feedback exceeds positive feedback, will not be recommended further. Feedback keeps on updating the recommendation system with changing interest of web users.

Interactivity: We focus on interactivity level of a page ,IP as well as interactivity level of users, IL in addition to sequence of access events and feedback. Interactivity of a page is defined as $IP=\Sigma IW_i$ where, IW is weightage assigned to interactive elements available on a page. For example a page having FAQ and Blog has interactivity, *IP=1+3=4* if *IW* of FAQ and Blog is 3 and 4 respectively.

Interactivity level of a user has been defined using time duration of accessing an interactive element and *IW* of that element. i.e $IL==\sum iTi * IWi / \sum iTi$ [19] where T isTime duration.

IL= (Time duration of using web page *Interactivity weightage 1+ Time duration * Interactivity weightage 2+ ---time duration * Interactivity weightage n)÷(Time duration1+Time duration2+--Time duration n).This can classify interactive users and non interactive users in separate classes. We always recommend the page with interactivity above some minimum threshold value to interactive users although it has low support value. The pseudocode in Figure 3 describes the algorithm to give recommendation to a user.

.

Algorithm **Recommendation _system**(
Input:

- PT:Pattern trie
- CS: **vector** of Current Page access pattern, PAP of a user
- Short_Length: Shortest length of access sequence considered for recommendation
- Long_Length: Longest length of access sequence considered for recommendation
- P_F :positive feedback, frequency for which a user accesses a particular recommended page
- N_F :Negative feedback, frequency for which a user does not access a particular recommended page
- IW: Weight assigned to various interactive elements such as blogs, chat, feedback.
- T :Time duration of accessing an interactive element

Output:

- RP :Set of pages recommended to a user)

Begin

1. Initialize RP = Ø.
2. **If** |CS| < Short_Length
   - **Return** RP
3. **If** |CS|> Long_Length
   -R_Length=|CS|- Long_Length +1
   -Delete first R_Length items from vector of CS.
   Else
   -set current_node pointer to the Root_Node of PT.
   p = &Root_node.
   Endif (step3)
4. **For** each item ai,aiε PAP, from the head[CS] to the tail[CS] **do** //head is first element of CS and tail is last element of CS
   4.1 **If** current_node has a child node labeled ai
   -set current_node point to this child node.
   Else
   -remove the first item from CS
   - Go to step 3.
   Endif (step4.1)
   End for- do (step4)
5. **If** current_node has child nodes
   - insert these child nodes into RP along with their support values
   -Arrange nodes in RP in order of decreasing support vector
   Endif (step5)
6. Compute interactivity level of a user (IL)
   $IL = \Sigma IWi\ i\varepsilon I * TSi / \Sigma TSi$
7. **if** IP(K)>IL // IL(K) is interactivity level of page K of website
   -add page K to beginning of RP
   Endif(step7)
8. Return RP
9. **For** each item aj in RP
   If user selects recommended page
   P_F(aj])=P_F(aj)+1 //increase positive feedback
   Else
   N_F[aj]=N_F[aj]+1 // Increment negative feedback
   Endif (step9)

Figure:3 Algorithm for recommending a set of pages of user interest

4. Experimental Results

Algorithms defined in figure2 and 3 have been executed on randomly generated data sets. Data set includes:
(1) Randomly generated page sequence of biased users, who are accessing similar page sequence in each session.
(2) Randomly generated page sequence of unbiased users, who access random page sequence in different sessions.
We measure correctness of our algorithms using correct recommendation, RC and incorrect recommendations, RI. Let *RC* be the set of page(s), RC= {a,b,…}.It represents the page(s) which the user accesses on our recommendation. |RC| is size of set RC. *RI* be the set of page(s) which represent the pages which user accesses without our recommendation. |RI| be the size of RI. Correctness of our algorithm is computed as per formula:
*Correctness% =(|RC |÷ (|RC| +|RI|)) * 100* .

We tested the correctness of our algorithm using only one parameter, page access sequence. Then we executed our system using all the three parameters, page access sequence, feedback and interactivity level to show the impact of feedback and interactivity level.

Quantitative analysis of correctness of algo in figure 2 and 3: Table 2 displays history of series of page access patterns, AS for unbiased user.

Table3 shows history of series of page access patterns, AS for biased user. Algo. of pattern trie construction in figure 2 works on data set of table 2 and 3 separately. This algo stores the data set in two separate trie data structures. The algo in figure 3 recommends the pages of user's interest after scanning the trie data structure.

We also tested the change in efficiency of our recommendation system with change in number of users. Figure 4 clearly shows that recommendation system based on feedback and interactivity level give recommendation more efficiently than the system based only on navigation path of users.

Table:2 History of previous access patterns for an unbiased user

Session ID	Access Pattern
131	abcd
132	abcde
133	abcea
134	abcfa
135	abdg
136	abde
137	abdea

Table3 History of page sequence access patterns for a biased user

Session ID	Access Pattern
141	abcde
142	bfgai
143	bkecd
144	feijh
145	gaeck
146	laeig
147	cdeah

Table 4: Recommendations generated for a biased user.
* Shows pages recommended due to interactivity of the user

CS	Recommendation without feedback and interactivity level	Recommendation using feedback and interactivity level
ab	c,d	f*,e*,c, d
abc	d,e,f	f,e,d
abce	a	f*,e*,a
abcef	Session ends	

Table5: Recommendations generated for an unbiased user

CS	Recommendation without including feedback and interactivity level	Recommendation using feedback and interactivity level
bf	g	e*,i*,g
bfg	a	e*,i*,a
bfgi	-	e*
bfgik	-	e*,i*
bfgikc	Session ends	

Table 6: Comparative correctness

User Type	Correctness (%)without including feedback and interactivity level	Correctness (%)including feedback and interactivity level
Random user	25	50
Biased user	66.66	100

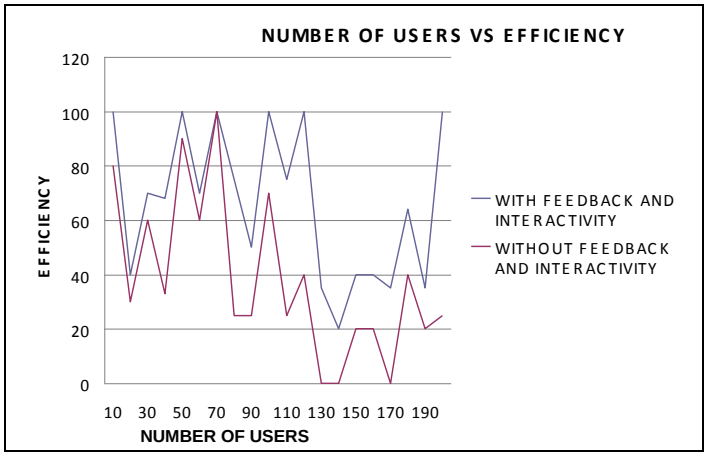

Figure 4 Change in Efficiency with change in number of users

5. Discussion

The model proposed in [4] focuses on analyzing implicit and explicit information of users at broad level. It recommends channels of user interest using peer group interest and content of channel. Our algorithm focuses at profound level of user interest. It focuses on behavior of user as discussed in 3.1.

The Model proposed in [5] analyzes navigation path of web users to find their behavior. It recommends frequently accessed pages to the user.

The system proposed in [9] [10] removes infrequently accessed pages which may neglect the recent interest of users. These construct a separate sub-transactional tree for each frequent item This algo uses a header table in each tree. Use of header table increases the

time and space complexity. Our algo considers infrequently accessed pages at least once for recommendation. Moreover, It constructs a single trie without using header table to improve efficiency of the system.

The authors in [14] give recommendation using navigation path of users. Our approach focuses on feedback and interactivity of users as in 3.2 in addition to navigation path. Feedback system keeps track of changing users' interest. Interactivity level separates information seekers from interactive users. Our system recommends the interactive page along with frequently accessed pages. This system constructs a single trie for all the users. It uses information gathered from experienced users to give better recommendation to naïve users.

6. Conclusion and Future Work

In this paper, we have defined positive and negative feedback of users on the basis of their current access sequence of web pages. We uses an efficient data structure, pattern trie to store page access sequence of a user as in figure 2. We use a single trie to store data of all the users. Algorithm in figure 3 focuses on parameters such as support vector of a web page accessed in different sessions, feedback system, interactivity level of a web page and interactivity level of a web user. Figure 4 shows efficiency of our system improves with increase in number of users as it uses experience of users of past sessions to provide recommendation to users of current session.

In future, we intend to develop a collaborative recommendation system for e-governance system to make it more user centric.

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The Impact of Net-Enablement Capability on the Decision to Sell Online in Sectors with Above-Average Adoption Rates: A Canadian Perspective

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Abstract

Although the adoption of e-business promises better efficiency and increase sales, many firms have not adopted it. Statistics Canada [1] reported that the average of online selling across different Canadian sectors is about 9%. This is a very low adoption rate when compared with Internet, email, and online buying use, which have an average adoption rates ranging from about 40% to 80%. In sectors that have above-average rates of online selling adoption, many firms are still not adopting online selling, and their percentages vary from about 70% to 90%. It is argued in the literature that non-adopters are normally constrained by having products that are not suitable for online market and having business environments that are not encouraging for such adoption. Besides what is already known in the literature, this paper suggests that the decision to adopt online selling is influenced by internal organizational capability of net-enablement.

Keywords: NEBIC, dynamic capability, e-business, online selling, net-enablement

I. INTRODUCTION

Many researchers have raised concerns about the scarcity in research related to online selling and uncovering its influencing and challenging aspects (e.g., [2], [3], [4], and [5]). In addition, Statistics Canada conducts an annual survey of e-business adoption in Canada, which reveals considerable differences among sectors in terms of firms' online selling activities [1]. The report shows that the adoption rates of online selling across different sectors range from about 0% to 30% with an average of 9%. In comparison, the same report shows that the average adoption rates of online buying are 45% and 82% for Internet use. These statistical results show how online selling adoption rates fall far behind those of other e-business technologies. This raises a concern to further investigate the very nature of online selling and the reasons for such scarcity in the related literature and low adoption rates.

Researchers have attempted to discover the reasons behind adopting online selling across sectors with above-average online selling adoption rates and found that both suitable products characteristics for online market and supporting business environments are the main sources that encourage firms in those sectors for such adoption [6] and [7]. However, the statistical data reported by Statistic Canada shows that the adoption rates in sectors with above-average rates of online selling (e.g., information and arts industries) range from about 9% to 30%, which is still low when compared with other e-business tools for the same selected sectors. This raises another concern: If the products/services are suitable for online market and if business environments support the adoption of online selling, why have many firms still not adopted this kind of service?

In response, this paper empirically investigates the impact of internal organizational capability of net-enablement, rather than product characteristics and business environments, on the adoption of online selling in sectors with above average adoption rates. This research utilizes Wheeler's [8] model of Net-enabled Business Innovation Cycle (NEBIC) as a theoretical framework. The study collected data from a sample of Canadian firms across all sectors characterized as having above-average adoption rates of online selling.

II. LITERATURE REVIEW

E-business streams

Many researchers have addressed issues related to e-business, yet there is a substantial shortage of literature related to the online sales aspect of e-business. For example, researchers have addressed the need to study the specific motives for sellers when they are considering decisions related to participating in the online context and whether the e-business tools quantify the benefits of using the online

context more effectively than traditional business tools [2], [5], and [9]. In addition, Jeffrey and Hodge [4] called for a further investigation into the possible economical benefits and increased sales revenue that online impulse shopping could bring for-profit firms. Also, Rask and Kragh [3] emphasized that different types of sectors pose different challenges and motives for online participation and pointed to the need for further investigation of the issue.

The annual survey of e-business adoption in Canada has revealed significant differences among sectors in terms of their adoption of online selling [1]. Table 358-0010 shows how many sectors use online selling options and the extent to which they do so. For example, in the 2000–2007 period, less than 9% of firms in the agriculture, mining, and health care sectors used the Internet for online selling activities (i.e., they had "lower rates of online selling adoption"), as compared with more than 18% of firms in the information and cultural sectors (i.e., they had "higher rates of online selling adoption") (see Figure 1 for more details). Further, from 2000 to 2007, the total online sales for Canadian private sectors increased from about 5.5 billion CAD to just above 58 billion CAD. This represents a significant increase in sales as well as a growth in the importance of the online selling context among all private sectors. Even some firms within the forestry sector, which generally has a lower rate of online selling, used the online context to conduct selling activity [10].

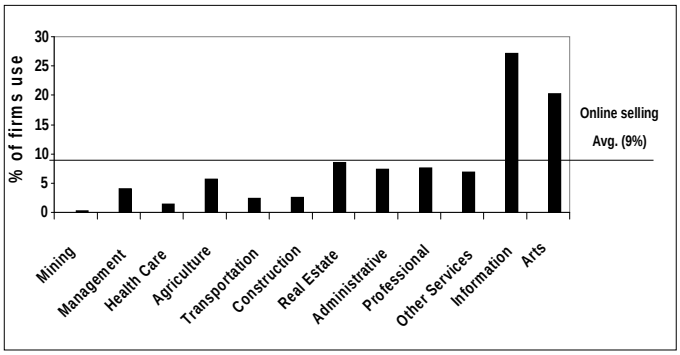

Figure 1: Percentage of online selling for some of the Canadian sectors [1].

Differences in terms of the percent of online selling, both within and between sectors, occur as a result of internal and/or external limitations. For example, earlier research studies have pointed to a lack of managerial support and lack of employee knowledge in the general IT context [11]. More recent studies have identified limitations, such as a firm's product characteristics and the surrounding business environment, deficiencies in the firm's online infrastructure, reluctance to change the current business model, and associated costs as the causes of eschewing the leap into online sales [7], [12], and [13].

Strategic effect of advances in IT

Advances in IT directly affect a firm's strategies and operations. Whether firms decide to take on these technological advances or leave them alone, they learn from the experience that results from their decision [14]. Indeed, according to Schon [15], a firm can be described as a learning system. Managers play a dominant role in the strategic development and use of IT solutions, and their responses to environmental changes and developments in the IT field range from full adoption to full rejection [11].

The adoption of IT normally means significant changes in a firm's way of doing business activities. As these changes become more sophisticated, they become difficult for competitors to imitate and capable of creating strategic competitive advantages [16]. While "old" IT strategies visualized IT as useful for driving business forces, they soon became tools for differentiation, pursuing opportunities, and supporting business activities. According to Carr [17], however, as the availability of IT increased and its price decreased, it became commoditized and thus ceased to provide a competitive advantage. Further, rather than being an opportunity for contemporary firms, IT became a source of threat, as high investment in IT led to lower short-term profits.

Benefits gained from advances in IT

The benefits that firms gain by adopting IT include, but are not limited to, reducing costs; supporting management; strategic planning; competitive market positioning; improving systems communication, control, and reliability; building barriers to entry; and opening channels with suppliers, customers, investors, and other intermediaries. The benefits gained by advances in technology could overcome the associated costs by reducing communication costs, exposing firms to new business opportunities, increasing market share, and reducing overhead [11] and [16]. Later studies have pointed to the particular benefits of advances related to networks, e-business, and the Internet, including integrating internal business units, connecting firms with their outside environments, eliminating traditional business location barriers, and improving a firm's efficiency. Thus a firm's competencies and resources should form the basis by which the firm decides on the level of information technology that can generate competitive advantages and performance improvement for the firm without overextending its resources. This kind of decision-making increases the possibility of successful adoption and the potential economic benefits of adoption (e.g., increasing sales, minimizing costs, increasing customer satisfaction) [18] and [19].

Another benefit of adopting advances in technology is the improvement of a firm's knowledge. Adopting new technology helps users (i.e., the firm's employees that use the new technology) learn this technology and use it, so users become accustomed to the technology and follow its advances, which positions the firm to take advantage of future technological innovations with a shorter learning curve. Customers, too, can use the same technology to establish networks among themselves, which helps to foster learning experiences and transfer knowledge among customers and back to the firm. This learning and knowledge could then be reflected in the firm's products or services (sometimes characterized as a unique product or service or a new way of doing business), which leads to gaining a competitive market position and creating customer value [15], [20], and [21].

One of the important outcomes of advancements in IT is the development of the Internet and networking technologies,

which are the backbone for conducting what is currently known as e-business [22] and [23].

Rates of e-business adoption

Compared with other countries, North American and West European countries, in addition to Australia and New Zealand, are the largest users of the Internet for online commercial transactions. Policies, regulations, investments, and implementations in these countries protect and promote the e-business environment, leading to a growing number of firms and customers conducting e-business activities safely [24].

The commercial use of the Internet has an increasing impact on its contribution to the overall economy. To understand how large that contribution is, du Rausas et al. [25] conducted a study to measure the Internet impact on economy and growth using data from thirteen countries: Sweden, the United Kingdom, South Korea, Japan, the United States, Germany, India, France, Canada, China, Italy, Brazil, and Russia. The study revealed that online transactions in the countries studied contributed to 3.4% of their total GDP and 2.9% of the worldwide total GDP ($1,672 billion of value) in 2009. The same study and other statistical indictors show that Canada lags behind many other countries in its overall Internet transaction including online sales, and this is the key point as this research concentrates on online selling in the Canadian market.

E-Business adoption benefits

Although external environmental pressures or internal business needs to adopt e-business tools has pushed some firms, others have proactively and strategically implemented e-business tools. Some firms (especially smaller ones) have reported that the Internet allows them to compete with larger firms on an equal basis, regardless of traditional barriers, such as firm size and location. Other firms have stated that the benefits they receive from e-business include lower costs and increased speed of communications, information gathering, and business transactions [6], [18], and [22].

E-business and its related technologies are also becoming more affordable, and the literature has described many ways by which e-business can benefit firms that may not have been able to afford it before. E-business can improve quality, profitability and strategic positioning [6], enhance customer satisfaction, establish interactive (two-way) relationships with customers, reach more suppliers, provide a medium for advertising and brand building, connect and match buyers and sellers at minimal cost [6] and [26], and reduce the limitations of some products that are unattractive to buyers in traditional shop stores [4]. Further, Fletcher et al., [19] and Porter [22] noted that e-business actually created new industries and markets that were not available before e-business was developed, including online education and travel agencies. While not all business activities are expected to be online, most businesses should at least have an online presence to publish information about itself and place its catalogues online.

Researchers have also found that what has been learned about IT adoption remains valid in terms of e-business technology innovations and advances. Advances in communication and network technology (i.e., as an example of e-business technologies) help firms share and acquire needed information and knowledge, improving users' and firms' learning as well as their ability to reduce the cost of acquiring new technology to improve their business activities, products, and services [27].

However, decisions regarding the Internet and e-business adoption are not always easy, as these decisions often entail changing the firm's structure and may have an impact on profitability or even lead to bankruptcy [22]. Further, Kioses et al. [6] stated that e-business benefits cannot be generalized to all firms and not all e-business benefits are generally accepted because each firm may benefit from e-business differently. In addition, undertaking e-business strategies can result in channel conflict with current business functions and intermediaries based on, for example, differences in incentives, rewards, policies, or support. According to Porter [22], adopting e-business tools in one business activity intensifies the role of some other business activities in the value chain; for example, online ordering shifts the business's emphasis toward both the warehousing and shipping departments. Also, when firms seek the help of intermediaries to highlight their products or services, a new type of intermediaries, namely reintermediaries, is created, and a direct channel between firms and their customers may limit or eliminate the traditional role of intermediaries (i.e., disintermediation).

Online Selling

According to Dubinsky [28] a complete personal selling process includes the following seven stages: prospecting, pre-approach, approach, sales presentation, overcoming objections, closing the sale, and post-sale follow-up. In other words, to sell your services or products, you need to identify your potential buyers, identify prospective buyers' needs and interests, conduct an initial contact with the prospective buyer, present the services or products that suit your prospect buyer, encourage the prospective buyer to purchase your offerings, reach an agreement, and finally provide your customer with post-sales services and satisfaction. This study utilizes the online selling definition of Statistics Canada in its Survey of Electronic Commerce and Technology (SECT) [29] as the act of selling products using the Internet, whether payment is made online or offline, pricing is fixed or dynamic (traditional commerce vs. auction), and sales are conducted using a firm's own website or through a third-party website. This definition also addresses online selling activities conducted between firms (B2B) and between firms and customers (B2C).

Characteristics of sectors with above-average rates of online selling adoption

The annual survey of e-business adoption in Canada has revealed significant differences among sectors in terms of their adoption of online selling [1]. Table 358-0010 shows how many sectors use online selling options and the extent to which they do so. For example, in 2000 to 2007 more than 9% of firms in the arts and information sectors used the Internet for online selling activities (i.e., they had "higher rates of online selling adoption"), in comparison to less than 9% of firms in the agriculture, mining, and health care sectors (i.e.,

they had "lower rates of online selling adoption"). In the sectors with above-average rates of adoption, the adoption rates ranged from about 11% to 30%.

Rask and Kragh [3] emphasized that different sectors pose different challenges and motives for online participation and pointed to the need for further investigation of the issue. In addition, differences in terms of the percent of online selling between sectors can occur as a result of internal and/or external factors.

Studies have identified product/services characteristics as the main reason behind online selling adoption in sectors with higher adoption rates [7] and [12]. That is, products and services are not the same when considering their suitability to the online market across sectors. For example, it is much easier to sell a book online compared with selling salts, oils, or mineral products. In addition, Rask and Kargh [3] asserted that external business environments influence the decision to utilize the online market. That is, while some firms are driven by their external business environment toward online selling adoption, others are proactively adopting the online selling tools. It is most likely that those sectors with higher adoption rates are associated with business environments that support the adoption on online selling.

While these sectors have products that are suitable to be sold online and that their business environments are encouraging such adoption, many firms are not adopting online selling. It is interesting to know why. This study suggests that internal organizational capability of net-enablement is another factor that encourages the adoption of online selling.

III. THEORETICAL BACKGROUND AND REASEARCH MODEL

This study uses the NEBIC model developed by Wheeler [8] as the theoretical framework to address the study's questions. The NEBIC model is an applied model of the dynamic capability and absorptive capacity theories. The model facilitates measuring, predicting, and understanding how firms transform capabilities associated with net-enablement into customer value. According to Wheeler, net-enabled firms are able to "continually reconfigure their internal and external resources to employ digital networks to exploit business opportunities" through their routines, knowledge, analysis, and rules [and] to create customer value from their net-enablement capability (p. 128). In addition, Wheeler [8] theorized that a firm's absorptive capacity (developed through prior related knowledge) affects its "ability to recognize and begin assimilating new technologies" (p. 128). That is, high absorptive capacity supports the firm's strategic options toward new technology adoption and business innovation. Low absorptive capacity, however, may hinder a firm's ability to recognize new technologies and limit its investment in strategic options.

The model includes four constructs that are central to successful net enablement: 1) choosing emerging/enabling technology, 2) matching proposed technologies with economic opportunities, 3) executing business innovation for growth, and 4) assessing customer/client value. In this study we used the first three constructs of the NEBIC model as they are all measured in the firm's level, while the last construct requires collecting data from customers, which was not attainable.

Choosing enabling technology

Choosing enabling technology is the activity of choosing one or more emerging/enabling ITs for possible adoption. A strong choosing construct produces a timely and well-examined flow of enabling technology choices and delivers it to the corresponding matching construct. The choosing construct also involves efficient communication with its proceeding matching construct [8].

Matching economic opportunities

This construct represents the firm's ability to match the proposed technology benefits with the possible economic opportunities that could be created for the firm by selecting the proposed technology. An IT could create benefits and strategic advantages for the firm and maybe even the whole sector; however, these benefits should be matched with the economic opportunities for the firm itself. Not all technology benefits are suitable for all firms, and some new technologies require substantial changes in the firm's resources, which require careful study prior to a decision to invest time and resources in those changes. Also, for some technologies, a firm's ability to sense and respond to changes or new trends in the market is important. Not all firms can quickly and effectively sense and respond to the effects and strategic advantages of enabling technologies in the market [8].

H1: The "choosing enabling technology" construct is positively related to the "matching technology with economic opportunities" construct.

***Executing online selling as business innovation for* growth**

The execution of the new technology (e.g., online selling) as business innovation for growth represents the firm's ability to reconfigure its products, services, sales channels, supply chain, and so on [8].

H2: The "matching technology with economic opportunities" construct is positively related to the "executing online selling as business innovation for growth" construct.

In the NEBIC theory, each new selection of IT or group of ITs begins a new business cycle of the model [8]. The NEBIC theory asserts that better developed net-enabled capability is associated with better IT adoption. In this study, we are testing online selling as an example of IT innovation adoption that can offer net-enabled firms the opportunity to improve business sales.

H3: Online selling adoption is associated with better-developed net-enablement capability than non-online sellers.

We assume that online selling is an IT innovation as it is not widely used in many sectors, and its adoption is more recent compared with other e-business tools. Figure 2

illustrates the research model with all proposed constructs and hypotheses.

III. METHODS AND RESULTS

Methods

In order to uncover the impact of a firm's net-enablement capability on the decision to sell online within Canadian sectors characterized as possessing above-average rates of online selling, this study used the NEBIC scales developed and validated by Basiouni and McNaughton [30] to measure the study's constructs. We have adopted and modified the scales to measure the net-enablement constructs. The targeted sectors were:

- Manufacturing
- Wholesale Trade
- Retail Trade
- Information and Cultural Industries
- Educational Services
- Arts, Entertainment, and Recreation
- Public Administration

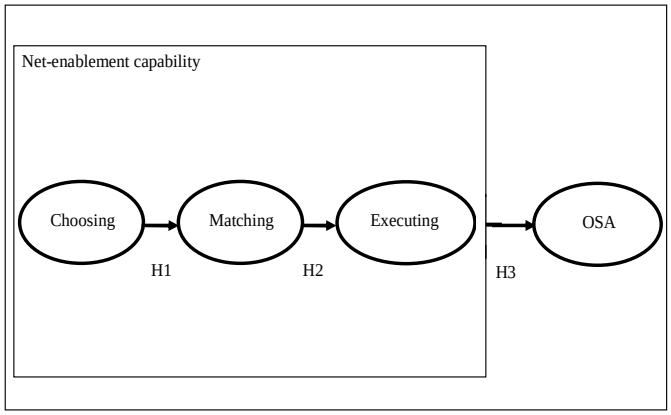

Figure 2: Research model of net-enablement capability for online selling. Source: Adapted with modifications from Figure (1) in [8]. OSA: Online Selling Adoption.

We have collected a total of 300 valid responses in which 137 were online sellers and 163 were non-online sellers. This is to confirm the research model as well as to identify the variability of the model against both types of respondents.

Results

To check for model reliability, Cronbach's alpha test was conducted as suggested by Hair et al. [31]. All the constructs had Cronbach's alpha values greater than 0.85, as presented in Table 1, which indicates the accuracy of the scale items in explaining the theoretical constructs. From a validity perspective, all constructs had average variance explained (AVE) greater than 70%, and all items' loadings were of at least 0.7. Another measurement for validity is to compare corrected item-total correlation (CITC) values. All values scored way above 0.4, indicating that the items indeed show validity as suggested by Guilford and Fruchter [32] and Zimmaro [33].

To test hypotheses 1 and 2, SEM analysis was conducted using AMOS 18.0. All paths were significant and strong. Choosing positively influences Matching, and Matching positively influences Executing as reported in Table 2. Additionally, goodness-of-fit analysis (GOF) was also conducted to test the fitness between the research model and the collected data. The X^2 is 3,721.12 with 1,419 degrees of freedom (p-value < 0.05); the normal chi-square is 2.6. The model CFI is 0.88 with a RMSEA of 0.074. These diagnostics suggest that the model provides a good overall fit.

Constructs	Cronbach's Alpha	# Items
Choosing	0.90	22
Matching	0.88	12
Executing	0.90	21

Table 1: Reliability coefficients.

Paths/Hypotheses	Standard Estimate	*p*-value
Matching ← Choosing (H1)	0.92	<0.001
Matching ← Executing (H2)	0.87	<0.001

Table 2: Results of path coefficient analysis.

To test H3, analysis of variance (ANOVA) procedure was utilized to assess the statistical differences between the two types of respondents (i.e., online sellers and non-online sellers) using a t-test analytical tool as suggested by Diekhoff [34] and Hair et al. [31]. This is to compare the level of development in the constructs of Choosing, Matching, and Executing. Table 3 shows that online sellers are associated with significantly higher means than non-online sellers among all the research constructs. See Figure 3 for further graphical representation.

	t-test			Group Statistics	
	T	df	*P*	N	Mean
Choosing	2.6	668	0.02	137	4.27
				163	3.83
Matching	2.9	580	0.00	137	4.53
				163	4.11
Executing	3.0	668	0.00	137	5.03
				163	4.63

Table 3: Results for the t-test for equality of means.

IV. Discussions and Conclusions

Discussions

The goal of this study is to understand the impact of net-enablement capability on the decision to adopt online selling in Canadian sectors characterized as having above-average online selling adoption rates. Previous studies argued that the suitability of a firm's products/services characteristics to be sold online and the existence of supporting business environment for such adoption are the main reasons behind

the higher rates of online selling adoption in some sectors. However, statistical data show that the reported rates are still lower than the adoption rates of using other e-business tools. In addition, the possibility of the influencing power of internal net-enablement capability being the reason for such adoption was not addressed in the literature.

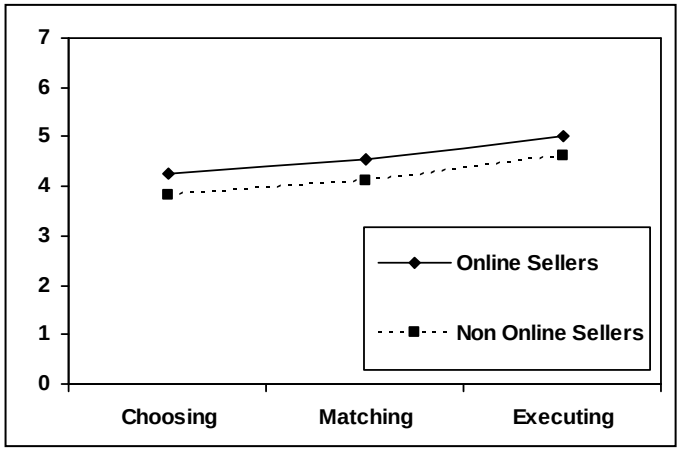

Figure 3: Level of development of net-enablement constructs between online sellers and non-online sellers.

The current research model tested the relationship between net-enablement capability and the decision to sell online and found that such decision is associated with better-developed net-enablement capability compared with non-online sellers, H3. Also, the empirical results confirmed that the net-enablement capability consists of three constructs: Choosing, Matching, and Executing as originally theorized by Wheeler [8] and validated by Basiouni and McNaughton [30]. Better selection of IT for possible adoption is associated with better matching process between the possible benefits of the proposed technology and the firm's economical opportunities, H1. This further can have a positive effect on the technology implementation process, H2.

Conclusions

This study can help to understand why many firms in sectors with above-average adoption rates are not selling online. The findings confirm that a firm's internal net-enablement capability has a positive effect on the decision to adopt online selling. This is a new influencing factor in addition to other factors that were already discussed in the literature (e.g., characteristics of products and business environment effect). By using the NEBIC model as a theoretical framework, this study contributes to the wider perspectives of dynamic capability and absorptive capacity theories by confirming the effect of a firm's continued process of information communication about new technologies and the effect of prior related knowledge on online selling adoption.

Practitioners are advised to develop their net-enablement capability by effectively building the capabilities of choosing, matching, and executing innovative technologies. This can be done by frequently scanning the market for new technologies. This should be followed by evaluating a firm's strategies and select the best technology that can best fit in achieving those strategies to help in a firm's business growth. Finally, the implementation of the selected technology requires effective project management and employee involvement to assure successful implementation. Overall, scoring higher in these three factors/constructs were empirically found to help firms innovatively sell online and benefit from those opportunities, while many other firms are still not seeing such strategic advantages.

Like other studies, this research has it own limitations. As this study is conducted on Canadian sectors with above-average rates of online selling, the findings may not be generalized to other countries and/or sectors. Researchers are encouraged to conduct this study in other countries and sectors to confirm the external validity and generalizability of the research findings.

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Model for Evaluation and Optimal Distribution of the Service Branches of Large Business Enterprises

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Abstract - *Large enterprises are often multi-level with numerous business locations. For example, SinoPec Group has five levels and over ten thousand gas stations that function as end service branches. It is a challenge for large companies to evaluate and to realize the optimal distribution of all these end service branches. The challenges are two-fold: one is to evaluate each branch's performance based on its business data without any subjective factors; another is to optimize the distribution of these branches based on social environmental data. The multidimensional decision model described herein processes and analyzes factor data from the ERP system, and assigns factor weights automatically. The model also incorporates GIS data, since an end service branch cannot simply be closed due to commercial viability without considering public welfare and strategic competitiveness. The model was successfully applied to ICBC and should be generally applicable.*

Keywords: Evaluation, Factor Analysis, Optimization, ERP, GIS

1 Introduction

Quantitative evaluation [1-4] of company branches has always been a challenging task for business management. Compared to general performance evaluations, quantitative evaluations of branches need to include all factors of enterprise business management: both from the standpoint of current business operation and prospects for future growth, including the social efficiency and communal impact of the enterprise. Large companies normally have multiple levels and numerous locations, For instance, SinoPec Group (China Petrochemical Corporation) has five levels of branches, three types of companies along the industry chain, at the end level of which are over 40,000 gas stations; the same is true for ICBC (Industrial and Commercial Bank of China Limited): six levels of local branches and over 20,000 customer service offices. All of these branches are end-user service providers. It is extremely difficult to quantitatively evaluate them and distribute them optimally.

Fortunately, with the popularization of ERP (Enterprise Resource Planning) systems [5] that reach each terminal branch of the company, it becomes possible to automatically evaluate each branch with real-time operational data collected into a central database. Our task is to devise an accurate evaluation system based on a reasonable performance index system. With such a system, we can automatically evaluate each branch and decide how to optimally distribute them based upon the evaluation results. Currently available evaluation systems suffer from two main drawbacks: one is that there are too many subjective factors utilized in the index system, another is that the determination of the optimal distribution of branches does not adequately incorporate social environmental data, which can be easily collected from public resources. These shortcomings may lengthen the evaluation process and make the results less convincing. To overcome these drawbacks, we have to accomplish the following tasks.

First, select a performance index system in a scientific and systematic manner. Branches of similar type and level should have similar operating data and social environmental data, which would enable us to form a common performance index system. Quantitative indicators will be chosen whenever possible. For those necessary qualitative indexes, quantitative processing may be done. In the index system, non-dimensional quantities should be adopted instead of human grading, e.g. growth rate, unit quantities, etc.

Second, subjective weighting should be avoided. In traditional evaluation systems, a weighting factor has to be decided upon for each index. The outcome can thus be manipulated by changing the weighing factors. It is not uncommon to hear complaints that each supervisor has his own standard and he can always find a reason to change the evaluation result. To avoid the human factor and keep a consistent policy, factor analysis [6] should be used to determine the weight of each index based on its intrinsic characteristics.

Last, determining the optimal distribution of branches must incorporate social environmental factors, including competitive factors, economic factors, cultural factors, and geographic factors. With the development of the digital society, accurate social environmental data is readily available in real time. With the assistance of GIS (Geographic Information System) data [7], our model will be upgraded from regular to multi-dimensional evaluation model. By thoroughly considering the geographic coverage of branches, a reasonable distribution can be achieved by eliminating or merging non-profitable branches, and adding new potentially

profitable branches. Nevertheless, the distribution of branches should not be solely base on their profitability in the short term, it may also be important to consider their growth potential, social efficiency, etc. Large national enterprises inevitably have public service obligation, they cannot simply withdraw from unprofitable regions as this might instigate public criticism. In addition, the distribution of branches must consider the need for competitive advantage within the same region, early occupant of the market will have competitive edge and wide operational room.

In this article, sections 2, 3, and 4 explain the basis of the enterprise evaluation model, while section 5 covers the optimal distribution of branches. Section 6 provides a real example, and section 7 states the conclusion.

2 General model for the evaluation of company branchs

Large enterprises consist of different types of businesses and different levels of branches. Thus, each branch needs to be evaluated in comparison with branches of same type and level. For example SinoPec Group has three types of companies: exploration and mining, refining and chemical engineering, sales and marketing. They all have different business scopes and operational models. Even branches of the same type but at different levels may have different business scopes, i.e. provincial branch, municipal branch, petroleum warehouse, gas station, etc. However, branches of the same type and level can be evaluated on the same platform, for they have a similar set of business operational data and social environmental data. In other words, they can use the same set of indicators. We can abstract the evaluation model as follows.

There are m branches with the same type and level in the selected company, with n indexes in the indicator library. We consider l time points (years, months, etc.). The index data can be REAL numbers with 3 dimensions: m*n*l.

The evaluated branch objects:

$$O = \{ O_1, O_2, \dots, O_m \}$$

The index system:

$$X = \{ X_1, X_2, \dots, X_n \}$$

The time points:

$$L = \{ 1, 2, \dots, l \}$$

The choice of time points can be by years, months, weeks, or days depending upon the particular application. Normally, for branch evaluation, annual sampling should be sufficient. We suppose the data are by years as follows.

The sample data of the branch object O_i in year k: $\{ x_{i1k}, x_{i2k}, \dots, x_{ink} \}$, which are from the index system $\{ X_1, X_2, \dots, X_n \}$. So the index data matrix can be:

$$x = \{ x_{ijk} \}\ x_{ijk} \in \mathcal{R};\ | i = 1,2, \dots, m;\ j = 1,2, \dots, n;\ k = 1,2, \dots, l$$

Above is the description of our sample data. Our goals are to find function $\mathcal{F} \in \mathcal{R}$ with n*l dimensions so that the evaluation results can be from the calculation:

$$V_i = \mathcal{F}\left(\{ x_{ijk} \mid j = 1,2, \dots, n;\ k = 1,2, \dots, l \}\right) \mid i = 1,2, \dots, m$$

Actually, V_i is the evaluation result of the object O_i. Reordering $\{ V_1, V_2, \dots, V_m \}$ will provide the final evaluations of all the branches of the business enterprise. Good or bad function $\mathcal{F}$ results in the matching physically. The function $\mathcal{F}$ has the characteristics that reflects each index data and must be objective and fair. Following two sections will discuss the solution.

3 Preprocessing the index data

The function $\mathcal{F}$ is built in the index data $\{ x_{ijk} \}\ x_{ijk} \in \mathcal{R};\ | i = 1,2, \dots, m;\ j = 1,2, \dots, n;\ k = 1,2, \dots, l$ with 3 dimensions. More comprehensive index data will make our evaluation function $\mathcal{F}$ more accurate. Our initial task is to program the index data X, which must reflect the business operating factors in detail. Next, the index data X must be obtained for each time point. The former is our main task and the latter is requirement for ERP or other MIS system. The function $\mathcal{F}$ is an establishment in 3 dimension data and requires significant processing time. Thus, we must shorten the dimensions so that the calculations can be practical. Moreover, we perform preprocessing for each index data waiting for the next step.

3.1 Processing the qualitative indictors

How do we achieve the goal that X well reflects all the operating information? In short, all factors influencing the organization evaluation will be accepted. These factors include not only the quantitative indexes but also the qualitative ones. For example, the rating result of the company is normally a qualitative index which influences the evaluation, so we must turn the qualitative index into a quantitative one.

Pure descriptive information cannot be incorporated directly into the model, but a classified index can be used instead. We can scan all the data and get the classified indexes. A new problem may now arise: All classification of

index data may carry the same weight which is against common sense. How can an AAA bank be placed on equal footing with an AA bank? So the processing is important for the classified index data with detail information. We process the classified indexes as follow:

3.1.1 With the grade score

The grade score is the index value. For instance, we usually set: Doctor: 3; Master: 2; Bachelor's degree: 1 when evaluating personnel.

3.1.2 With the required amount for each categories

Assume there are three types of gas stations: wholly owned subsidiary: 70%; independently owned league gas station: 20%; others: 10%. Based on the existing amount of the three types: M, N and L, the index values will be set as follows:

$$\frac{0.7(M+N+L)}{M}、\frac{0.2(M+N+L)}{N}、\frac{0.1(M+N+L)}{L}$$

It is very obvious that the greater value is better for the branch company due to "the sparse thing is expensive".

3.1.3 With the required balanced development

If we request the balance to develop all branch types then based on the last example, the index values will be:

$$\frac{M+N+L}{M*3}、\frac{M+N+L}{N*3}、\frac{M+N+L}{N*3}$$

The greater value is better.

3.1.4 Others

If the index carries no significance in an evaluation, we can set a fixed value.

3.2 Processing the time dimension

Facing 3 dimension index data matrix: $\{x_{ijk}\}\ x_{ijk} \in \mathcal{R};\ |\ i = 1,2,\dots,m;\ j = 1,2,\dots,n;\ k = 1,2,\dots,l$, the structure of function $\mathcal{F}$ is very difficult to solve. In fact, the value of the time dimension lies in comparison, and ratio indexes are more valuable, e.g. increasing rate, etc. For example, an increasing rate of national resident deposits is negatively correlated to the stock index, however, the pure absolute amount of resident deposits provides limited information about the stock index.

Thus, calculation of the time dimension can be the ratio of different index data from different time points. For example, the ratio of this month's data to last month's; the ratio of one specific month's data to the same month's data in the previous year; the average increasing rate in the past 3 years, etc. The processing will derive new indexes which will be added to the index library.

So far, we have converted the 3D data into 2D data by removing the time dimension and only using the data from the most recent time point. The new index database is as follows:

$$X' = \{x'_{ij}\}\ |\ x'_{ij} \in \mathcal{R};\ i = 1,2,\dots,m;\ j = 1,2,\dots,n';\ n' > n.\ \text{in general}$$

3.3 Nonlinear Processing

We know that most of mathematics models contain perfect solutions for linear processing. We will handle the nonlinear factors in preprocessing, so that all the processing is linear. Nonlinear processing includes compound operations among the index data. With various possible compound operations, we may design the new compound indexes according to the understanding of the normal regulations. For example, we may make the ratio of devotion to produce, and personnel cost profit margin, etc.

Most of the ratios among the indexes are beneficial to research. For example, bright manager pay attentions to the cost of labor profit margin, not to the cost of labor. Both are great in better companies, in which the employer likes the former and the employees like the latter.

In fact, we can design practical, effective compound indexes for many applications, based upon the experiences of experts from different profession. For example, Professor Liu from Central University of Finance and Economics revealed false data reporting by LanTian Company using Quick Ratio, an index she pioneered. For identifying a bad loan in its early stage and avoiding significant loss to the bank, she got the national economic award in 2002.

With more derived nonlinear indexes from experts, we can make an improved evaluation system.

3.4 Standardizing the index data

For the convenience of further processing, we need to carry on standardizing the index data: throwing away the measure dimension, mapping all data to region [0,1], and setting monotonous ascension with the evaluation result. The greater the index value is, the better the evaluation result is.

Assume the original index data matrix is:

$$X = \{x_{ij}\}\ |\ x_{ij} \in \mathcal{R};\quad i = 1,2,\dots,m;\ j = 1,2,\dots,n$$

The new index data matrix will be:

$$Y = \{y_{ij}\}\ |\ y_{ij} \in [0,1];\quad i = 1,2,\dots,m;\ j = 1,2,\dots,n$$

In order to obtain monotonic index data, we must process the data as follows. Assuming an index X, with minimum and maximum values of X_{min} and X_{max} respectively: If $X_{min} = X_{max}$, set y = x for each value. If $X_{min} < X_{max}$ for each index value x, we set the value of y as indicated below.

3.4.1 The index is monotonically increasing

The index is monotonically increasing, such as yield, etc.

$$y = \frac{x - X_{min}}{X_{max} - X_{min}}$$

3.4.2 The index is monotonous decreasing

The index is monotonous decreasing, such as defective rate, etc.

$$y = \frac{X_{max} - x}{X_{max} - X_{min}}$$

3.4.3 The median X_0 is the best

The median X_0 is the best, such as error margin, etc.

$$y = 1 - \frac{abs(x - X_0)}{X_{max} - X_{min}}$$

3.4.4 .Others

Based on the three kinds of circumstances above, we set the value by segment processing.

Through the standardizing processing, all the index values will be in the region [0,1], monotonically increasing with the evaluation, and unitless.

4 Evaluation analysis

Through the processing in Section 3, we get a standardized index database, which contains the original indexes $\{X_j\}$ and derived indexes $\{X'_j\}$ as follows.

$$Y = \{y_{ij}\} \mid y_{ij} \in [0,1];\quad i = 1,2,\dots,m;\ j = 1,2,\dots,n$$

More excitingly, the index values are monotonous to the evaluation results. With the index weights w_1, w_2, …, w_n, $\mathcal{F}$ can be made as follows.

$$V_i = \mathcal{F}(y_{i1}, y_{i2}, \dots, y_{in}) = \sum_{j=1}^{n} (y_{ij} * w_j) \mid i = 1,2,\dots,m$$

$$\text{and} \sum_{j=1}^{n} w_j = 1 \mid w_j > 0 \quad j = 1,2,\dots,n$$

Two problems arise: whether subsets of $\{Y_j\}$ need to be selected, and how to set the index weight w_j?

4.1 Selecting the subsets

We can select a subset Y' from the index set Y for different evaluation targets.

$$Y' = \{Y'_1, Y'_2, \dots, Y'_k\} \subset \{Y_1, Y_2, \dots, Y_n\} \mid k \le n$$

For example, in the bank evaluation that we will discuss later, there were four kinds of evaluation targets: profit, debt (deposits), developing, and comprehensive evaluation. For each target, we selected different subsets of the index set.

Different solutions select different subsets that may have overlapping index items, so the evaluation results are different, which is what users want. The result may answer the questions: which branch is the best in profit, debt, developing and overall?

4.2 Correlation analysis

The number of the index factors may be so big that calculation of them may waste space and time. We may find and remove correlative factors. The best tool to study linear correlations in mathematics is to calculate the correlation coefficient, the definition of which between two factors x and y is:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

$$\text{and} \quad \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \qquad \bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}$$

In general, r_{xy}>0.3 means the two factors x and y are correlative, and r_{xy}>0.7 means strongly correlative, in which case, we can get rid of one of the factors.

Usually we study the correlation matrix with n factors to find and remove some correlated factors.

4.3 Factor analysis

We now address the earlier problem of how to select the values of the factor weights: w_1, w_2, …, w_n.

How do we give weights $\{w_i \mid i = 1,2,\dots,n\}$? The traditional method gives weights according to the opinions of the leadership and experts, but different weights directly influence the evaluation results and therefore the weightings are controversial. Nowadays, university ranking are different depending upon the evaluating organizations. Although, the same evaluation indexes are adopted, different results come from different index scores and weights, and the results are thus unconvincing.

Our goal is to calculate the weights from the factor information, i.e. information weights, so that we can have an objective evaluation without artificial interference.

We make the new factor system $\{ Z_1, Z_2, \dots, Z_n \}$ by setting the coefficient matrix $A = \{a_{ij} \mid i, j = 1,2, \dots, n\}$

$$Z_i = \sum_{j=1}^{n} (a_{ij} * y_{ij}) \quad | \quad i = 1,2, \dots, n$$

Theoretically, if rank(A) = n, $\{ Z_1, Z_2, \dots, Z_n \}$ may be equivalent with $\{ Y_1, Y_2, \dots, Y_n \}$. Moreover, if A is fitting, then Z_1's variance is very big and the variances of the other factors Z_2 to Z_n are very small, so that we carry on the evaluation only using Z_1, without losing more information.

Fortunately, principle component analysis in statistics already gives the entire solution. With principle component analysis in Y, if the contribution rate of the first characteristic value is greater than 90% , we can adopt first characteristic vector$\{ \propto_1, \propto_2, \dots, \propto_n \}$ as the weights to set up the evaluation function $\mathcal{F}$.

$$V_i = \mathcal{F}(y_{i1}, y_{i2}, \dots, y_{in}) = \sum_{j=1}^{n} (y_{ij} * \propto_j) \quad | \quad i = 1,2, \dots, m$$

The greater the contribution of the first characteristic value is, the better the result is. It is generally accepted that if it is more than 90% the results will be good and if more than 95% they will be better still. If the contribution rate is too small, for instance less than 90%, we will have to adopt more characteristic vectors, which may give worse results.

We can even get more results from the function $\mathcal{F}$ by cluster analysis and classify analysis [8].

Without marking the index and giving the weights, we get the whole evaluation function according to the information weights. The contribution rate of the first characteristic value may be regard as the evaluate accuracy: if the contribution rate is more than 99%, we can say that the evaluation error margin is within 1%.

5 Optimizing the branch distribution of companies

In this section, evaluation analysis of business operating data will be presented followed by a discussion about the optimal distribution of branches: to add, merge or close some branches. We will only discuss merging and closing a branch, because adding a branch is the same process where no closing means adding.

The decision to close a branch must incorporate social environmental factors, including competitive factors, economical factors, cultural factors and geographic factors, etc. With the assistance of GIS, we will get more abundant information and make our decision more accurate.

Our task is to bring these factors into the decision model, therefore we propose the business radiation radius and pure overlay value with calculations as follows.

5.1 The business radiation radius

In general, the service district of a branch is subject to the limitations of transportation, but we still suppose the service district is a circle region for simplification. The calculation of the business radiation radius must consider the population density, income, consumer level, local GDP, competitor, etc. To simplify the description, we now only consider two factors: population density and local GDP data from GIS, The business radiation radius can be defined as follows:

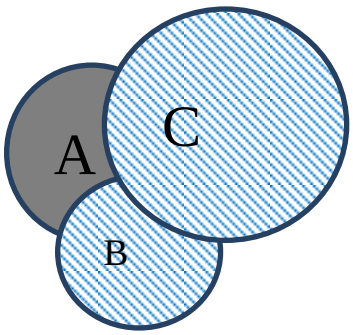
$$R_i = \frac{C * V_i}{\rho_i * \mathbb{G}_i} \quad | \; i = 1,2, \dots, m$$

R_i is the business radiation radius of the branch O_i, unit: KM; ρ_i is the population density in the region, unit: 10000 people/KM^2; $\mathbb{G}_i$ is average of GDP, unit:10000$/capita; C is a regulating factor, which adjusts the number and unit. For banking business, we can set C=1. $V_i \in [0,1]$ is the evaluation result of O_i.

Generally speaking, in regions with more population and higher income, more branches should be set up, so the above definition is reasonable. Why do we add the factor V_i? An excellent company attracts more people, so we hear that "The wine is fragrant, no afraid in the deep lane ".

5.2 The pure overlay value

The pure overlay value can be comprehended as the value of the non-overlapping region. A branch may overlap with others as follows.



The pure overlay region of A is in pure gray. We may calculate the pure overlay region of A by counting the dots as follow,

$$\mathrm{abs}(x - x_a) < 0 \cap \mathrm{abs}(y - y_a) < 0$$

$$\mathrm{abs}(x - x_i) > 0 \cup \mathrm{abs}(y - y_i) > 0 \mid i = 1,2,\dots,m; i =\neq a$$

Among them, $(x_i, y_i) \mid i = 1,2,\dots,m$ represent the geography position O_i , from GIS systems

Suppose the pure overlay area is $S_i \mid i = 1,2,\dots,m$, we can give the definition of pure overlay value as follows:

$$\varphi_i = S_i * \rho_i * \mathbb{G}_i \mid i = 1,2,\dots,m$$

From the definition, the pure overlay value means the maximum value in the region that the branch covers by itself only, the greater the value the better.

5.3 The solution to optimizing the branch distribution

Branches with low evaluations and low pure overlay regions should be cut off. The former is from evaluation result V_i, and the latter is from the pure overlay value.

The absolute value of V_i is meaningless. Two possible ways of determining whether branches should be cut off would be either to cut off branches with an evaluation ranking in the bottom M%, and with a pure overlay value ranking in the bottom N% or to cut off branches with an evaluation ranking in the bottom M%, and with a pure overlay value of L (maybe a small number). In fact, we selected the first option in the following example.

From the definition of φ_i , a branch will never be closed if its service region is not overlapped by that of other branches, even if it evaluates very bad. Consequently, service is guaranteed in regions where the number of the branches is relatively low.

For adding a branch, suppose the evaluation result is 0.5, it should be set up if it is not to be closed

6 Brief introduction to an example

We now give a brief introduction of the application of the model to ICBC (Industrial and Commercial Bank of China Limited). We selected a city to test the model, in which there are 12 bank branches, 27 small local office and 169 savings sites. Our task is to evaluate and optimize the distribution of the 169 savings sites with same type and same level (level 6).

Previous evaluation models were not convincing due to artificial factors. Therefore, ICBC sought an outside organization to give objective evaluations.

The normal business data contained: balance sheets, savings and loan data in 3 years from ERP, but no social environmental data. With our suggestion, they collected some social environmental data: geographic coordinates, population density, local GDP, competition distribution from the public systems (e.g. public GIS).

By preprocessing the index data, we formed 16 indexes. We proposed 4 solutions to evaluate the 169 savings sites, after discussions with the users.

- Comprehensive evaluation solution

  With 16 indexes.

- Profit oriented solution:

  With 10 indexes.

- Savings oriented solution

  With 7 indexes.

- development oriented solution

  With 9 indexes.

Using principle component analysis, all the contribution rates of the first characteristic value were greater than 95% in all four solutions. In all four solutions, there were 10 savings sites that ranked in the bottom 10%. When the president of the bank saw the evaluation results, he said in surprise that the results were what he predicted and thanked us for giving him scientific evidence.

Calculating the pure overlay value, the 10 above-mentioned savings sites all fell into the bottom 20%. With the ICBC's "Cutting off 10% savings sites" program, all highlighted 10 savings sites were cut off in the first round.

7 Conclusion

In this paper, a new method to evaluate large enterprises using preprocessing indexes and principle component analysis is presented. From calculations of pure overlay value, we can optimize the distribution of the company branches in conjunction with many social environmental factors. This model was considered objective and effective when it was used by ICBC.

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A study of the new Mayor's Email-box service of the E-government based on the multiple classifier system

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Abstract *— The Mayor's email-box is one of the important customer service systems of E-government. However, the processing of citizen's requests currently depends heavily on manpower. This not only increases the service cost, but also delays the time it takes to respond to the requests. Therefore, how to classify the citizens' opinions quickly and correctly has become an import challenge for the E-government. This study proposes a new framework which combines the concept of knowledge mapping with text mining technology for automatic and correct classification of the email to forward to the responsible departments. Furthermore, the proposed module can identify which department should the organizer or co-organizer. Extensive experiments are completed using a real data set to verify the efficiency and accuracy of the proposed framework. The experimental results indicate that the proposed system is computationally efficient, and can effectively categorize documents.*

Keywords： Knowledge management, Knowledge map, Text mining, Association Rules

1 Introduction

The goal of E-government is to use information and communications technologies to enable government organizations to provide better service and to increase the effectiveness and efficiency of that service for the people [1]. The "Mayor's Email-box" is one of the best ways to handle citizen complaints and opinions. However, most such problems are complex and several departments need to work together to solve them. A sample email is illustrated below.

About two or three homeless people live in the Park. The homeless people sleep on the benches during the day, and wander the streets at night. Someone has sprayed graffiti on the walls of the public toilet. There are several mounds of discarded stuff: broken umbrellas, worn-out shoes, empty plastic bottles and so on. They do not bathe and make the park messy. No one can stay in the park. The air smells uncomfortable ….

According to the above statement, this email should be assigned to two departments to take responsibility. The department of social welfare should take care of the homeless and the department of environmental protection should arrange for workers to clean up the environment of the park. Since the citizen seemed more concerned about the destruction of the park environment, the department of environmental protection should take more responsibility and organize the solution process.

To cope with such classification and sorting problems, this study proposes a framework which will be able to automatically handle citizens' requests by first analyzing the contents and then distributing the email to the most appropriate departments. The proposed framework contains two important phases: (1) the Knowledge Extraction Phase and (2) the Task Distribution Phase. First, the knowledge extraction phase constructs a knowledge map based on the algorithm proposed in our recent work [2]. Knowledge mapping is a technique for representing knowledge [3, 4]. The knowledge map should be built based on association rules discovered from the training data.

During the task distribution phase, unclassified documents will be categorized based on comparison with the knowledge map. Since the email requests often need to be assigned to more than one organization to be dealt with and responded to, we propose a multiple classifier methodology for document classification. It consists of three different classifiers, which are utilized to learn the email, and then output a set of candidate departments for the proposed voting method, to decide which one(s) should the organizer or co-organizers.

The reminder of this paper is organized as follows. Section 2 describes the proposed framework. Section 3 discusses how the proposed model determines the assignment of the citizen's request, which one or more departments should take responsibility, and which one should be the organizer or co-organizer. Finally, in Section 5, we present our conclusions.

2 The proposed framework

The proposed framework contains two important phases: the Knowledge Extraction Phase and the Task Distribution Phase. The proposed framework is illustrated in Fig.1 and described in detail below.

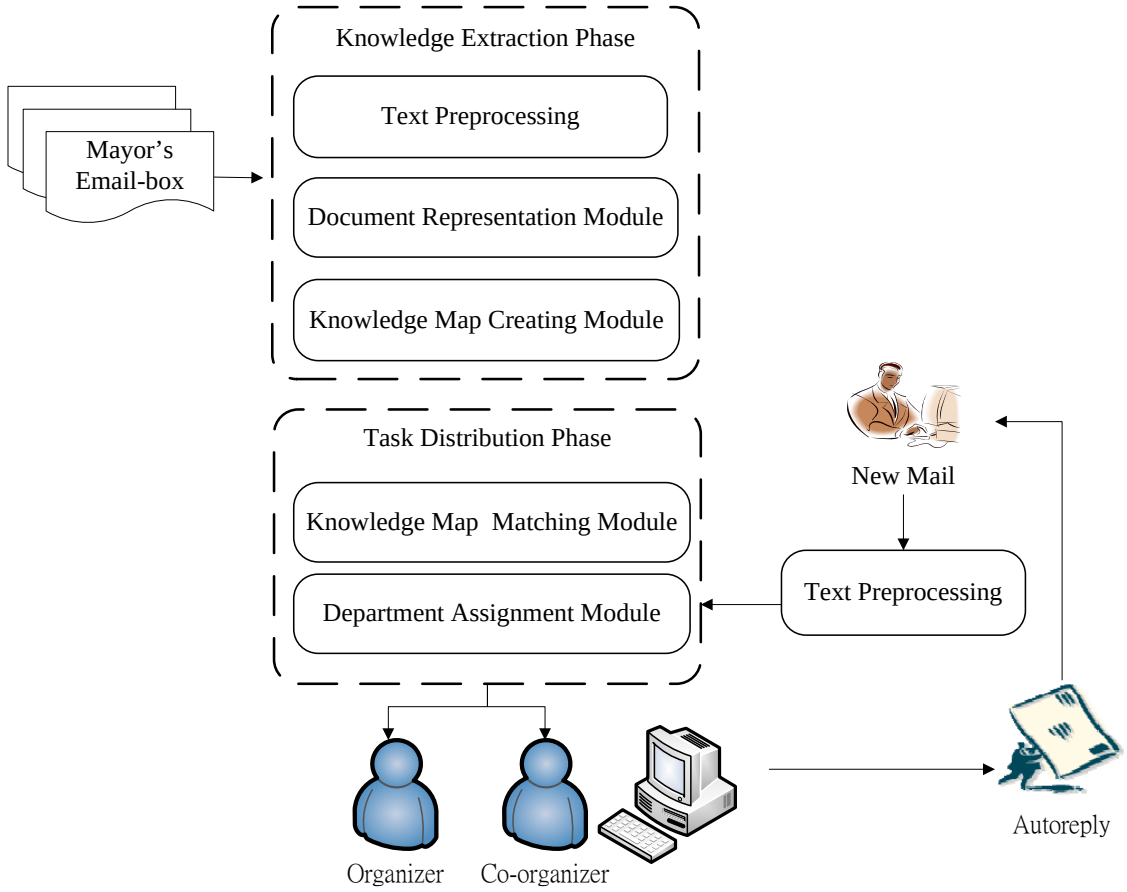

Fig. 1 The proposed framework.

2.1 Knowledge extraction phase

The knowledge extraction phase is comprised of three modules: text preprocessing, a document representation module and a knowledge map creating module. In a recent work we proposed an algorithm based on the association classification method which is used with part of the emails from the Mayor's email box for training. After executing the association classification process, we filter out the most frequent rules containing several key-phrases and departments that appear together.

Let $D = \{d_1, d_2, \ldots, d_n\}$ be the set of departments, where n is the total number of departments. Let $M = \{m_1, m_2, \ldots, m_j\}$ be the set of emails, where j is the total number of emails in the "Mayor's Email-box". Let $K = \{k_1, \ldots, k_q\}$ denote the set of all key-phrases in M. In addition, email m_k is assigned to the department described as $Dept(m_k)$. For example, if email m_1 is assigned to d_1 and d_2 then it is assigned to $Dept\ (m_1) = d_1$ and $Dept\ (m_1) = d_2$.

2.1.1 Text preprocessin

It is generally agreed among researchers that word segmentation is a necessary first step in Chinese language processing [5]. However, unlike English text, in which sentences are sequences of words delimited by white spaces, in Chinese text, sentences are represented as strings of Chinese characters. We use a representative Chinese POS tagger, provided by the Chinese Knowledge Information Processing Group (CKIP) at Academia Sinica [6], to handle the Chinese word segmentation. Chinese word segmentation is a major preprocessing step in the processing of Chinese text. In traditional Chinese or Taiwanese orthography, the writing lacks spaces between words, so segmentation is both fundamental and difficult.

The main purpose of this phase is to clean and preprocess the emails. During preprocessing, the tasks of syntax tagging, word stemming, and stop-word elimination are executed. The Part-Of-Speech (POS) tagger is a syntax tagging tool. The tagging procedure distinguishes words or terms in sentences based on their syntactic or morphological features. After POS tagging, only nouns and verbs are reserved. The reserved terms are then plugged into the process and stop-word elimination is conducted.

2.1.2 Document representation module

After executing the previous step, each email in the database will be represented by several features, which could be the same as some of the filtered important key-phrases or the responsible department name. Term frequency–inverse document frequency (TF•IDF) is a well-known scheme for retrieving important key-phrases in the given document [7]. Based on the tf-idf value, we can filter out common terms and retrieve important key-phrases in the given document. A high term frequency and a low document frequency of the term in the whole collection of documents will lead to a high tf-idf value. Each email can be represented as n key-phrases according to the tf-idf values of the terms in the given email.

Since an email is a structured text, it may have some useful features that can be used to improve retrieval performance. The structure includes the subject part and the content part. The subject title always illustrates the most important message which can be used represent the whole email. In a recent work, we investigated the relationships between the structure of an email and the term weighting schemes [2]. We found that the best way to combine these two features was to design a novel retrieval method to improve the performance. For example, there is an email m1 for which the filtered key-phrases are k_1, k_2, k_3. The assigned department is d1. This email would be represented as m_1 = { k_1, k_2, k_3, d_1}. Let $w(k_1)$ be the tf*idf values of key-phase k_1 in email m1. If k1 appears in the subject title, the weight will be adjusted to 1.2* $w(k_1)$. The final top 10 weight key-phases used to represent an email are shown in Table1.

Table 1 Example of the document database.

Email number	Key-phrases
m_1	k_1, k_2, d_1
m_2	k_1, k_2, k_3, k_4, k_{13},d_{12}
	….

2.1.3 Knowledge map creating module

After executing the previous step, each email in the "Mayor's Email-box" database is transformed into a set of index key-phrases which are stored at a new document database. The associative classification method will generate several rules [8]. We use the given thresholds, minimal support and confidence, to filter out the important rules to build up the knowledge map.

The rules can be summarized according to each department. An example of a knowledge map is shown in Fig. 2.

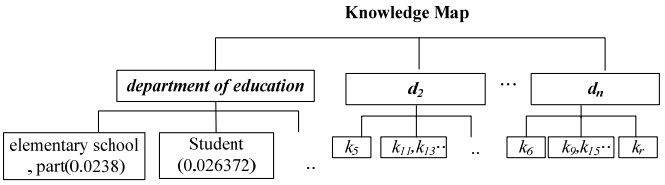

Fig. 2 The structure of the knowledge map.

2.2 Task distribution phase

The development of an E-mail based customer service system has been discussed and presented in several studies [9,10,11]. In most existing studies, automatic e-mail assignment functions are considered to distribute the request the mail to only one department. However, in reality, the citizens' emails are always complicated. The problems in the email need to be solved by several departments together. Citizens may inquire about the laws involved in solving the problems and they may also need some assistance from another department. This study proposes a novel framework which can correctly distribute the citizens' emails to several departments. The task distribution phase includes two modules: a knowledge map matching module and a department assignment module.

2.2.1 Knowledge map matching module

A knowledge map is composed of several department subtrees. Each department can be represented as a subtree, as shown as Fig. 2. The leaf node contains several key phases which most frequently appear together with this department name. The formula used to calculate the similarity between the email and the tree nodes is modified from previous studies[12].

For each key-phase k_j in email m_p, equation (1) is used to accumulate the weight sum of the key-phases for department d_r. Let $nw(k_j)$ be the weight of key-phase k_j in department d_r a subtree of the node.

$$Ws(m_p) = \sum_{k_j \in m_p, k_j \in d_r} w(k_j) * nw(k_j) \qquad (1)$$

For each new email, the knowledge map will be traversed and the weight sum accumulated for every department. Those weight sums will be used in the department assignment module. Additional instructions on sections and subsections

Avoid using too many capital letters. All section headings including the subsection headings should be flushed left.

2.2.2 Department assignment module

There are several different methods available to help classify documents, such as the Support Vector Machine (SVM), Neural Networks (NN), logistic regression and so on. These methods can classify documents into only one class. However, the department module should automatically assign the citizens' email to one or more departments. Multiple classifier systems must combine several individual classifiers to deliver a final classification decision. In this study, we design a multiple classifier system to judge which one or more departments are assigned to take the responsibility for an email. We use a hybrid classifier system with three integrated classifiers and a voting scheme to decide the final result.

3 Experiment evaluation

3.1.1 The experimental case I

To evaluate the performance of the proposed framework, we collected real citizens' email data from the "Mayor's Email-box". The domain experts had already read all of these emails and assigned them to the responsible departments according to their content. One hundred emails are channeled to two departments to take the responsibility of solving the citizens' problems. Another fifty emails only need to be assigned to one department to take charge of the request. Some metrics are adopted to evaluate the correctness of the assignment duty in this study. Accuracy is defined as the ratio of correct assignment and can be expressed as follows:

Accuracy = (A+D) / (A+B+C+D), (2)

A: the number of emails correctly assigned by the system to two departments;

B: the number of emails assigned by the system to two departments but the experts decided to assign it to one department;

C: the number of emails assigned by the system to one department but the experts decided to assign it to two departments;

D: the number of emails correctly assigned by the system to one department.

There are two kinds of multiple classifier systems needed to deliver a final classification decision. One classifier system, SNL, combines three methods including SVM, NN and logistic regression methods. The other system, CNL, integrates CHAID, NN and logistic regression methods.

Table 2 The accuracy measurement of the two proposed multiple classifiers.

	Accuracy
SNL (SVM - NN - Logistic regression)	0.82
CNL (CHAID – NN - Logistic regression)	0.88

The proposed framework performs well in terms of the accuracy of assignment. We conclude that the best combination classifier system is the integrated logistic regression with CHAID and NN.

3.1.2 The experimental case II

In real cases, experts read each citizen's email, they judge whether this request needs to be solved by one or two departments. If two departments are needed to take responsibility, the experts then decide which one will be the major organizer and which the co-organizer.

Since the number of departments suggested by the experts may be two, we adjust the measures to be computed according to Table 3 in order to meet our system requirements. Table 3 contains information about the results decided by experts and results decided by the system. Generally speaking, precision is indicated by the proportion of accurate department assignments. Recall is what the system can find and the proportion of related department among all the departments' classifications.

Table 3 The confusion matrix for our scheme.

		Decided by experts	
		organizer	co-organizer
Decided by system	organizer	A	B
	co-organizer	C	D

Evaluation of organizer assignment:

Recall rate = A / (A+C) (3)

Precision rate = A / (A+B) (4)

Evaluation of co-organizer assignment:

Recall rate= D / (B+D) (5)

Precision rate = D / (C+D) (6)

F-measure =(2*recall*precision) / (recall+precision)(7)

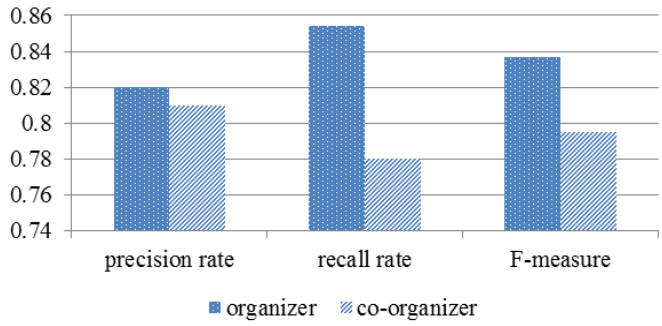

Fig. 3 Evaluation of the proposed framework related to organizer and co-organizer assignment.

The results in Fig. 3 show the effectiveness of the proposed framework. Our method performed well in terms of precision rate and organizer and co-organizer assignment.

4 Conclusions

This study proposed a framework for the automatic assignment of citizens' requests to the most feasible department to take responsibility. The proposed framework can automatically decide which one or more departments should take responsibility for the request. Moreover, it can learn from citizens' emails to increase the accuracy of assignment. The experimental results show that the proposed framework is able to provide efficient services which will not only decrease the service cost, but also increase the satisfaction of the citizenry.

ACKNOWLEDGMENT

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SESSION

E-LEARNING

Chair(s)

TBA

Teaching Mobile/GPS Device Forensics by E-Learning

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Abstract **-** Many law enforcement and military personnel are deployed in places where specialized learning such as mobile / GPS device forensics are not feasible by traditional methods such as a classroom. Students may find that they cannot leave their forward operating base, Green Zone, and travel may not be safe. Sending a teacher to a classroom with only two or three students to a dangerous remote location may also not be feasible. Therefore using an online learning environment such as Moodle or Blackboard in conjunction with online tools may allow the student to learn the necessary the necessary theory and practical skills of mobile / GPS device forensics. The student may also learn at his or her own pace, take an exam, and print a credential. The netbook, digital camera, cell phone, and GPS navigation device are all discussed here.

Keywords: A forensic imaging, data carving, e-learning, GPS forensics

1 Introduction

Dr. Doherty is the Cybercrime Training Lab Director at Fairleigh Dickinson (FDU) University in New Jersey at the Metropolitan Campus which is approximately ten miles from New York City. Dr. Doherty teaches two graduate classes in management information system (MIS) and computer / network security by a videoconferencing system to a class on another campus of FDU in Vancouver, British Columbia. Dr. Doherty also teaches graduate school classes in computer seizure and examination as well as network security to both civilian students and National Guard students using an online environment known as Blackboard. Dr. Doherty also teaches cell phone forensics, PDA forensics, and digital camera forensics to in person classes as part of a continuing education program. Many policemen have taken classes and learned how to do a variety of hand held device forensics due to funding from FDU as well as grants from places such as the Department of Justice (Award No. 2005-DD-BX-1151).

2 GPS Forensics

Many students who are continuing education students in cell phone forensics are police detectives in small towns. They say that they are seeing an increasing number of automotive GPS navigation devices such as the Magellan, Tom Tom, and Garmin in their cases. A suspect will often deny that he or she was stalking an ex-lover or spouse. Suspects will often deny they were at a crime scene. However; there may be a number of mobile devices that hold evidence that refutes the suspect's statements and need to be examined. There is a system that collects information from automotive transponders known as EZPass in New Jersey that can show the time and date that the vehicle passed various tolls on toll highways and bridges [1]. People can get that data from their online accounts and police detectives could obtain that information with a search warrant. Many states including New Jersey have video from cameras on top of poles along highways that could also be examined for proof that the suspect passed a certain point at a certain time [2]. The cell phone that person carried with them has also had pinged various towers at certain times and dates. The Angle of Arrival (AOA) gives an approximate location of where the person traveled over a period of time. That information could be subpoenaed by the police from the telecommunication provider. Lastly the GPS device such as the Garmin, Tom Tom, or Magellan should hold information about tracks and waypoints. If the device was a Tom Tom, some of this information may possibly be obtained with different forensic programs known as TomTology. Blackthorn 2 is a GPS forensic program from the Berla Corporation. The condition of the GPS navigation device and the model of the device make a difference in the recovery efforts. Blackthorn 2 can often quickly show a map at a high level such as a state or at a detailed street level with many waypoints showing the date, time, and speed. Below in figure 1 is a picture of a trip in a retirement community in New Jersey.

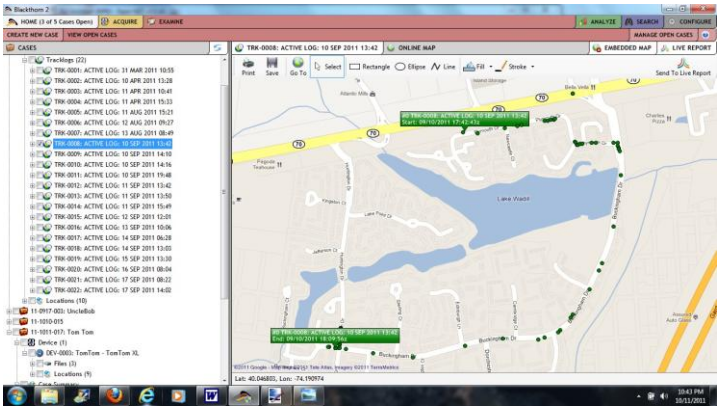

Figure 1 – GPS Trip with Waypoints and Route

The interesting thing is that the results from the GPS device can quickly show where one was and it can be compared with other data gathered from the cell phone and the EZPass transponder. This is just some of the electronic data that is produced as someone drives around. There are also speed camera pictures, highway cameras, and it is possible that some gated communities with guard booths such as Leisure Village might have IP cameras connected to a digital video recorder.

Students need to be taught to think about all the possible locations of electronic evidence that show where a suspect travelled.

3 Mobile / GPS Device Forensics is Great for E-Learning

One could easily envision a course with perhaps one hundred Microsoft PowerPoint slides being used to teach how to use Blackthorn 2, TomTology, or Easy GPS to forensically recover evidence from a GPS navigation device. These slides would be on a link within Moodle or Blackboard. A person could call up a place such as Fairleigh Dickinson University and then register for the course in the continuing education department. The student would get a username and login to enter the course after paying with a valid credit card. Then he or she enters the course and downloads the slides. Perhaps the forensic software vendors could make a thirty day trial available to the student. The student could then activate his or her copy of the GPS forensic software and then use their GPS navigation device to do the examination. There could also be additional instructional materials in MS Word or PDF documents to teach core concepts. These core concepts could include filling out a chain of custody form, isolating the examination machine from outside connections and malware, and looking for both exculpatory evidence as well as evidence to show one is guilty. Other links could include search and seizure rules for a variety of countries.

Then one could practice the concepts multiple times with one's device and read through the materials again. Once a person was comfortable with both the theory and the practical concepts, a ten question quiz could be given. A score such as eighty percent might be passing and then one could print out a customized certificate. This could be a credential that could be presented to court to show some knowledge in this area of e-forensics and investigation. If the person passed, one could be told about more in depth courses available from places such as the SANS Institute. Susteen, maker of Secure View, has both traditional classroom instruction and online learning for their forensic software for cell phones [3].

3.1 Increased Interest and/ or Need for International Training in Mobile Device Training

It is Dr. Doherty's opinion that there is a need for international training in cell phone forensics, GPS navigation device forensics, and netbook forensics worldwide. Even if there is not a need for the training in certain countries, other police forces may wish to see how other educators educate people in e-forensics and visit to promote international good will. "Two members of the Royal Thai Police (RTP), Major General Manit Wongsomboon and Colonel Niwate Arpawasin, recently promoted to superintendent of RTP high-tech section, received digital forensics training at FDU's Cyber Crime Training Laboratory in Dickinson Hall, Metropolitan Campus. Laboratory Director Eamon Doherty, administrative science (Metro), conducted the training. Robert Kugler, chief, Saddle Brook (N.J.) Police Department, was a guest for the day [4]".

It would also have been good if other busy policemen in remote areas of Thailand could have taken a course on mobile device forensics online. Perhaps materials could be translated roughly to Thai or Chinese with Google Translate and then detailed proofreading could be done with a professional translation service. The professional translation service could be outsourced to other countries to keep the costs low too. There are many options on how to deliver the information in a person's native language.

4 Teaching Data Carving Remotely

One of the other courses that might be good for e-learning is data carving. Suppose that an investigator forensically images a USB flash drive with a tool such as FTK Imager and then believes there are still remnants of images, voice mail messages, and emails in the memory. However; he does not know how to data carve and recover the digital evidence in the image. Perhaps he or she does know how to do data carving but needs a credential. There could be a course in Blackboard or Moodle on data carving. The person would call, pay with a credit card, and then get a username and password. Once he or she logs in, then the course materials could be downloaded. A small dd file with a forensic image of a thumb drive / USB flash drive could be downloaded. Then there could be links to online tools such as Scalpel and Foremost. Then the student could try to recover the files. If an image is provided, the student would have to recover all the lost files and learn to look for all the headers and footers. Data carving seems to be an important skill for police investigators since so many people download child pornography and then delete the film after watching. It is important to be able to carve pictures or video from unallocated space or RAM so people can be successfully prosecuted.

5 Night Shift Work and Education

A continuing education student who was a prison guard told Dr. Doherty that he worked the night shift or what was commonly known as third shift at the local prison. His work hours and sleeping hours severely limited his options for digital forensics education. He took courses from eight until noon and then went home to bed. He said that he wished that the same continuing education courses were offered online for a fee and then a credential could be printed. He also wanted to see more of these types of courses offered online and then perhaps an option for perhaps ten of them to be considered a college course for three credits. His wife wanted him to take the CLEP tests for all his knowledge, perhaps get some credit for life experience including training for being a corrections officer, and then get a college degree by distance learning.

5.1 E-Learning is Good for Telecommuting

Dr. Doherty was teaching the management information system class by videoconferencing to students three time zones away in Vancouver. One of the students said that he was from Mumbai, India and many people are expected to telecommute since office space is so expensive. It is often said that Mumbai is one of the most expensive places to purchase real estate and rent office space in the world. The student said that his office had cubicles with ports and people occasionally came in to download large files, video conference with America, or have face to face meetings in the conference room. He said that online continuing education in e-forensics would be interesting to him and something he would definitely do.

6 Everyone is Going Online and Has a Facebook Page

In the MIS class, it was discussed that nearly everyone has a Facebook account. Movie stars, teenagers, President Fidel Castro of Cuba, President Barrack Obama of the United States, The Pope, The Dali Lama, and many others have a Facebook page. Facebook is interesting because it allows you to contact and friend anyone. This social media tool has a tremendous amount of information about a person and may include links to friends, political and religious beliefs, social organizations, where a person worked, went to school, and many other interesting things. It could be an important piece of information to an intelligence officer or policeman in an investigation.

6.1 Teaching Facebook Investigations by E-Learning

A teenager may have run away or perhaps they met someone in Facebook and took off with them. A frantic parent may call a policeman in a small town and file a missing person's report. Time is of the essence in a missing person case. An older investigator in a small town may not be familiar with Facebook, how it works, and how to get in someone's account. A class on Facebook and social media would be a good thing. There could also be links for immediate download. One example is the free tool available for download such as Elcomsoft's Facebook Password Extractor [5]. This could help the policemen in an exigent situation see who the teenager was interacting with.

7 Creating an Online Education Business from Home

Perhaps a retired educator and retired detective find it too difficult to live on a pension and need extra income. Both people may develop courses and offer them online to private investigators, police departments, universities, and public safety personnel at universities and colleges. The retired teacher would probably be very good at formatting content, presenting it online, and doing testing. The retired detective could create the educational content and have online links for tools. His or her experience would also lend credibility to the course. The two of them may wish to form a LLC and advertise online and have a table at conferences.

There is also a good book called "Home Workplace" that is a handbook for employees and managers [6]. It is important to understand how to set boundaries between home life and work. It is also important to learn about the telecommunication equipment that one will need to video conference, upload multimedia to a website, and know about the bandwidth requirements to work from home. It is important to get the correct equipment in the first place and to create the proper work / home balance so that one does not burn out and scrap the business. There are a lot of social issues that need to be addressed. Another book that addresses these psychological / social issues is called "Technostress [7]."

There may also be a demand for one to one instruction. Tools such as Citrix Go to Meeting and IP Phones are good for small classes. There could also be many creative options such as distributing CDs, using a combination of YouTube videos and emailed content and tests. The way to conduct the education is limited only by one's imagination and what the consumer will accept. It is often said that at anytime there are many wars on the planet. Teaching mobile device forensics could also be done free as a humanitarian gesture. Consider the unfortunate reality that there are also many powerful weapons that may only leave little more than one's shoes and mobile devices of some sort, be they old fashioned film cameras or the digital devices of today. Dr. Doherty's uncle, an ex military veteran who spent some time in Nagasaki right after the atomic explosion, was discussing the issue of the difficulty of identifying remains. The photo album of the atomic devastation can be seen in Dr. Doherty's book, "A New Look at Nagasaki 1946." There may also be a need for people worldwide to learn to examine mobile devices and be able to notify a person's next of kin. In the United Kingdom, many people put ICE, in case of emergency, in their phones so that if something happens to them, their loved ones can be called.

7.1 E-Learning and Specialized Markets

It seems that e-learning fills a market need for investigators worldwide who work varied hours, cannot travel, and need to learn about highly specialized technology investigation tools that change quite often. The Android phones are very popular in 2011 and 2012 but many will probably go in someone's drawer by 2013 and something else will be popular. Police investigators and private detectives need the training and tools to be able to investigate what is used by the public now. They also need the credentials to be credible to a jury now. Many private education vendors and schools may not offer highly

specialized in person classes to small markets that provide little profit margins The e-learning environment is perfect for teaching these classes because once the class is made, it could be offered numerous times over many years as needed to an audience worldwide. There may be occasions where a criminal uses an old GPS navigation device or an old phone or even has them paired by Bluetooth in the hopes that if he does get caught, nobody can examine these devices. As time goes by, the repository of classes to offer students worldwide builds. At some point, telephone collectors such as the Antique Telephone Collectors Association, may wish a class on a certain old cell phone for their collection. The forensics would be so that they could see the data within it. The Infoage Museum in Wall, New Jersey has a large collection of computer, phones, and televisions. A class on mobile device forensics might be good to offer there or online.

8 Getting an Idea of the Mobile Device Forensic Classes Needed

If one wishes to get an idea of the mobile / GPS device forensic classes needed, one only needs to go to the High Tech Crimes Investigative Association (HTCIA) conference and ask attendees. They are more than willing to tell you what they need to learn to do their job. They will even tell you what tools they would like training in. One could also go to an International Association of Computer Investigative Specialists (IACIS) and ask them. One can go to the New Jersey Private Investigators Association of New Jersey and ask what kind of training they would like. Each state has many private investigator associations that need training. Consider all the sexting, divorce cases, and other times that mobile devices need to be investigated. Many of these individuals work all hours around the clock and need online classes since they are convenient.

8.1 Forensic Imaging Classes Taught Online

It is often said that the most important item to get in computer forensics or mobile device forensics is the forensic image of the storage and memory. An online class that teaches people about changing the boot sequence of a computer or small netbook so it starts with a USB drive, CD, or floppy disk would be good. That class would start with preserving evidence and not booting to the hard drive where so many temp files can change. Then there a number of tools that are free and cost money that can be downloaded free or purchased to do a forensic image and save it to a storage device. Bitflare is a program that is widely used in the eDiscovery community and would be good to learn about. An online class could discuss some operating systems, the BIOS, the need to preserve evidence, and the chain of custody. Then the class could advance to topics such as changing the boot sequence and then using Bitflare to bootup to. The students could also learn about contacting the vendor to get the full support copy to save all the evidence on a portable external USB drive. After the student takes the online class and gets a certificate, they may wish to get a full in depth in person class later and get the vendor's certification.

These specialized online classes could get investigators started and be a figurative 911 for them until they have the time and funding to get other training. It is most important to offer classes that give people training in the most basic and most important forensic tasks first. Then other more specialized classes can be added later. Perhaps one can take a lesson from the Clinton Administration and set up polling and focus groups to see what people are thinking and learn what their needs are. Then one can set up the training that they need at a price that they can afford.

8.2 Committees for Classes Taught Online

One thing that seems to really be helpful with these specialized classes is to first present them to an advisory committee before offering them online. The committee should be made up of educators, practitioners, and theorists who can advise if there is a good mix of practical and theoretical knowledge for that discipline. The committee can also discuss if the course is relevant and complete. If needed material could be added or deleted from the course. Committees with a variety of people can also provide feedback about the quality of the material and if it is written in a manner comfortable to the audience for whom it was intended. Sometimes a committee will suggest that more multimedia be used to illustrate concepts that are difficult to express only in words.

9 Conclusion

These specialized online digital forensic classes could help investigators get started in new narrowly focussed areas of investigation such as GPS forensics. The classes could give fundamental knowledge and provide a credential. Any relevant credential is of some use in case they must testify in court. Then they could seek more specialized in depth vendor specific credentials if it was thought to be necessary. The online classes may be the only way to feasibly teach subjects such as GPS forensics to law enforcement personnel and defense contractors who work in remote areas where travel is not possible due to limited resources. These E-Learning environments that include videoconferencing, virtual classrooms, and asynchronous environments may also be good for those who work at night, have rotating shifts, or live in congested suburbs with inadéquate public transportation.

The E-Learning environment is also a way to facilitate a community of practice among highly specialized professionals who are in remote locations or for those who become more isolated by working the third shift or overnight shift. Some investigators and defense contractors may not wish to disclose their true identity, their location, or details of their employment. The E-Learning environment lets people reveal as little or as much as they are comfortable with. Some people

may want to skip the use of real names and just adopt nicknames such as Tom Cruise's character 'Maverick' in the 1986 movie known as 'Top Gun.' It may also be possible to create a vetting process at registration time and create classes for defense contractors and have other classes for law enforcement. Students could be given a choice of possible classes and letting them self identify for inclusion in appropriate classes might be the best choice.

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Online Course Content Auditing: Templates and Practices

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Abstract - *This paper introduces and discusses the Blackboard Content Audit tool developed by a CS school within an Australian university. Based upon the key sections of a unit's site in the Blackboard LMS, the tool establishes sets of basic, intermediate and advanced criteria and a rating scale upon which to assess the criteria. By specifying the basic criteria as a minimum standard, the consistency of unit sites can be improved. This helps to close the perceived quality gap between the schools online unit offerings, where in the past some staff had engaged more than others with the features of Blackboard. The audit process involves a semester based self-assessment by teaching staff for their units, followed by a review of the self-assessment by a member of the schools teaching and learning committee. This institutes an ongoing cycle of review, encouraging staff to continuously improve their online unit offerings. The auditing tool itself will also undergo regular review and refinement to ensure it remains relevant to the school's ongoing T & L needs. Such a tool could be adapted for any LCMS and institution in order to meet their specific needs and context.*

Keywords: e-learning, audit, quality assurance, review, LCMS

1 Introduction

E-learning is an accepted part of higher education and tertiary teaching. A large literature base exists covering pedagogy, teaching, content and synchronous versus asynchronous issues [1]. Where the literature on e-learning tends to fall short, for the moment at least, is in the area of auditing and quality assurance of online learning. The quality of e-learning and distance education in general has been a topic of note and concern in the literature [2-5]. This paper presents an auditing mechanism used by a university school of computer and security science in order to set and assess minimum standards for online content contained within the school's various units of study. The university in question uses Blackboard™ as its primary Learning Content Management System (LCMS), and in the school in question all units in all courses were available online. The school uses a blended approach to online learning, with both on-campus and off-campus (online) students using the same materials in the same Blackboard site.

Even though the school has been an institution leader in having a strong online curriculum for more than a decade, the varying quality of online unit offerings within the school has been an issue. Some lecturing staff fully engaged with the online medium and developed rich learning resources in their units hosted in Blackboard, offering a variety of media, content and learning materials that were equally relevant to both the on-campus and online students. Other lecturing staff took a more minimalist approach, placing few resources online (beyond the basic lecture slides) and having learning tasks or assessments which were aimed more at the traditional classroom than the online student cohort, leading to issues of online students feeling marginalised. Feelings of isolation or marginalisation amongst online students have been raised in numerous pieces of literature [3, 6-9].

The university, through its central teaching and learning committee and governance structures, developed an auditing tool which was a word processed form of approximately 65 pieces of criteria covering the core items that were deemed necessary as part of good online teaching practice. This auditing tool was used centrally as a mechanism by which to report on online teaching quality across the university, with audits being conducted by governance staff rather than the staff teaching the units in question. The school decided that it would develop its own auditing mechanism, based on this centralised model, but using a more transparent and streamlined process. The decision to develop a different auditing document was driven by concern that the original document used rather vague and formal "teaching and learning language" and was also subjective as to how certain elements of "quality" could be interpreted. Etedali and Aharpour Feiznia [3] acknowledge the vague nature of quality as a concept:

> *Being too abstract to have any impact, quality cannot be described and fixed by merely defining it. It has to be defined and specified contextually and situationally considering the prospective stakeholders involved.*

To this end a new audit document was designed, driven in large by the actual structure of Blackboard and the types and breadth of content the school would expect to be present in each part of the overall Blackboard unit offering. Dubbed the Blackboard Content Audit tool (BCA tool), the document primarily addresses topics of the content, design, structure, technology usage and communication faculties of a unit site in Blackboard – aspects noted as having potentially significant impacts upon e-learning quality and learner satisfaction [3, 4, 10, 11]. The focused nature of such a tool mirrors those of other "checklist-based" quality assurance mechanisms which have been proposed or adopted for e-learning [3, 11-13]. The following sections will examine the structure of the BCA tool, the logic behind the design decisions and the process by which it is conducted.

2 Audit Document Design

As stated, the main elements of the BCA tool are based upon the sections of a unit's site in Blackboard. This approach was adopted so as to avoid the ambiguity of other audit mechanisms – staff can clearly map the elements of the BCA to the sections of a unit's site in Blackboard. Blackboard, like all modern LCMSs, offers a wide range of features and tools, not all of which were considered "must haves" in the design of the BCA tool. The sections of the BCA tool are:

- Announcements
- Unit Overview
- Unit Schedule
- Staff Information
- Assessments
- Readings
- Communication
- Links
- Tools

A rating key was devised to describe the level of development in terms of usage and content of the items above. Figure 1 shows the five levels within the key, starting at zero (not implemented) through to four (excellent).

Rating	Description	Notes
0	Not Implemented	Ratings of 0 for Basic criteria require urgent attention
1	Rudimentary	Ratings of 1 for Basic criteria require attention before next run of unit
2	Average	Ratings of 2 for Basic criteria indicate unit is at an acceptable level
3	Very Good	Ratings of 3 for Basic criteria indicate the unit is very well developed
4	Excellent	Ratings of 4 represent exemplary examples of Blackboard site content

Figure 1: Rating key for the BCA tool

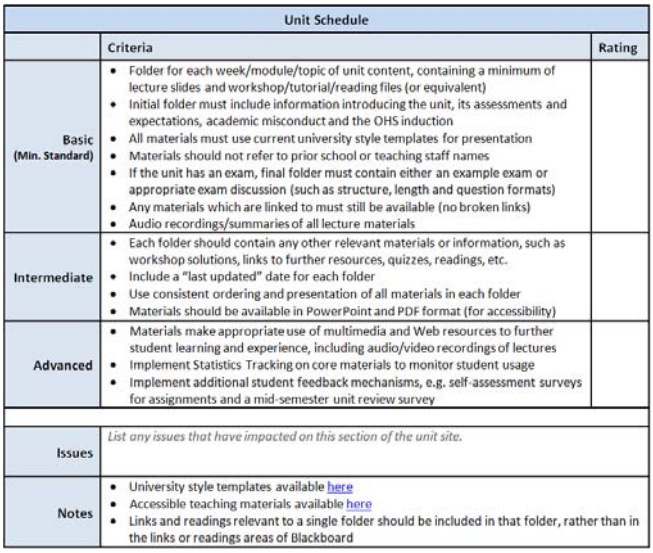
As Figure 1 illustrates, the key was designed to not only rate how developed each section of the Blackboard content was but also to indicate any actions required as a result. For some sections of a Blackboard unit site, the unit content, materials or communication may have been very good, requiring little further effort on behalf of the staff, whilst others may need urgent attention to bring the content up to an acceptable level. Each section of the BCA tool is broken into Basic, Intermediate and Advanced sets of criteria, with staff indicating their perceived rating in these areas based on the criteria. Notes were also specified where necessary, typically to outline "best practice" in terms of utilising that function of Blackboard. An Issues area is included in each section, allowing staff to raise any specific issues that may have affected their use of the given functionality in Blackboard for the teaching semester in question. Figure 2 shows the audit criteria for the Announcements section of the BCA tool.

Announcements		
	Criteria	Rating
Basic (Min. Standard)	• Welcome/Introductory announcement at the start of semester • Announcements detailing any significant changes to unit content, schedule, assessments, due dates or staffing	
Intermediate	• Mid-semester summary/recap announcement • Announcement regarding availability of unit evaluation surveys • End of semester farewell/debriefing announcement	
Advanced		
Issues	*List any issues that have impacted on this section of the unit site.*	
Notes	• Important announcements should be emailed to all students by ticking the appropriate box • Minor announcements can be posted in a discussion board to ensure sustained visibility, as the default view of announcements only shows those from the past week. If this is done, consider making an announcement to announce the presence of the discussion board post	

Figure 2: Announcements section of the BCA tool

As Figure 2 depicts, the Announcements section of a unit's Blackboard site is expected to have a "welcome/introductory announcement at the start of semester" and "announcements detailing any significant changes to unit content, schedule, assessments, due dates or staffing" to achieve the Basic criteria. . An Intermediate implementation requires three additional pieces of criteria, and the Notes section provides a brief discourse on suggested methods of using the Announcements feature. The criteria for each implementation level of each section of the BCA and the accompanying notes were developed by a small group of lecturing staff who are recognised as having a strong commitment to online teaching and whose Blackboard sites have been rated highly by students in end-of-semester unit evaluation surveys.

Obviously this paper does not allow room for the discussion of every section of the BCA tool, however the Unit Schedule section will be discussed due to its critical nature – it represents the section of a Blackboard site which contains a bulk of a unit's teaching and learning materials. Figure 3 shows the BCA tool's audit criteria for the Unit Schedule section.



Unit Schedule		
	Criteria	Rating
Basic (Min. Standard)	• Folder for each week/module/topic of unit content, containing a minimum of lecture slides and workshop/tutorial/reading files (or equivalent) • Initial folder must include information introducing the unit, its assessments and expectations, academic misconduct and the OHS induction • All materials must use current university style templates for presentation • Materials should not refer to prior school or teaching staff names • If the unit has an exam, final folder must contain either an example exam or appropriate exam discussion (such as structure, length and question formats) • Any materials which are linked to must still be available (no broken links) • Audio recordings/summaries of all lecture materials	
Intermediate	• Each folder should contain any other relevant materials or information, such as workshop solutions, links to further resources, quizzes, readings, etc. • Include a "last updated" date for each folder • Use consistent ordering and presentation of all materials in each folder • Materials should be available in PowerPoint and PDF format (for accessibility)	
Advanced	• Materials make appropriate use of multimedia and Web resources to further student learning and experience, including audio/video recordings of lectures • Implement Statistics Tracking on core materials to monitor student usage • Implement additional student feedback mechanisms, e.g. self-assessment surveys for assignments and a mid-semester unit review survey	
Issues	*List any issues that have impacted on this section of the unit site.*	
Notes	• University style templates available here • Accessible teaching materials available here • Links and readings relevant to a single folder should be included in that folder, rather than in the links or readings areas of Blackboard	

Figure 3: Unit Schedule section of the BCA tool

There are quite a few expectations of staff in the Unit Schedule section of the BCA tool, with many pieces of criteria specifying elements of design, layout, content and grouping of learning materials. Given the relatively open and flexible nature of the way in which items can be added and presented within Blackboard, situations can arise where the content of the Unit Schedule of a unit's Blackboard site is internally consistent within that site, but lacks external consistency with the sites of other units or staff members. As well as appearing less professional to students, this can lead to confusion and concern as students can have issues finding resources, following a learning program or discerning lecture related materials from lab/workshop materials. Reju [14] and M'Hammed [11] both discuss the importance of adhering to standards for the structure and delivery of content to ensure consistency within an institution.

By adhering to the Basic criteria of the Unit Schedule section of the BCA, a degree of consistency is assured between all unit sites within the school. The criteria is not overly specific when it comes to the exact content required, allowing staff to present content as appropriate for the unit while maintaining external consistency. The Basic, Intermediate and Advanced levels of implementation and additional Notes encourage staff to grow and develop their unit offerings. In this sense, the structure of the BCA tool reflects that of the educational quality standards discussed in Etedali and Aharpour Feiznia [3] and Ehlers and Pawlowski [15] – standards establish only a basic framework in order to prevent the restriction of flexibility or creativity

The BCA tool was not developed as a fine grain tool for the analysis of teaching and content quality – a somewhat subjective concept which no generic tool can adequately assess. It was designed to set minimum standards for the usage of the key sections of the Blackboard LCMS within the school, and to encourage the continual improvement of e-learning in the school. The tool seeks to help close the perceived "quality gap" between unit sites in Blackboard, which manifests itself via inconsistencies in the content depth, variety, logical presentation, communication and feedback provided in these sites. The audit mechanism was designed to capture the presence, presentation and usage of these items across the core areas of Blackboard, not to judge to quality of the content within.

3 Audit Process

The process for disseminating and assessing the BCA tool is based around the two semesters taught in the university each year. Staff are required to self-audit each of the units they are teaching in a given semester, preferably towards the end of the semester (which typically runs 12-13 teaching weeks). For the self-audit, staff complete the BCA tool by indicating the rating level they perceive their unit to have achieved in each section. The Issues field can be completed to raise any issues relating to that section of the BCA tool. Staff also indicate their name, the year and semester, and the number of semesters they have taught the unit at the beginning of the BCA tool. This last item can be very important, in that the current state of a unit and the actions required as a result can vary depending upon whether the staff member is new to the unit and its content.

The final section of the BCA tool asks staff to rate the unit's materials and assessments against those specified in the unit's outline – the official public document that defines the unit's content, assessment structure, textbook, and so on. Ensuring that unit offerings comply with what is specified in the outline is an important issue, and the BCA tool is used to assist in ensuring compliance. Once staff have completed their self-audit, they upload the completed document as a hidden file in the unit's Blackboard site (see Figure 4).

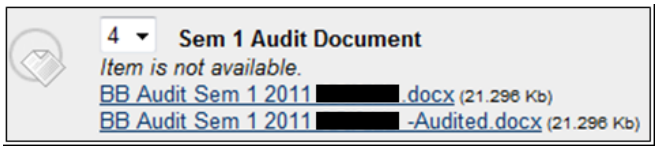


Figure 4: Audit document as a hidden file

Members of the school's teaching and learning committee then commence a review of each audit document and the unit to which it is attached, adding any notes or required actions to a section at the bottom of the document (see Figure 5). The reviewed audit document is then added alongside the original audit document, allowing staff to view the comments of the committee against their self-audit.

Review Date	
Reviewer Name	
Notes / Issues	
Actions Required	

Figure 5: Audit signoff by T & L Committee member

As each unit's content is "rolled over" to the following semester, so too are the audit documents - allowing for an audit and review history to follow each unit on an ongoing basis. The goal of this approach is to have a documented record of audits and the recommended actions from audit reviews, followed by some improvement in the unit's site before the next cycle of audit and review. This correlates well with the process-oriented lifecycle model presented by M'Hammed [11], in which "QA is dynamically and iteratively intertwined with the e-learning development process."

4 Future Work

The BCA tool is coming towards the conclusion of its first full year of use. At that time the tool will be re-examined to identify weaknesses in design and usage and also where the tool has succeeded in identifying issues in Blackboard unit offerings. As the university in question has seen a change of version from Blackboard 8 to Blackboard 9 some tweaks will need to be made to the associations between the functional elements of Blackboard and the sections in the audit tool. The process for audit and review will also need to be examined, due in large to the number of reviews required for staff on the school's teaching and learning committee. A small committee of individuals cannot hope to review all audits each and every semester, and to a certain degree those conducting the audit reviews need to be "Blackboard experts" or "e-learning technologists" [16] in order to offer detailed reviews and suggestions for improvement. At the time of writing, a process of random selection was being used in order to conduct audit reviews, along with some targeted auditing of units which had been rated poorly by students in the prior semester's unit evaluation survey.

By continually re-evaluating and refining the tool, the authors hope to ensure it remains highly relevant and focused upon the improvement of Blackboard unit sites and the school's high standards. The ongoing cyclic process of self-auditing, review and improvement should help to address the issues regarding the perceived quality gap between various Blackboard unit sites in the school [11].

5 Conclusion

This paper briefly outlines one possible approach for the auditing of online content contained in the Blackboard LCMS. The key concept of this paper, and of the auditing tool itself, is that by aligning the structure of the auditing tool to the structure of Blackboard (or any target LCMS) itself, ambiguity and potential misinterpretation of "minimum standards" can be significantly reduced. In this case the auditing tool both provides a guide as to how staff should be utilising each feature of Blackboard, whilst allowing for self-audit and external review within a single instrument which then follows the target unit forward in time.

Whilst this instrument was designed to meet the needs of a single computing school using the Blackboard LCMS, it could easily be adapted to any other learning management system, such as Moodle™ or Sakai™.

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Support services experienced by university instructors in e-learning

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Abstract - *This paper explores the support services that influenced instructor use of e-learning in a national research-based university in Taiwan. An interpretive paradigm utilizing quantitative method was adopted. The paper outlines the findings from 69 e-learning instructors in a questionnaire about instructor perceptions of support services they received from the university. The advantages and disadvantages of having and not having student assistant support were also described. The findings suggest the instructors need student assistant and technical support staff from the university and found them helpful in their development of e-learning courses. Ongoing administrative and technical support and recognition of instructor effort are important factors to encourage the use of e-learning. University administrators interested in solving the issue of the under-use of e-learning would be wise to recognize the support services instructors needed and to provide the necessary support to help instructors overcome the barriers if they wish to promote the use of e-learning.*

Keywords- blended learning, e-learning, university instructor, support services, policy

1 Introduction

Courses may be delivered completely online or via 'blended learning' which involves a combination of an online component of technology-based and face-to-face learning [1][2]. E-learning is a key component of blended learning and was the catalyst for the rapid growth in this form of learning [3]. Currently many institutions are opting for the blended learning delivery of courses [1]. Blended courses that include face-to-face and e-learning has been offered in universities in Taiwan but very little research has been undertaken on instructor perspectives of support services that influenced their use of a blend of e-learning and face-to-face instruction.

The Taiwan government has built up a good ICT infrastructure and encouraged universities to develop e-learning systems. University instructors in Taiwan have begun to use universal Internet access, multimedia, and state of the art computer labs, wired and wireless campus network for teaching and learning because these have been implemented and become mainstream. However, a majority of instructors still resist the use of e-learning regardless of its suggested benefits [4] [5]. This leads to questions about instructor perspectives and expectations of e-learning and the reasons why very few instructors use e-learning. This paper outlines the findings from a survey to 55 of 69 e-learning instructors at the National Research University (NRU, a pseudonym). These voluntary e-learning instructors were asked about their perceptions and experiences of e-learning and their perceptions of the support services experienced in their e-learning teaching.

2 E-learning in the Taiwan context and at the National Reserch University

The Internet has been an important influence on the Taiwan higher education environment for many years. Most students in universities and colleges access the Internet daily. In September 1990, the Ministry of Education [MOE] began the construction of the Taiwan Academic Network (TANet) [6] with the aim of supporting educational research activity in schools and institutions, and for universities to cooperate and share information. The TANet provided a good medium for students around the country to discuss and learn after class without time and distance barriers [6]. In June 1994, the Executive Yuan organized a steering committee, NII, to setup the National Information Infrastructure Plan and established a task force to build a national information superhighway [7]. This plan included upgrading TANet framework and the use of broadband routes to engage in "distance teaching", revising inadequate laws and regulations to do with distance education.

Taiwan provides a unique context for the development of e-learning. In 1995, the MOE chose five universities to advocate distance teaching and provided these universities with funds to buy the requisite facilities and to employ technical staff. The National Research University (NRU, a pseudonym), the site for this study, was one of the five universities. It is responsible for broadcasting courses to other universities in southern Taiwan. In 1999, the MOE proposed a number of additional e-learning projects to promote e-learning. In 2000, the Taiwan government initiated the Challenge 2008-the six-year National

Development Plan. This plan stresses the cultivation of e-generation talents. The 2000 e-leaning development policy, declared by the National Executive Yuan as the Digital Content Project, included a number of e-learning related sub-projects. ICT and Internet education designed by the MOE aims at establishing a mature e-learning environment enriched with substantial learning content. Recently, a number of projects [5][8] have been proposed by the MOE including promoting e-learning usage and content, developing digital content for life-long learning, and advocating distance teaching/learning, etc. It is hoped that, with proper guidance from educators and help of technological tools, the general public's ability to acquire and accumulate knowledge will be enhanced. Meanwhile, life-long learning will no longer be an unattainable dream as the Internet makes possible education beyond and outside formal routes. The ultimate goal is that, with knowledge being constantly created, the collective growth of individual citizens will lead to the uplift of the entire society and the nation's competitiveness.

From the descriptions above, one knows the Taiwan government has done much to put in place a good infrastructure and environment for e-learning. However, infrastructure and equipment are just one of prerequisites for successful e-learning. Computers alone are insufficient to meet the extravagant claims made for technology [9]. Successful e-learning practice depends on the involvement of instructors and students, and institutional administrative support. Hence, this study focused on the perspectives of a range of stakeholders involved in e-learning at a National Research University (NRU).

NRU is a national public research-based university which offers a full range of undergraduate programs, is committed to graduate education through the doctorate, and gives high priority to research. NRU has been chosen by the MOE to be involved in the Program for Promoting Academic Excellence of Universities, and starts to receive an extra government grant of 3.1 billion NT dollars (1,000NTD $\cong$ 30USD) per year for five consecutive years (from 2006 to 2015). The major concern of this project lies in two areas: firstly, aiming at quality improvement in seven research centers, and secondly, aiming at quantity improvement in overall research performance. This project provides further rewards to encourage research. Faculty members who publish papers or books receive special research funds. Those who make progress in research also receive awards. Because the university is research-based, the university considers research capability as a primary qualification for appointment, promotion, and tenure of faculty members (instructors). NRU also has graduate students and post-doctoral fellows in far greater numbers than other institutions, since graduate education is a major component of its mission.

As a national public university, NRU differs from other private institutions so significantly in governance and funding arrangements so it provide very different learning contexts. The university goal is influenced by the national policy. Therefore, the national e-learning policy also is a critical issue for university e-learning practice. How to encourage instructors involved in e-learning practice becomes a problematic issue particularly in such a national public research-based university. Although NRU has provided many funding and staffing supports to the instructors for encouraging the development of e-learning such as providing student assistant support, only few instructors have applied the assistant support to design e-learning courses and not many instructors like to implement e-learning courses without applying the support from university. This was one of the reasons for conducting this research.

National policy has influenced the university's development goals and tenure promotion policy. In 1999, NRU chose to define itself as a research-oriented university and subsequently it has emphasized research and changed its tenure system. Now when the university evaluates instructors, their research is a very significant contributor to their rating, meaning instructors feel pressure to undertake research for promotional purposes. Within this emphasis-on-research context, how to sustain or entice more instructors to persist with e-learning teaching has become a major challenge to the university.

In 1999, NRU provided monetary rewards and student-assistants to help instructors to video-record their classroom teaching and to put these videos, and other course materials, onto the e-learning system. Initially, the response from instructors was very positive. However, as of the 2001, the university stopped providing funding to all e-learning instructors: funding was provided only on the basis of a positive evaluation of practice. In 2005 all such support was withdrawn.

Irrespective of whether the university provided funding and student-assistants to instructors for e-learning development, statistical data from the Office of Academic Affairs and the Computer and Network Center (simply called the Computer Center) at NRU shows that only a few instructors use the NRU e-Learning System and incorporate e-learning in their courses. Moreover, although NRU has provided funding and manpower support, only a few instructors have applied for support to design e-learning courses and very few instructors implement e-learning courses without applying for support from university. It would seem worthwhile, therefore, for university administrators to explore why only a few instructors apply for student assistants and why some still use e-learning without support. This was one of the reasons to conduct this research. Furthermore, the students in this study are not required to use e-learning because e-learning is treated as an assisted learning tool. These factors may be important for the university when effective enhancement strategies for e-learning practice are being considered.

The National Research University (NRU) in Taiwan has developed its own e-learning system and provided

funding and staffing support for e-learning practice since 1999. NRU follows the government definition of e-learning and treats e-learning as an 'assisted' teaching and learning tool. That is, e-learning is incorporated into face-to-face courses to provide instructors and students access to a blend of face-to-face and e-learning opportunities [1] [7]. Again, this leads to questions about instructor, student, perspectives and expectations of e-learning; the reasons why so few instructors use e-learning; what gaps exist in instructor, student and administrator understandings of the nature and value of e-learning; and the effective strategies to enhance university e-learning. Thus, investigations of participant perceptions of e-learning, the factors influencing the use of e-learning, and the nature of effective strategies are all salient. This paper sets out to find answers to the question about instructor perspectives of support services that influenced their use of a blend of e-learning and face-to-face instruction.

3 Literature review and research design

The Internet has developed into a tool that is pivotal in world communications. The convenience offered by the Internet and other Information and Communication Technology (ICT) has accelerated the emergence of an information society and knowledge economy [10]. ICT technological advancements and the impending knowledge society have impacted on the educational environment through the implementation of electronic learning (e-learning) systems. Broadly speaking, e-learning is a network technology-based mode of education that uses a mix of computer and other ICTs, across time and place constraints to deliver instruction and provide access to information resources [11]. It can involve delivery systems such as videotape, interactive audio-video, CD-ROMs, DVDs, video-conferencing, VOD, e-mail, live chat, use of the Web, television and satellite broadcasts. Access to these resources means students can do coursework at a time of their convenience, so learning may happen synchronously or asynchronously (Stuart, 2004). Blended learning involves a combination of traditional face-to-face and online technology-based learning [1] [12]. Shoniregun and Gray (2004) [13] argue that institutions are opting for the blended learning delivery of courses to the extent that it is 'the quiet secret' of e-learning [12]. Almost every tertiary institution does more blended learning than is talked about. This research focuses on the e-learning or online component of blended learning courses.

E-learning provides students with an anytime/any place independent learning environment. This has altered, and will continue to affect, teaching and learning contexts in universities and tertiary institutions across the world [14] as has been the situation in Taiwanese tertiary institutions. However, support for the introduction of e-learning has not been universal. In Taiwan, for example, the Ministry of Education [MOE] has developed an e-learning service center to provide many training courses and support services for all levels of schools but a majority of instructors still do not know about it and refuse to change their teaching approaches, regardless of its supposed benefits [4]. Questions such as, "What are the challenges and benefits of e-learning practice for students, instructors, and administrators?", "What are the factors associated with these benefits and challenges?", and, "What are the effective enhancement strategies for university education in e-learning?" are being asked by educators in Taiwan.

Much literature on e-learning focuses on "how to do" e-learning and how to design e-learning environments (e.g., [15]). Research studies have also elaborated on the advantages and benefits of e-learning for institutions, instructors and students [16] [17]. For instance, e-learning can increase institutional reputations, improving teaching and learning quality, and provide more flexibility in student learning (e.g., [18]). However, when instructors teach through e-learning they face multiple challenges such as the need for skills to work with new media, a lack of reliable technological infrastructure and support services, being overloaded, time constraints, support service crisis and the need for different pedagogical approaches [17][19]. Research has also identified instructor concerns about recognition and administrative support [19]; teaching online is not always highly valued or rewarded in tenure and promotion decisions [20] [21]. Fewer articles discuss the views of instructors who teach on e-learning courses and why they participate while others do not yet. Instructors' perspectives and experiences are important because they are the final policy brokers [22] [23]. Previous studies suggest that successful institutions usually have a well documented e-learning strategy which sets out the institution's overall e-learning direction and objectives (e.g., [24]). Without a shared vision for e-learning and an explicated strategic plan, implementation programs can meet with difficulty and progress slowly. Taken together, these studies suggest that the motivating and inhibiting factors for instructor e-learning use may be both personal and to do with the context of university policy along with technological and pedagogical factors [23] [25]. In this paper we elaborate on university instructor perspectives of the support services they had received for their engagement in e-learning.

An interpretive paradigm utilizing quantitative methods was adopted to gain rich data on instructor perspectives of the support services they experienced in their e-learning teaching [26]. The 150 instructors who used "NRU e-Learning System" were asked to respond a questionnaire on aspects of their use of e-learning. The data for this paper is from 69 e-learning instructors in a questionnaire about the support services that affected their e-learning teaching. The instructor volunteers came from different departments within a number of different colleges at NRU. The following will describe the support services

that experienced by instructors in their e-learning teaching. In order to obtain the feedback regarding the e-learning support services from the university, departments, and peers, the questionnaire instructors were asked about the support services they had received and found helpful, the number of e-learning courses for which they had student assistant support from the university and the advantages and disadvantages of having and not having student assistant support.

4 The Findings

This section synthesizes the feedback from the instructors regarding the e-learning support services from the university, departments, and peers. Four subsections include the support services they had received and found helpful, the number of e-learning courses for which they had student assistant support from the university, and the advantages and disadvantages of having and not having student assistant support were also described by the respondent instructors.

4.1 Responses of support services instructors have used and found helpful

The respondents to the questionnaire were asked about the support services they had received and found helpful. The instructors could tick as many as applied for their current use and helpful ones. Of the sixty-nine respondents, fifty-two (75%) replied to this question. Forty-nine (71%) indicated which service they found to be helpful. Table 1 summarizes the questionnaire responses about support services the instructors have experienced and found helpful.

Table 1 Support services instructors have experienced and found helpful

Support services	Have experienced		Found helpful	
	N (=52)	% of N	N1(=49)	% of N1
Student assistant	38	73%	37	76%
Technical support staff	32	62%	27	55%
Training course	26	50%	10	20%
Demonstration	20	39%	15	31%
Seminars	11	21%	6	12%
Provision of extra technology	10	19%	9	18%

Based on Table 1, the support of the student assistants and technical support staff for the questionnaire respondents was important and helpful. However, providing training courses, good course demonstrations, seminars, and provision of extra technology support seemed not to be very helpful for enhancing e-learning practice. A Chi-Square test and Phi value show all the support services such as student assistants and technical staff support the instructors have used did not have any significant relationships with the proportion of the instructors found those support services helpful (all Pearson Chi-Square Asymptote Significance greater than 0.005 and Phi values approximately between 0.128 and 0.326).

3.2 Courses have received student assistant support

When the instructors were asked how many e-learning courses they have received student assistant support for from the university, four instructors did not answer this question. Table 2 shows the frequencies of e-learning courses having received student assistant support from the university.

Table 2
E-learning courses which received student assistant support

Courses	Respondents (N=65)	Percent of respondents
1 course	25	38%
No course	22	34%
2 courses	11	17%
3 courses	4	6%
5+ courses	3	5%
4 courses	0	0%

Over half of the instructors received student assistant support from the university in one e-learning course (38%) or two courses (17%) or three (6%) and five or more (5%) e-learning courses. However, just over one third (34%) of the instructors did not have any such support for their e-learning courses.

3.3 Advantages of having student assistant support

Instructors were asked to describe the advantages of receiving student assistant support from the university. Over two thirds (68%) of instructors described their e-learning experiences and perceptions of student assistant support. Nearly one third (32%) of respondents did not answer this question. Based on these forty-seven respondents' descriptions in this open-ended question, eleven response sub-categories were developed. Each response was coded against these categories. Some responses were counted in two or more categories. Five main categories had been developed and grouped. The first dominant category is e-learning content creation and maintenance which indicated all e-learning content related issues such as inputting and updating course materials online, designing a webpage and setting up or maintaining a website, video-recording and putting video online. Second, the technology category included any technical problem-solving and knowledge of technology. Third, a general category included any time-saving issues for dealing with e-learning related chores and brainstorming on e-learning course design. Fourth, interaction with students' category included all the help in managing student online discussions and answering questions or interaction with students. Fifth, managing student academic records category included all the assessments of student assignments or tests or exams. Table 3 names the analytical categories, and gives numbers of responses which were classified into each category.

Table 3
Frequencies of advantages of student assistant support

Main category	Sub-category	N (=47)	% of N
Creation and maintenance of e-learning content	Course materials online	21	45%
	Video recording and video online	20	43%
	Webpage design or website setup	4	9%
Technology	Solve technical problem	18	38%
	Improve knowledge of technology	5	11%
General	Save time for chores	13	28%
	Improve teaching quality	5	11%
	No great help	3	6%
Interaction with students	Answer or interact with students	6	13%
	Manage online discussion	5	11%
Manage student academic records	Assess student assignments/tests	7	15%

The instructors pointed out that student assistant support mainly could help them create and maintain course materials online (45%), video-record class lessons and put videos online (43%), solve technically related problems in class (38%) and could save much of their time on all e-learning chores (28%). However, three instructors (6%) pointed out that the student assistant might not provide great help for their e-learning teaching because they might not familiar with the course content although they might be experts in technological knowledge or skills.

3.4 Disadvantages of no student assistant support

Instructors were asked to describe the disadvantages of not receiving student assistant support from the university. Nearly three quarters (74%) of instructors responded with their e-learning perceptions of no student assistant support. Eighteen respondents did not answer this question. Based on these fifty-one respondents' descriptions in this open-ended question, eight response categories were developed. Each response was coded against these categories. Some responses were counted in two or more categories. Table 4 below shows the analytical categories and gives numbers of responses.

Table 4
Frequency of disadvantages of no student assistant support

Category	N (=51)	% of N
Need more time	20	39%
Quit e-learning	13	25%
Face more technical challenges	11	22%
Increase teaching load	7	14%
Decrease teaching quality	7	14%
Reduce motivation	6	12%
No influence	5	10%
Need more funding	3	6%

Not many instructors (39%) indicated the first disadvantage was they need more time to make or update the course materials online but they said they did not have enough time to do it unless they reduced their research time. A representative comment was:

> I have to do all the work myself when I have other things to take care of. It is very hard to do the e-learning because there are too many things to do and too little time available; especially, as NRU is a research university. Usually the instructors do not have enough time to deal with all e-learning related work by themselves. (QI.26.300)

One quarter (25%) of respondents identified the second disadvantage as being that they could not video-record their class teaching and transfer video to e-learning system by themselves and solve all related maintenance works of e-learning course so they would quit e-learning teaching. A representative comment was:

> If there is no student assistant helping me on e-learning system, I could not provide class teaching video because I could not video-record my class teaching by myself and then transfer video file to e-learning system. Moreover, on-line debate or online discussion would become hard to control or access. Therefore, I will quit the e-learning teaching. (QI.26.236)

Over one fifth (22%) of respondents remarked the third disadvantage was they would face more technical problems and challenges. One instructor said:

> I do not have much time to manage my academic work. When I have problems of operating technology, I cannot get the instant assistance from student assistant and it will waste my valuable time to try or figure out how to proceed or operate those facilities. Thus, the e-learning course materials and audio-video files could not put online in time. (QI.26.53)

Seven instructors (14%) reported that if they did not have student assistant support of their e-learning teaching, it would increase their teaching load or their own students' workload because they still needed to deal with all e-learning related work. Similarly, seven respondents (14%) also indicated that a disadvantage of no student assistant support was the teaching quality would be decreased because they could not fully provide all functions of e-learning such as online class video, course materials, and discussion. A representative comment was, "If there is no student assistant helping me on e-learning system, some interactive teaching methods such as on-line debate, online discussion, video recording, and VOD would become impossible" (QI.26.159).

A small number (12%) of respondents indicated no student assistant support would decrease their motivation to use e-learning because the student assistant support could save much of their time on all e-learning related chores. Three respondents (6%) reported that if they did not have student assistant support from the university they needed more funding to find another assistant to deal with those e-learning chores for them. A representative comment was:

> I have to pay for the student assistant to support my work so I need to find more funding. Otherwise, I don't think I can manage both e-learning teaching and researches in balance situations. It means, we will usually choose the research quality rather than the extra loading from e-learning. (QI.26.46)

Only five respondents (10%) indicated there was no influence on them because they could do it by themselves although it spent much of their time and effort. Some representative comments were, "I have to do all the related

work. But that's all right for me" (QI.26.48), "It is no influence to me because I just put my lecture notes online" (QI.26.247), and "It will not influence me a lot because I need to do the e-learning course design and assess the students' assignments by myself in order to really understand what the students need and adjust my teaching approaches to improve their learning outcomes" (QI.26.89).

A majority of instructors who completed the questionnaire were professors and came from non-science colleges. A majority of instructors were familiar with university e-learning policy but not national. A majority of instructors were relatively inexperienced with e-learning, had less than three years experience in e-learning and had taught fewer than three e-learning courses. They rated themselves as having a low level of e-learning ability. Data shows instructor age or professional position was not an issue in their ability to use e-learning. However, the fewer years teaching in e-learning the lower level of self-rated e-learning ability they had.

5 Discussion and Conclusion

This paper has described instructor perceptions of the support services they experienced in their e-learning teaching. Instructors reported they have used different dynamics of technology in terms of specific delivery systems such as interactive audio-video, videotapes, digital and video cameras, scanners, CD/ROMs, DVDs, VOD, audiocassettes and even computer videoconferencing, e-mail, live chat, sophisticated use of the Web, television and satellite broadcast in their e-learning teaching. The use of different technologies could result in the removal of time and place constraints so student learning could happen synchronously and or asynchronously. Instructors said these types of equipment helped them in providing the same face-to-face class teaching environment online and in providing more supplementary course materials to improve student learning outcomes and more opportunities to improve the quality of interactions.

However, to utilize these various technologies, the instructors needed technical support from the university. A majority of the questionnaire respondents had had the support of a student assistant and technical support staff from the university and found them helpful for their use of e-learning. They also had had training courses, good course demonstrations, seminars, and extra technology support but it seemed not to be very helpful for enhancing their e-learning practice. Most instructors indicated that a student assistant could help them in the creation and maintenance of e-learning content; solve technological problems and improve their knowledge of technology; save much of their time on all e-learning chores and provide new ideas or brainstorming on e-learning course design; answer or interact with student and manage online discussion; and manage student academic records for them. Some disadvantages of no student assistant support were also identified. These included instructors needing more time to make or update the course materials online; they could not video-record their class teaching and transfer video to e-learning system by themselves and solve all related maintenance work of e-learning course so they would quit e-learning teaching; and would face more technical problems and challenges. In a word, the instructors needed student assistant support in their development of e-learning courses.

Simultaneously, the documents described in Section 2 indicated national policy in Taiwan seeks to promote and guide the introduction of e-learning. This policy, along with that of the university itself, provides the context for administrator, technical support person, and instructor and student experience of e-learning. University e-learning practice has been promoted and guided by national e-learning policy. The university has faced organizational and cultural changes for e-learning practice such as a new e-learning support unit and an increase in technical people in the university, collaborative instruction online with other universities, and a new relationship with the community via e-learning. These changes influenced instructor and student teaching and learning. However, the documents and the findings also indicate changes to national policy impacted significantly on the university and when the university redefined its goals to emphasize research and changed its tenure system so, too, instructors focused more attention on research because of its links to promotion. A majority of instructors noted the lack of a well-defined university e-learning policy and goals had influenced instructor adoption of e-learning. The recommendation was for a well-documented e-learning policy and strategy to encourage instructor and student use of e-learning. Other research studies (e.g., [24] [25]) have also indicated that without a knowledgeable and supportive leader, a shared vision for e-learning, and an explicated strategic plan, implementation programs can meet with difficulty.

In this study, the lack of consistency in support for e-learning as evidenced by the provision and withdrawal of student assistant support also inhibited the adoption of e-learning. Ongoing administrative and technical support and recognition of instructor effort are important factors to encourage the use e-learning (see also [19] [27]). In sum, a majority of instructors employed by the university perceived effective leadership, well-defined e-learning goals and policy, administrative or technical support, university organization and culture, reputation and financial issues are important political factors as a whole to entice instructors to use e-learning. University administrators interested in solving the issue of the under-use of e-learning would be wise to recognize the support services instructors needed and to provide the necessary practical support to entice instructors to use e-learning if they wish to promote the use of e-learning as a part of the blended delivery of courses.

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Building Decision Trees and Classification Rules form Educational Data

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Abstract— **The paper presents two state-of-the-art techniques of analyzing data. The employed techniques are decision trees and classification rules. The analyzed data is represented by user traffic gathered from an e-Learning platform. User traffic data is represented by actions performed by platform's users. In our analysis we are interested only in student's performed actions. The analysis process creates a decision tree from collected data and than derives the classification rules on the same dataset. We investigate the accuracy and interestingness of the two models.**

Keywords-eLearning; decision support system; software architecture

I. INTRODUCTION

The e-Learning platform represents a collaborative environment in which all users (secretaries, professors, students and administrators) accomplish their duties. The administrator, with the help of secretaries and professors are responsible for managing the environment in which the students will be through-out the e-Learning process.

The platform has built in capability of monitoring and recording user's activity. The activity represents valuable data since it is the raw data for our machine learning and modeling process. User's sequence of sessions makes up his activity. A session starts when the student logs in and finishes when the student logs out. Under these circumstances, a sequence of actions makes up a session.

There is a wide range of machine learning data representations that may be used but from all of them we choose decision trees and classification rules.

We think that these representations and especially decision trees can give relevant results regarding the "goodness" of data. Decision trees are quite simple structures but with great relevance regarding the quality of data. Classification rules are a popular alternative to decision trees [1].

The final goal is characterizing of students on one hand and the platform on the hand. Student's characterization may have a predictive value in the sense that from the activities a student has made there may be pulled conclusions about his learning proficiency. On the other hand, platform's characterization may have as result an estimation of the capability of an e-learning system to grade and order students according to their accumulated knowledge. This analysis is critical for having as conclusion that a system can support generalized tests.

II. DESCRIPTION OF THE E-LEARNING PLATFORM

The main goal of the application is to give students the possibility to download course materials, take tests or sustain final examinations and communicate with all involved parties. To accomplish this, four different roles were defined for the platform: sysadmin, secretary, professor and student. The relationship between roles is presented in figure 1.

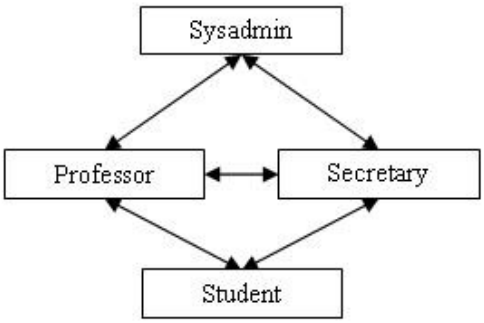

Figure 1.Relationship between roles.

The main task of sysadmin users is to manage secretaries. A sysadmin user may add or delete secretaries, or change their password. He may also view the actions performed by all other users of the platform. All actions performed by users are logged. In this way the sysadmin may check the activity that takes place on the application. The logging facility has some benefits. An audit may be performed for the application with the logs as witness. Security breaches may also be discovered.

A sysadmin may post an instant message to any user and can view users that are active. For each of them, the sysadmin may obtain the list of executed actions.

A statistics page is also available. It presents the number of users that entered the application, the total number of students, and the number of students with and without activity and other information that gives an overall view on the activity on the application.

Secretary users manage sections, professors, disciplines and students. On any of these a secretary may perform actions like add, delete or update. These actions will finally set up the

application such that professors and students may use it. As conclusion, the secretary manages a list of sections, a list of professors and a list of students. Each discipline is assigned to a section and has as attributes a name, a short name, the year of study and semester when it is studied and the list of professors that teach the discipline which may be maximum three. A student may be enrolled to one or more sections.

The secretaries have also the task to set up the structure of study years for all sections. The structure of a study year is made of a list of periods. All periods that define the study year are disjunctive in time and are characterized by a name, start date and end date. For each period there are also set up the exams that may be taken and the grants that are needed. For example, in winter examining session there may be taken only exams from the first semester and there is no need for grant from either professor or secretary. This way of defining what the student can do and when proved to be very flexible and easy to understand and use.

The secretaries have the possibility of searching students using different criteria like name, section, year of study or residence. The secretaries have a large set of available reports regarding the student's status. Among them there is a list of students who took all exams, a list of students who requested grant for taking an exam one more time and many other reports specific to secretary work.

The main task of a professor is to manage the assigned disciplines while s discipline is made up of chapters. The professor sets up chapters by specifying the name and the course document. Only students enrolled in a section in which a discipline is studied may download the course document and take tests or examinations. Besides setting up the course document for each chapter, the professor manages test and exam questions. For each chapter the professor has to define two pools of questions, one used for testing and one used for exams. He specifies the number of questions that will be randomly extracted to create a test or an exam. Let us suppose that for a chapter the professor created 50 test questions and 60 exam questions and he has set to 5 the number of test questions and to 10 the number of exam questions that are to be randomly withdrawn. It means that when a student takes a test from this chapter 5 questions from the pool of test question are randomly withdrawn. When the student takes the final examination at the discipline from which the chapter is part, 15 questions are randomly withdrawn: 5 from the pool of test question and 10 from the pool of exam question. This manner of creating tests and exams is intended to be flexible enough for the professor.

All tests and exams are taken under time constraints. For each chapter the professor sets up a number of seconds necessary to answer questions that chapter. When a test or exam is taken all the seconds are summed thus obtaining a maximal interval of time in which the student has to finish the test. The elapsed and remaining time are managed on server side and presented to the student after each answered question.

The professor has also enough flexibility for creating and editing questions. A question may contain pictures, thus equations, formulas or other graphics may be imbedded into it. For each question the professor sets up the visible answers and the correct answers. For example, if a question has four possible answers he will have to check the checkboxes called A, B, C and D stating that the student will have four choices. Error checking is enforced such that when a question has three visible answers and the correct answer is D an error is shown to professor and the question can not be saved.

There are two formulas that are implemented and may be used for calculating grades. For each discipline the professor chooses and sets any of the formulas such that it will be used for all tests and exams taken at that discipline.

Professors have also the possibility of searching students using different criteria and a large set of available reports that help them in working with students.

Tesys application offers students the possibility to download course materials, take tests and exams and communicate with other involved parties like professors and secretaries.

Students may download only course materials for the disciplines that belong to sections where they are enrolled. They can take tests and exams with constraints that were set up by the secretary through the year structure facility.

Students have access to personal data and can modify it as needed. A feedback form is also available. It is composed of questions that check aspects regarding the usability, efficiency and productivity of the application with respect to the student's needs.

All users must authenticate through username and password. If the username and password are valid the role of the user is determined and the appropriate interface is presented. The platform assigns a set of actions that the user may perform. Each time a user initiates an action the system checks if that action allowed. This approach ensures security at user's level and makes sure that a student may not perform actions that are assigned to professor, secretary or sysadmin users.

A history of sustained tests is kept for all students. In fact, the taken test or exam is fully saved for later use. That is why a student or a professor may view a taken test or exam as needed. For each question it is presented what the student has checked, which was the correct answer, which was the maximum points that could be obtained from that question and which was the number of obtained points. At the end it is presented the final formula used to compute the grade and the grade itself.

Besides these core functions for on-line testing other ones are implemented or currently under development. A message board is implemented for professors, secretaries and students to ensure peer-to-peer communication. This facility is implemented within the platform such that no other service (e.g. email server) is needed.

In order to enforce the year structure facility that is set up by secretary a grant/revoke system is implemented for students, secretaries and professors. A student may request to professor and secretary a grant to take an exam. This situation occurs when the student fails the exam or wants to increase the grade and taking the examination for a second time is preconditioned by other actions like taking more tests, paying fees, etc. If a

professor and/or a secretary revoke an exam the student cannot sustain that exam until the requirements of the professor and/or the secretary are fulfilled.

The logging facility that is mainly used by sysadmin is transparently implemented for all users (secretaries, professors and students). Whenever one of them performs an action (e.g. a student starts or finishes an exam) that action is recorded for later use.

III. Methods of Recording User Traffic

User's activity is monitored and recoded through dedicated modules implemented within the platform. This facility was taken into consideration since the design phase of the platform. In was one of the requirements that the platform to be able to record user's action with fine granularity.

From the design phase of the platform, there were adopted two methodologies for monitoring actions. Since the business logic of the platform is Java based, log4j utility package was employed as a logging facility and is called whenever needed within the logic of the application. The utility package is easy to use; log4j.properties properties file manages the logging process. The setup process states the logs are saved in idd.log file. The main drawback of this technique is that the data from the file is in a semi-structured form. This makes the information retrieval to be not so easy task to accomplish. On the advantages, logging activity may be very helpful in auditing the platform or even finding security breaches. This logging facility is also very helpful when debugging during development or when analyzing peculiar behavior during deployment.

To overcome the semi-structured shape of logged activity a structured way of gathering activity information was enforced. The activity table was added in the database and all actions were recorded in the manner of one record per action. In the table 1 it is presented the structure of activity table.

TABLE I. Structure of Activity Table

Field	Description
id	primary key
userId	identifies the user who performed the action
date	stores the date when the action was performed
action	stores a tag that identifies the action
details	stores details about performed action
level	specifies the importance of the action

In Table 1 the action field is represented by a tag. The detailed explanation of what the tag means is set in a properties file. For each language a separate properties file is created, each file containing the same tags but with description in a different language.

The details field stores specific information regarding the action that was executed. For example, if a secretary modifies the profile of a student in the details field there will be stored information about what fields were updated.

The level field specifies the importance of the executed action. There are defined three level of importance: 0, 1 and 2 where level 0 specifies the critical actions.

After five months of deployment, the activity table contains more than 50,000 records and we suppose that until the end of the learning cycle there will be close to 100,000 records. All this logged activity may also be very helpful in an audit process of the platform. The records from the activity table represent the raw data of our analyzing process.

IV. Methods of Analysis

The main purpose of the analysis process is to obtain a classifier with great accuracy. This makes sure that obtained knowledge is sound and may be used for improving the performance of the e-Learning platform. Performance is seen from two perspectives. One regards the learning proficiency of students and the other the capability of the platform to classify students.

The analysis process uses activity data and employs different techniques to build classifiers. Estimating each classifier's accuracy is important in that it allows the evaluation of how accurately the classifier will label future data, that is, data on which the classifier has not been trained. In our analysis process the employed structures are decision trees like C4.5 [4] and classification rules.

Choosing between two learning algorithms given a single dataset is not a trivial task [5]. From all these representations we think decision trees are a very good start in the process of data analysis. Decision trees, as structures, may give a very conclusive idea regarding the "goodness" of data we try to analyze. Starting an analyzing process with shaping the data in the form of decision trees gives a very good idea whether or not the data that we have may lead to conclusive or important results. Still, the whole process is much more than choosing an algorithm. Many learning schemes have various parameters, and suitable values must be chosen for these. In most cases, results can be improved markedly by a suitable choice of parameter values, and the appropriate choice depends on the data at hand. For example, decision trees can be pruned or unpruned and, in the former case, a pruning parameter may have to be chosen. More generally, the learning scheme itself will have to be chosen from a range of available schemes. In all cases, the right choices depend on the data itself [1].

The basic algorithm for decision tree induction is a greedy algorithm that constructs decision trees in a top-down recursive divide-and-conquer manner. The basic strategy is as follows. The tree starts as a single node representing the training samples. If the samples are all of the same class, then the node becomes a leaf and is labeled with that class. Otherwise, an entropy-based measure known as information gain is used for selecting the attribute that will best separate the samples into individual classes. This attribute becomes the "test" or "decision" attribute at the node. A branch is created for each known value of the test attribute, and the samples are partitioned accordingly. The algorithm uses the same process

recursively to form the decision tree. Once an attribute has occurred at a node, it need not be considered in any of the node's descendents. The recursive partitioning stops only when one of the following conditions are true. All samples for a given node belong to the same class. There are no remaining attributes on which the samples may be further partitioned. This involves converting the given node into a leaf and labeling it with the class in majority among samples [2].

For this stage, the outcome is a set of attributes that are most relevant for class characterization. Irrelevant attributes pose a significant problem for most machine learning problems [6, 7]. From entire set of attributes there should be identified irrelevant or weakly relevant ones and excluded from the concept description process. The incorporation of this preprocessing step into class characterization or comparison is referred to as analytical characterization or analytical comparison. The first limitation of class characterization is the handling of complex objects. The second limitation is the lack of an automated generalization process: the user must explicitly tell the system which attributes should be included in class characterization and to how high a level each attribute should be generalized. Actually, each step of generalization or specialization on any attribute must be specified by user [2].

Impurity measures are another important parameters regarding the quality of the decision tree. Many different measures of impurity have been studied. Some algorithms measure "impurity" instead of "goodness" the difference being that goodness should be maximized while impurity should be minimized [8, 9, and 10].

Consequently the data must be preprocessed to select a subset of attributes to use in learning. Learning schemes themselves try to select attributes appropriately and ignore irrelevant and redundant ones, but in practice their performance can frequently be improved by preselection. For example, experiments show that adding useless attributes causes the performance of learning schemes such as decision trees an rules, linear regression, instance-based learners, and clustering methods to deteriorate [1].

In the tree building stage, the most important step is the selection of the test attribute. Information gain measure is used to select the test attribute at each node in the tree. Such a measure is referred to as an attribute selection measure or a measure of the goodness of split. The attribute with the highest information gain (or greatest entropy reduction) is chosen as test attribute for the current node. This attribute minimizes the information need to classify the samples in the resulting partitions and reflects the least randomness or "impurity" in these partitions.

The knowledge represented in decision trees can be extracted and represented in the form of classification rules. One rule is created for each path from root to a leaf node. Each attribute-pair along a given path forms a conjunction in the rule antecedent. The leaf node holds the class prediction, forming the rule consequent. The IF-THEN rules may be easier for humans to understand, particularly if the tree is very large [2].

The main difference between decision trees and classification rules is that rules can be symmetric whereas trees must select one attribute to split on first, and this can lead to trees that are much larger than the equivalent set of rules [1].

The antecedent or precondition of a rule is a series of tests just like the tests at nodes in decision trees, while the consequent or conclusion, and gives the class or classes that apply to instances covered by that rule. Generally, the preconditions are ANDed together, and all the tests must succeed if the rule is to fire. However, in some rule formulations the preconditions are general logical expressions rather than simple conjunctions. It is easy to read a set of rules directly off a decision tree. One rule is generated for each leaf. The antecedent of the rule includes a condition for every node on the path from the root to that leaf, and the consequent of the rule is the class assigned by the leaf. This procedure produces rules that are unambiguous in that the order in which they are executed is irrelevant. However, in general rules that are read directly off a decision tree are far more complex than necessary, and rules derived from trees are usually pruned to remove redundant tests. Because decision trees cannot easily express the disjunction implied between the different rules in a set, transforming a general set of rules into a tree is not quite straightforward. When we have the same structure but different attributes it is necessary to break the symmetry and choose a single test for the root node. This is known as the replicated subtree problem [1].

One reason why rules are more popular is that each rule seems to represent an independent "nugget" of knowledge. New rules can be added to an existing rule set without disturbing those already there, whereas to add a tree structure may require reshaping the whole tree. However, this independence is something of an illusion, for it ignores the question of how the rule set is executed. If rules are meant to be interpreted in order as a "decision list", some of them, taken individually and out of the context, may be incorrect. On the other hand, if the order of interpretation is supposed to be immaterial, then it is not clear what to do when different rules lead to different conclusions for the same instance. This situation cannot arise for rules that are read directly from a decision tree, for the redundancy included in the structure of the rules prevents any ambiguity in interpretation, but it does arise when rules are generated in other ways.

If a rule set gives multiple classifications for a particular example, one solution is to give no conclusion at all. Another is to count how often each rule fires on the training data and go with the most popular one. These strategies can lead to radically different results. A different problem occurs when an instance is encountered that the rules fail to classify at all. Again, this cannot occur with decision trees, or with rules read directly off them, but it can easily happen with general rule sets. One way of dealing with this situation is to fail to classify such an example; another is to choose the most frequently occurring class as a default. Again, radically different results may be obtained by these strategies. Individual rules are simple, and sets of rules seem deceptively simple – but given just a set of rules with no additional information, it is not clear how the rules should be interpreted.

The problem with rule-generation schemes is that they tend to overfit the training data and do not generalize well to

independent test sets, particularly on noisy data. In order to be able to generate good rule sets for noisy data, it is necessary to have some way of measuring the worth, or significance, of individual rules. The measure based on binomial distribution was introduces in a system called Induct [12], a development of Prism [11]. To avoid the risk of overfitting to the training set, one option is to withhold some of the training examples as a test set and measure the performance of the rule on that. This idea is known as reduced-error pruning [13] and it forms the basis for fast and effective rule induction [14].

V. Experimental Results

Activity data obtained while running the platform represents raw data. The analysis process is conducted by running algorithms implemented in Weka workbench [3]. This workbench accepts data that has a specific format called arff. That is why we developed an of-line application that gets data from the platform's database and creates a file called activity.arff. This file is used as input in our analyzing process.

The activity.arff file has a standard format which is composed of two sections. In the first one there is defined the name of the relation and the attributes. For each attribute there is defined the set of nominal values it may have. The second section of the activity.arff file is represented by the data itself. In this section there are all instances that will enter the analysis process, each row represents an instance.

For a student in our platform we may have a very large number of attributes. Still, in our procedure we used only three: the number of loggings, the number of taken tests and the number of sent messages. In figure 2 is presented a sample of the arff file.

```
@relation activity
@attribute nLogings {<10,<50,<70,<100,>100}
@attribute nTests {<10,<20,<30,<50,>50}
@attribute avgTests {<3,<6,<10}
@attribute nSentMsgs {<10,<20,<30,<50,>50}

@data
<50,<20,<3,<10,
<50,>50,<6,<20,
<10,<20,<3,<10,
<50,<10,<3,<10,
<100,<50,<10,<50,
```

Fig. 2 Sample arff file

The activity.arff has 375 instances, each one corresponding to a student and each instance has four attributes: the number of logins, the number of taken tests, the average grade for taken tests and the number of messages sent to professors. After running the algorithm the obtained tree had 17 leaves (which represent in fact classes) and 25 nodes. The time to build the model was 0.13 seconds.

After running the Prism algorithm [11] there were created 54 classification rules in 0.05 seconds. Among the most interesting rules is: If (noOfLogins = <70 and noOfTests = <50 and avgOfTests = <6) then (noOfMessages<30). The most challenging part is to prune the decision tree and to employ an accuracy formula that guarantees that the most interesting rules are obtained.

Still, the most important part is the data evaluation. This analysis ensures that the model is valid and provides solid knowledge. The stratified cross-validation evaluation technique revealed that 321 (85.6 %) instances were correctly classified and 54 (14.4%) were incorrectly classified. The confusion matrix showed exactly which the distribution of incorrectly classified instances among classes is.

VI. Conclusions and Future Works

We have designed and implemented the e-Learning platform. The design of the platform is based on MVC model that ensures the independence between the model (represented by MySQL database), the controller (represented by the business logic of the platform implemented in Java) and the view. The platform is currently deployed and used by 400 students and 15 professors.

The platform has an embedded that monitors and records all user's activity. Data obtained in this manner represents the raw material for our analysis.

All data is preprocessed by an off-line application that transforms it into a structured format, called arff. Once we have obtained the arff file we may start the analysis.

There are many machine learning algorithms that may be used to analyze student's activity. In this paper we focused on techniques that may be applied in order to obtain knowledge regarding user behavior. We used state-of-the-art methods of analysis like decision trees and classification rules. We also analyzed the way classification rules may be obtained from decision rules.

We defined a set of four attributes and run the decision tree creation algorithm. We assumed this as the baseline study. We have also run the algorithm creating the classification rules on the same data. In our study we took into consideration only four attributes. We think interesting results may be obtained if other attributes relevant for learning process are added.

The obtained accuracy guarantees that obtained knowledge from the analysis process is valid and may be used together with domain knowledge to improve the performance of the e-Learning platform. Having this as start point, different machine leaning algorithm and models may be used with the final goal of classifying students.

We plan using the same procedure on same platform (same disciplines and same test and exam questions) but on different generation of students.

The procedure may be also accomplished for data obtained from different e-Learning systems that means using our analysis process but with data from other developed platforms.

From a different perspective, platform characterization is another goal that may be achieved through this kind of analysis. Platform's characterization may have as result an estimation of the capability of an e-learning system to grade

and order students according to their accumulated knowledge. This analysis is critical for having as conclusion that a system can support generalized tests.

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Applying Augmented Reality to E-Learning for Foreign Language Study and its Evaluation

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Abstract - *Various studies have been undertaken to adapt Augmented Reality (AR) technology for use in education. We see AR as being suitable for creating an enjoyable learning experience (edutainment) for students. In this study, we developed an AR application based on the same content as conventional printed teaching material focusing on the field of foreign language study. The learning efficacy of the two media was assessed by comparing verification test results and monitoring brain activity during the learning process. The results show that there is no significant difference in test results between the two media. However, we found that the subjects' brains were more active while studying the printed teaching materials than the AR teaching materials. We believe this shows that the proposed method of study is overall a more natural one and, when compared with traditional methods of study, has the potential to be less stressful for students.*

Keywords: Augmented reality (AR), E-Learning, Edutainment, Brain Activity, NIRStation

1 Introduction

1.1 Background

Augmented reality, commonly referred to as AR, has garnered significant attention in recent years. This terminology has been used to describe the technology behind the expansion or intensification of the real world. To "augment reality" is to "intensify" or "expand" reality itself [1]. Specifically, AR is the ability to superimpose digital media on the real world through the screen of a device such as a personal computer or a smart phone, to create and show us a world full of information that we could never have been able to conceptualize until now.

There are various types of AR, generally divided into the following broad categories [2]. First, there is the marker type—using a camera connected to a device, and once a "marker" comes into view, the digital image data are superimposed onto the display. In contrast to this, there is the marker-less type—the subject of the image taken from the camera itself has its particular shapes and colors analyzed and the digital image data are superimposed based on these shapes and colors. Both kinds of AR use what is called, image recognition technology. Moreover, location information AR, utilizes a GPS and other sensors installed on smart phones to gather location data and superimpose digital information relating to that particular location. This variation in AR technology is commonly known through the popular Japanese smart phone application, Sekai Camera [2]. Sekai Camera enables users to view the scenery, superimpose information about the subject of the scenery (such as information about a store) onto the image using the "Air Tag" feature, and upload it for other users to view.

Using AR technology, we are able to bring concepts that have only existed in fantastical worlds, such as those in Manga and Anime, to the real world; the ability to enrich our world further with, "interesting," and "fun" aspects excites us. As Kobayashi [3] noted, "There is no reason that media such as television and movies, as well as Manga and video games, cannot be used for just entertainment. Of course, the enjoyment gained from these media is the fundamental component; that component can be taken to create an 'enjoyable learning experience,' in other words, 'Edutainment' [4]. With that in mind, even as a new medium, AR is suited for this as well." We also believe in the promotion of the concept of creating an enjoyable learning experience for students utilizing AR technology and used this as the basis of our research.

1.2 Previous Research

Various studies have been undertaken to adapt AR technology for use in education.

In Chang's study [5], the authors used AR technology to implement an AR learning system for learning English vocabulary. The results of this study show that system quality is a critical factor affecting perceived satisfaction, perceived usefulness, and AR learning effectiveness.

You [6] demonstrated a new e-learning/e-business experience using mobile AR. This system employs advanced image processing and search technologies that allow users to capture designated images such as product advertisements and quickly match them to the vendor's database to obtain detailed product information associated with the images. The same is possible in an e-learning environment.

Kondo's research [7] showed that AR is advantageous in expanding the functionalities of the traditional education textbook. This was demonstrated with educational material developed to explain the structure of the human brain using 3DCG (computer generated 3D technology) and sound technology. In addition, educational material was developed to help students learn about mathematical shapes, and this was

used in high school classes, followed by a questionnaire to measure the success of the experiment. According to the results of the questionnaire, 70% of the students were of the opinion that the AR teaching material was helpful in understanding the subject matter.

In the research by Teshima et al. [8], the team developed their own teaching materials using 3DCG and AR technologies for use in children's geography classes and provided proof that these were successful in enhancing the learning experience for the students. As a result of the AR teaching experience, students achieved higher scores in naming regions and identifying their locations. From these results, Teshima et al. showed that AR technology is an important element in geography education, particularly for the recall of geographical names and locations by students.

However, to date, there have been no studies showing for which subjects AR-based learning aids are specifically effective, or whether AR is even a valid learning aid for any subject, thus leaving this open to discussion.

1.3 Aim of Study

The aim of this study is to assess whether AR teaching materials are useful in learning foreign languages. For this experiment, we developed an AR application for learning purposes using the same content as selected conventional print media teaching material. The learning efficacy of the two media was assessed by comparing verification test results and monitoring brain activity during the learning process. Based on the results, this study not only shows the suitability of having AR-enabled teaching materials in a foreign language learning environment, but it also considers the benefits of using this technology across other fields of study.

1.4 Structure of the Paper

Section 1 provides background information, previous research related to the subject matter, current issues, and the purpose of this study. Section 2 introduces the development environment, the materials used for AR development and the verification tests based on the content of the foreign language teaching materials. Section 3 introduces the two experiments based on the teaching materials developed in the previous section. Section 4 presents the results of the experiments carried out and provides an analysis thereof. Section 5 discusses the future potential of AR technology as a teaching aid based on the results. Section 6 provides a summary of the paper.

2 Creation of Teaching Materials

2.1 Development Environment

2.1.1 ARToolKit

ARToolKit is a C/C++ Library Package used to implement AR applications using AR marker technology. The example application shown in Fig. 1 overlays a 3DCG image on top of a marker detected by the Web camera. The marker and the 3DCG images can be developed by the user.

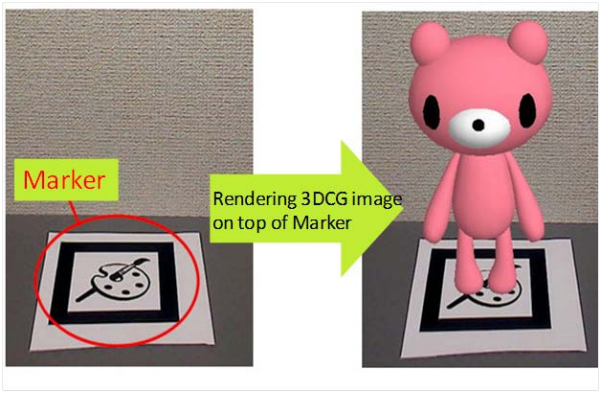


Fig. 1 Example of an application created using the ARToolKit

In this study, the ARToolKit was used to create the teaching material application. Table 1 gives details of the application environment.

Table 1 Application environment used in this research

NoteBook PC		WEB Camera	
Product	Fujitsu FMV-E8290	Product	Logicool 2.0-MP Webcam C600
CPU	Intel(R) Core(TM)2 Duo CPU P8700(2.53GHz)	Capture capability	2 Mega pixels (Max1600×1200)
Memory	2GByte	Frame rate	Maximum 30fps
OS	Windows 7 Professional		

2.1.2 Metasequoia

Metasequoia is 3D Object Modeling software that can be used to edit 3D objects. For this study, we created two scenarios for use as teaching material using the freeware version of Metasequoia (Figs. 2 and 3).

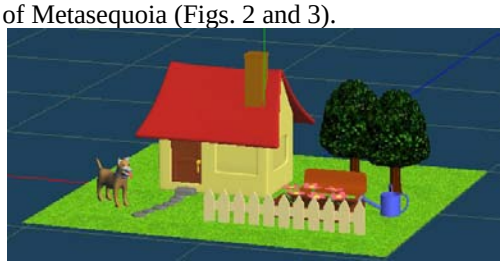


Fig. 2 Teaching Material 3DCG（A）

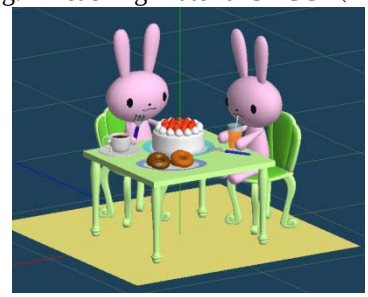


Fig. 3 Teaching Material 3DCG（B）

2.2 Application of Augmented Reality

In this study, teaching material applications for the study of foreign languages were developed using AR technology. The

teaching materials were picture-based, but instead of using illustrations, 3DCG images were projected with the expectation that this would have a significant impact on the student's overall learning experience.

2.3 Deciding which Foreign Language to use

For this study, Indonesian was chosen as the foreign language, because for the best results in the experiment, it was necessary that the subjects were taught a foreign language in which they had had no prior tuition. In addition, non-alphabet languages such as Chinese and Greek were excluded, since it was felt that the difficulty of learning a different character set would interfere with the assessment of the teaching materials. Having taken the above factors into consideration, we decided that Indonesian was the most suitable foreign language for the purposes of this study.

2.4 Development of Teaching Materials

In this study, an adaption of AR for use in learning a foreign language (hereafter referred to as AR Material) and conventional print media (hereafter referred to as Printed Material) were created for comparing the learning efficacies of the two different media. In addition, since each subject would see both the AR and Printed Materials, two sets of teaching materials (A and B) were created in each media to avoid any overlap in content.

In the AR Material, a Web camera was connected to a notebook PC and the 3DCG image of the teaching material was overlaid onto the marker (Fig. 4) with the vocabulary boxes containing both the Japanese and Indonesian words. The execution process is shown in Fig. 5.

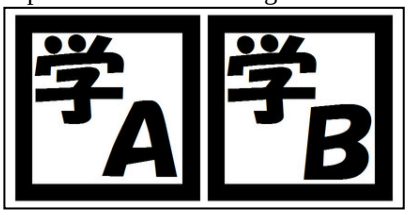


Fig. 4 Markers used in the AR teaching material application (Left: marker A, Right: marker B)

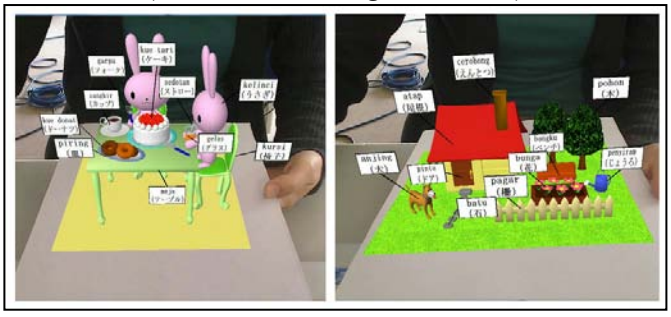


Fig. 5 Execution process of the AR teaching material (Left: teaching scenario A, Right: teaching scenario B)

For the Printed Material, the 3DCG images used in the AR Materials were rendered and printed; the vocabulary boxes were used in the same way as in the AR Material.

2.5 Verification Test

For the experiment, a verification test was created based on the materials introduced in Section 2.4. Questions are presented in Japanese; the subject then selects the Indonesian word from a group of words on the question paper and writes the answer in the corresponding answer field.

3 Experiments

3.1 Experiment 1 - Verification of the Efficacy using the Confirmation Test

3.1.1 Aim

The efficacy of the AR Teaching Materials was assessed using the results of the verification test following the study phase of this experiment. In addition, questionnaires seeking the thoughts and opinions of the subjects on their experiences in the experiment were also used in the evaluation.

3.1.2 Subjects

Thirty students from the Tokyo University of Science, Suwa, and Nihon University participated as subjects in this experiment.

3.1.3 Materials

- Four sets of teaching materials (AR Materials A and B, and Printed Materials A and B)
- Web camera with a notebook PC
- Two different verification tests (Tests A and B)
- Questionnaire
- Clock for measuring time
- Stationery for writing

3.1.4 Method

For each set of teaching material, a 2-min period was given in which to study the materials and another 2-min period was given to complete the subsequent verification test. However, a further 30-s initial allowance was given for the subjects to familiarize themselves with the AR Material. During this time, the words were not displayed in the vocabulary boxes. Furthermore, in order to prevent any bias in the implementation data, the teaching material for each subject included a set of rules, which the subject had to follow during the study phase. After completing both verification tests, the subject then completed the questionnaire.

3.1.5 Process

The experiment was carried out using the process described below.

First, the Web camera was connected to the notebook PC and the AR application started. This was done to ensure that the teaching materials were instantly accessible by the subject. The subjects were called one by one and asked to carry out the activities detailed in Section 3.1.4 in the order given below.

For the AR Teaching Materials

1. Summary and explanation of the teaching materials to the subject.
2. The examiner gives the marker to the subject.
3. Practice session with the AR application for 30 s.
4. Study phase with the AR application for 2 min.
5. Terminate the AR application and return the marker to the examiner.
6. Subject completes the verification test within a 2-min period.
7. Subject returns the verification test paper and writing implements.

For Printed Teaching Materials

1. Summary and explanation of the teaching materials to the subject.
2. The examiner hands over the teaching materials. Study phase with the Printed Material for 2 min.
3. The teaching materials are returned to the examiner.
4. Subject carries out the verification test within a 2 min period.
5. Subject returns the verification test paper and writing implements.

3.2 Experiment 2 – Monitoring Brain Activity during the Study Phase

3.2.1 Aim

The efficacy of each set of teaching material was assessed by monitoring the brain activity of the subject during the study phase of this experiment. The aim was to determine whether there was any significant difference in the subject's brain activity during the study phase with each set of teaching material.

3.2.2 Subjects

Ten students from the Tokyo University of Science, Suwa, participated as subjects in this experiment.

3.2.3 Materials

・Four sets of teaching materials (AR Applications A and B and Printed Materials A and B)

・Web camera connected to a notebook PC

・Brain activity monitoring device (NIRStation: multi-channel near-infrared (NIR) spectroscopic brainwave measuring device)

Details about the NIRStation:

NIR light passes through fiber-optic sensors placed on the scalp, allowing the device to display fluctuations in the blood flow through the cerebrum on the monitor (Fig. 6). In active regions of the brain, there is an increased rate of blood flow (hereafter referred to as hemoglobin levels (oxy-Hb). Approximately 25-30 mm below the scalp, NIR wavelengths disperse and are absorbed repeatedly until they weaken and return to the scalp. During the monitoring period, the rate of change in blood flow can be calculated using the detected absorption rate of oxy-Hb and optical path length (Fig. 7). The subject wears a headset with NIR-detecting plots attached to it during the monitoring process (Fig. 8).

Fig. 6 NIRStation (source: Shimadzu Corporation home page)

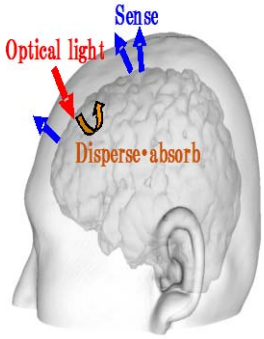


Fig. 7 NIRStation measurement method

Fig. 8 Monitoring a subject

3.2.4 Method

Subjects were given 2 min to study each set of teaching material, during which time their brain activity was monitored. They were given a 10-s rest period before and after each study session and were instructed not to say or think about anything so as to completely rest their brains. This was done in order to derive the difference in brain activity between the rest period and study session and further to avoid any bias in the data. Each subject rigidly followed the procedure set out for them. As the aim of the experiment was to measure the subject's brain activity during each study session, the verification test results were not taken into consideration for this experiment. However, as this could have affected the subjects' attitude toward the study session and, therefore, the results of the experiment, this was not disclosed to the subjects.

3.2.5 Process

The experiment was carried out using the process described below.

First, the Web camera was connected to the notebook PC and the AR application started. The brain activity monitoring device was also prepared so that subjects could be tested in a timely manner. The subjects were called one by one and were asked to carry out the activities in the given order.

For AR Teaching Materials

1. Summary and explanation of the teaching materials and method to the subject and an explanation of the monitoring device.
2. The headset is placed on the subject's head and its functionality tested.
3. The marker is given to the subject and the monitoring period begins.
4. The AR teaching material application is started.
5. Ten-second rest period → 2 min study period →10 s rest period
6. The monitoring period ends, the AR application is terminated, and the marker is returned to the examiner.

For Printed Teaching Materials

1. Same as for AR Material.
2. Same as for AR Material.
3. The Printed Materials are given to the subject and the monitoring process begins.
4. Ten-second rest period → 2 min study period →10 s rest period
5. The monitoring period ends and the teaching materials are returned to the examiner.

The experiment ends once all activities have been carried out twice and the helmet has been returned to the examiner.

4 Results and Analysis

4.1 Results and Analysis of Experiment 1

First, a t-test was carried out to ascertain whether there was a significant difference between the verification test results for each set of teaching material.

Table 2 T-test results based on the verification test

	AR	Printed Material
Mean	6.533	6.567
Variance	5.361	3.840
Observations	30.000	30.000
Correlation coefficient	0.357	
Hypothesized mean difference	0.000	
df	29.000	
t	−0.075	
P(T<=t) one-tail	0.470	
t Critical One-tail	1.699	
P(T<=t) Two-tail	0.941	
t Critical Two-tail	2.045	

As shown in Table 2, the calculated P value is above the critical threshold of 0.05, showing that no significant difference exists between the efficacies of the different teaching materials.

Next, the results of the questionnaire following the use of the teaching materials were aggregated into five focus areas. The averages for each area were compared in a radar chart.

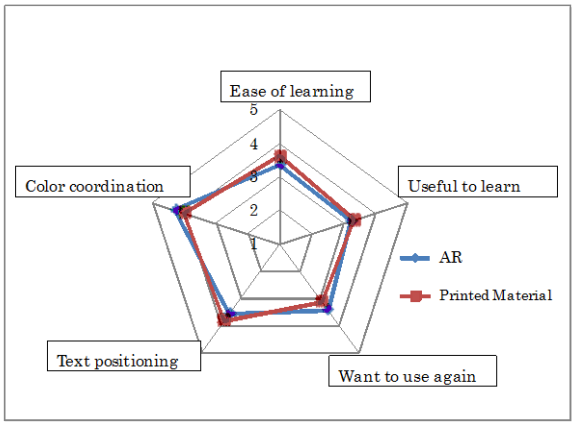


Fig. 9 The mean value for each area

It can be understood from Fig. 9 that the AR Teaching Materials and the Printed Teaching Materials generally have similar results. Because of this, a t-test was carried out to ascertain any differences within the areas; the only significant difference observed was the difference in "Ease of Learning" between the two sets of teaching materials.

A P value below the critical threshold of 0.05 was obtained, showing that subjects found it easier to learn from the Printed Materials than from the AR Materials.

In addition, the subjects were asked to give their opinions as to the positive and negative points of each set of teaching material. Common opinions were summarized and the number of people giving that opinion was recorded.

Table 3 Positive and negative points of the two sets of teaching materials

	Positive Comments	Subjects	Negative Comments	Subjects
Printed Material	Just like I have always studied	13	Boring	3
	Easy to see	4	Hard to memorize word	3
	Illustration is easy to understand	3	Feel that something is missing	2
	Many way to use	2		
AR	Flesh stimulus	9	Vocabulary is hard to see	9
	Visualized in 3D	7	Hard to concentrate to learn	5
	Easy to memorize word	4	Operation is little bit hard	2
	It is fun and interesting	3	Tired eyes	2
	Rabbit is cute	3		
	Feel future possibility	3		
	Easy to cope with	2		

(Note: Only opinions shared by two or more people are listed.)

As seen in Table 3, the most prevalent positive point about the Printed Material was that it was, "Just like I have always studied," with almost half the subjects agreeing. This opinion was drawn from the fact that the subjects were familiar with

studying using printed media prior to this experiment and therefore found it easier to use. Based on this observation, it is clear why the subjects rated the Printed Teaching Material higher in the "Ease of learning" category; the subjects had no prior experience with the AR Teaching Material and were so accustomed to the use of print media that this strongly influenced how they felt.

To summarize the comparative opinions of other subjects, many shared the opinion that the AR Teaching Material was a "fresh stimulus," and that the major positive difference was that it was "visualized in 3D." As for the negative points, the subjects commented that the "vocabulary is hard to see [in the vocabulary boxes]," and also that "it was hard to study."

4.2 Results and Analysis of Experiment 2

To ascertain the differences in the subject's brain activity when studying the different sets of teaching materials (AR and Printed), the rate of oxygenation (Hemoglobin/oxy-Hb) in the subject's brain was monitored.

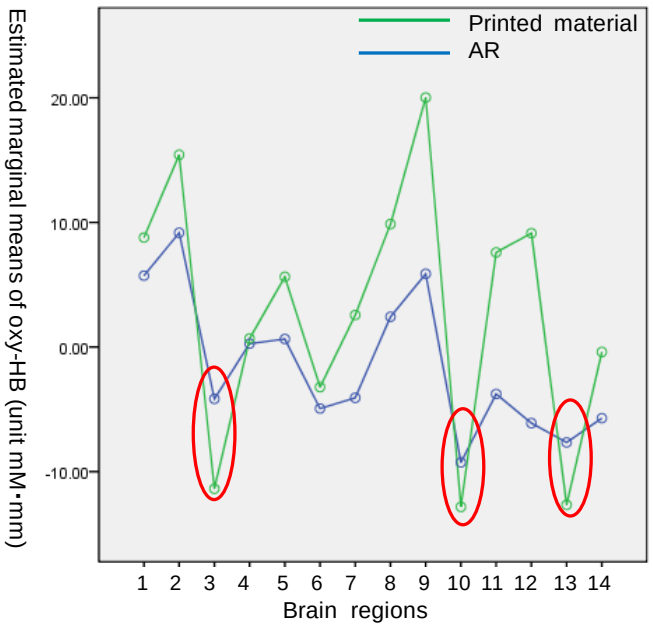
Table 4 Results of variance in amount of oxy-Hb for each set of teaching material (UNIANOVA)

Source	TypeIII Sun of Sequences	df	Mean Square	F	Sig. (p)
Intercept	309.882	1	309.882	1.790	.181
A subject testee	23276.812	9	2586.312	14.939	.000
Learning Method(LM)	3645.227	1	3645.227	21.055	.000
Brain area	44794.318	13	3445.717	19.903	.000
LM * Brain area	9433.124	13	725.625	4.191	.000
Error	145944.601	843	173.125		
Total	226152.584	880			
Corrected Total	226098.227	879			

From Table 4, it can be seen that there is a significant difference in brain activity when using the AR Teaching Materials and the Printed Teaching Materials, since the significance probability (p value) of 0.000 is well below the critical threshold of 0.05. The brain activity observed during the study sessions with the Printed Materials can be understood as overall stimulation.

Following this, the results of the t-test carried out to show the estimated average rate of oxygenation in the brain regions are shown in Fig. 10. In most of the regions, the Printed Teaching Material activates the brain more than the AR Teaching Material. However, the AR Teaching Material activated (3) the left angular gyrus, (10) the right angular gyrus, and (13) the right superior parietal association cortex as shown in Fig. 10.

In particular, the parietal association cortex exists to gather visual, somatic sensation, and hearing information and, based on this, co-ordinate the visual focus, hearing, sense of balance, and other sensations. The parietal association cortex then integrates all this information together. In other words, it can be said that the parietal association cortex is there to integrate the absolute, real space (Newton space) with the sense of self-awareness (sensation space) [12].



1.Left dorsolateral prefrontal cortex,2.left inferior frontal gyrus,3.left angular gyrus,4.left superior frontal gyrus,5.left frontotemporal region,6.left superior parietal association cortex,7.left motor cortex,8.right dorsolateral prefrontal cortex,9.right inferior frontal gyrus,10.right angular gyrus,11.right superior frontal gyrus,12.right frontotemporal region,13.right superior parietal association cortex,14.right motor cortex

Fig. 10 Estimated marginal means of oxy-Hb for each region of the brain

We believe that the parietal lobe area was activated by the sight of the 3DCG image being overlaid on the marker. When using the AR Teaching Material, the illustrations from the Printed Teaching Material appeared as 3DCG images and had a 3D effect on the eye. If the subject turned the marker, the 3DCG image would also turn in the same manner, allowing the subject to view the 3D image in whatever way he/she preferred. As a result, we hypothesize that there was a tendency for the subjects to experience 3DCG as an inclusive or surreal experience as the 3D effect made the imagery more believable. This sensation is indeed understandable as it is a characteristic of AR to "extend and expand reality as we know it," and we believe that this is a prime example of the characteristic.

In addition, the angular gyrus acts as the center of various sensory receptors such as vision and hearing and, as such, can be thought of as being primarily responsible for storing vocabulary, understanding, and verbalizing this when it comes to languages. If this area were to be compromised, the ability to read and write would also be compromised; a person with a damaged angular gyrus would not be able to understand a metaphor, for example [14].

Following on from this, it was found that when it came to the frontal lobe the Printed Teaching Materials had a stronger effect in activating the frontal lobe. The frontal association cortex plays a key role in the brain's thought, planning, conceptual thinking, and judgment. In order for these to perform, as Baddeley [15] pointed out, "working memory" needs to be accessed while these thoughts are being processed [13]. In other words, when studying a foreign language the

brain acquires and stores new words and needs to frequently access the working memory, thereby creating much activity, which we detected.

To summarize the above, the subjects who used the AR Teaching Materials to study did not experience significant brain activity. Their sense of reality was synthesized with the virtual world via the PC monitor and the 3D imagery interacted with their own co-ordinate space. We believe this allowed the brain to associate the foreign words with the imagery, allowing it to acquire and store words more naturally.

We observed in Experiment 1 that there was no difference in learning efficacy between using the AR Teaching Materials and the Printed Teaching Materials. This shows that, when taking into account the fact that the AR Teaching Materials were compared with a pre-existing method of study, it is possible for AR to be a more natural means of acquiring new information with lower stress.

In addition, this experiment showed the characteristics of the brain's memory system when using the AR Teaching Materials to associate the imagery within the co-ordinate space with vocabulary. This reinforces the findings of the research conducted by Teshima et al. [8]. Their thesis "Development and Adaption of Augmented Reality for Children's Education" demonstrated the enhanced capability of children to learn place names and associate them with locations using AR. We believe that this shows great potential for AR technology to be used to learn place names and physical locations by association.

5 Future Work

Based on the experimental results discussed above, we support the hypothesis that "AR technology has the potential to be a more effective means of learning physical locations and names by means of association." For this investigation, we suggest the following learning materials:

(1) for studying the anatomy of an organism of a human or animal body, and (2) for memorizing complex mechanical structures, such as automobiles and ships.

By developing these and other AR teaching materials, we wish to validate the hypothesis by measuring brain activity and the efficacy of the teaching materials and confirming their relationship to one another.

Also, related to the opinions stating that the words in the AR teaching materials were too hard to read, there is a need to improve the system to make the characters easier to read on the AR display.

6 Summary

In this study, we conducted experiments to assess the efficacy of AR technology as a practical teaching tool using verification tests and focusing on the field of foreign language study. The results showed that there were no significant differences using AR Teaching Materials or Printed Teaching Materials.

However, in the experiments carried out to measure the brain activity of the subjects in the study, a significant difference was observed in the use of the two types of media. In this experiment, we found that the subjects' brains were more active while studying the Printed Teaching Materials than studying the AR Teaching Materials. We believe this shows that the AR method of study is overall a more natural one and, when compared to traditional methods of study, has the potential to be less stressful for the student.

In addition, the experimental results have resulted in a new hypothesis: "AR technology has the potential to be a more effective means of learning physical locations and names by means of association." We believe that this hypothesis warrants further investigation.

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Development of an Adaptive E-Learning Model for Students with Disabilities: Mathematics Learning as an Example

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Abstract *– This research developed an innovative adaptive learning model by using multi-source of personalization information, that is, personal cognitive strengths and weaknesses, thinking style, learning style, and prior knowledge. Based on the innovative adaptive e-learning model, a multi-characteristic-based adaptive learning system has been developed. Finally, implications for practice and future research were discussed.*

Keywords: *Special Education,e-Learning,Adaptive Learning*

1 Introduction

Based on the educational concept of "No Child Left Behind," improving the educational system for children with mild disabilities is a key focus of educational reforms.

With advancements in information technologies and the ever-increasing popularity of the Internet, e-learning models that integrate the Internet and information technologies have become a newly emerging learning trend in addition to educational upgrades and reforms[1].

Experts of special education expect information technologies to increase the competence of students with disabilities, compensating for their underperformance or insufficient abilities [2].

The physical, mental, and learning characteristics of students with disabilities differ from those of non-disabled students and include a lack of concentration, poor short-term memory, weak abstract reasoning, and slow learning abilities. Because of these characteristics, they experience greater difficulty learning, their learning performance is lower, and they are less able to learn in a traditional manner compared to non-disabled students. An e-learning environment differs from traditional classrooms and can reduce the learning difficulties encountered by students with disabilities, enabling them to learn more effectively.

According to the current studies, although e-learning development and applications have been diversified, e-learning are insufficient for special education in elementary schools. Few online learning materials are specially designed to accommodate the needs of different students [3]. Additionally, most current online learning systems only provide remedies after students have encountered learning errors and do not provide measures to prevent mistakes and reduce their frustration with examinations. Therefore, considering the personalities of students with disabilities from a procedural perspective, providing an adaptive learning experience and preventing potential errors can improve their e-learning performance.

Mathematics is an essential skill for resolving daily issues and is the foundation for learning science subjects. Studies have shown that approximately 6% to 7% of non-disabled students experience difficulties learning mathematics[4]. The percentage is even higher among students with disabilities.

For students with disabilities, we designed an adaptive mathematics e-learning model according to their existing knowledge and characteristics, such as their learning and thinking styles, strengths, and weaknesses. This model provides students with adaptive learning procedures, content, presentation methods, error prevention strategies, tests, and remedial methods to enable them to learn effectively. Then, using this model, we developed an e-learning platform and implemented supporting technologies. Additionally, we also verified the validity of this model through experiments.

2 Model Design

Based on the learning theories discussed previously, adaptive e-learning, and e-learning for students with disabilities, we propose an adaptive e-learning model for disabled students in this section (Fig. 1). We use this model to design the structure of an e-learning system structure (Fig. 2) to be used as a reference for mechanism and technological developments in the future, as explained below.

(1) Pretest and Student Model Construction: Students must complete the pretest the first time they enter the learning platform. The computerized adaptive test assesses students' mathematics abilities and constructs a knowledge model for students based on the test results. The scales for learning and thinking styles are then employed to assess students' learning and thinking styles.
(2) Adaptive Learning and Supporting Mechanisms: After students begin the learning process, the learning path planning mechanism is used to determine a learning path for students. Adaptive learning materials are provided according to students' strengths, weaknesses, and thinking

and learning styles. Potential errors for students during concept learning are predicted and learning error prevention strategies are applied.

(3) Concept Testing and Computerized Adaptive Testing: After each concept learning process is completed, students receive a computerized adaptive test that presents questions that match students' abilities and determine their learning status.

(4) Remedial Learning and Learning Error Adaption: Students' answers reflect their learning status. If they provide the correct answers in the test, they continue onto step 1 for the next learning unit; otherwise, the learning error is identified based on the items selected by students, and the appropriate remedial learning strategy is provided to the student.

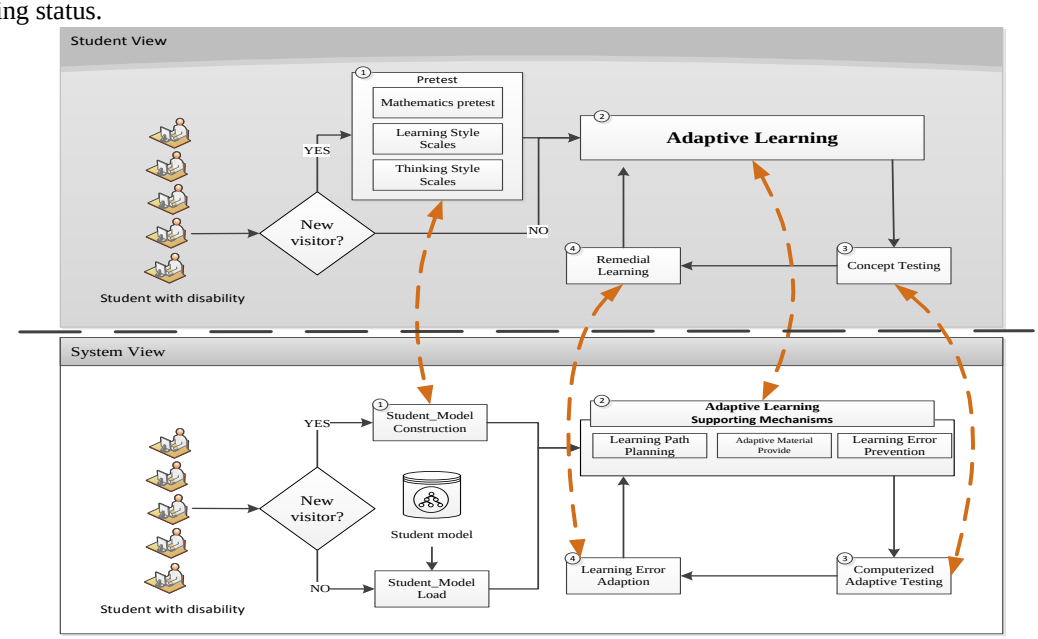

Figure 1. Adaptive e-Learning Model for Students with Disabilities

3 Mechanism and Techniques of e-Learning Platforms

3.1 Student Model Construction

To record each student's characteristics, knowledge structure, and learning-related information to plan adaptive learning for each student, we designed a student model.

In the e-learning environment, two major standards are used when referencing user information[5], that is, personal and private information (PAPI) presented by IEEE, and learner information packaging (LIP) presented by IMS. These two standards defined the syntax and semantics of a learner model. However, PAPI and LIP have certain common properties; differences only exist in the details of their classification. We incorporate both standards according to the requirements of this study to define the five categories in the student model (Fig. 3): (1) personal information; (2) personal preference; (3) students' abilities; (4) learning activity; and (5) learning performance. The fields in the circle are data inputted by students. The fields in the oval contain related student information obtained from the pretest. The fields in the rectangle are student learning data obtained during the learning process.

When students first enter the system, student model construction includes two major components, namely, the "student knowledge structure construction" under "students' abilities" and the "relevant personal characteristics" under "student preferences." Construction of the student model involves two major components, that is, the "student knowledge structure construction" and the "personal characteristics test."

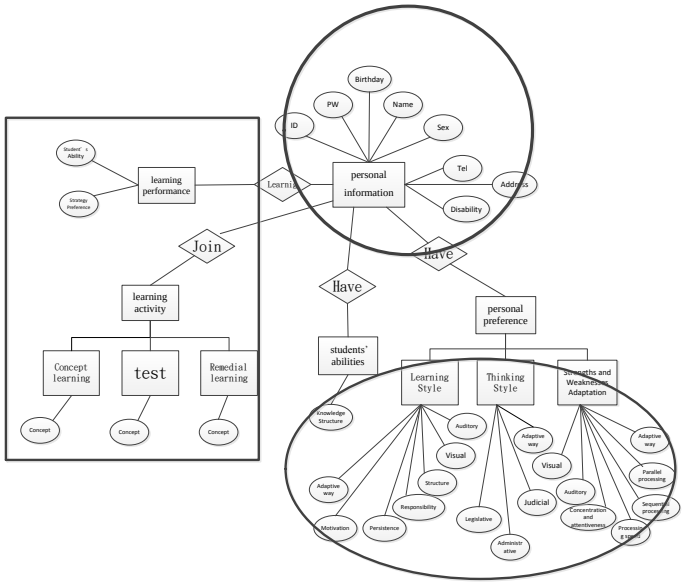

Figure 3. Student Model

3.1.1 Student Knowledge Structure Construction

Based on the adaptive pretest results and the preconstructed learning knowledge structure, we established a personal knowledge structure for students. For the knowledge-structure-based adaptive test (KSAT) [6], because each concept in mathematics contains numerous test items, we incorporated item response theory (IRT) into the design to achieve a hybrid adaptive test.

(1) KSAT

KSAT can be used to reduce the number of test items effectively. In the example shown in Fig. 4, the students first completed a test for Concept A. If they answered incorrectly, they were required to complete tests for Concepts B and C. If they answered Concept B incorrectly but Concept C correctly, we assumed that they already understood allconcepts under Concept C; thus, two questions were skipped. They were only required to complete a test on Concept D afterward. This approach not only reduces testing time but also clearly identifies the student's misconceptions. Because the participants of this study were students with disabilities who typically had low learning achievements, the adaptive test began with simple questions and gradually increased the difficulty level.

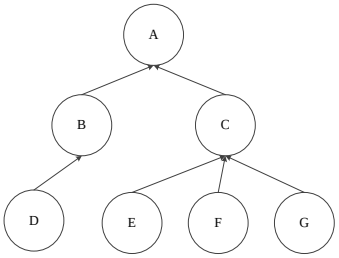

Figure 4. Knowledge Structure

(2) Item Response Theory

Item response theory is a modern method for selecting test questions, using probability to identify the relationship between a person's ability to take an examination and the questions in the examination. The selected test items in each examination match the student's ability. However, the difficulty level cannot meet the requirements of each student regarding their abilities. The optimum test arrangement is to provide each student with a test suitable for their condition and based on their ability. According to the correctness of the student's answer to the previous question, the system selected the subsequent question. This method constructs a student knowledge model, and is also used in the examination after each concept learning process is complete. The process steps are detailed below.

(a) Estimating Student's Ability

During this step, test items that are suitable for the student according to their ability are provided to avoid a situation in which randomly selected questions are too difficult and reduce the student's correctness rate. This study also used the three-parameter logistic model[7], as shown in Eq. (1).

$$P_i(\theta) = c_i + (1 - c_i)\frac{1}{1 + e^{-a_i(\theta - b_i)}}. \quad (1)$$

In this equation, θ represents the student's ability, b_i represents the difficulty parameter of question i, a_i represents the discrimination parameter of question i, and c_i represents the guessing parameter of question i.

The maximum likelihood procedure is used to estimate students' ability. During the test, students' responses to the questions are scored as zero or one using a dichotomy. The known test item parameters are included in the test item response vector to calculate the student's ability, as shown in Eq. (2).

$$\hat{\theta}_{s+1} = \hat{\theta}_s + \frac{\sum_{i-1}^{N} -a_i[u_i - p_i(\hat{\theta}_s)]}{\sum_{i=1}^{N} a_i^2 p_i(\hat{\theta}_s) Q_i(\hat{\theta}_s)}. \quad (2)$$

In this equation, $\hat{\theta}_s$ represents the estimated value of the student's ability regarding question a_i, where I = 1, 2, …, N. u_i : represents the student's response to question i, where zero indicates an error and one indicates a correct answer. $p_i(\hat{\theta}_s)$ represents the probability of answering correctly in the item characteristic curve based on the ability value of $\hat{\theta}_s$. $Q_i(\hat{\theta}_s)$ represents the probability of answering incorrectly in the item characteristic curve.

(b) Maximum Information Item Selection

We adopted the method of maximum information item selection commonly used in IRT for selecting the questions in the test. This method can provide examinees with the test items that have maximal information based on their abilities. Previous studies [8] have proposed an equation for maximum information item selection that is applicable to the three-parameter logistic model, as shown in Eq. (3).

$$I_i(\theta) = \frac{a_i^2(1 - c_i)}{[c_i + e^{a_i(\theta - b_i)}][1 + e^{-a_i(\theta - b_i)}]^2}. \quad (3)$$

In this equation, θ represents the student's ability, b_i represents the difficulty parameter of question i, a_i represents the discrimination parameter of question i, c_i represents the guessing parameter of question i, e represents the natural logarithm, which is 2.71828, and $I_i(\theta)$ represents the maximal information that question i provides to the student whose ability value is θ.

3.1.2 Personality and Characteristics Construction

The preferences in the student model include the student's personality, such as their learning and thinking styles, strengths, and weaknesses. This information can be obtained from relevant scales. Learning style refers to the psychological experiences of awareness, memory, and thought achieved when a student participates in learning activities, and the habitual characteristics of thinking, sentiment, and physiology evinced in external behavior through. thinking style refers to the way an individual uses and exerts their talent and intellect. The strengths and weaknesses of students were assessed and analyzed using WISC-III measures.

3.2 Learning Path Planning

Before planning a learning path for a student using the student knowledge structure diagram, the conceptual learning disability and misconception of the student must be identified. It also enables further planning of the student's learning process.

(1) Identify Learning Disability

Because students do not complete all conceptual tests in the KSAT computerized adaptive pretest, the student's stopping point when the KSAT test was finished was used to identify the student's learning disability.

(2) Generate a Personalized Learning Path

The student's stopping point in the mathematics pretest is the concept node that the student answered incorrectly, which was defined as the disability node. Therefore, a method must be provided to the student to remedy their learning disability for a concept and plan to learn a new concept. As shown in Fig. 5.

```
Void Main() {
        Call Find_Remedial_Instruction_Path(k,Cj)
//Cj as the disability node ,K as the less diffuculty of Cj parent-
concept
        Call Learn_New_Concept(Cj,Ch)
//Ch as a new concept
              }
Procedure Find_Remedial_Instruction_Path(k,Cj){
  If(Cj== disability node)
  {
  Push Cj;
  W=Max{Wcicj|1<=i<=n};//Find the weight of the largest node
                        of Cj with the parent concept
  While(Ci != Root Concept)  //when Ci is not Root Node
    Push Ci base on W;
  While Stack is not empty
  RIP=Find_Remedial_Instruction_Path(I,Pop());
   //RIP:Remedial_Instruction_Path
  }End Procedure
Procedure Learn_New_Concept(Cj,Ch){
        M=Max{Wcjch|1<=i<=n}// Find the largest weight of  node
                                of Cj sub-concept.
}End Procedure
```

Figure 5. Learning Path Planning Algorithm

3.3 Learning Error Prevention

Learning error prevention is used to predict students' learning errors according to their learning and thinking styles. The goal is to increase the precision of this prediction. First, the common mathematical errors of students with disabilities must be compiled, and the errors must be classified into different categories. The dimensions of learning style and thinking style are seen as the potential features of learning errors. Potential errors in the learning process are predicted using the document classification method, and the preventative strategy is provided to the student. In this section, we describe the construction of an error prediction classifier, including (1) features selection, (2) classification model training, and (3) correctness assessment.

3.3.1 Error Prediction Classification Model Constrcution

(1) Features Selection

Features selection involves deleting the less meaningful features of students' personalities. In this case, we delete the personality dimensions that have a smaller impact on students' correctness rates. From the numerous selection methods available, we chose to use Grey Relational Analysis (GRA) [9]. Grey Theory has the advantage of using minimal samples and employing multiple-factor analysis. GRA not only identifies correlation results, but can also be used for scheduling, which is suitable for selecting features using a minimal number of samples. Therefore, we use GRA to analyze the correlation between the personalities of students with disabilities and their correctness rates. Personality dimensions with higher correlations were selected as the features. However, those that do not predict learning errors effectively are deleted. The steps are explained below.

(a) Initialize Personality Dimensions

Through numerical calculations of students' personality dimensions, we obtained the following correlation series:

$$\omega_0 = (\omega_0(1), \omega_0(2), \omega_0(3), \dots, \omega_0(k))$$

$$\omega_1 = (\omega_1(1), \omega_1(2), \omega_1(3), \dots, \omega_1(k))$$

$$\dots\dots$$

$$\omega_i = (\omega_i(1), \omega_i(2), \omega_i(3), \dots, \omega_i(k))$$

In the set, i = 0, …,m; k = 1,…,n, ω_i represents the student information series in the i[th] personality dimension or the correctness rate. $\omega_i(1)$ represents the first student's information in the i[th] personality dimension.

The information series is then included in Eq. (3) for initialization, as shown in the following equation.

$$x_i(\mathrm{k}) = \frac{\omega_i(k)}{\omega_i(1)}, \forall \mathrm{k} \in \{1,2,\dots,\mathrm{n}\}\ \mathrm{i} \in \{0,\dots,\mathrm{m}\}. \quad (3)$$

Here, $x_i(\mathrm{k})$ is the transformation series of $\omega_i(k)$. $\omega_i(k)$ is the information of the K[th] student in the i[th] personality dimension.

(b) Calculate the Difference Series for Each Personality

All series obtained in Step (a) are considered comparison series. The correctness rate $x_m(\mathrm{k})$ is used as the reference series. As shown below, Eq. (4) is used to calculate the difference series for obtaining the measurement of a distance space.

$$\Delta_{0i}(k) = |x_0(k) - x_i(k)| \quad (4)$$
$$\forall \mathrm{k} \in \{1,2,\dots,\mathrm{n}\}\ \mathrm{i} \in \{0,\dots,\mathrm{m}\}.$$

In this equation, $x_0(\mathrm{k})$ represents the transformation series of the correctness rate and $x_i(\mathrm{k})$ represents the transformation series of personality.

(c) Calculate the Grey Relational Coefficient for Personality

The difference series obtained in Step (b) is included in Eq. (5) to calculate the grey relational coefficient for personality. Because the comparison series intersects with the reference series, we typically have $\Delta_{min} = 0$.

$$\gamma\big(x_0(\mathrm{k}), x_i(\mathrm{k})\big) = \frac{\min_i \min_k \Delta_i(k) + \rho \max_i \max_k \Delta_i(k)}{\Delta_i(k) + \rho \max_i \max_k \Delta_i(k)}. \quad (5)$$

In this equation, $\min_i \min_k \Delta_i(k)$ is the absolute minimal difference value among all series, $\max_i \max_k \Delta_i(k)$ is the absolute maximal difference value, and ρ is the discrimination coefficient, which indicates the loss of information or distortion caused by over reducing the absolute maximal difference value; the scale is zero to one.

(d) Calculate the Weight of the Grey Relational Coefficient for Each Personality

The grey relational coefficient obtained in Step (c) is averaged using Eq. (6) to obtain the relational weight for each personality dimension. The equation is shown below.

$$\gamma(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} \gamma\left(x_0(\mathrm{k}), x_i(\mathrm{k})\right) \qquad (6)$$

Here, $x_0(\mathrm{k})$ is the transformation series of the correctness rate, $x_i(\mathrm{k})$ is the transformation series of personality, and $\gamma\left(x_0(\mathrm{k}), x_i(\mathrm{k})\right)$ is the relational coefficient between the correctness rate and the i[th] personality dimension for the k[th] student.

(2) Classifier Training

We used the support vector machine (SVM),which was proposed by Vapnik in 1995 and is based on statistics theory. This is a linear binary classifier with a linearly separable hyperplane. SVM provides numerous advantages for resolving nonlinear, high-dimensional model differentiation problems with minimal samples. Two sets of data were prelabeled with the classification values (1 or -1) and trained using a linear function until the optimal decision function of the two sets of data were obtained. Through the optimal decision function, we identified the optimal classification hyperplane that causes the maximum margin between the two sets of data.

When classifying data into two groups during the training stage, the SVM classifier calculates the distance among vectors for training sample S and finds an equation for a straight line that can separate the training data, as shown in Eq. (7).

Training Data: $\mathrm{S} = \{x_i, y_i\}, \mathrm{i} = 1 \ldots \mathrm{n}, x_i \in R^d, y_i \in \{+1, -1\}$

$$\text{Subject to } y_i(w \cdot x_i - b) - 1 \geq 1, \forall i \ \min \frac{1}{2}\|w\|^2 \ . \qquad (7)$$

In this equation, x_i is the i[th] data, y_i is the data type of the i[th] data, which is either a positive (1) or negative type (-1), w is the normal vector for x_i corresponding to the line, and b is the amount of displacement for this straight line. Which of these two sets this point belongs to is determined based on the sign of the point. All points with yi = -1 belong to the set f(x) < 0, and all points with yi = +1 belong to the set f(x) > 0. Thus, we can determine which set data belongs to according to the sign of f(x). During this step, the thinking style and learning style features were used as training data to obtain the cut-off function between the two classified groups. The boundary of the two classified groups was expanded its the maximum along the vertical plane of the hyperplane, until it reached a certain group. This method separates the two types of data with the longest distance to the classification plane and generates a definite classification function.

3.3.2Variables for Prevention Strategy Determination

Because prediction may have duplicate results, we designed a discriminant equation to determine whether to provide a prevention strategy. The method is explained below.

(a) Discriminant Equation

$$\begin{cases} e_i^k = 1 & provide \\ e_i^k = 0 & do\ not\ provide \end{cases}$$

$$\forall\, e_i^k \epsilon\, S \ , i = 1,2,\ldots,n, k = 1,2,\ldots,m.$$

In this equation, e_i^k represents the given determinant variable of the i[th] error type in the remedial learning strategy for the k[th] student. The default value is always one.

(b) Variable Adjustment

$$\begin{cases} e_i^k - 1 & if \ \ s_i = 1 \\ e_i^k & others \end{cases}$$

$$\forall\, s_i^k \epsilon\, S \ , i = 1,2,\ldots,n, k = 1,2,\ldots,m.$$

In this equation, e_i^k represents the given determinant variable of the i[th] error type in the remedial learning strategy for the k[th] student. The default value is always one. s_i indicates whether a prevention strategy is provided on this occasion; one means a strategy is provided and zero means a strategy is not provided.

3.4 Adaptive Material Providing

This module provides adaptive materials to students according to their learning and cognition style, strengths, and weaknesses as recorded by the student model.

(1) Learning Style Adaptation

Learning style adaptation comprises the six dimensions proposed by[10], namely, motivation, persistence, responsibility, structure, visual types, and auditory types. Each dimension ranges from 0 to 16. The adaptive strategy for each personality dimension is listed in Table (1).

Table 1. Adaptive teaching strategies for learning styles

Dimension	Strategy	Adaptive Presentation Method
Motivation	<10	Different kinds of encouragement are given for the correct answer in each step
Persistence	<10	Emphasizes important messages
Responsibility	<10	Displays the percentage of completion
Visual	>Auditory	Digital voiceover
Auditory	>Visual	Supplements pictures with text descriptions

(2) Thinking Style Adaptation

For this study, we investigated three functional thinking styles: legislative, administrative, and judicial. These three dimensions ranged from 0 to 25. The dimension that scored the highest of the three was used as the student's thinking style. Methods for adaptation are shown in Table (2).

Table 2. Adaptive teaching strategies for thinking styles

Thinking style	Strategy	Adaptive Method
Legislative	Structured	Display step-by-step solutions
Administrative	Guidance	Display three solution strategies and ask the student to select the correct one
Judicial	Inductive	Provide minimal hints initially, increasing hints as the error rate increases

(3) Strengths and Weaknesses Adaptation

Students' strengths and weaknesses were assessed in advance using the WISC-III intelligence test. The adaptive teaching strategies are shown in Table (3).

Table 3. Adaptive teaching strategies for strengths and weaknesses

Dimension	Strategy	Adaptive Presentation Method
Visual	Strong	Supplement pictures for text descriptions
	Weak	Digital voiceover
Auditory	Strong	Digital voiceover
	Weak	Supplement pictures for text descriptions
Concentration and attentiveness	Weak	Increase font size and circle important messages
Processing speed	Weak	Display the multiplication table
Sequential processing	Strong	Display step-by-step solutions
	Weak	Display all solution steps simultaneously
Parallel processing	Strong	Display all solution steps simultaneously
	Weak	Display step-by-step solutions

3.5 Computerized Adaptive Testing

After each concept is learned, the system provides a computerized adaptive test based on IRT. The most suitable questions are selected according to the student's ability. The IRT adaptive test was explained in Section 3.1.1.

3.6 Learning Error Adaptation

This module provides necessary remedial learning when students encounter learning difficulties. We used the concept of formative evaluation to understand students' learning status and responded with appropriate strategies to resolve problems using collaborative filtering. The steps in this module are learning problem detection, matching strategies to a problem, and strategy selection for problem solving.

3.6.1. Learning Problem Detection

The first step in adaptation is the identification of students who require remedial learning using screening or assessments. Official measurement is then conducted to identify the potential learning difficulties of these students, followed by remedial learning. Adaptive learning content must meet the requirement of each student. Based on the collected literature, experiments, and the analysis and compilation based on expert instructors, we used the common error types as distracters for the standard question answers. Preprocessing for this method is relatively complicated. However, it aids analysis of online error types if the common errors are anlalyzed accurately.

3.6.2. Strategy to the Problem Matching

Besed on a survey completed by expert instructors and review of relevant studies, we identified the common mathematical error types and the corresponding strategies for students with disabilities. We present nine common error types and several corresponding solution strategies for each error.

3.6.3. Problem Solving Strategies Selecting

We used the concept of collaborative filtering to select strategies for problem solving. This method was first realized in the Tapestry mail system[11]. The purpose is to recommend information of interest to users based on the preferences of a group with common interests and experiences. Through a corporative mechanism, each participant responds and records the filtered target to enable other participants to screen information. This method allows concepts that are difficult to describe to be filtered out (for example, personal preference), and enables other users to learn rapidly from the feedback. This method is further explained below.

(1) Collect User Information

Use students' learning and thinking style in the student model as user information.

(2) Nearest Neighbor Search (NNS)

Calculate the similarity between two users. Divide the system users into N groups with high similarity using Pearson's correlation analysis, as shown in Eq. (10).

$$\mathrm{sim(a,b)} = corr_{ab} = \frac{\sum_{j=1}^{M}(P_{ai} - \overline{P_a})(P_{bi} - \overline{P_b})}{\sqrt{\sum_{j=1}^{M}(P_{ai} - \overline{P_a})^2 \sum_{j=1}^{M}(P_{bi} - \overline{P_b})^2}}. \quad (10)$$

Here, P_{ai} is the score of i[th] learning style of Student A, P_{bi} is the score of i[th] learning style of Student B, $\overline{P_a}$ is the average score of all learning styles of Student A, $\overline{P_b}$ is the average score of all learning styles of Student B, and $\mathrm{sim(a,b)}$ is the Pearson's correlation coefficient.

(3) Generate Recommendations

We employed the news recommendation method using collaborative filtering[12] and considered the preferred strategies of each student to calculate the weight of each solution, as shown in Eq. (11).

$$P_{ac} = (1 + \frac{R_c}{R_{all}}) \times (1 + \frac{R_{ac}}{\sum_{c=1}^{N} R_{ac}}) \times (1 + \frac{R_{sc}}{\sum_{c=1}^{N} R_{sc}}). \quad (11)$$

Here, R_C is the number of times Strategy C was read by all students, R_{all} is the total number of times that all strategies are read by all students, R_{ac} is the number of times Strategy Ccwas read by Student a, and R_{sc} is the number of times Strategy c was read by students in the same group as Student a.

4 Experiment

Participants were 68 elementary school students with mild disabilities. To verify the impact of this adaptive design on their learning performance, We used the pretest and posttest results and the difference in learning performance between these two groups to assess the effectiveness of the system.Table 4. Shows the mean scores of 68 students for both the pre-test and post-test are 26.0294 and 56.4706,respectively. Table 5.gives the comparison results of the paired samples t-test of the pre-test and post-test scores.This study found that the difference of the mean scores between the pre-test and post-test score is 30.441, the result reach the significant level under a degree of freedom of 67. In other words, after using the proposed adaptive e-learning model, the promotion of student learning performances is significant.

Table 4. Paired samples statistics

	Mean	*The number of samples*	*Std. deviation*	*Std. error mean*
Pre-test	26.0294	68	31.39254	3.8069
Post-test	56.4706	68	25.72905	3.12011

Table 5. Paired samples test

	Paired differences					*t*	*df*	*Significance (2-tailed)*
	Mean	*Std.deviation*	*Std. error mean*	*95% confidence interval of the difference*				
				Lower	*Upper*			
Paird Sample test	30.441	20.106	2.438	25.574	35.308	12.485	67	0

5 Conclusions and Future Research

This study developed an adaptive mathematics learning model for students with disabilities. Using the student model, instructors can plan a learning path and learning material for each student that meets their unique instructional needs. Using the computerized adaptive test, learning errors caused by mismatching question difficulty level with the student's ability can be avoided. Adaptive strategies for learning difficulties enable students to resolve the learning error and avoid repeating the mistake. In the studies conducted in the last decade, emotion has been shown to be an critical factor in e-learning [13]. In future studies, we aim to incorporate an emotional identification design into our system, which can enable us to determine whether students' poor performance is caused by inadequate material or design procedures, or because of the student's emotional state.

Acknowledgement

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Monte Carlo Simulation-based software for e-learning in RAMS technologies

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Abstract—*This document presents an application named SIM, designed specifically for online courses about RAMS technologies (Reliability, Availability, Maintainability and Safety), which have remarkable importance, nowadays, because of its real usefulness in many technical and industrial areas.*

SIM is essentially a discrete event simulator based in Monte Carlo simulation that allows the user to run case studies to simulate systems Life Cycle, necessary to support decision making in Asset Management.

Keywords- *E-learning Customized Software; RAMS Technologies; Dependability; Monte Carlo Simulation; Life Cycle Management*

1 Introduction

As far as we know, there have been some previous initiatives in presential courses partially o entirely related to RAMS technologies (Reliability, Availability, Maintainability and Safety), with their corresponding materials and tools, which are widely managed in many areas with important benefits.

However, the software developed and presented in this article combines the idea of providing RAMS utilities with e-learning purposes, as a result of studying didactic innovation.

Moreover, there are a lot of developments of professional software for RAMS, but not for learning uses and designed specifically for them. As a reference, a preliminary version of the application presented in this article, has been tested in CEANI Division (Las Palmas de Gran Canaria University) in a post graduate degree named MICRO [14].

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Technological e-learning supposes a relevant challenge for developing innovative tools and methodologies, in order to facilitate the optimum assimilation of concepts that frequently requires strong mathematic basis and complex calculations.

This specialized learning is focused either for different level profiles, students or professionals with a little time for studying and whose aim is to acquire the theoretical and the practical knowledge for applying for a job or promotion in a company.

Because of this factors, it is significant for technological e-learning the availability of specific tools designed for both acquiring the concepts and training with data results in an efficient and effective way.

In this line of work, this document presents a software development called SIM, designed specifically for online courses about RAMS technologies, after some years of CEANI Division experience in online learning in these matters.

RAMS technologies are very important nowadays because of its real usefulness in many technical and industrial areas (aeronautics, oil and chemical industry, nuclear industry, transports and others), being used in different operational tasks, (systems reliability calculation, maintenance management, risk analysis). So it is common the use of calculation applications that implement numeric models with diverse complexity, managing a lot of variables without which it would not be possible to obtain results for the problem.

Since random or pseudorandom numbers are easily generated by means of a computer, it is even more justified the use of advanced software for RAMS teaching. This is because of the stochastic nature of both, failure and repair processes, given by the amount of non-controllable variables that influence them.

SIM is custom made software for educational purposes, based on the study of commercial tools, with the aim of incorporating only the needed calculation and simulation tools for simplifying the understanding of complex notions, thanks to a combination of the suitable text, creating an interactive practical-theoretical lesson.

SIM user can create many real scenarios based on different management strategies, or selecting several models related with Maintainability or Reliability indicators of technical systems. Other functionality is to validate results of practical test cases.

This implementation is developed to complement the rest of existing technologies like e-learning platforms, or traditional non-presential learning methodologies, so it is perfectly compatible with all the present tools.

2 Current development of SIM

2.1 Background

The SIM software is one of the latest developments achieved by the CEANI research group. Several lessons learned from previous works of the group and conclusions of many other published research papers were used to create this computer-based simulation didactic unit.

Figure 1. SIM main Window

Some references for SIM can be cited, among others the computer code called AF Free (AFF) [1], devoted to Fault Tree Analysis for on-line courses, and the Reliability & Risk Engineering (ICR) computer-based interactive didactic code [2]. AFF provided the first scientific evidence that complex academic technical contents in the RAMS field, can be introduced on-line using C-based code and a friendly user interface. ICR showed high performance combining theoretical contents and computer-based exercises as well as the impact of the built in graphic capabilities included in new development environments like C#.

SIM introduces the use of C# forms as the basis for to develop book-like environments, classified in chapters and lessons with interactive exercises, plus professional skills which give the added value of being useful for technical analysis in the real world. In that sense SIM provides the students both a powerful didactic unit and professional software. There is no software in the RAMS field specifically designed for teaching, being normal the use of professional codes to help in the practical aspects of the courses. Usually, the result is that the professional-codes power implies the use of complex user interfaces that become in a source of problems for the teaching objectives to be achieved.

2.2 SIM utility areas

SIM is essentially a discrete event simulator based in Monte Carlo Simulation, especially oriented to learning and applied research in asset management in industrial area.

Independently from the case considered, asset management refers to three main stages of the Action Cycle:

- Collection and generation of necessary information to create state indicators of technical systems
- System modeling and calculation or estimation of mentioned indicators
- Planning and carrying out management activities

It is necessary to collect new data after improving actions have been made, in order to close the cycle.

SIM gives support for two of these stages mentioned above: on one hand, it allows to obtain models for characterizing state indicators of technical systems, and, on the other hand, it is a powerful tool to validate and measure the effectiveness of management measures that have been adopted by means of previous simulations of systems Life Cycle (LC).

SIM have been implemented with IDE Visual Studio using C Sharp programming language. This election has been motivated by the suitability of providing a simple and user-friendly graphic interface to handle the simulator.

2.3 The aim of SIM

The final purpose of SIM is to generate a laboratory that permits to tackle in a robust way diverse problems related to Life Cycle management. This feature allows the user to study the effects of the designed maintenance strategies considering ageing models and health loss associated to systems. It provides Key Performance Indicator (KPI's) that informs

about the expected evolution of the functionality of the systems.

Therefore, is obvious the benefit of using this type of software due to its generality, that permits to set up several scenarios, so in only one environment numerous problems without customizing the programming code for each can be solved. This speeds up the running of practical cases and even real problems. Otherwise, the handling of this type of software minimizes procedure failures, offering better reliability of the obtained results.

Mentioned properties of SIM are very useful for didactic purposes. Moreover it is significant that handling this type of application makes calculation independent from analysis process. This characteristic is ideal for the user to be focused in evaluating obtained results and the conceptual reasoning of the problem that is dealing with.

In the research field, the features of SIM are important too, given that the optimizer-simulator tandem is a strong tool in optimum strategies searching related to technical system management. SIM helps to maximize the operating capacity and minimize the exploitation costs in a combined way. This is a current issue in the matter being mentioned that nowadays some authors are working in. To further information the reader is encouraged to consult these references: [6], [7], [8], [9], [10], [11], [12], [13].

So, in short, the power of SIM lies in its capacity for evaluating every solution (management strategies) generated for the optimizer during the search for the optimum one.

3 SIM internal architecture

The application has an internal organization based on a determined disposition of different modules called *Lessons*. These *Lessons* are ordered from minor to major degree of complexity by means of a random number generator to finalize in a complex LC of technical systems simulator.

Every *lesson* is composed by a descriptive section including the variables needed by the functions describing the reliability, maintainability and cost models. Besides, every form has an area to present the results both in graphical or in text format. To finish, every *Lesson* has a section whose aim is monitoring the advances in the calculation process (useful to make the software more user –friendly), using two buttons to start the calculations and execute predefined examples,

The main modules of the application are:

3.1 Random number generator

This *Lesson* enhances the importance of generating random numbers which follow a predefined Probability distribution, as it is essential for Monte Carlo Simulations. This lesson is formed by two sections: one needed to choose the distribution function and another to present the results obtained in a frequency chart graph.

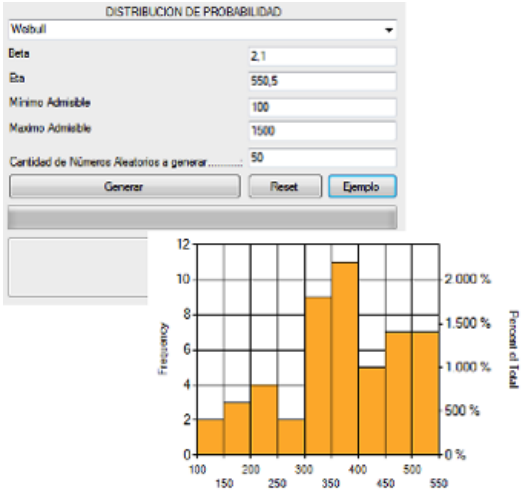

Figure 2. Random Sampling module

3.2 Components Availability

This *Lesson* tries to find the intrinsic availability of a component when its functioning and reparation laws are uniform. This *Lesson* introduces the LC simulation that will be profusely analyzed in future modules. The section for controlling the inputs includes the parameters associated to the functioning and reparation distributions, as well as the time to be simulated and the number of simulations to be run.

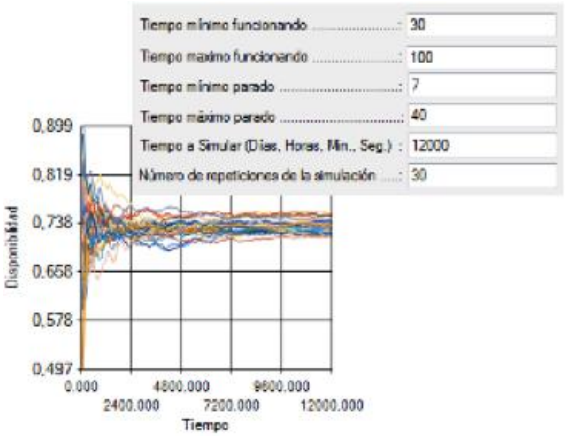

Figure 3. 50 simulations of single component availability

3.3 Functioning-fault Cycle

In this Lesson the system functionality cycle or the life cycle simulation is introduced. The inputs control area of this module is formed by the inputs of the costs, functioning, repairing and recuperation models. The outputs are the *Operational Unavailability* and the applied *Cost* indicators. The consequences of management measures based on simplified models can be analyzed.

3.4 Availability with several laws.

This *Lesson* extends the second module and it includes the possibility of working with different probability distribution functions, as well as with the Uniform Law.

3.5 Adjust to distributions.

This tool obtains models that represent e.g. the functioning, fault and recuperation laws that will be later used in the Life Cycle simulation. This is important because it offers the possibility of facing problems where the functions of the system models are unknown and they must be obtained from the experimental data.

3.6 Extended functioning-fault Cycle

This *Lesson* is an extension of the third module of the application and it is the main tool. The inputs control area includes the definitions of the laws that rule the repairs and costs, or the preventive maintainability planning. The generated outputs offer more details about what is happening inside the system. This Lesson allows doing a more complete survey of the possible impact when maintainability strategies are used. This *Lesson* will be explained in the next section.

Figure 4. Extended functioning-fault module

4 Estochastic simulation of discrete events with SIM

Simulations processes are intended to emulate the behaviour expected which is foreseen from a determinate real process. This fact has a great impact over the prediction of many phenomena, to improve the option to anticipate and plan strategies which optimizes (maximizes o minimizes) the derived effects of these phenomena.

In asset management engineering, as it has been said, the potential usefulness of a simulator is predicting the *Functionality Profile*, e.g. predicting the operability/inoperability cycles of an asset. Obtaining this profile depends on acquired knowledge about models ruling on the losses of quality over the time (Reliability) and functionality updates (Maintainability) of assets.

In order to define these models it is necessary to have operational experience developing an activity. Therefore for accomplishing a simulation process there is a previous step to be done which consists of fitting experimental observations to theoretical models.

Since executing a simulation process needs a procedure to fit models as the simulator by itself, SIM provides both tools with the objective to offer the most build-in software as possible. A detailed description will be given at this point.

4.1 Main form description.

The *Extended Working-Failure Cycle* lecture offers the most complete Life Cycle simulation provided by SIM software.

Once characterized the models that emulate the performance of a technical system, the form makes easier the implementation of various management strategies whose definition depends on the requirements and user criteria. This versatility is one of the highlighted features of the application.

There are a wide range of models, so the definition of the problem will be detailed depending on the quantity of information available about the system. All the implemented models are accepted by European rules or by reputed authors in the field of RAMS [15], [16].

As both the failure process and the reparation are highly fortuitous, the functions that describe their performance are probability functions. SIM contains the most widely used functions in Asset Management Engineering: e.g. Weibull distribution, one and two parameter exponential, normal distribution or log-normal distribution.

This model has imperfect maintenance models, where the system recovery or maintenance activities of the system are random variables that can be characterized by some of the previously mentioned models. Finally, the user can detail the period of time for simulation. All the information indicated until this point are the inputs required by the application to run the Life Cycle Simulation.

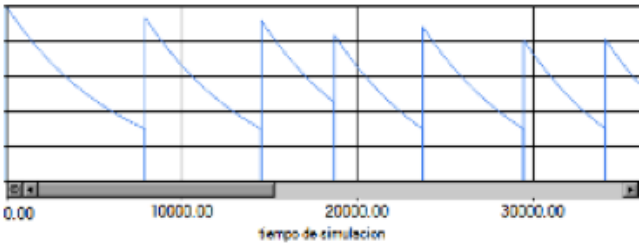

Figure 5. Functionality Profile

SIM offers like outputs from the simulation process a set of parameters that allow giving management support by means of objective criteria. These are the Key Performance Indicators (KPI's). Among them, the indicators of Operational Availability, the evolution of Mean Time Between Failures, the evolution of Mean Time To Repair with and without logistics, system management cost, etc. This is perhaps the real potential of SIM.

At the end of simulation process, the user has a range of indicators that permit validating the management or giving support to making decision referring to the variety of strategies. Operational Availability, Mean Time Between Failures and Accumulated Recovery Cost indicators are shown in the following figure.

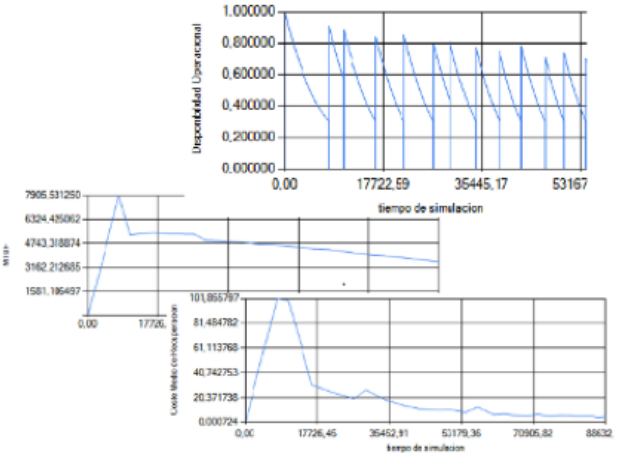

Figure 6.-Key Performance Indicators

5 Conclussions

SIM provides a valuable tool in improving teaching methodologies applied to knowledge transmission of RAMS technologies.

Through the development of this application the initial generated expectations have been fulfilled: Providing a simulation platform of the Life Cycle of technical systems for the purpose of asset management in an efficient way; providing a flexible framework enough that allows dealing with several case studies without the need to particularize the code of the simulator for each one. And, finally, to familiarize the user with the main Key Performance Indicators and RAMS+C models, used both, to monitor or evaluate the performance of technical systems.

By means of this kind of software the user is capable to address moderate complexity problems and focus all efforts in analyze the case studies and the results obtained, allowing him to acquire abilities in mono and multicriteria decision making.

Future line in relation to keep providing a robust and competitive software specially developed for teaching, reside in integer new RAMS models and, by other hand, to implement methodologies based on the evaluation of relationships between subsystems to acquire deeper knowledge about the state and performance of technical systems.

6 The future after SIM

Once proved the success obtained in e-learning courses using SIM beta version, from the point of view of the concepts assimilation and acceptance of the students, further step in e-learning innovation for technological subjects is being developed.

The objective is integrating all the necessary tools in an only environment, allowing the student to access to different kind and formats of information of interest to understand in a simple and optimized way, using the acquired knowledge. The Multimedia Interactive Didactic Unit (UDIM), could be customizable to see at the same time in the interface, one or some of the following information:

- Several indexes of all the chapters of the subject, and in each one of them, an index of the rest of types of materials that can be consulted, detailed below
- Information of the subject in text. There are links in the document to access to the rest of the elements listed below, and there are indexes for each list of them (audiovisual, examples, references) to access directly

- Short audiovisual webinars including explanations to more complex concepts
- Access to a version of software like SIM from this application directly, to see both loaded examples or to make new ones for practising or doing the exercises
- Access to an internet navigator for detailed references

This innovative Unit could be used in addition to e-learning platforms, and in online or offline mode (connected or not to internet), but in any case, it is ideal for specialized non presential teaching combining theoretical and practical concepts whose learning is much more achievable thanks to this kind of new interactive and comprehensive concept of e-learning.

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E-learning acceptance: Technological key factors for successful students' engagement in E-learning system

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Abstract - *The benefits derived from the E-learning system will not be achieved if the students do not accept and participate effectively in their university's E-learning systems. The technological factors appear to have a significant influence in making the system usage perceived as useful, functional, interactive and easy to use (Palloff & Pratt, 1999; Selim, 2003; Pituch & Lee, 2006).Thus, the technological factors that are related to E-learning system need further investigation regarding its significant influence on the students' acceptance of E-learning in higher education environment particularly in Saudi Arabian universities. By reason of a broad global attention given to E-learning and its related challenges, various studies had been conducted by academe, different organizations as well as the government of various nations (Rosenberg, 2001). Saudi Arabian universities are among those universities that implement and promote using E-learning systems. However, recent research indicated that majority of students in Saudi Arabian universities are still unwilling to use online system (Al-Jarf, 2007, Alenezi, et.al.,2011). Therefore, many factors need to be investigated in order to enhance the students' acceptance and usage to use E-learning tools and participate effectively in their courses using the specific Learning Management systems (LMS) in each university. The current study has extended Technology Acceptance Model (TAM) to investigate the effects of System Performance (SP), System Functionality (SF), System Response (SR) and System Interactivity (SI) on students' acceptance of E-learning. The mediating effects of Attitude in the relationship between perceived usefulness, perceived ease of use and the students' acceptance was significantly confirmed.*

Keywords: *E-learning acceptance, Technology Acceptance Model (TAM), System Performance, System Functionality, System Response, System Interactivity.*

1 Introduction

E-learning has been used in education as early as the 1950's. At that time E-learning was referred to as distance learning (Clark, 2000). The term E-learning refers to the learning methods which use electronic channels to deliver the instructional content. Moreover, E-learning is also referred to as web-based learning; technology based learning; online learning; networked learning and so on (Gotschall, 2000; Trombley & Lee, 2002). This way of learning gained its popularity just a decade ago according to Rosenberg (2001). Due to a broad global attention given to e-Learning, various reports and studies have been conducted by educational institutions, different organizations as well as the governments of various nations (Rosenberg, 2001). The Saudi Ministry of Higher Education is among those educational organizations that proposed the use of E-learning in Saudi Arabia. The Saudi Ministry of Higher Education recognised the need of integrating Information and Communication Technology (ICT) in various universities in Saudi Arabia. The Saudi Gazette (2008) by Madar Research reported that "the Saudi Arabian E-learning industry is projected to reach USD 125 million in 2008 and is set to grow at a compound annual rate of 33 per cent over the next five years". The increased projection shows vital focus on the advantages of E-learning in Saudi Arabia's modern education. However, many factors still influence negatively on the students' participation in the online courses. Al-Jarf (2007) pointed out that using the online system for her English course was a total failure. The author has also observed that the interaction between the participants was lacking and that the students had a negative attitude towards online courses. Nevertheless, the factors that have affected the acceptance of the system have still not been investigated yet. Al-Jarf (2007) found that in two Saudi universities, the students were still apprehensive, shy and hesitant to participate in this project. Moreover, the author pointed out that the online project in the two universities proved to be a total failure. Therefore, the researcher is interested in empirically extending the Technology Acceptance Model (TAM) to investigate the effects of System Performance (SP), System Functionality (SF), System Response (SR), and System Interactivity (SI) on students' acceptance of E-learning. It also aims to examine the Attitude mediating effects on the relationships between the main TAM model predictors and E-learning acceptance.

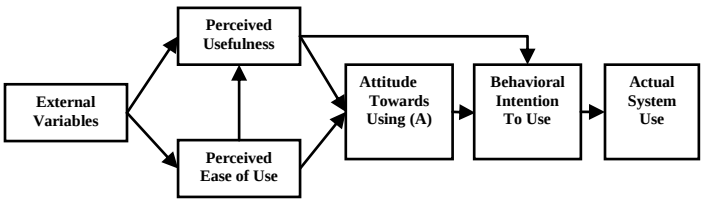
2 Literature review

2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is one of the most widely applied models to studies on individual acceptance and the usage of technologies. The TAM was adapted from the more general human behaviour which is the theory of reasoned action (TRA). The model was initially developed

and validated by Davis (1986, 1989). Davis et al. (1989) developed TAM as a theoretical basis, to provide an explanation of the determinants of human computer usage behaviour that is general, directly from generic TRA (Fishbein & Ajzen, 1975). Moreover, according to Davis, Bagozzi, and Warshaw (1989, p. 985), the TAM is the proficient of explaining users' behavior crossways of a broad range of end-user computing technologies, alongside both parsimonious and hypothetically justified. The TAM model has been extensively validated across an array of settings and contexts (Davis et al., 1989; Venkatesh & Morris, 2000; Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003). Furthermore, many studies have examined the TAM's applicability and validity to investigate students' acceptance in using the E-learning technology in higher education institutions (Landry, Rodger & Hartman, 2006; Masrom, 2007; Ngai et al., 2007; Roca et al. , 2006; Saadé & Galloway, 2005; Saadé & Bahli, 2005; Selim, 2003). The TAM suggests that perceived ease of use and perceived usefulness of Information Technology (IT) are the main determinant factors of IT usage. Davis (1993, p. 447) defines perceived ease of use (PEOU) as, "the degree to which an individual believes that using a particular system would be free of physical and mental effort". Moreover, Davis (1989) defined perceived usefulness (PU) as "the degree to which a person believes that using a particular system would enhance his or her job performance". The two major key constructs of the TAM: PU and PEOU, have the capability to predict an individual's attitude towards using a particular system. Both constructs, PU and PEOU, will influence an individual's attitude (A). Davis et al., (1989) defined attitude as an individual's positive or negative assessment of the behavior and is a function of Perceived Usefulness and Perceived Ease of Use. Attitude (A) will influence the Behavioral Intention (BI) of using a particular system, and in turn, influence the Actual use of the system (AU). Actual use (AU) will be predicted by the individual's Behavioral Intention (BI). Behavioral Intention (BI) refers to an individual's intention to perform a behavior and is a function of Attitude and Perceived Usefulness (Davis et al., 1989). According to Davis et al. (1998), Actual Use of a particular system is defined as a behavioral response, measured by the individual's action. The relationships between the mentioned constructs are presented in Figure 1, as shown below.

Figure 1.Technology Acceptance Model (TAM)



2.2 System Performance (SP)

System Performance (SP) refers to the degree to which a person believes that a system is reliable and responsive during a normal course of operations (Liu& Ma, 2006). This concept has its intention in different domains such as the wireless system (Shankaranarayanan, 2001), website software purchase (Mahinda & Whitworth, 2005) and medical records (Liu & Ma, 2006). Thus, this factor seems to be a crucial antecedent of both TAM beliefs constructs: perceived usefulness and perceived ease of use.

Liu and Ma (2006) extended the technology acceptance model with the construct perceived system performance. System performance consisted of two sub-constructs: reliability and responsiveness. Perceived system performance has explained around 46% of the variance in perceived ease of use and 56% of the variance in behavior intention. Thus, the perceived system performance seems to be vital in terms of its applicability to predict the users' perception towards a specific system. Furthermore, when the perceived system is nonexistent, the relations between the TAM constructs are still supporting. However, the association between perceived ease of use and intention of using the system is weak.

Mahinda and Whitworth (2005) have come up with a new model called The Web of System Performance. They extended the TAM to include system related factors such as security, connectivity, flexibility, extendibility and privacy. The study aimed to investigate the proposed factors on the users' online software purchase. The findings indicated that security, privacy, usability, functionality, reliability and connectivity play a significant role that users would consider when they purchase software via online.

2.3 System Functionality (SF)

System functionality (SF) refers to the perceived ability of an E-learning system to provide flexible access to instructional and assessment media (Pituch & Lee (2006). System functionality is a very important factor which is related to a system's characteristics. Many studies have investigated the relationship between system characteristics and users' acceptance (Davis, 1993; Venkatesh & Davis, 1996, Igbaria et al., 1995; Pituch & Lee, 2006; Ruth, 2000). Several researches study the system impacts on the E-learning environment (Palloff & Pratt, 1999; Pituch & Lee, 2006; Selim, 2003). In this research, system functionality will be studied with other associated system characteristics as technological factors.

Seels and Glasgow (1998) conducted a research investigating the affecting factors on the instructional design decisions. The research indicated that the system function is related to its capabilities to integrate different types of media such as Video and Audio. The researchers indicated that the high level of the system functionality can be derived from making a clear and interactive instructional design in order to gain the students intention to use a specific system. At the same time, Selim (2003) has referred to system functionality for its ability to provide superior system accessibility from remote and different locations around the world.

Pituch and Lee (2006) investigated the influence of system characteristics on E-learning use. They proposed and tested alternative models that can search for an explanation on students' intention to use an E-learning system when the system is utilised as an additional learning tool. The data were collected from 259 students from a Taiwanese university. The researchers proposed system functionality, system interactivity, system response, self-efficacy and internet experience as external variables of the TAM. The results indicated that the system characteristics influenced both the E-learning usage outcomes and the users' beliefs. They indicated that the system characteristics must be considered at the development stage of the E-learning design. The researchers also mentioned that the developers of E-learning system should select the specific system characteristics before the implementation stages.

In short, System functionality seems to be a pre-implementation factor that could has its impact on the students' willingness to use E-learning system tools in the higher educational environment. Thus, system functionality will be assessed as an external construct and its influences will be examined in relation to students' E-learning acceptance.

2.4 System Interactivity (SIN)

System Interactivity (SIN) refers to the perceived ability of an E-learning system to provide the interactions among students themselves and the interactions between faculty and students (Pituch & Lee, 2006). Palloff and Pratt (1999, p.5) cited in (Pituch & Lee, 2006) stated that for E-learning systems, the ''key to the learning process are the interactions among students themselves, the interactions between faculty and students, and the collaboration in learning that results from these interactions''. In the line with this matter, the current E-learning system has been interactive since it provides interactivity tools such as the E-mail and chat room. Therefore, system interactivity will be studied as a critical factor that could determine whether it influences the students' acceptance of E-learning implementation or not.

2.5 System Response (SR)

System response (SR) is defined as the degree to which a learner perceives the response from the E-learning system as fast, consistent, and reasonable (Pituch & Lee, 2006). Besides the importance of system performance, functionality and its interactivity, the system response is a crucial factor that influences the students' perception of both usefulness and ease of use of the E-learning system. Kerka (1999) affirmed that the E-learning system has disadvantages upon its wide communication tools and its limitation in bandwidth capacity. Thus, the system response must be the priority of E-learning design and implementation.

Pituch and Lee (2006) investigated the influence of system response on E-learning use. They indicated that the system response has a crucial influence on the students' acceptance of using the E-learning system. For instance, the students who perceived the E-learning system to be responsive will indicate that the system is easy to use and is useful. Eventually, their intention to use the system will be high and positive.

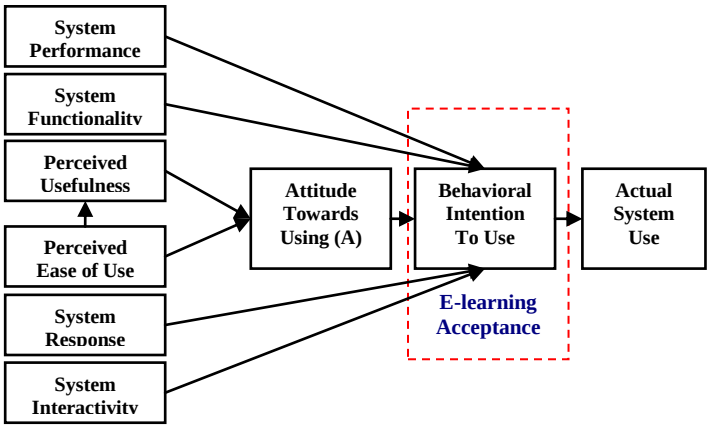
In brief, system performance, system functionality, system interactivity and system response appear to be significant as antecedents of both the TAM beliefs constructs. It also appears to influence the students' intention to use E-learning system. Thus, the present research will utilise the proposed constructs to investigate the technological factor that could affect the students' acceptance of E-learning in Saudi Arabian universities.

3 Research methodology

3.1 Research model and hypotheses

Based on the original TAM model and based on the previous inconclusive findings in the literature review regarding these four variables, null hypotheses are summarized as follows and the Research model is proposed (as depicted in Figure 2).

Figure 2: Proposed Research Model



$H_0$1: System Performance (SP) has no influence on the students' E-learning acceptance.
$H_0$2: System Functionality (SF) has no influence on the students' E-learning acceptance.
$H_0$3: System Response (SR) has no influence on the students' E-learning acceptance.
$H_0$4: System Interactivity (SI) has no influence on the students' E-learning acceptance.
$H_0$5: Perceived usefulness has no influence on students' attitudes toward the using E-learning.
$H_0$6: Perceived ease of use has no influence on students' attitudes toward the using E-learning.
$H_0$7: Attitudes toward using of E-learning have no influence on the students' acceptance.
$H_0$8: Attitude towards using E-learning does not mediate the relationship between perceived usefulness and E-learning acceptance.

$H_0$9: Attitude towards using E-learning does not mediate the relationship between perceived ease of use and E-learning acceptance.
$H_0$10: There is no relationship between perceived usefulness and perceived Ease of use.
$H_0$11: E-learning acceptance has no influence on the actual E-learning system use.

3.2 Research Design

The questionnaire consisted of 34 Items in order to measure the proposed research model factors. The measurement was adapted from prior research (Liu & Ma, 2006; Ngai, Poon, & Chan, 2007; Pituch, & Lee, 2006; Suh & Lee, 2007) .Pilot study was conducted in order to develop the measurements adapted scales. Moreover, the pilot study was performed in order to detect the internal consistency and reliability of utilised questionnaire. The questionnaire was distributed to 50 students from Al-Jouf University in session one 2009/2010. The returned and usable questionnaires were 48 and two questionnaires were excluded from the analysis due to enormous unanswered questions. The analysis of internal consistency was obtained from the interval scale items only. Overall, the pilot study data revealed acceptable high alpha reliability coefficient of all items which were above 0.70. Therefore, all items were retained for the main study. Thus, the questionnaire distribution to the targeted sample can be justified.

3.3 Sample and data collection

Based on research population which is 156, 429 bachelor students, it is appropriate to select a minimum sample of 384 students from the entire research population (Krejcie, & Morgan, 1970). The numbers of 480 questionnaires were randomly distributed to the students at five universities in Saudi Arabia. The usable response rate was 85 % with 408 undergraduate students from five different government universities. The profile of respondents is portrayed in Table 1.

Table 1: *Profile of respondents*

University	Frequency	Percentage
King Saud University	125	30.6
King AbdulAziz University	161	39.5
King Faisl University	38	9.3
King Khalid University	45	11.0
Aljouf University	39	9.6

4 Data analysis and findings

4.1 Reliability and factor analysis

Construct validity and reliability analysis were examined to ensure that the obtained responses are valid and reliable for further analysis. Exploratory factor analysis (EFA) represented by principal components analysis (PCA) with Varimax rotation were performed. All required criterion to perform the factor analysis were achieved. Kaiser-Guttman criterion was applied regarding to the number of variables to be extracted which only variables with an eigenvalues equal or greater than one can be extracted (Guttman, 1954; Kaiser & Dickman, 1959). The items with only loading 0.300 or greater were consider as acceptable (Hair et al., 1998). The factor analysis has individually been performed on each of the following scales because the ratio of five subjects per item (5:10) suggested by Coakes and Steed (2003) and the ratio of ten subjects per item (1:10) to run a single factor analysis were not achieved (Hair et al., 1998). Therefore, the factor analysis was performed separately for original TAM constructs and the technological factors namely system performance, system response, system interactivity and system functionality. The Cronbach's alpha coefficient above 0.60 is considered as acceptable and justified (Nunnally& Bernstein, 1994; Sekaran, 2000). Therefore, the suggested acceptable cut-off level of 0.60 was applied in this research. Table 2 represents the obtained results from factor analysis of TAM model. Table 3 represents the obtained results from factor analysis of system performance, system response, system interactivity and system functionality.

Table 3: *Factor loading for Technological Factor (TF)*

Items	SF	SR	SP	SI	α
(SF1)	0.86				
(SF2)	0.85				
(SF3)	0.67				0.82
(SF4)	0.66				
(SF5)	0.62				
(SR1)		0.78			
(SR2)		0.77			0.72
(SR3)		0.75			
(SF6)		0.69			
(SP1)			0.88		0.79
(SP2)			0.82		
(SP3)			0.79		
(SI1)				0.83	0.70
(SI2)				0.75	
Eigenvalues	4.54	2.17	1.45	1.09	
Percentage of Variance Explained	32.46	15.51	10.36	7.81	
Total Variance explained	21.28	39.25	54.76	66.149	
KMO	0.772				
Bartlett's test	2470.254				
Df	91				
Sig.	.00				

Table 2: *Factor analysis of TAM constructs*

Items	1	2	3	4	5	α
AU1	0.824					0.7
AU1	0.807					
BI1		0.788				0.7
BI2		0.781				
BI3		0.766				
BI4		0.727				
A1			0.828			0.7
A2			0.827			
A3			0.719			
PEU1				0.727		0.7
PEU2				0.708		
PEU3				0.688		
PEU4				0.683		
PEU5				0.654		
PEU6				0.446		
PU1					0.770	0.7
PU2					0.724	
PU3					0.722	
PU4					0.672	
PU5					0.639	
Eigenvalues	1.045	2.346	1.887	3.255	1.983	
Percentage of Variance Explained	11.611	58.641	62.914	29.595	18.027	
Total Variance explained	65.713	58.641	62.914	24.088	47.622	
KMO	0.597	0.747	0.649	0.806	0.806	
Bartlett's test of sphericity approx. chi square	1143.143	395.366	230.264	960.369	960.369	
Df	36	6	3	55	55	
Sig.	.000	.000	.000	.000	.000	

According to Table 2, the overall KMO were exceeded the minimum requirement of 0.50. The probability association with Bartlett's test of sphericity was significant (p<0.05). The results for factor analysis yielded that the two factors (AU, BI, & A) have eigenvalues greater than one that explained 65.71, 58.64, and 62.914 respectively of the total Variance explained. Perceived usefulness with eigenvalues of 1.98 explained about 47.62% of the total variance Perceived ease of use with eigenvalues of 3.25 explained about 24.09% of the total variance. The factor loading for all examined variables were acceptable and justified. Therefore, the results indicated a goodness of the current study factors' measurements and consider acceptable for further analysis.

As shown in Table 3, the KMO value for technological factor items was 0.77. The Bartlett's test of sphericity was also found to be significant (p<0.000). Thus, factor analysis of these items indicated as appropriate to be conducted. The principle component methods revealed the presence of four components with eigenvalues exceeding one, explaining 66.15% of the total variance. System Functionality (SF) includes six items accounted for 32.46% of the total variance explained with an eigenvalue of 4.54. The factor loading of its items was acceptable which ranged form 0.62 to 0.86. One item (SF6) contributed highly to system response with loading of 0.69. Thus, according to Hair et al (1998) items that contributed highly to other variable can take the label name or retain the original variable**.** Therefore, SF6 retained the related variable**.** System Response (SR) (eigenvalue = 2.17) contributed 15.51% of the total variance explained. It has factor loading ranging from 0.69 to 0.78. Thus, the factor items met the current research criteria and three items were retained. System Performance (SP) represented by 3 items and accounted 10.36% of the total variance explained with an eigenvalue of 1.45. Items factor loading ranged from 0.79 to 0.88. The last factorability of System Interactivity (SI) indicated this factor with an eigenvalue of 1.10 accounting for 7.81% of the total variance explained. Items factor loading ranged from 0.75 to 0.83. The results of analysing the factorability of Technological factor items has met the proposed criteria and resulted in the elimination of one item. The total items used in the analysis are 14 items.

4.2 Hypotheses testing

Three analysis techniques were used in testing the proposed hypotheses. Stepwise regression analysis was performed in order to investigate the factors' influence on the students' E-learning acceptance. Moreover, hierarchical regression analysis and Baron and Kenny criteria was carried out in order to test the mediation affect of the students' attitude towards using E-learning. The final technique used the product-moment correlation analysis in order to test the relationship between perceived usefulness with perceived ease of use and E-learning acceptance. Before testing the proposed hypotheses, several assumptions were met such as normality, linearity, homoscedasticity and independence of errors terms, multicollinearity and multivariate outliers (Hair et al, 1998; 2006; Pallant, 2001; Coakes and steed, 2003).

To examine the (**$H_0$1- $H_0$4)** hypotheses, Stepwise regression analysis was performed. Table 4 shows the results of stepwise multiple regression analysis.

Table4: *Stepwise multiple regression analysis of Technological factors*

TF	R^2	Adjust R^2	Uco.B	Sco. Beta	t	p.
SR	0.91	0.841	.818	.819	35.0	.000**
SF	0.93	0.861	.206	.187	7.92	.000**
SI	0.92	0 .863	042	.043	2.16	.032*

* p <.05, ** p <.01

As depicted in Table 4, the technological factors namely System response, System functionality and System Interactivity were regressed in stepwise technique. The regression model utlised to predict E-learning acceptance resulted in Adjusted R Square = 86.2 % at significant 0.05 levels. Out of four examined technological predictors, three predictors activated prediction equation and were also associated with a significant percentage of variance in E-learning acceptance, $F_{(3, 398)} = 834.314$, $p<0.01$. The first significant variable that predict E-learning acceptance is System response with $\beta = .819$, $t = 35.043$, at the significant level of $p < .01$, two tailed. The second significant variable predicted the E-learning acceptance is System functionality with $\beta = .187$, $t = 7.923$, at the significant level of $p < .01$. The third significant variable predicted the E-learning acceptance is system Interactivity with $\beta = -.043$, $t = -2.157$, at the significant level of $p < .01$. However, System performance was excluded from the model due to its insignificant association with E-learning acceptance at the significant level of $p < .01$. Hence, from technological prospective and based on the findings, students' who perceived E-learning system with satisfied level of response, functionality and Interactivity will have high level of E-learning acceptance. Therefore, three hypotheses were rejected while one hypothesis was accepted.

To examine the (**$H_0$5- $H_0$7)** hypotheses, simple liner regression was performed to investigate the influence of perceived usefulness and perceived ease of use on the students' attitudes toward the using E-learning as well as investigate the influence of the Attitudes on the students' E-learning acceptance.

Table5: *Simple Liner regression analysis on the influence of perceived usefulness and perceived ease of use on the Attitude, the influence of the attitude on E-learning Acceptance*

Variable	R^2	F	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			B	Std. Error	Beta		
PU [a]	.12	6.720	.161	.062	.129	2.592	.010*
PEU [a]	.25	26.758	.323	.062	.250	5.173	.000**
A [b]	.11	5.159	.110	.048	.113	2.271	.024*

a. Dependent Variable: Attitude ; b. Dependent Variable: E-learning Acceptance

As shown in Table 5, the results indicated that the perceived usefulness significantly influence students' attitude towards using the E-learning with $\beta = .129$, t (401) = 2.592, significant at the level of $p < .05$. The perceived ease of use has also significantly contributed to the students' attitude towards using the E-learning with $\beta = .250$, t (401) = 5.173, significant at the level of $p < .01$. The results also indicated that the attitude significantly influence students' E-learning Acceptance with $\beta = .113$, t (401) = 2.271, significant at the level of $p < .05$. Therefore, the examined null hypotheses were rejected.

4.3 Mediating analysis

Two null hypotheses were formulated to examine the mediating effect of students' attitude on the relationship between the internal independents variables, namely perceived ease of use/ perceived usefulness and students' E-learning acceptance. In order to investigate the mediating effectsthe assumed null hypotheses of mediation were examined using hierarchical regression analysis and Baron and Kenny's (1986) approach, as shown in Figure 3.

Figure 3: Mediation Model: Baron & Kenny (1986)

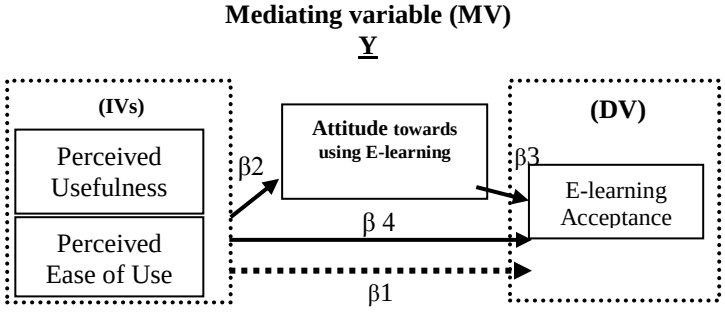


Table 7*: Hierarchical regression analysis using Attitude toward E-learning as a mediator in the relationship between perceived ease of use and E-learning acceptance*

Model		Uco.		Stz. Co	t	Sig.
		B	Std. Error	Beta		
Step1 Model 1	(Constant)	2.45	.193		12.69	.000
	PERCEIVED EASE OF USE	.164	.062	.130	2.63	.009
Step2 Model2	(Constant)	2.27	.220		10.3	.000
	PERCEIVED EASE OF USE	.137	.064	.109	2.13	.033
	ATTITUDE	.083	.050	.086	1.67	.095

R^2 = 0.130 in step 1; R^2 = 0.155 in step 2

The Baron and Kenny's significant criteria were met in the examined (**$H_0$5- $H_0$7)** hypotheses. Therefore, Hierarchical regression was performed to examine the Attitude total effects on the relationship between the IVs and Dv. The results in Table 5 demonstrate the results of hierarchical regression analysis using Attitude as a mediator in the relationship between perceived usefulness, perceived ease of use and E-learning acceptance.

Table 6: *Hierarchical regression analysis using Attitude toward E-learning as a mediator in the relationship between perceived usefulness and E-learning acceptance*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Step1 Model 1	(Constant)	2.541	.201		12.659	.000
	PU	.127	.061	.104	2.085	.038
Step2 Model2	(Constant)	2.284	.237		9.664	.000
	PU	.111	.061	.091	1.815	.070
	ATTITUDE	.098	.049	.101	2.026	.043

R^2 = 0.104 in step 1; R^2 = 0.144 in step 2

As portrayed in Table 6, the results indicate that in the first model, perceived usefulness significantly contributed to E-learning intention, R^2 = 0.104, F $(_{1,\ 400})$ = 4.346, p<0.05. Model one shows that perceived usefulness is positively related to E-learning acceptance, β = .104, *t* = 2.085, at the significant level of p < .05. In model two, the Attitude was added to the equation, the R^2 = 0.144 significantly change with F $(_{2,\ 399})$ = 4.241, p<0.05. Model two shows that perceived usefulness is insignificantly reduced, β = .091, *t* = 1.815, at the significant level of p < .05 In testing the mediation effect of Attitude, in model 1 the relationship between perceived usefulness (IV) and E-learning acceptance (DV) was significant. While in Model 2 the relationship between IV and DV becomes insignificantly reduced. Therefore, the attitude towards E-learning fully mediates the relationship between perceived usefulness and E-learning acceptance.

As presented in Table 7, the results indicate that in the first model, perceived ease is significantly contributing to E-learning intention, R^2 = 0.130, F $(_{1,\ 400})$ = 6.926, p<0.05. Model one shows that perceived ease of use is positively related to E-learning intention, β = .130, *t* = 2.632, at the significant level of p < .05. In model two, the Attitude was added to the equation, the R^2 = 0.156 significantly change with F $(_{2,\ 399})$ = 4.880, p<0.05. Model two shows that perceived ease of use was still significant but reduced, β = .109, *t* = 2.134, at the significant level of p < .05 In testing the mediation effect of Attitude, in model 1 the relationship between perceived usefulness (IV) and E-learning intention (DV) was significant. While in Model 2 the relationship between IV and DV was still significant but the magnitude of the relationship between them is reduced (β = .130 to.109, *t* = 2.632 to 2.134. Hence based on Baron and Kenny approach, the attitude towards E-learning partially mediates the relationship between perceived ease of use and E-learning intention.

In order to investigate **$H_0$10** which examines the relationship between perceived usefulness and perceived Ease of use, Pearson correlation coefficient was used. Table 8 shows the results of correlation test between perceived usefulness and perceived Ease of use.

Table 8: *Correlation test between perceived usefulness and perceived Ease of use*

		1	Perceived Ease Of Use
Perceived Usefulness (1)	Pearson Correlation	1	.254(**)
	Sig. (2-tailed)	.	.000
	N	402	402

** p <.01

The result in Table 8, indicated the positive and weak strength relationship between *perceived usefulness and perceived Ease of use* with coefficient's value *r* = 0.254, *n* = 402, *p* = 0.01. Therefore, the null hypothesis is rejected.

In order to investigate **$H_0$11** which examines the influence of the E-learning acceptance on the actual E-learning system use? Regression analysis was performed. Table 9 shows the results of regression analysis.

Table 9*: Simple Liner regression analysis on the influence of E-learning acceptance and actual E-learning system use*

Variable	R^2	F	Unstandardized Coefficients		StandardizeCoefficients	t	Sig.
			B	Std. Error	Beta		
ELA[a]	.211	106.77	.566	.055	.459	10.333	.00**

** p <.01, a. Dependent Variable: Actual E-learning system Use

As portrayed in Table 9, the results indicate that the E-learning acceptance significantly contributed to the actual E-learning system use, R^2 = 0.10, F ($_{1, 400}$) = 10.333, p<.01. Therefore, the examined null hypothesis was rejected.

5 Conclusion and discussion

The result indicated that among the technological-related variables, namely system performance, system functionality, system interactivity and system response were significant with the exclusion of system performance influence. The most contributive variable was system performance followed by system functionality and lastly by interactivity. The results obtained are confirmable by Pituch and Lee (2006), who investigated the influence of system characteristics on E-learning use. The results indicated that the system response, system interactivity and system functionality have a positive relationship with the TAM constructs and that it had influenced the E-learning acceptance. However, the obtained findings regarding to system performance were inconsistent with that of Shankaranarayanan (2001) in addition to that of Liu and Ma (2006). Liu and Ma (2006) extended the technology acceptance model with the construct of perceived system performance. The results indicated a strong relationship between system performance and users' acceptance which explained 56% of the variance in behaviour intention. However, in this research system performance was insignificant in stepwise regression compared to other related variables in the technological factor. The reason could be the reduced intention paid to system performance problems since the recent enhanced and updated new E-learning systems that are provided by the national centre of E-learning. At the same time, the students' intention might be intended to evaluate the provided new system characteristics such as system functionality, system interactivity and system response.

The research findings were consistent with the majority of previous researches on TAM model particularly the affect of both TAM predictors' namely perceived usefulness and perceived ease of use on the users' behavioral intention (E-learning acceptance) to use new technology (Landry, Rodger, & Hartman 2006; Masrom, 2007; Ngai et al., 2007; Roca, Chiu, & Martínez, 2006; Selim, 2003; Saadé & Bahli, 2005; Saadé & Galloway, 2005). The obtained findings indicated that the attitude towards using E-learning fully mediated the relationship between perceived usefulness and E-learning acceptance . It is also partially mediated the relationship between perceived ease of use and E-learning acceptance. The results contradicted to the Davis et al. (1989) findings, which demonstrated that the power of the TAM in predicting the individual's acceptance is equally good and parsimonious without the attitude mediating effects. Likewise, Venkatesh and Davis (1996) eliminated the attitude variable from their proposed model because the attitude as a mediating construct did not seem to mediate fully the effect of perceived usefulness and perceived ease of use on behavioural intention as confirmed also by Wolski and Jackson (1999), who stated that the relationship between Attitude and behavioural intention was not supported. Hence, the present research findings could be dissimilar with above authors' findings by reason of the struggling capability of TAM main constructs in predicting the users' acceptance in different settings particularly with the presence of Attitude as mediator variable. So, the mediating effect of the Attitude could be absence or presence due to the nature of study and the examined culture. Conversely, the present research finding was supported by many studies in the area of technology acceptance which had confirmed the positive relationships of the Attitude with perceived Ease of Use, Perceived Usefulness and Intention to use E-learning in mandatory settings (Brown, 2002; Lee et al., 2005; Ngai et al., 2005; Saadé & Bahli, 2005). The research findings were confirmed by Brown (2002), who conducted a research in South African universities in order to investigate factors affecting perceived ease of use of web-based learning technologies. The proposed factors were directly tested with TAM's main constructs. In terms of attitude findings, the result indicated that attitude has an important role in enhancing the students' ease of using the web-based learning. Lee, Cheung and Chen (2005) modelled the students' acceptance using the TAM extension to include extrinsic factors (perceived usefulness and ease of use) and intrinsic factors (perceived enjoyment). The findings related to the mediating attitude role with perceived usefulness were fully confirmed. However, the relationship between the perceived ease of use and the students' acceptance to use online activities through attitude were partially supported. Therefore, these research findings could be justified since the literature review provides contradicting findings in the relationship between them. In consistent with this research findings, Ngai et al. (2005) in his research findings confirmed that usefulness and ease of use are the main factors affecting the attitude of students using WebCT, and ultimately affect their intention to use WebCT activities.

As pointed out earlier, the finding indicated that there was a positive relationship between perceived ease of use and perceived usefulness. This can be confirmed by the majority of technology acceptance research findings particularly E-learning acceptance findings (Babenko-Mould, Andrunsyszyn, & Goldenberg , 2004; Davis et al., 1992; Gefen & Straub, 2000; Masrom, 2007; Ngai et al., 2007; Ong et al., 2004; Rezaei, Mohammadi, Asadi, and Kalantary, 2008; Selim, 2003;; Sun, Tsai, Finger, Chen, & Yeh, 2008; Szajna, 1996; Tung & Chang, 2008; Saadé & Bahli, 2005). In

consistent with this research finding, Sun, Tsai, Finger, Chen, & Yeh (2008) conducted an empirical study to investigate the significant factors affecting online system satisfaction. The research confirmed the positive relationship between perceived ease of use in relation to perceived usefulness. The findings also indicated that perceived usefulness of the online learning system would positively influence the learners' satisfaction with this system. Furthermore, Tung and Chang (2008) utilised the TAM in order to investigate the students' intention to use online courses. This study investigated whether the Taiwanese students accepted the online courses or not. The study findings also indicated the original positive relationship between ease of use and usefulness as proposed by Davis et al. (1989). In line with this research finding, Ong and Lai (2004) conducted a research to examine the students' acceptance of E-learning by extending the TAM with gender as a demographic characteristic. The study showed that the students who had a high level of belief that online courses were easy to use showed an increase in their acceptance of online learning. In addition, they found that the perceived ease of use has a significant relationship with the perceived usefulness of using E-learning system. Therefore, the relationship between perceived ease of use and perceived usefulness possibly justified because of their nature that related to the E-learning system characteristics and their proven influence on the users' beliefs, attitudes and their behavioural Intentions.

The findings indicated that there is a positive relationship between perceived usefulness and E-learning acceptance, which indicated through the behavioural intention variable. The previous research findings were confirmed and support this research finding of the relationship between perceived usefulness and students' acceptance (Davis et al., 1992; Gefen and Straub, 2000; Ong et al., 2004; Masrom, 2007; Ngai et al., 2007; Rezaei, Mohammadi, Asadi, & Kalantary, 2008; Saadé & Bahli, 2005; Selim, 2003; Szajna, 1996; Tsai, Finger, Chen, & Yeh, 2008, Tung and Chang, 2008). For instance, Rezaei, Mohammadi, Asadi, and Kalantary (2008) conducted a research in order to predict the factors affecting the E-learning system in Agriculture schools in higher education. The study showed "a strong direct influence of perceived usefulness on students' intention to use e-learning" (Rezaei et al., 2008, p.90). It also indicated that there was a positive relationship between students' intention to use E-learning and perceived usefulness besides the internet experience, computer self-efficacy and affect.

The findings also indicated that the E-learning acceptance significantly contributed to the actual E-learning system use. TAM hypothesizes that the behavioral Intention to use a particular system is determined by the actual use of particular system. The Actual use or system usage has been extensively used in information system (IS) research as key success factor of IS investment projects. It is also considered as an important factor of Information Technology (IT) acceptance (Davis, 1993; Taylor & Todd, 1995). Several studies have tested the perceived ease of use and perceived usefulness directly to Actual system use and they have dropped the behavioral intention (Thompson, Higgins, & Howell, 1991; Al-Ghatani & King, 1999). Al-Ghatani and King (1999) in their study suggested that system usage is an indicator of IT success and superior indicator of information technology acceptance. Similarly, Davis (1993) has stated that the success and failure of Information system projects are determined by the users' acceptance to use these systems. Moreover, many studies have confirmed the strength of Usefulness – Actual use relationship in comparison with the Ease of Use – Actual use relationship. According to Igbaria et el. (1995), perceived usefulness used to has a strong direct relationship with actual system use. In line with this matter, Davis et al. have reported the same findings reliable with the recent research. In contrast, several studies have affirmed that perceived ease of use is an important factor in determining the actual use of system (Davis, 1989). Rogers (1995) in IDT has claimed that embracing the technology is a function of varieties of variables such as relative advantages and ease of use the innovation. However, it is not always that the researchers have reported positive information about the relationship between perceived ease of use and the actual system use (Adams, Nelson, & Todd, 1992). While other researchers have found that both perceived usefulness and perceived ease of use positively related to the system actual use (Igbaria et al., 1996). Furthermore, this research utlised self reported usage measurement. The majority of TAM model research relied on subjective Self-reported measures of system usage (Saadé, Tan, & Kira, 2008). However, several researches criticized the subjective measurement of the actual use because of the respondents can deduction the researchers' expectation or follow the social norms (Saadé, Tan, & Kira, 2008; Straub et al., 1995). Therefore, the accuracy of actual E-learning system use influence need to justified.

6 Implications, limitation and recommendations

The applicability and validity of the TAM and its related original constructs were confirmed in the Educational context especially in the area of E-learning in Saudi Arabian institutions of higher education as consistent with the research that examined the TAM's applicability in the area of E-learning (Lee et al., 2006; Masrom ,2007; Rezaei, Mohammadi, Asadi, & Kalantary ,2008; Saadé, Tan, & Nebebe ,2008). In terms of significant technological variables, the findings are likely to be relevant to learning and content management system designers. System response, interactivity and functionality were significantly influenced the students' acceptance. In other words, when the students' perceived the system as interactive, functional and highly responsive, their acceptance level will be increased. Therefore, system designers must take this into consideration in achieving these significant system characteristics. Furthermore, the influence of original TAM's main constructs, namely perceived usefulness and perceived ease of use also confirmed. Thus, the E-learning system should be perceived as both easy to use and useful to maximize use of the system. Universities' learning management system should be perceived as both useful and

easy to use in order to maximize the system acceptance and ultimately increase the students' participation.

Even though, there are limitations related to the sample size and number of universities that participated in this study. It would be certainly useful for future research to implement the research examined factors and its related instrumentations with additional universities' either governmental or private ones, in order to obtain a better representation for entire population and ultimately represent optimum generalization. Furthermore, the research was limited only to university students, it is therefore future research should consider other university members such as research assistants, lecturers and administrators in order identify their trend to accept E-learning and determine the important factors that could affect their acceptance. This study is also limited to subjective measure of the Actual use (Self-reported) which influences the accuracy of measuring the students' actual system usage and its related relationships. Therefore, future research should examine the actual system usage using objective measures such as computer recorded (actual system access frequency recorded by computerised system). The reported R-square yielded other additional variables that might be needed particularly from the technical perspective since the technological factor was the most contributive factor among the proposed factors. Therefore, future research could investigate and test more additional technological related variables such as system interface design, credibility, privacy, quality and complexity. Based on the findings, it is suggested that, among others, higher educational institutions consider the influence of technological, institutional, social and psychological factors in the process of implementing E-learning. In conclusion, further research is still needed in the area of E-learning readiness, adoption and perception in order to adopt, implement and use successfully future updated E-learning management systems In Saudi Arabia..

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TradeMapper: An E-Learning Tool for Entrepreneurship Education in Global Markets

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ABSTRACT

This paper examines TradeMapper, an e-learning tool for entrepreneurship and management students to understand historical trade patterns between countries. TradeMapper features a "living" network diagram that shows changing total trade volumes among the Top 25 industrialized countries between 1955 and 1992 depending on user selections. A set of simple controls enable the user to interact with the dataset, dynamically rendering different snapshots of country-to-country, regional and global trade. A spring-embedding algorithm lays out the network map and shows the "closeness" of countries based on total trade volumes for any selected time period. The user can animate the data to see a "movie" of unfolding trade patterns or set a filter to see only trade relationships above set dollar volumes. TradeMapper offers entrepreneurship and management educators an engaging, interactive tool to show the changing nature of global trade patterns and can be used both in the classroom and online. In designing the interactive e-learning tool, we focused on simplicity and ease of use to encourage visual knowledge discovery and educational discussion.

Keywords:
e-learning, international trade, entrepreneurship education, data visualization, visual knowledge discovery

1. INTRODUCTION

TradeMapper, shown in Figure 1, is an e-learning and visual knowledge discovery tool to understand shifting trade flows and the criticality of world actors in global trade between WWII and the last decade. It provides entrepreneurship and management students an interactive and intuitive interface to see changing world trade patterns between the Top 25 industrialized countries [1]. The tool may be used "live" in class by an educator to show dynamics of global trade patterns. Or, used online in blended or distance education, TradeMapper can serve as an independent, interactive exercise that allows students to pose and explore questions about the changing dynamics of world trade.

In business schools, a key pedagogical challenge is to highlight the international nature of entrepreneurial opportunities, industries and competition. Specifically, faculty commonly aim to highlight the global design of industry supply chains, customer markets and the international footprint of organizational capabilities and resources [2]. Business students know, for example, that the BRIC countries (Brazil, Russia, India and China) are growing in prominence, but struggle to grasp these countries growing trade volumes and interrelationships with other major economies, let alone broad shifts among the highest volume traders (U.S., Japan, Germany). Similarly, most discussions of the global nature of business occur qualitatively, with little actual examination of data characterizing the macro business environment.

TradeMapper was created to give entrepreneurship and management students an intuitive sense of the dynamism of world trade and to show, for example, the shifting importance of the United States in world trade.

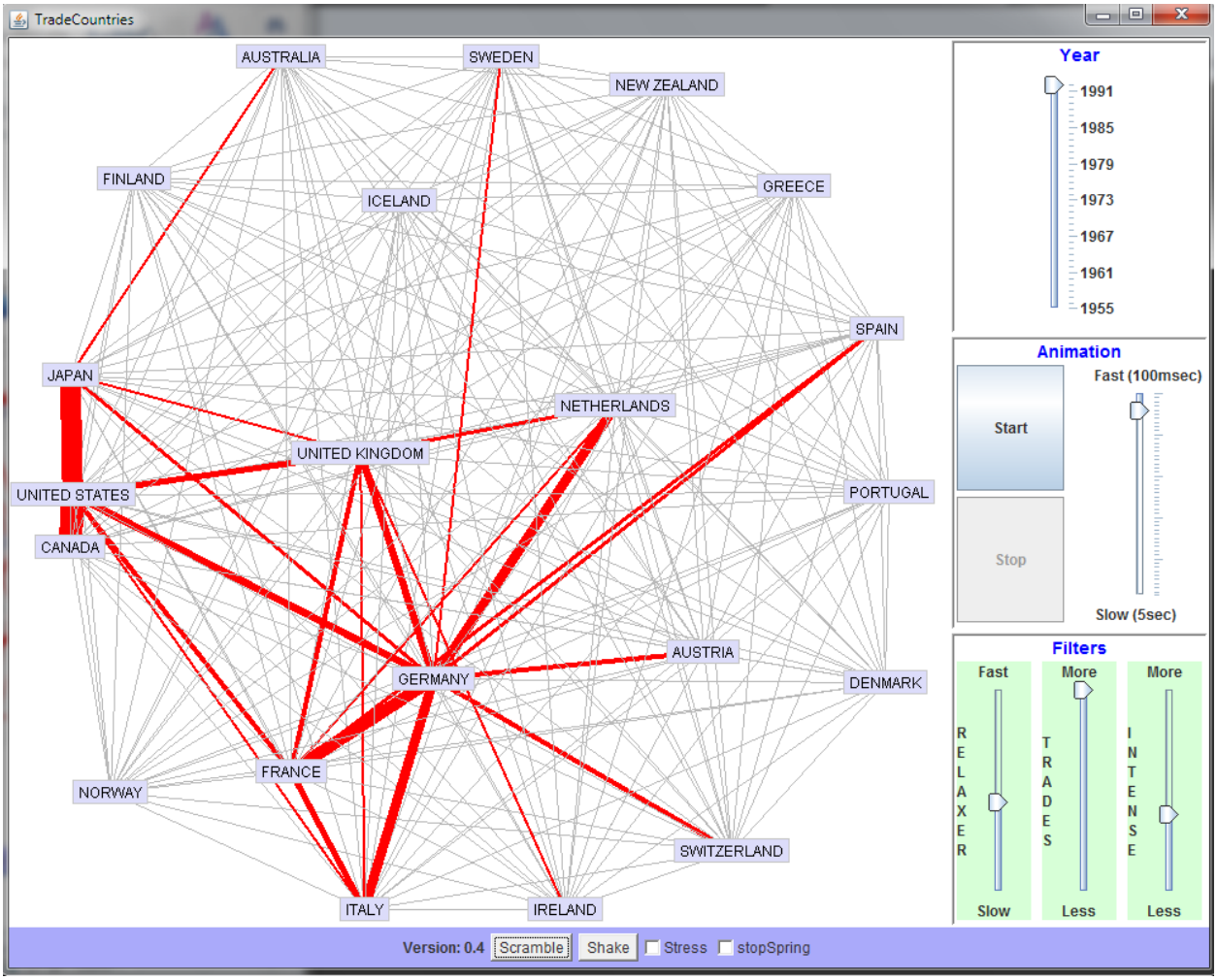

Figure 1. TradeMapper visualization and interface.

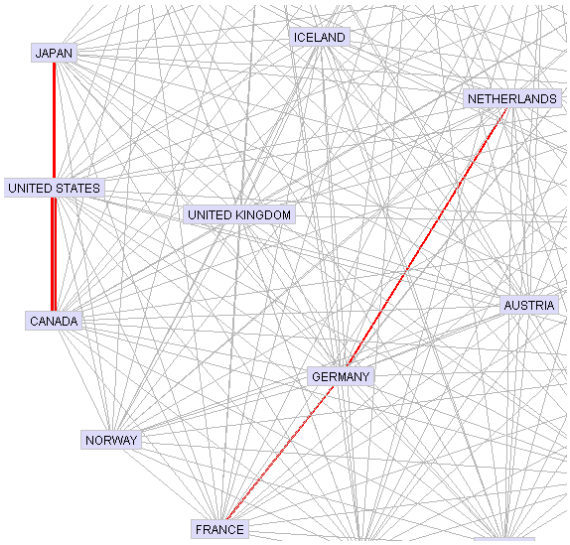

Figure 2. In 1970, the United States is shown to be a world hub for trades.

Where in the 1960's and 1970's (illustrated in figure 2) the United States was unarguably a world hub for trade, now massive flows of trade are moving within specialized trade blocs and the United States is diminishing in overall importance and centrality to the flow of world trade [3]. This can be shown in TradeMapper.

A network view – as opposed to a standard non-relational line chart of simple trade volumes – adds critical dimensions and interactivity to the typical presentation of trade data. In a classroom or remotely on the web, business faculty and students can explore, discuss and reveal interesting longitudinal patterns in world trade as part of discussion about the changing business environment for industries and entrepreneurial opportunities.

Figure 1 shows trade relationships among the Top 25 industrialized countries in 1992. Closeness between countries in the network diagram signifies these countries are major trading partners. The thickness of the red line also indicates the overall volume of trade, considering total imports and exports between the two countries. As one can see, in 1992, the U.S., Japan and Canada make up a large and tight trading bloc. These countries import and export a tremendous amount of goods from each other. As such, the countries appear in close proximity to each other on the network map. Germany--shown centrally in the diagram-- trades in high volumes with many countries and therefore appears nearer to the center of world trade. These patterns fit with Germany's reputation as an industrial powerhouse of Europe and the world. As shown, Germany is more central in the overall world patterns of trade than the U.S. for instance, which may be surprising to a business student. Germany's large trading partners include France, Sweden, the Netherlands, Italy and Spain. The United Kingdom has strong trade relations with the United States as well as with France which positioning it as a broker between Europe and North America.

TradeMapper, a java-based tool, may found at http://faculty.cs.wit.edu/~ldeligia/PROJECTS/TRADE. The same website also has a short demo video showing usability of the tool. Looking at the top right of the graphical user interface (Figure 1), if one drags the "year" slider, say from 1955 to 1965, the countries reorganize to show the evolving strength/volume of trade ties during that decade which looks quite different than the diagram of 1992 above. Next, the user can initiate an animation, or "movie", of evolving trade by hitting the start button in the animation window and control the speed of the animation. At the bottom right, the user can filter in or out countries (i.e., nodes in the network map) by setting minimum trade volumes, which is dynamically rendered in the main window. Finally, the user can control the strength, or forcefulness, or trade ties with the "relaxer" to influence the speed at which the network optimizes the network layout. This function is interesting because year-over-year animation renders different "transition states" where countries are looking to move and establish new positions based on changing trade patterns. Collectively, the user has the experience of controlling the key parameters (year, minimum trade threshold, and the forcefulness (or relaxedness) of the network ties, which gives the user authorship in examining or presenting key facets of the data. As such, TradeMapper is both a tool for personal visual knowledge discovery but also a potential collaborative platform to present and even debate trade dynamics.

2. E-LEARNING

Clark and Mayer [4] define e-learning as:

> *instruction delivered on a digital device such as a computer of mobile device that is intended to support learning*.

They specify that e-learning *uses media elements such as words and pictures to deliver content* and *may be instructor-led (synchronous e-learning) or designed for self-paced individual study (asynchronous e-learning).* Our tool, TradeMapper, is decidedly visual but the technology and suggested educational applications line up with common definitions or requirements of e-learning.

E-learning can facilitate online as well as face-to-face community by offering a shared reference for discussion and analysis [5]. The goal of e-learning often is exploit the capabilities and efficiencies of technology to create new, valuable learning experiences. These include, but are not limited to, new educational and interaction experiences for students, new means of sharing and assessing ideas within an educational group, and novel approaches to scale or save costs on curricula and programs. Key challenges in realizing the benefits of e-learning include the user-friendliness of e-learning platforms and tools, and the costs and complexity to develop and maintain e-learning systems.

While TradeMapper is an idiosyncratic type of e-learning tool, it is also an example of interactive information visualization [6]. Interactive information visualization, often called just information visualization, is its own research community focused on the amplification of cognition through controllable, data-rich, visual interfaces [6][7]. It is an outgrowth of research on visual perception, graphic design, information design, and human-computer interaction. More than other fields, information visualization wrestles with the usability merits of representing data in two dimensions (i.e., in X-Y space) versus three dimensions (in X-Y-Z space). TradeMapper is a two-

dimensional visualization, although it is possible to arrange changing trade networks in three dimensions. This stated, recent research shows that two-dimensional visualizations are often more comprehendible by the user and lead to better outcomes [9] [10] [11].

3. IMPLEMENTATION

By applying a network layout algorithm and creating user controls, TradeMapper shows the bi-directional flows and value of trade between the Top 25 industrialized countries, where countries which move closer to each other intensify trade relations during a selected time period. The legend in Figure 1 details how to use these relatively simple controls. As shown in figure 3, the thickness of the lines (or ties) between countries illustrate the total combined value of imports and exports between any two countries.

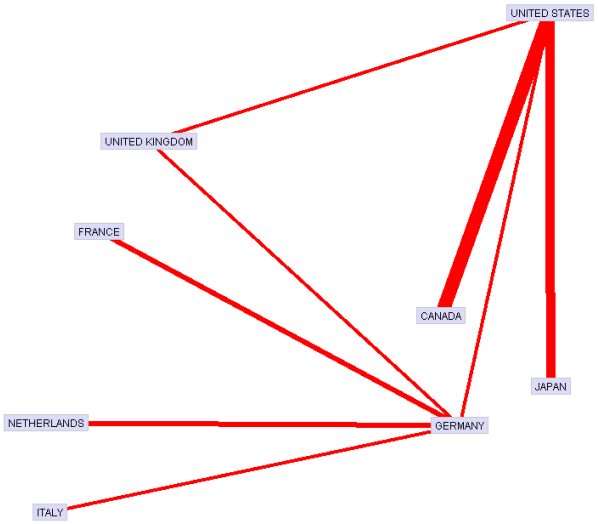

Figure 3. Showing countries involved in heavy trading, and their relationships between them (in 1982). Low trading countries are filtered out. The thickness of the line indicates the ties between countries; the thicker the line the greater the combined value of imports and exports between the two countries.

Using the animation function, the user can play a "movie" and see shifting patterns of world trade including the emergence of trading blocs for the past 60+ years. Additionally, using sliders, the user can drill down and focus on a snap shot or subset of relationships in world trade. TradeMapper is implemented entirely using Java and can be accessed online using WebStart technology.

4. CONCLUSIONS AND FUTURE WORK

In this paper we introduce TradeMapper, an e-learning and visual knowledge discovery tool with data exploration and animation capabilities. The tool is designed to be used by entrepreneurship and management educators and students to show and understand the dynamic nature of the global trade between WWII and the last decade.

Our work with TradeMapper is ongoing. Our next step is to evaluate TradeMapper's effectiveness as a teaching tool in real-life classroom settings. Part of this study may involve a direct comparison of TradeMapper versus static network graphs generated by NodeXL or Tableau. Likewise, we believe a head-to-head comparison versus traditional, non-interactive time series charts rendered by Excel will clarify the value of TradeMapper. A key question remains, does the interactivity and layout of the data affect the speed and accuracy of comprehension for general and specific global trade relationships? Relatedly, are there ways to more quickly situate entrepreneurship and management students in the global realities of word trade, cross-border entrepreneurial opportunities and international competition? We would like to evaluate TradeMapper versus other ways of presenting data on global trade and see what is most effective both in a face-to-face as well as distance-based education environment.

In the future, visualization-based e-learning tools such as TradeMapper might be used for extrapolation to consider emerging trading relationships on the globe. While this study only examines combined total trade values, i.e., the total of combined value of all imports and exports between two countries, new layers highlighting dynamics in particular global industries can be added and interrelated (e.g., the global biotech industry, the automotive industry, the mobile phone industry). We hope that students will be able to engage in discussions and explore different aspects of the trading countries' relationships. TradeMapper can be a vehicle for students to explore and convey complex global contexts for entrepreneurial and managerial action.

ACKNOWLEDGEMENTS

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Improvement of Skills and Knowledge Via e-Training Programs

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Abstract

This paper describes the employees' skills and knowledge progress through several virtual courses (e-Training) coordinated by an American County Appraisal District during the period 2000-2010; where, each employee must maintain updated his/her state-license and as well as the overall employment requirements with the District. A nonparametric statistical technique named bootstrap method was selected (whose justification is explained) to perform the data analysis. This report focuses on the statistical summary of the employees' performance through course examinations, and as well as on the linear tendency of the annual labor turnover ratio %; a diagram of parameters is shown to facilitate the comprehension of the factors involved in the learning-training process; which is an activity intrinsically related with the intellectual capital of an organization.

Key words: e-Training, e-Learning, Internet, bootstrap method, parameters diagram.

1. Introduction

The purpose of this article is to describe some relevant aspects of the e-Training programs, and to get the right conclusions from an appropriated statistical analysis about the data generated from a sample of employees that had been participating in an e-Training program during a period of 11 years (2000-2010).

The term "e" of e-Training meant to be electronic, just like every other e (i.e. e-Commerce, e-Business, etc.); and the span of electronic in the term e-Training can include: Internet, intranet, extranet, satellite broadcast, audio/video tape, interactive TV and CD ROM.

Teaching involves the transfer of knowledge and feedback at two levels: group communication and individual communication.

The virtual courses provide the opportunity to obtain a professional training when face-to-face training and geographical, physical and schedule limitations exist; but some employees without this kind of limitations are using this resource expecting easy courses, less assignments, or less effort; and in this way to obtain a higher examination grade. Thus, the virtual courses are real academic challenges for all trainers, whose priority is to offer high-quality training maintaining an ethical and professional environment.

First was the arrival of the computer and later on the appearance of Internet; but, before the communication via Internet, the "distance learning" courses were provided by correspondence (mail); the technology is periodically and progressively changing our knowledge; the technology has always been the changing force for mankind [[3] Close 2000]. Now the Internet combined with other technologies enables any person to have access to a never-ending process of information and knowledge.

The technology and the Internet empower individuals and facilitate a more active position in the e-learning and e-training process.

Some of the advantages of taking virtual courses are the convenience and the flexibility for studying from any computer at any time and any where, which permits to comply with working, personal and family responsibilities; but the most notorious disadvantages are the lack of interaction with trainers, advisors and job-mates, the lack of updated computing equipment (hardware & software) and the lack of self-didactic skills (the discipline of reading). The trainers/advisors provide power-point and audio presentations for the lessons, but it do not make up for the lack of a lecture; because most of the power

point presentations are taken directly from the manuals. Therefore, reading is an essential part in being successful in virtual courses. About not-frequent disadvantages, we can mention the lack of computer knowledge from employees, the slow e-response time from advisors and the lack of reading's skills [[12] Steen 2006]. In addition, the exams will be held under controlled conditions of place, date and time.

2. Interactive Software

The major objective of interactive software is to provide to the learners with an understanding of how to interpret results, and how to solve problems (*basic competences*) as applied to job scenarios. In general, the selected software should run in different modes**:** First, using the instruct mode, the user gain an understanding of the technique and/or methodology. Second, using the practice mode, the participant gains the mastery of the technique with hints and help available to assist his/her training. Third, using the certify mode, the user are required to obtain his/her certificate indicating mastery of the topic without help or hints. At the end of a time-period of training, the employee will be credited for each certificate earned. The total credit will be equal to a specific percentage with each certificate carrying a specific weight.

3. e-Training and Technology

The term e-Training can include Internet and several more electronic media technologies; of course, in this world of global communications, other factors affecting the e-Training activity are the virtual teaching styles/techniques as well as the social environment (see Figure 1).

Cisco Systems is one of the largest corporations of e-Training users (technical participants) that explains its compromise with the e-Training's components, where "components" can include content delivery in multiple formats, management of the training experience, and a networked community of learners [[6] Crews 2012], content developers and experts. e-Training provides faster learning at reduced costs, increased access to learning, and clear accountability for all participants in the learning process. In today's fast-paced culture, organizations that implement e-Training supply their work force with the ability to turn change into an advantage [[9] Kirschner 2001].

In this context the differences between e-Training, and online-training should be noted**:** e-Training represents the whole category of technology-based training, while online-training is synonymous of a web-based training; in order to be more precisely, an online-training is in fact a component of e-Training. Thus, we can sketch a definition of e-Training as any combination of virtual teaching methods and styles supported by different electronic media technologies including Internet [[10] Pena-Sanchez, 2007], Intranet, Extranet, Satellite Broadcast, Audio/Video Tape, Interactive TV, CD ROM, etc.

e-Training helps us increase access to training and ensure that it is immediately relevant and cost-effective. Some advantages of an online-training include: Anywhere, Anytime, Anyone: e-Training is available 24 hours a day, around the world. Organizations can distribute training and relevant information to multiple locations easily and conveniently, allowing employees to access training at their convenience.

Training Definition: *"Organized activity aimed at imparting information and/or instructions to improve the recipient's performance or to help him or her attain a required level of knowledge or skill"*.
Source:
http://www.businessdictionary.com/definition/training.html

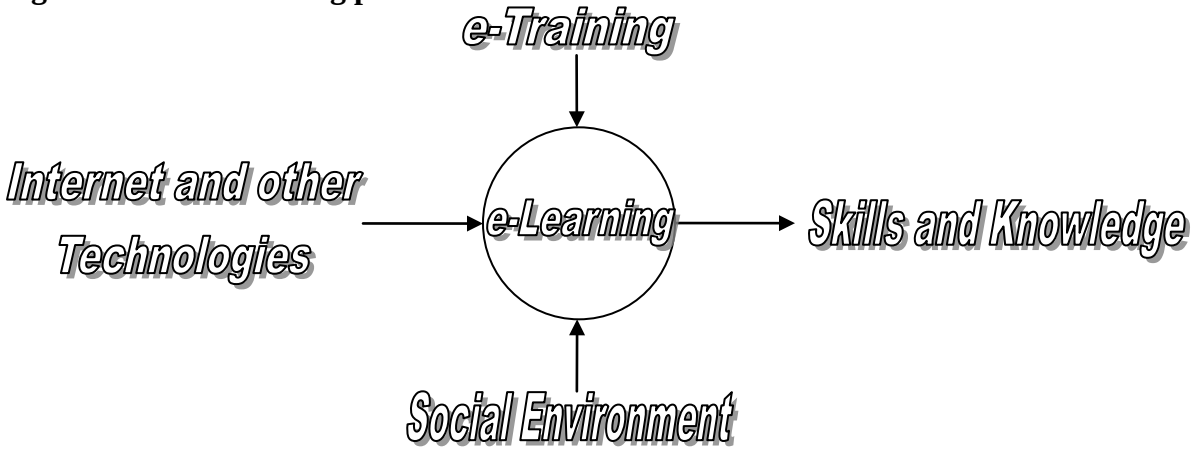
Since geographical and time barriers are virtually removed, e-Training is no longer limited to a few people who can travel to a seminar or conference. e-Training can occur throughout organizations and e-collaborative [Kock 2005] individuals, accelerating the transfer of knowledge, and transforming training from an isolated example of qualified development into a powerful tool for managerial decisions.

4. Research Hypotheses

The following hypothesis uses the employee performance through the examination on the virtual-courses taken by the employee, where the dependent variable is his/her percentage (%) of correct answers. In all organizations if the employee score is less than a specific minimum sufficient score (say a M %), then the employee must be rescheduled to retake the virtual-course and its correspondent exam until he or she will be reaching or exceeding the M % score; thus, the research hypothesis is

$$H_{A1}: \mu < M\ \% \qquad (1)$$

Figure 1. The e-Learning process and its related factors



Where μ represents the average percent of correct answers, which can be associated to the effectiveness average of the training program for all employees. Then, the corresponding null hypothesis is

$$H_{01}: \ \mu \geq M\ \% \qquad (2)$$

The manager of the human resources department in collaboration with his/her training coordinator will be defining the M % score for each virtual-course.

Year after year (from 2000 until 2010) the ratio of the number of removed employees (terminations) from his/her organization to the number of employees on payroll (positions) [[2] BLS 2012] during the same year represents a measure of the labor turnover (LT)**:**

$$LT = [\text{Terminations} \div \text{Positions}] \bullet 100 \qquad (3)$$

We want to test the assumption or hypothesis that during the last five years the e-Training program has been reducing the labor turnover ratio in this organization; clearly, the dependent variable will be labor turnover proportion; whose reduction can be measured through a negative change in its linear tendency. Consequently, the second research hypothesis is

$$H_{A2}: \ \beta_{2006\text{-}2010} < \beta_{2000\text{-}2005} \qquad (4)$$

Consequently, the appropriated null hypothesis is

$$H_{02}: \beta_{2006\text{-}2010} \geq \beta_{2000\text{-}2005} \qquad (5)$$

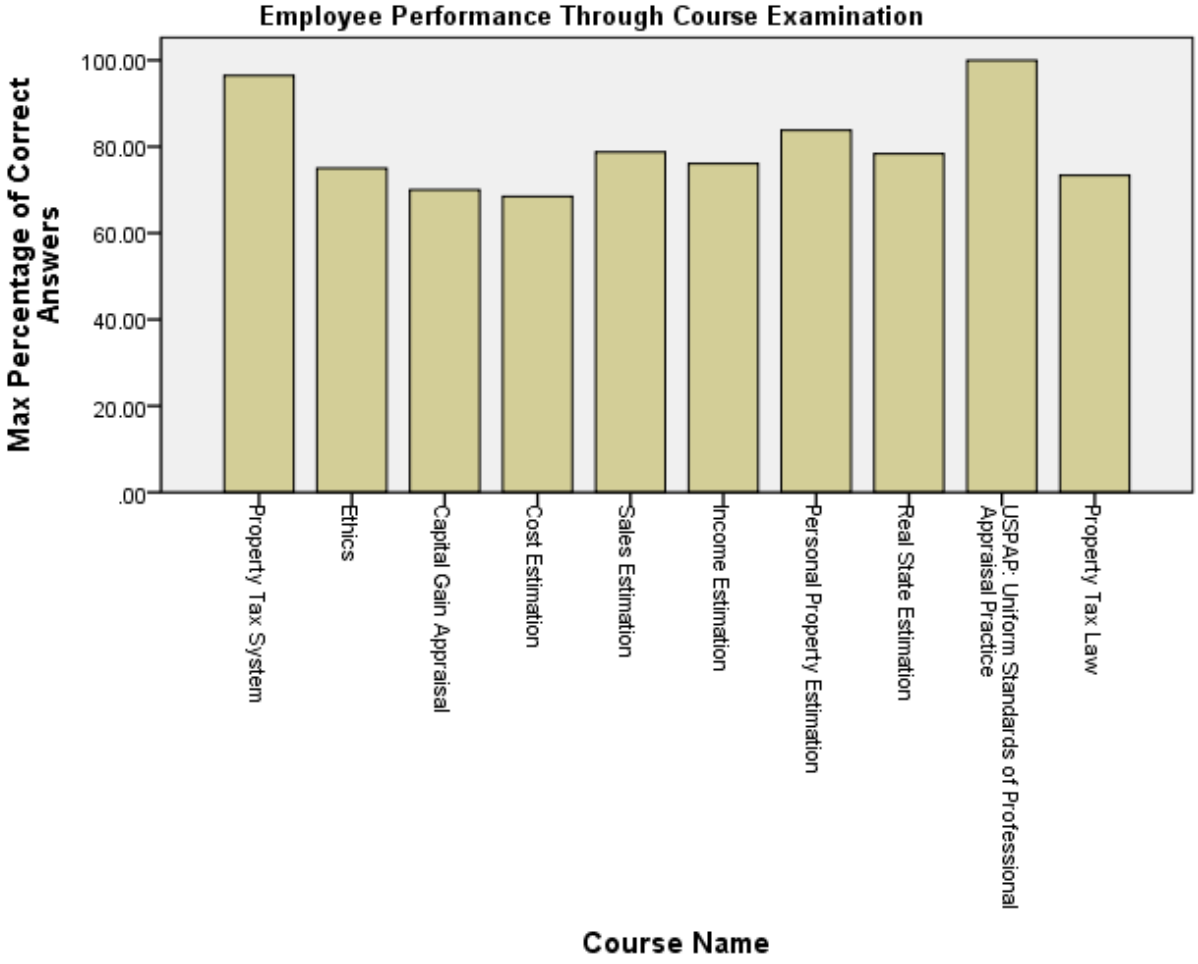
Where, β represents the slope of the linear trend for the labor turnover percentage at the specified period of time.

5. Data and Methodology

A sample of 11 years with an average of 51 employees per year (and a standard deviation of 6 employees per year) at an American County Appraisal District was used to test the previous hypotheses. The first dependent variable corresponds to the employees' final score reported as the percentage of correct answers per course examination, for 10 different courses [[13] USPAP 2008], the course names are shown in Figure 2; this percentage can be viewed as a measure of the effectiveness of the training program. The second dependent variable is the labor turnover ratio during a period of 11 years from 2000 to 2010, where each employee must maintain updated his/her state-license and also his/her overall employment requirements with the District [[1] Borchard 2012].

To avoid any conflict related to the lack of fulfillment at parametric assumptions**:** Normal distribution of the dependent variable, homogeneity of variances, etc.; we have been decided to test the previous null hypotheses through a nonparametric technique [[5] Conover 1999] named *bootstrap method*.

Figure 2. Percentage of Correct Answers per Course Examination



6. Statistical Analysis

Table 1 contains the bootstrapped results for the variable Percentage of Correct Answers; where the lower limit of the 90% Confidence Interval bootstrap estimate is **75.1140**; and so, the first null hypothesis will be rejected for any **M** score less than **75.1140**, at a significance level of α=0.05; this is because working with a **90 % CI:** each curve-tail has a half alpha value of 5 % or 0.05 as probability measure.

Similarly, Table 2 indicates that the first null hypothesis will be rejected at any M score less than **74.02781**, for a significance level of α=0.025.

To test the 2nd null hypothesis we decides to estimate the bootstrapping statistics for the linear regression slope of the labor turnover ratio using the factor time in years as the independent variable; the years 2000-2010 were relocated with values from **1 to 11** respectively. Figure 3 contains the information associated to the 2nd null hypothesis. The Tables 3 and 4 contain the bootstrapped statistics estimates of such linear regression slopes for periods 2000-2005 and 2006-2010 respectively.

As we can see on Table 4 the 2nd null hypothesis can be rejected, given that the lower (**-12.980**) and the upper (**-4.830**) limit for the slope during period 2006-2010 shows both negative values, which is an indication of a negative tendency (or reduction) for the labor turnover ratio at this segment of time; while, during the period 2000-2005 Table 3 shows a negative lower limit (**-1.940**) combined with a positive (**7.531**) upper limit; therefore, the data indicate that there is no linear trend ($\beta \approx 0$) for the period 2000-2005.

Table 1. Bootstrapping statistics for the variable Percentage of Correct Answers for a 90% Confidence Level.

	Mean Estimate	Bootstrap for One-Sample Test [a]				
		Bias	Std. Error	Sig. (2-tailed)	90% Confidence Interval	
					Lower	Upper
Percentage of Correct Answers	80.02300	.03386	3.19462	.001	**75.11400**	85.73024

a. Bootstrap results are based on 1000 bootstrap samples

Table 2. Bootstrapping statistics for the variable Percentage of Correct Answers for a 95% Confidence Level.

	Mean Estimate	Bootstrap for One-Sample Test [a]				
		Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Percentage of Correct Answers	80.02300	-.07338	3.13597	.001	**74.02781**	86.50655

a. Bootstrap results are based on 1000 bootstrap samples

Table 3. Bootstrapping statistics for the linear tendency of the labor turnover ratio from 2000 to 2005.

Model: $\hat{y} = \beta_0 + \beta_1 t$, $1 \le t \le 6$	β Estimate	Bootstrap for Coefficients [a]				
		Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
β_0	22.597	-.737	9.298	.114	8.622	40.195
β_1	1.507	.330	2.628	.426	**-1.940**	**7.531**

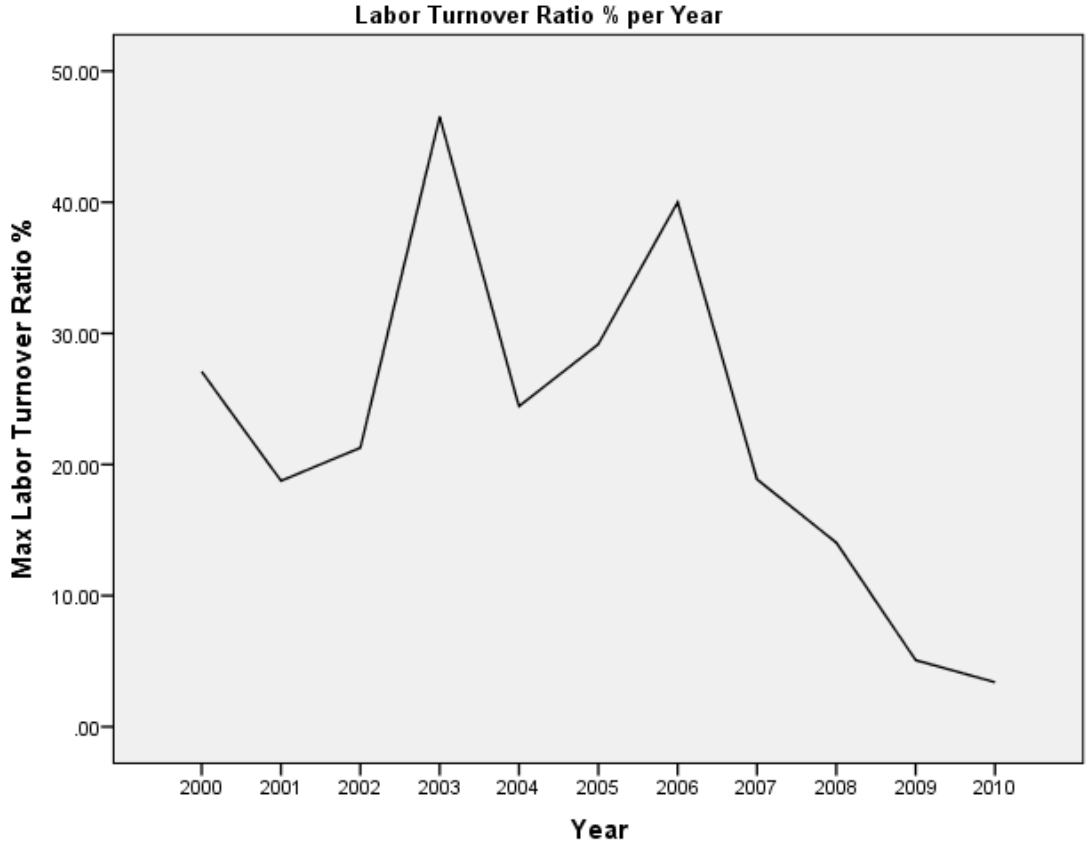
a. Bootstrap results are based on 1000 bootstrap samples

Table 4. Bootstrapping statistics for the linear tendency of the labor turnover ratio from 2006 to 2010.

Model: $\hat{y} = \beta_0 + \beta_1 t$, $7 \le t \le 11$	β Estimate	Bootstrap for Coefficients [a]				
		Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
β_0	94.585	-1.957	25.120	.138	56.512	130.860
β_1	-8.701	.075	2.775	.194	**-12.980**	**-4.830**

a. Bootstrap results are based on 1000 bootstrap samples

Figure 3. Annual Labor Turnover ratio



7. Conclusions

Our conclusion supported by a nonparametric statistical analysis through the bootstrap method is that the effectiveness of a training program measured as the employee performance depends on several factors (see Figure 1), whose optimal combination in general produce tangible benefits.

The first null hypothesis, where the dependent variable is the percentage of correct answers, can be rejected for any M score less than the lower confidence limit (**75.1140** at α=0.05; or **74.02781** at α=0.025); consequently we can conclude that for those employees whose percentage of correct answers is equal or exceeds to M should not be required to retake the exam (Tables 1 & 2); meanwhile, for the 2nd null hypothesis, where the dependent variable is the labor turnover ratio, Table 4 shows a decreasing linear tendency during the last five years (2006-2010), which can be interpreted as a reduction on the labor turnover, provided that both limits of the confidence interval for the slope appear as negative estimates; the diminishing behavior of the annual labor turnover ratio since 2006 is exhibited in Figure 3.

From Figure 1, we have a new perspective**:** We can see or perceive the **Internet** as the **"New Virtual Industrial Revolution"**.

One the contributions of this article is precisely Figure 1, which is presented as a diagram of "parameters"; this diagram enables a research team to identify and review signal factors (Internet and other technological tools), control factors (e-Training methods), and noise factors (social environment) that affect the e-Learning activity. This result in creating an understandable and well-defined e-Learning function in terms of a measurable objective**:** the improvement of skills and knowledge.

8. Recommendations

Given that "e-Learning" can be viewed as a process in which the learners increase their skills and knowledge (see Figure 1); by experience, we can say that the lack of skills as a self-didactic is a critical

factor for to be a successful online learner. Therefore, before initiating a virtual course [[13] USPAP 2008], we recommend reinforcing such abilities**:** habit for reading, reduction and/or elimination of distractions, optimal time-planning to meet the technical prerequisites [[14] USPAP 2012], to attend the induction provided by the e-Training supervisor, etc.

Some quantitative oriented courses (cost estimation, income evaluation, etc.) are difficult because they contain formulas and it would be better to see an instructor explaining his/her interpretations and applications during a classic training, than to read about the subject matter in a manual or handbook.

9. Directions for Further Research

These findings should influence both administrators and instructors about their choice for some software and/or technology to support technical learning [[7] Hilton 1999]. As instructors we all should seek the most effective and efficient tool for basic competences, as well as for e-collaborative tasks [[8] Kock 2005].

It is hoped that this paper will foster more research into the relationships between software diversity, e-communication [[4] Clyde 1999] and academic tasks for e-Learning purposes, so that more effective and efficient decisions will occur both in universities and organizations [[11] Sitkin 1992].

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Satisfaction of Learners in the Online Learning Environment

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Abstract - *In the past few years the number of courses offered online has greatly increased as technology has made delivery of such courses more feasible. The aim of this study is to investigate the satisfaction of students taking online course and using an online learning environment. Participants were 24 undergraduate students, between the ages from 17-29 years old. For the data collection at the end of the course, students completed a questionnaire to evaluate their satisfaction about the online learning course. Students' satisfaction had been acknowledged as an important factor in order to measure the effectiveness of an online course. Data analysis showed that perceived e-learner satisfaction was higher than the average, indicating students' high satisfaction with the overall learning experience.*

Keywords: Learner, satisfaction effectiveness.

1 Introduction

The debate over the merits of online learning has come to the forefront of research with the substantial increase in the number of online courses offered at universities worldwide. Moreover, online course delivery became significant in the educational process. The delivery systems such as Blackboard/Moodle are employed to deliver the course by adding an online component to traditional course.

The developments of technology in the Kingdome of Saudi Arabia and the rapid adoption of technological solutions in every aspect of education may necessitate a paradigm shift in our understanding of the educational experience. More importantly, the impact of online courses on the learner has not been examined to a great extent. Proserpio and Gioia (2007) believe that this generation should be termed the *virtual generation*. They assert that today's learner is much more interested in online learning, given the focus on living their lives in the virtual world, with cell phones, texting, instant messages, and social networking.

In addition, many developments of online learning often appear as electronic versions of traditional courses. Many researchers are arguing that online learning environments should provide active and engaging activities for students (Collis, 1997; Duschatel, 1997). In particular, learners should have the opportunities to construct knowledge rather than just being exposed to the transmission of knowledge. Some important questions arise: do learners expect such online learning environments? Do they receive the sufficient level of motivation? This paper describes a study to measure the satisfaction of learners attending an online course.

2 Satisfaction in the Online Learning Environments

Research on online learning in general reported high levels of students' satisfaction with the courses (Collins, 2000; Fredericksen, et al. 2000; Motiwalla and Tello, 2000; Oliver and Omari, 2001). Moreover, in their studies of thirty-one online courses, Motiwalla and Tello (2000) found that the students appreciated the flexibility of accessing the courses anytime and anywhere. Likewise Wegner et al. (1999) reported that 21% of the students in their study of an online course stated that the convenience of not having to travel and having flexible study hours was an added advantage.

Results from a study of Matuga (2001) showed that strategies used within regular classroom environments did not appear to work in online courses. One learner exclaimed: "*I have learned that self-motivation is something that I really have to work on when I am really busy with lots of things. It is really easy to say that I will do this stuff tomorrow, and then never do it tomorrow because I do not have a classroom to go to. I think I will focus on why I want to learn this stuff, rather than just getting it over with because it is a requirement for my major.*" Carswell (2000) compared a traditional course and another version of the course using the Internet for communication. The learners felt that they gained valuable experience in using the Internet and its associated tools. Likewise, Collins (2000) reported that learners enrolled in an online course also commented that they had gained experience with the Internet and email. In general, learners were tolerant of technical problems, as long as they are solved. Although learners did experience problems with modems, lost lines and servers but they accepted this as a fact of life (Carswell, 2000). However, Horvath and Teles (1999) concluded in their study that problems with the computers generated high levels of frustration and anxiety. Learners' difficulties were caused not only by the lack of computer/technical and skills

to solve the problem but, more importantly, by the elevated level of anxiety which blocked rational behavior. The learners tend to feel embarrassed in response to these problems (Carswell, 2000; Horvath & Teles, 1999).

In their study, Oliver and Omari (2001) found that the majority of learners saw value to be gained from, and appeared satisfied with, their learning experience. However, for nearly 50% of the learners, this was not their preferred form of learning. Similarly, the majority of learners stated a level of enjoyment in the online learning environment but nearly 50% again said they would prefer to work alone rather than in group.

According to Proserpio and Gioia (2007) study, learners of recent generation dislikes group projects that require face-to-face meetings and prefer using groupware software and the Internet. Obviously, not all learners are completely experienced with the Internet. However, if learners are accepting the technology involved in online courses, and experiencing its' flexibility and ease of use, it follows that they should be more satisfied with, and committed to, the course.

3 Methodology

In this study we conducted a survey targeting 24 learners attending an online course in higher education. There was an initial face-to-face meeting for the learners to get to know each other and the instructor, the structure of the course, and to be familiar with the key features of the online system. Subsequently there was a face-to-face lecture at the end that enabled the instructor to obtain feedback.

Data was gathered by the end of the semester through a questionnaire. The questionnaire measures the learners' perceptions of the course, learner-learner and learner-teacher interactions. For each of the statement, the learners had five choices (5-point Likert type scale) anchored with the statements "Strongly Disagree" = 1, "Strongly Agree" = 5, and "Neutral" as the mid-point. Questionnaire is shown in Appendix A.

4 Results and Discussions

A total of 24 questionnaires returned, and overall 11 (45.8%) students reported their age as being 17-19 years old, 7 (29.1%) were between 20-22 and 3 (12.5%) were between 23-25 years old, and 3 (12.5%) students were between 26 and 29 years old. Moreover, answering the question about how many times students access the online learning environment, 19 (79.1%) of the students reported using it every day, 3 (12.5%) were using it three times every week and 2 (8.3%) twice times a week. The percentages of students' and their access to the online learning system are displayed in figure 1.

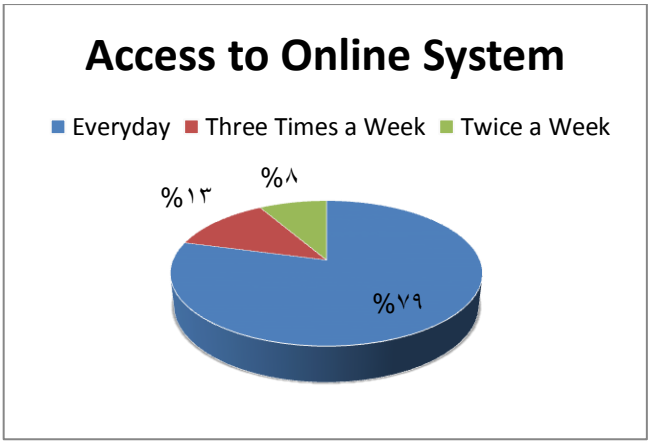

Figure 1: Access to the Online Learning Environment

Results, shown in Table 1, indicate that the majority of learners were satisfied with the online course. In fact, only 8.3% of learners disagreed on recommending this course to other learners, while another 8.3% stand in the middle. Also, about 85% of the learners are willing to take other online courses.

Table 1: Results of the Questionnaire

Statements	1	2	3	4	5
The course provides a satisfying learning experience.	-	-	3	9	13
The course is an interesting one.	-	-	2	10	13
The course does a good job of developing my skills	-	1	4	8	11
The course is more satisfying than traditional courses	-	1	2	11	10
I am willing to take another similar course on another topic	-	2	2	10	11
I will recommend this course to other students	1	1	2	9	11

Students' satisfaction had been acknowledged as an important factor in order to indicate the effectiveness of online courses and programs. Although students' satisfaction hadn't necessarily been associated with achievement, satisfied students are motivate and are more likely to accomplish their goals.

5 Conclusion and future work

The purpose of this study was to investigate the satisfaction of students in the online environment, and how students perceive the online course offerings. Researchers pointed out that students with more exposure to online learning settings were more likely to express greater satisfaction with the learning environment than with traditional courses (Arbaugh,2004; Flowers, Moore III, and Flowers, 2008). Only about 17% of the students expressed a negative/neutral opinion about the possibility of attending an online course in the future. In future work we will create a typical model to consider being as a guidelines to measure learner's satisfaction during the e-learning process.

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7 Appendix A

Your Age: **17-19** **20-22** **23-25** **26-29** **more than 29**						
How many times you access the online learning environment? **Everyday** **3 times a week** **2 times a week** **once a week** **less than once a week**						
Please Rank the following:						
	Disagree		→		***Agree***	
The course provides a satisfying learning experience.	○	○	○	○	○	
The course is an interesting one.	○	○	○	○	○	
The course does a good job of developing my skills	○	○	○	○	○	
The course is more satisfying than traditional courses	○	○	○	○	○	
I am willing to take another similar course on another topic	○	○	○	○	○	
I will recommend this course to other students	○	○	○	○	○	

ACO-driven Personalized E-learning with Perspectives and Learning Aims

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Abstract *– A proposal scheme to personalize students' learning based on her learning aim in an e-learning environment. The system acknowledges a distinct set of students' aims that prioritize various Learning Objects (LOs) such as theory, case studies etc. according to student's Learning Aim (LA). We also propose a new way to model the course as a directed acyclic graph in which nodes at each level represent a collection of different perspectives for the same concept. All concept perspectives encapsulate a set of LOs. This allows students to strengthen their learning along both dimensions; depth of coverage as well as perspective breadth by suitably adding to her repertoire of multiple viewpoints contributed by different authors on the same concept. This paper illustrates an Ant Colony Optimization (ACO) based personalized e-learning scheme to generate an initially optimized path taking into account the priorities of learning objects and the contribution of concept perspectives for different learning aims.*

Keywords: Personalized E-learning, Learning Objects, Learning Aims, Ant Colony Optimization, Directed Acyclic Graph, Concept Perspectives

1 Introduction

The Internet has become a centerpiece of a learner's educative environment, allowing her to learn at any time and any location conveniently [1]. Acknowledging the difference between diverse users' learning aims and their characteristics necessitate the need to create personalized environment for learning. A Personalized e-learning system tailors the courses according to individual users' requirements and preferences. Enormous work has been done in the field of personalized e-learning based on user profiles [2]. The profiles determine student behaviors that guide the e-learning system in generating a personalized path for each student.

An immense variety of learning material as well as different student's learning preferences drives the need for more and more sophisticated personalization techniques and ideas. Studies mainly emphasize on adaptation of course material based on user's learning style, background, qualification and experience [3, 4, 5]. Existing systems do not recognize the relevance of ordering various LOs according to users' Learning Aim (LA).

As an example to explain the motivation for the work in this paper, let us suppose that a learner's aim for taking up a course is to carry out project work. Then the priority assigned to the various LOs may be ordered as: detailed theoretical concept, case study, and simulation. Another user who aims at gaining cursory knowledge on the subject can choose basic concepts followed by an example. Therefore, we need to bring in the primary aim of learning as a steering factor for personalizing a course.

Further, for each concept that is part of the syllabus for a course, it can be explained by different authors from their own individual perspectives. Moreover, new perspectives that emerge when progress is made in the field must be added so that the course is regularly updated. On one hand, this allows the course to be enriched greatly by incorporating diverse ideas and viewpoints from different authors honed by individual experience. On the other hand, this also benefits learners by gaining maximally from the repository of perspectives according to their own needs, interests and time constraints. An optimized selection of these perspectives allows the learner to broaden her vision by studying different interpretations, thereby broadening her vision and augmenting her learning achievement. This paper proposes a framework that emphasizes the significance of user's LA while selecting the LOs as well as adding to the kitty of perspectives for grasping a concept.

Section 2 presents a discussion of related work. Section 3 introduces the proposed framework for an e-course and implementation of Ant Colony Optimization (ACO) based personalized learning path generation. In Sections 4 formalizes the experimental results. Section 5 discusses the simulation results. In Section 6, we conclude the paper and give directions for future work.

2 Related Work

The domain of personalized e-learning has benefitted from significant contributions made by different authors. Marwah et al. (2009) represented the content structure as a Directed Acyclic Graph (DAG) of LOs [6]. They proposed an algorithm that works on Elimination and Optimized Selection (EOS) to generate an adaptive learning path. The authors assess the concept relevance in the specific domain to recommend appropriate concepts to the user.

Wong et al. (2009) introduced a course sequencing technique that exploits rule-based prescriptive and ACO based inductive planning [7]. They developed DYnamic Learning Path Advisor (DYLPA) to provide recommendations for most appropriate learning pathway for the learner. Inductive

mechanism of DYLPA identifies similar learners from user logs and induces a suitable path for the new learner.

Marquez et al. (2008) structured the course in the form of sequencing graph in which the pedagogical team decides the sequencing of children according to course requirements [8]. This paper describes a way to generate learning path using ACO keeping the assistance provided by a pedagogical team through Bayesian Networks (BN).

Fung et al. (2011) employed a concept clustering technique to group similar concepts and determine precedence between various course modules [9]. The precedence relation information is then passed to a GA to optimize the learning sequence of relevant course modules.

Bhaskar and Chithralekha (2010) identified various LOs such as concept, example and case study of the course based on user's intentions and preferences [10]. The system sequences these LOs according to psychology of the learner. The authors make use of GA to generate a learning path accommodating learner's content, presentation and media level contexts.

Acampora et al. (2008) defined the course in an ontological form in which various concepts are connected through three types of relations: the *Has- Part*, the *Is-Required-By* and the *Suggested-Order* [11]. The proposed system exploits memetic algorithm to determine an optimized path from the defined ontology.

Azough et al. (2010) implement Genetic Algorithms (GA) to establish an optimal path adapted according to learner's profile [12]. The generated path satisfies the pedagogical objectives set by the experts for the course.

Hong et al. (2005) utilized the cosine similarity measure to determine the degree of relatedness between the concepts [13].The cosine similarity measure takes into account the term frequencies as well as the Importance weights assigned to concepts. These relations are then passed to a GA to determine the optimal learning path for an individual learner.

Liu and Yang (2005) proposed an Adaptive & Personalized e-Learning System (APeLS) that represents the course in the form of dual weighted directed graph [14]. Each node represents a learning object and its weight signifies the required learning time as defined by the experts. Directed edges express the precedence relationship and their weights imply the difficulty level from one node to the next node. The system establishes the best learning path from the course graph using Dijkstra's Algorithm. It also evaluates the quality of the determined path on the basis of user's goals and learning achievement. Zhao and Wan utilized the same course structure [15] with a new algorithm to find out shortest learning paths to gain the required knowledge.

Jiuxin et al. (2008) put forward a self adaptive framework of learning objects in accordance to the learning context of user [16]. Learning context includes the learner's internal and digital environments such as access devices, network and personal information. The framework generates different versions of learning objects dynamically according to learner's learning context.

A scrutiny of the above mentioned works reveals two lacunae: Firstly, a concept is considered closed once it is part of a course. In reality a concept is very much a dynamically changeable artifact. It can be enriched by contributions from different authors, each adding his/her own expertise. Besides, as time progresses, new perspectives on the same concept emerge. These fresh viewpoints must get incorporated for the course to remain relevant. Examining different perspective provide additional knowledge and leads to more satisfaction towards the user's LA. We recognize that there is a need to allow adding different perspectives for a concept in a flexible and modular manner. Depending upon the current state-of-art of a domain, the relative importance of different perspectives may change. Therefore, the learner and the recommendation system that guides the learner in choosing an optimal path must be assisted by attributing contributory weights to the various perspectives.

Secondly, past work does not identify the significance of prioritizing various type of LOs according to user's learning aims. LA is a vital parameter that influences the user's selection of learning material as well as the learning process.

3 Proposed Framework

We explain below the proposed framework for modeling the course structure in a personalized e-learning system. We provide an algorithm for the system to recommend an initial learning path that is fine-tuned to the learner's own aim for taking up the course. This algorithm is named PAL(.) (Perspectives and Aims for Learning).

3.1 Course Organization

The course is organized into a sequence of *nC* concepts $C_1, C_2 \ldots C_{nC}$. The learner has to proceed from one concept to the next to go through the course and cannot entirely miss any concept. Each concept is presented from different authors' points of view, called *Perspectives*. The course is divided into levels in which each level contains various perspectives of a concept. The number of levels is equal to the number of concepts prescribed for the course. This provision allows more than one expert to contribute to the course material and subjects the learner to various angles of a concept as interpreted by different subject experts. The learner has the choice to grasp the same concept from one or a combination of these various perspectives to strengthen her knowledge by broadening her vision. This aspect of learning is assessed by a metric called *Concept-Depth CD*.

Further, each concept is broken down into a set of pre-defined Learning Objects *LO* including artifacts such as basic theory, detailed theory, case study, audio-visual demonstration, simulation, point-wise summary and quiz. For a given level L_j, there are *nLO(j)* learning objects prescribed for the corresponding concept attached with that level. Each author contributing to a concept must cover all *LOs* necessary for that concept. At least one *LO*, the basic theory, must be chosen by the learner to concretize the underlying concept. However, it is not essential for a learner to go through all these learning objects.

As an initial recommendation, the learner is prescribed a learning path that includes an optimized combination of *LOs* for each concept as guided by her learning objective and time constraints. As she progresses along the course, the dynamic recommendation system can dynamically adjust the learning path based on her performance and choices.

3.2 Inputs

1. *Course Graph:* A weighted Directed Acyclic Precedence Graph (DAPG) for the course: *CG(V,E)*. If node v_1 precedes v_2, it is denoted as $v_1 \rightarrow v_2$.

1.1 *Levels, concepts and Perspectives: CG(.)* is partitioned into discrete levels: $L_1, L_2, \ldots L_i, \ldots, L_{nL}$, each level representing one specific concept of the course. Each level comprises a subset of vertices: $L_{j=} \cup \{v_{j,k}\}$, each vertex representing a definite perspective $P_{j,k}$ for the same concept. For a given level L_j associated with one concept, there are *nP(j)* number of perspectives. For convenience, the course starts with a single concept from a unique introductory perspective. This node is designated as v_1. Each of the vertices belonging to a specific level leads to all vertices of the next level. Hence we have:

$\forall k, m: k \in \{1..nP(j)\}$ and $m \in \{1..nP(j+1)\}$, $v_{j,k} \rightarrow v_{j+1,m}$

This precedence rule ensures that whatever perspective(s) a learner chooses to learn a concept, she has to make a transition from the concept encapsulated at that level to the next concept in the prescribed sequence.

1.2 *CG(.) Node Weights:* Each vertex has a weight $T(v_{j,k})$ assigned by experts that denotes the total time taken by a learner visiting that node if she were to learn all the learning objects contained within that node.

1.3 *CG(.) Edge Weights:* Edge $e_{j,k1,k2}$ represents a transition from a perspective at one level (concept) $P_{j,k1,}$ to the a perspective at the next level (another concept) $P_{j+1,k2}$. The edge weight $DL(e_{j\,k1,k2})$ represents the Difficulty Level (DL) in making the corresponding transition. DL is determined by an expert. We normalize the DL at a particular level by dividing it with maximum DL at that level. A learner transits from one level to next via exactly one of these possible paths. Once having reached the next level, she can add to the number of perspectives provided at that level without additional difficulty.

2. *Learning Aims:* User chooses from among a list of primary Learning Aims *{LA}*, indicating the purpose of her taking the course. For example, the learning aims possible for a course can be 1. Gaining in-depth knowledge 2. Preparing for an interview 3. Apply associated practical skills 4. Satisfy cursory interest 5. Professional training 6. Preparing for examination. Let there be *nLA* such learning aims. LA_a is the learning aim associated with user U_a.
3. *Learning Objects***:** Each vertex $v_{j,k}$ can be exploded into sub-graph $LOG_{j,k}(V,E)$, whose vertices represent Learning Objects $\{LO_j\}$ and whose edges represent possible transitions from one learning object to another. Vertex $v_{j,k,l}$ represents the l^{th} *LO* of the k^{th} perspective at the j^{th} conceptual level. The starting node is fixed and represents a mandatory *LO* that the learner must cover to have a basic understanding of the concept. The learner can close the concept by exiting from any of the visited nodes. Unlike the main course graph, there is no difficulty in moving from one LO to another within a concept. As an independent entity, this sub-graph does not have edge weights. However, in order to enable the agents to move freely between LOs, they are all assigned zero weights. Thus, the ants can collect LOs to enhance learning as long as the maximum duration of the course is not exceeded.

LOG(.) Node weights: The total time $T(v_{j,k})$ allocated to a vertex $v_{j,k}$ of the graph *C(.)* is divided among its various *LOs* as per the priorities pertaining to the learning aim LA_a of a user U_a. The time taken at the vertex $v_{j,k,l}$ of the sub graph $S_{j,k}(.)$ is its weight:

$$T_{j,k,l}(a) = \frac{T(v_{j,k}) \times LALOPT(a,l)}{\sum_{l=1}^{nLO(j)} LALOPT_j(a,l)}$$

4. *Priority Table:* Experts prescribe a Priority Table $LALOPT_j(.)$ for each level *i.e.* concept. This table shows the relative priorities assigned to each of the Learning Objects *LO* for each of the possible Learning Aims *{LA}*. This tables has *nLA* rows and *nLO(j)* columns.

Table 1 - Learning objects' priority according to learning aim for a particular concept

Priority Table $LALOPT_j(R[nLA] \times C[nLO_j])$						
Learning Aims {**LA**}	Learning Objects $\{LO_i\}$ for the concept at Level L_j					
	$LO_{j,1}$	$LO_{j,2}$	…	$LO_{j,l}$	…	$LO_{j,nLO(j)}$
LA_1						
LA_2						
.						
LA_a						
.						
LA_{nLA}						

5. *Learning Perspective Contribution Table:* A user adds to her learning when she learns from different perspectives for a given concept. At each level, the contribution of each perspective towards learning varies according to the learning aims of the learner. Experts determine how much a particular perspective on a concept will contribute to the overall learning of a user as per her desired learning aim. This is captured in a Perspective-Aim Contribution Table $PACT_j[.]$ declaring the contributions of various Perspectives towards the users' Learning Aims. Let $C_{j,z}$ be the relative contribution of the z^{th} perspective at j^{th} level for a specific LA.

Table 2 - Concept perspectives constribution towards various learning aims

Contribution Table $PACT_j(R[nLA],C[nP_j])$						
Learning aim {LA}	Perspectives *{P}* for a concept at Level L_j					
	$P_{j,1}$	$P_{j,2}$	…	$P_{j,l}$	…	$P_{j,nP(j)}$
LA_1						
LA_2						
.						
LA_a						
.						
LA_{NLA}						

5.1 *Perspective sub-graph*: All perspectives within a level are interconnected into a completely connected sub-

graph $PG_j(V,E)$ whose vertices comprise all vertices of a level L_j. There is no difficulty in moving from one perspective to another. Hence the edge weights are not significant but are assigned zero value to enable the learning agents to move smoothly from all perspective to another in an effort to her perspective width.

5.2 *Concept Depth v/s Learning Achievement:* It is assumed that the first vertex visited at a given level is the primary contributor to Learning Achievement α_a of a user. Additional vertices add to the concept depth Ω_a.

6. *Timing Constraints:* T_{max}*:* The maximum time decided by the user to finish the course.
7. Source node V_s and destination node V_d provided by the user U_a.

3.3 Output

An optimum Initial Learning Path ILP_{opt} comprising at least one and possibly more node(s) from each level and learning objects gathered for each node.

Let *nP_taken(j)* be the number of perspectives that the learner has taken at level L_j. Let the nodes of this path be $ILP_{opt}=\{\mathbf{v}_{j,k,l}\}$. Then index *j* varies from 1 to *nL*, for each of these levels *k* varies from 1 to *nP(j)* and each combination of *j* and *k*, l varies from 1 to the number of LOs picked up at node $v_{j,k}$ of CG(.).

3.4 Objectives

1. Learning of a user comprises of three factors:

a) Coverage Factor (CF): It measures learning of a user across various concepts selected in the learning path. CF only considers the first concept perspective selected at particular level in the learning path. The learning achievement at each level L_j is given by:

$$LA_{j,1} = M_j(1 - e^{-\propto t_{j,1}}) \qquad (1)$$

Where, M_j is the maximum learning achievement at that level set by the experts. α is the user' Learning Ability determined through pre-test, and $t_{j,1}$ is the time taken by the learner at the first node she visits at that level. CF can now be defined as:

$$F = \sum_{j=1}^{nL} LA_j \qquad (2)$$

b) Depth Factor (DF): It evaluates depth of learning of a specific concept attained by selecting various concept perspectives. The depth of learning at a particular level is:

$$DF_j = \frac{\sum_{k=1}^{nP\_taken(j)} LA_{j,k} \times C_{j,k}}{\sum_{k=1}^{nP(j)} LA_{j,k}} \qquad (3)$$

The overall depth factor is

$$DF = \sum_{j=1}^{nL} DF_j \qquad (4)$$

c) *Cumulative Difficulty Level (CDL):* CDL signifies the difficulty of the selected path. Only the transition edges from one level to another level of the selected path contribute to CDL as adding perspectives do not increase the difficulty. It is calculated through summation of difficulty level of all these transition edges.

$$CDL = \sum_{j=1}^{nL} DL_j \qquad (5)$$

The main aim of undertaking a course is to

(1) Maximize Coverage Factor CF:

$$\sum_{m \in PT_{op}} CF_m^{op} > \sum_{p \in PT, n \in PT_p} CF_n^p$$

(2) Maximize Depth Factor DF:

$$\sum_{m \in PT_{op}} DF_m^{op} > \sum_{p \in PT, n \in PT_p} DF_n^p$$

Where PT_{op} signifies the optimized path and PT = {P_0, P_1 , ……., P_n}represents set of all possible paths from source to destination concept.

(3) Minimize Cumulative Difficulty level CDL for the optimized path:

$$\sum_{m \in PT_{op}} CDL_m^{op} > \sum_{p \in PT, n \in PT_p} CDL_n^p$$

All these factors contribute towards the overall fitness *f(.)* of the solution for the particular user with specific *LA* according to the function

$$f = w_1 \times CDL - (w_2 \times CF + w3 \times DF) \qquad (6)$$

where w_1, w_2 and w_3 are the constant weights assigned according to these factors significance. Minimum the value of *f*, most appropriate is the path for the user.

3.5 Constraints

The system discards all those paths in which *time taken* > T_{max}. This constraint signifies that user must have to keep in mind the time deadline set by her.

3.6 An ACO Scheme for personalized learning

ACO is meta-heuristic algorithm employed to solve many optimization problems [17, 18]. ACO initializes many artificial ants that walk through the input graph to find optimized path. The movements of each ant depend on the pheromones laid by the ants on the path. Ants prefer the path with comparatively high amount of pheromones on it. The pheromones value of the selected path is updated simultaneously as well as after an ant reached the destination on the basis of fitness of the obtained solution. The pheromones also evaporate from the paths to avoid local optima solution. Selection of next node is based on probability state transition rule that works on two factors: heuristic factor $\vartheta_{u \to v}$ as well as pheromone factor $\tau_{u \to v}$. Next node will be selected according to probability distribution determined by

$$p_{u \to v} = \frac{\tau_{u \to v}^{\alpha} \times \vartheta_{u \to v}^{\beta}}{\sum_{w \in v} \tau_{u \to w}^{\alpha} \times \vartheta_{u \to v}^{\beta}} \qquad (7)$$

where $\alpha \geq 0$ *and* $\beta \geq 1$ determine the relative impact of pheromone and heuristic factor on decision of the ant. Heuristic factor $\vartheta_{u \to v}$ is calculated according to following rule:

$$\vartheta_{u \to v} = LA_v \qquad (8)$$

The local update of pheromone value on the selected path is determined by

$$\tau_{u \to v} = \begin{cases} \tau_{u \to v} + \in \times \delta & DL_{u \to v} = 0 \\ \tau_{u \to v} + \frac{\epsilon}{DL_{u \to v}} & otherwise \end{cases} \qquad (9)$$

where ϵ denotes the initial pheromone value set on the edge $u \to v$ and δ denotes a large positive constant. The global update of pheromones value on the selected path is done by

$$\tau_{u\to v} = \tau_{u\to v} + \frac{\psi}{pathValue(ILP_{current})} \quad (10)$$

where ψ controls the pheromone value deposited on the best path, set as $T_{max.}$ The evaporation of the pheromones value is computed by

$$\tau_{u\to v} = \begin{cases} \epsilon & \epsilon > \tau_{u\to v} \times (1-\mu) \\ \tau_{u\to v} \times (1-\mu) & otherwise \end{cases} \quad (11)$$

Here μ signifies the evaporation rate of pheromones on each edge.

The pseudo code in Figure 1 describes the implementation of ACO algorithm to find optimal path according to user's aim LA_a

PAL (
Input: *CG = (V,E), LALOPT, PACT, LA, LA_a , T_{max}*
Output: *ILP_{opt} , bestPathValue* **)**
Begin
1. Initialization phase
- Initialize an initial population of ants X_i , i = 1,2...,m and *bestPathValue* = ∞
- Initialize all constant parameters and pheromone trails value for each edge in CG.

2. Starting tour
- Place all ants on source node *Vs*
- Maintain list time_spent for each ant to store time spent on each added edge.

3. Search ant path
For counter *i=1 to number_of_iterations* do
For *ant* X_k counter *k= 1 to m* do
- **Select_Next_Node** ***(u, v, CG)*** */* Select_Next_Node* select node *v* to move to from *u* in *CG* */*
- Add *v* to ant's path and store time spent on vertex *v* to ant time_spent list

If *(next vertex v = destination node V_d)*
4. Compute *pathValue* for each ant's path according to user's aim LA_a
- Compute *pathValue* using formula (6) and total *timeSpent* on the selected path

If (*timeSpent* > T_{max})
- Set *pathValue* = ∞

Else
If ($bestPathValue > pathValue$)
- Set $bestValue \leftarrow pathValue$
- $ILP_{opt} \leftarrow ant.path$

End If
End If
- Re-initialize *ant* so that it can start to search for path again.

End If
End For
5. Update the pheromone factor
- Update pheromones locally on selected path by ant using (9)
- Update pheromones globally on path selected by ant using (10)
- Evaporate pheromones value on the path with formula (11)

End For
- **Return** ILP_{opt} , $bestValue$

End

Figure 1 - Pseudocode to find optimized learning path through ACO

The pseudocode in Figure 2 choose next node by applying fitness proportionate selection[19] to cumulative probability list of all adjacent nodes to *u.*

Select_Next_Node (
Input: Current vertex *u*, Course Graph *CG*
Output: Next vertex *v***)**
Begin
- Calculate *probability* $p_{u\to w}$ using (7) for each of the *n* vertices adjacent to *u* and store it in probability list *P* where each index *i* corresponds to the specific adjacent vertex *w.*
- Create list *cp* of cumulative probabilities from *P* with size *n+1* and $cp_i = cp_{i-1} + p_i$ taking $cp_0 = 0.0$
- Take a random variable *rp* with value between 0.0 *to* 1.0 and set $v \leftarrow w$ where *w* is denoted by index *i* and satisfy the condition $cp_i \leq rp < cp_{i+1}$
- Select *random number* of LOs' for selected vertex including the compulsory LO.

End

Figure 2 - Pseudocode to select next node in ant's path

4 Simulation Results

The section presents the experimental results of the proposed algorithm. The proposed algorithm is implemented with JAVA SE 6 platform on Intel Corei3 2.13 Ghz computer with 4GB RAM. The values of parameters in ACO are number of iterations $I = N * 10000$, where N = total number of nodes, ant population $m = 10, \alpha = 0.8,\ \beta = 1.0,\ \mu = 0.9, \epsilon = 0.1, \delta = 100$. The values of weights for fitness f are $w1 = 0.5,\ w2 = w3 = 1.0$

This work utilizes the course graph presented in Fig. 3 and input Table 3 to Table 15 and the time constraint $T_{max} = 20$.

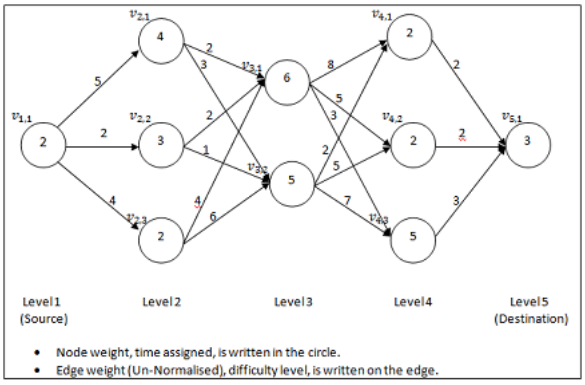

Figure 3 - Course Graph

Table 3 - Number of LO's at Level

Level	1	2	3	4	5
Number of LOs	2	3	2	2	3

Table 4 - Number of Perspectives at Level

Level	1	2	3	4	5
Number of Perspectives	1	3	2	3	1

Table 5 - Maximum Learning Achievement at various Levels

Level	1	2	3	4	5
Un-Normalized Maximum Learning Achievement	10	15	20	20	13

Table 6 - Priority Table Level 1

Learning Aim / LO	1	2
1	0.62	0.38
2	0.52	0.48
3	0.26	0.74

Table 7 - Priority Table Level 2

Learning Aim / LO	1	2	3
1	0.50	0.34	0.16
2	0.26	0.26	0.48
3	0.15	0.21	0.64

Table 8 - Priority Table Level 3

Learning Aim / LO	1	2
1	0.18	0.82
2	0.26	0.74
3	0.89	0.11

Table 9 - Priority Table Level 4

Learning Aim / LO	1	2
1	0.39	0.61
2	0.16	0.84
3	0.61	0.39

Table 10 - Priority Table Level 5

Learning Aim / LO	1	2	3
1	0.33	0.33	0.34
2	0.40	0.25	0.35
3	0.10	0.86	0.04

Table 11 – Contribution Table Level 1

Learning Aim / Perspective	1
1	1.00
2	1.00
3	1.00

Table 12 – Contribution Table Level 2

Learning Aim / Perspective	1	2	3
1	0.45	0.32	0.23
2	0.40	0.17	0.43
3	0.36	0.34	0.30

Table 13 – Contribution Table Level 3

Learning Aim / Perspective	1	2
1	0.50	0.50
2	0.45	0.55
3	0.48	0.52

Table 14 – Contribution Table Level 4

Learning Aim / Perspective	1	2	3
1	0.11	0.50	0.39
2	0.29	0.36	0.35
3	0.46	0.22	0.32

Table 15 – Contribution Table Level 5

Learning Aim / Perspective	1
1	1.00
2	1.00
3	1.00

The learning paths generated for various aims via the proposed ACO algorithm is shown in Fig. 4, Fig. 5 and Fig. 6 highlighted with different colors. The pattern of 0 and 1 associated with each node selected in path represent the LOs selected to maximize learning.

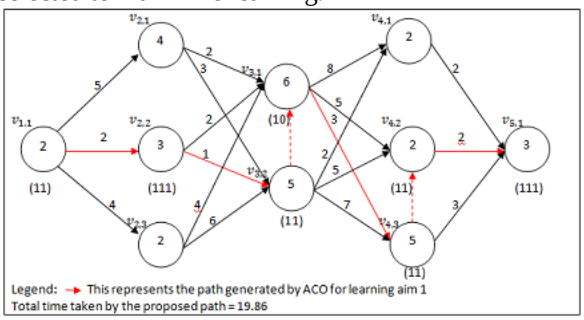

Figure 4 – Proposed path for learning aim 1

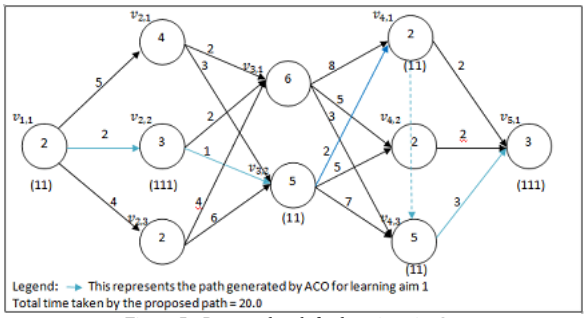

Figure 5 - Proposed path for learning aim 2

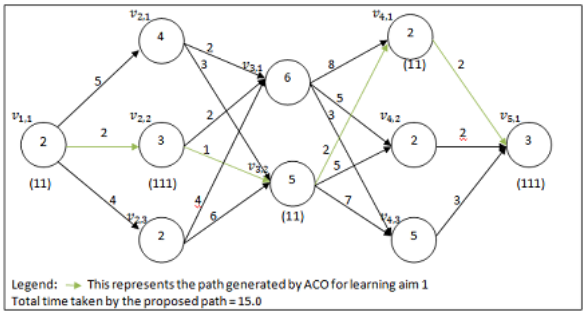

Figure 6 - Proposed path for learning aim 3

5 Discussion

Simulation results show that ACO generate optimal path for user with particular learning aim. The generated path capitalizes user's learning by emphasizing the following factors:

- Maximizes depth of learning within the time period T_{max} provided by the user by selecting the relevant concept perspectives that contributes more towards user's learning aim
- Enhances user's learning achievement by selecting appropriate LOs
- Minimizes the difficulty level

6 Conclusion and Future Work

Although optimal learning path generation is not a new idea in e-learning field, this study could still be considered novel as it is the first path generation scheme that broadens the learner's vision by explicitly including various perspectives of a concept to provide in-depth knowledge. It leads to more satisfaction towards user's learning aim. This paper has also presented a positive impact of prioritizing LOs according to user's LA, on user's learning. An ACO based solution scheme has been developed to generate learning path that provides more satisfaction towards user's aim.

For future work, we would like to focus on transforming this static path generation scheme to a dynamic path adaptation. Personalization of evaluation and scoring system according to user's LA could also be an innovative idea for adaptation as it gives more concise knowledge about user's learning that assist in personalization of learning path.

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Arabic E-learning and Computer Tools

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Abstract *This paper reviews software solutions which the authors use in the Arabic teaching, as well as problems related to the Arabic language formalization. These solutions are implemented both in full-time training and in e-learning programs. It also deals with the two types of e-learning portals used at the St. Petersburg State University, Russia as a main medium for the software tools: Sakai and IBM Workplace Collaborative Learning, as well as the principles of computer selection of the teaching material, advantages and difficulties of the software designed for the Arabic script. The authors also focus on the use of the standard software for purposes of education and analyze the experience of the e-courses for Arabic.*

Keywords: Arabic, e-learning, teaching, computer tools, formalization

1 Introduction

For the last decades the modern Arabic teaching approach has undergone through the significant changes. Thus, on the initial stage of the ICT implementation in education the world practice defined two different tendencies of the Arabic teaching approach: classic old school teaching and modern computer based education. However today we can speak about the existence of the teaching methods combining both educational approaches. The application of the specified hard and software, as well as fast evolution of Internet became an important part of the educational process. Although teachers do not always require applying modern technology instruments the students use hi-tech equipment anyway. Thus it makes the teachers follow the modern trends and be aware of the technologies available on the market, e-resources as well as skilfully apply their computer knowledge on practice.
The above mentioned tendencies created necessity for the development of the advanced training program for the teachers of Arabic.

Therefore in 2010 the program called "The Arabic language and innovative education" was developed in St. Petersburg State University within the scope of the project headed by Professor Oleg Redkin.

The program is aimed to give the teachers of Arabic additional skills to improve their professional competence, such as:

- Skills to create digital teaching materials (e-books, presentations, multimedia applications, etc.);
- Knowledge of the alternative teaching methods (e-learning, use of ICT for teaching and so on);
- Use of e-resources in Arabic.

During the last two years more than 50 teachers of Arabic from different part of Russia have graduated from this program via videoconference based distant education.

The use of electronic resources and technical tools can significantly improve the quality of teaching process and provide maximum of information supplied to students in a limited period of time. In addition, electronic media also provide access to electronic resources and databases, etc., as well as electronic dictionaries online.

The last decades in the field of language teaching and research are characterized by deep methodological changes caused by intensive ICT development. Innovative hard- and software solutions upgrade effectiveness of the educational process along with the Internet which turned to be the main information source for linguists. Nowadays the quality of the educational programs and success of the scientific activity largely depend on the successful use of ICT in teaching and research.

Distance learning is a relatively new but rapidly growing area of educational cluster in Russia. The evidence of it is that on February 29 2011 (29.02.12) former President D. Medvedev signed amendments to the Federal law "On Education" stating that the "e-learning, distance education technologies can be used for the implementation of educational programs, regardless of the form of education".1

As the perfect example we may review the projects that have been carried out at the Arabic Philology Department of St. Petersburg State University in Russia.

Although the teaching of Arabic at St. Petersburg State University has a long history, the authors try to use their experience and keep classical teaching methods in the implementation of the innovative programs. That classical education background gave birth to the spark of the innovative concepts, which resulted in the successful implementation of some projects, such as «Oriental Languages Distant Learning System», «A Mathematical Model of Pattern Recognition and Processing of Texts in Arabic Based on the Segmentation of Relevant Components», «Software Localization for the Near Eastern Consumer Markets» etc.

The project of the oriental language distant learning system development at St. Petersburg State University started in

[1] http://kremlin.ru/acts/14625#sel=

2006 within the scope of Federal Program targeted at the improvement of higher education system in Russia. The major part in the above mentioned Federal Project was dedicated to the development of the e-learning materials and necessary resources for oriental languages. As a result, we developed a complex of new e-learning text-books, which included sections on phonetics, morphology, syntax, vocabulary, supported by texts, video and audio fragments. Tests and reference materials allow to use e-learning technologies for all kind of education activity.

This paper reviews software solutions that we use in the Arabic teaching, as well as problems with the Arabic language formalization. These solutions are used both in full-time training and in e-learning programs.

2 E-learning portals

The use of computer technologies enhances the capabilities of both teachers and students, besides that, enables to transfer skills through a network based on various types of e-learning portals. So it was several years ago when a project aimed at development of teaching books and e-dictionaries for distance learning along with the introduction of a new teaching software and technologies was launched along with on-line retraining courses for Arabic teachers from different schools and universities.

Two types of e-learning portals were used at the University as a main medium for the software tools: Sakai and IBM Workplace Collaborative Learning. In the course of successful implementation of the Arabic material in both platforms we defined differences in the principle of their operation.

The main ideas of the "Oriental Languages Distant Learning System" project were focused on the development of the medium for e-learning and students' communication, as well as on the development of the system for e-books scanning and storing in order to provide access to the e-library resources. The software part of the project was developed on the basis of the IBM platform.

IBM Workplace Collaboration Services was used for e-learning, means of the collaboration and e-mail access. IBM DB2 Content Manager was chosen for e-books and multimedia content storing, while audio and video conferencing activities were carried out using IBM Lotus Sametime.

From a user perspective this solution is a portal that consists of several sections. The access to the portal is realized via the department local computer network or via Internet. The e-learning courses were developed by teams of teachers and programmers working together on this project.

Figure 1. Example of the e-course in IBM Workplace Collaborative Learning. Mass media in Arabic.

A special attention was paid to practical exercises consisting of several types of tests, including the computer-verified tests and multiple choice tests. Development of the computer-verified tests for grammar could be regarded as a big achievement considering the difficulties associated with Arabic formalization. The e-courses were developed in SCORM format using the tools of IBM and Adobe.

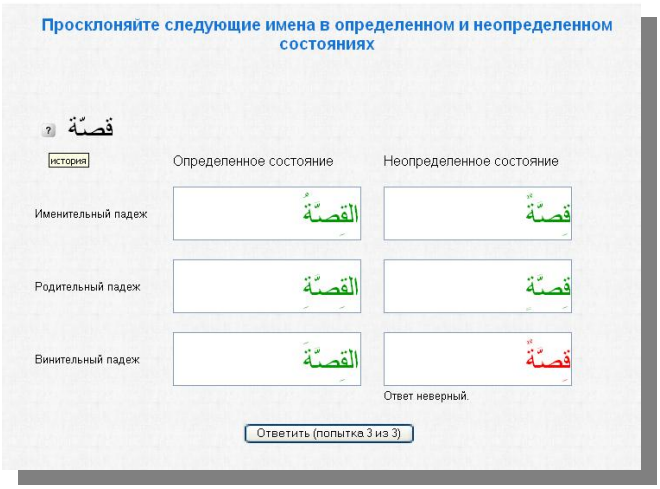

Figure 2. Example of the grammar test. The task was to decline the word "story". System automatically verifies the answer, marking wrong answers with red.

Solutions for the e-library generation were especially important for the Department of Asian and African Studies, as it obtains huge collections of manuscripts that previously were difficult to analyze. The automated manuscript scanning complex was used to generate the e-library, the complex included manuscript scanner and special software for image processing. After scanning the librarian made bibliographical description and uploaded the e-copy of the manuscript into the storage, which in its turn was developed using IBM DB2 Content Manager.

Initial testing of e-learning system for educational purposes gave positive results, but after the project was finished we faced the problem of updating educational material – it was possible only with the help of programmers whose work was not budgeted any more. At the same time other e-learning platforms such as Sakai, allowed teachers to upload language material by themselves. Besides, when programmers customized courses for integration into IBM platform a lot of mistakes connected with the difficulties of Arabic adaptation were found and we had to test the integrated course several times. In order to facilitate integration of the materials in Arabic programmers used graphic files instead of simple text in Arabic. The latter made it impossible, for example, to mark necessary abstract or copy it to the e-dictionary. This greatly limited the possibilities of e-learning. These complaints related to the difficulties of IBM Workplace Collaborative Learning application were probably due to incorrect settings. However we just described our experience from a linguist point of view.

Sakai portal for e-courses in Arabic does not need any special programming skills and provides flexibility for e-learning. In comparison with the IBM Workplace Collaborative Learning it correctly displays Arabic graphic and allows performing all text processing operations. It has all necessary tools for collaborative work.

Modern technologies give e-learning new opportunities by using videoconferencing along with the medium for collaborative learning.

Figure 3. Videoconference system.

In addition to using the special video conferencing equipment we integrated the BigBlueButton into Sakai platform in order to deliver learning material to the remote students. Videoconference system provides audio and video teacher-student communication. Up to 12 participants can simultaneously take part in the discussions. BigBlueButton is a tool that was integrated to the Sakai platform (http:islamedu.spbu.ru). Using this tool a teacher can communicate with students and has an opportunity to demonstrate presentations, pictures and other software applications from his own PC.

3 Windows Software for Arabic Data Processing

Selection and processing of the teaching content has the same importance as the choice of the software platform. Meanwhile, a number of peculiarities and special features of the Arabic text should be taken into account. For example, the previous versions of Windows (Windows 3.11. and Windows 95 – both English or Russian) represented certain difficulties for the realization of the Arabic script.

Special software products designed for “arabization" of Windows such as Sakhr or Dagesh were not fully compatible with the Windows 3.11 and Windows 95. It also did not provide a solution for all of the problems related to typing and processing of the Arabic text. At this stage partial solution was found in the simultaneous use of parallel computers with the Russian (or another language) and Arabic-supported Windows, or the use of a single computer operating with these two versions of Windows, while the language data were exchanged through a clipboard.

Such versions of Microsoft Windows (English or Russian), as Windows XP or Microsoft Windows 2000 and higher support Arabic, but still certain problems remain. Thus, copying the Arabic texts from the web pages or special software to the clipboard often transferring to the final document is often accompanied by numerous mistakes – incorrect realization of word order, alignment, character shapes, as well as vowel and special signs.

There are also difficulties of the integration of Arabic script into the texts based on Cyrillic or Latin alphabet. These minor difficulties (direction of the cursor, realization of consonant characters and vowel signs) can be solved by installation of the Arabic text support or additional fonts.

Similar problems of the realization of the Arabic text are typical to mobile devices with operational systems based on Windows Mobile and Linux. These operating systems require the use of applications that allow software to adapt the device to applications in Arabic.

Along with Microsoft Office Word, Microsoft PowerPoint is another effective tool for development of interactive language courses. In addition to its relatively low cost and simplicity another advantage of this software is its optional features. Various aspects of the language training are optimized by means of animation. It can be used by the teacher himself/herself without any help from technicians and it simplifies and accelerates the development of educational software products. Besides, the combination of independent material allows the instructor to emphasize the

new teaching material and to develop language tests. Integrated video and audio files, visual effects aimed at the creation of the associative links support language acquisition in general and vocabulary in particular and contribute to the development of communicative skills of the students. Another advantage of this program is that it supports scripts of major oriental languages (Arabic, Chinese, Japanese, etc.).

Besides teacher's skills, experience and software, the linguistic content especially the vocabulary of the courses online plays a vital role in the e-learning. Meanwhile, except for the specialized dictionaries, the authors do not explain or stipulate the principles of the formation of the linguistic content and reflect author's personal attitudes and experience.

The authors have developed computerized methods of the definition of the frequency code of the Arabic words, i.e. the number the word entrances in the entire text on the basis of the analysis of some 1 million words from various texts in Arabic.

It allows us to include the most frequent words into the linguistic content of the text-books. The vocabulary of the text-books based on the principle of the frequency code proved to be very useful, especially on the initial stages of studying Arabic.

4 Conclusions

Basing on the experience of several projects related to the development of the e-courses for Arabic we came to the following conclusions:

4.1 The most effective methodology for the Arabic teaching relies upon simultaneous use of classical language teaching and ICT. The latter includes media for collaborative work, office editors (such as Microsoft Office, MS Excel, MS Power Point, etc.), e-libraries.

4.2 Comparisons of different types of e-learning portals for e-learning showed their similarity in the basic tools and differences in the e-learning courses implementation approach. Meanwhile among the existing platforms for Arabic the most convenient one is Sakai which allows to reflect the peculiarities of the Arabic text adequately. Another platforms are not so accurate while representing Arabic characters.

4.3The problems of the Arabic language technological adaptation are manifested in several areas: the graphical representation - covers all uses of written language, language data processing aimed at ensuring the functions of machine translation and related problems of formation of concordance word forms and their construction to the word-based.

4.4 Among the strengths and benefits of computer tools are vast reference resources for academic pursuits, teacher's control which spreads beyond the classroom. The weak point is the lack of personal 'eye to eye' contact.

Among the advantages of the e-learning one can also mention its simplicity and possibility of solving the problems, regardless of the computer skills of the students participating in the program, as well as the ability to work in real time and embrace the most remote regions.

The full-time students can also enjoy the advantages of distance learning and can use teaching materials and home assignments on the web.

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E-learning System for Vocational Rehabilitation Including a Rehearsal Function for Intellectual Disabilities

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Abstract *- This paper develops a vocational rehabilitation system including a rehearsal function for intellectual disabilities. The developed system is composed of vocational rehabilitation content, a user rehearsal function and sensory system that can feedback against the signal. In this study, the system developed will be effective to conduct vocational rehabilitation.*

Keywords: E-learning, intellectual disabilities, vocational rehabilitation, E-learning system

1 Introduction

In recent years, modern society has been become to obtain information on-line because of the development of IT technology. The development of information transfer units and information technology for accessing information has brought about a change to many parts of modern human life, and this change also had an influence on education. The development of the information transfer unit and information technology have developed the E-learning concept. The advent of E-learning led to a change in the methods of education from an off-line teaching style to an on-line teaching style [1–2], and has provided opportunities for education without being under time and space constraints. Such a change is applied on part of disabilities who need special education and stimulation. However, multimedia software for the disabled is not enough, and currently developed multimedia also has become conspicuous in not considering the characteristics of children with disabilities.

Hye [3] pointed out that it is quite difficult to use educational software with children with intellectual disabilities. He stated that software to be developed mentally retarded children needs to provide a repetitive chances with various items by detailed educational affiliation, after analysis E-learning software what used in special education.

Furthermore, it will effectively enable to memorise from. Therefore, this study aims to develop an E-learning system for those with intellectual disabilities that need vocational education that can be providing subdivision category and looking rehearsal.

2 System Design

Three specialists were chosen from special educational teachers, PhD rehabilitation psychology and PhD rehabilitation science and technology candidates for the design of an E-learning system for those that need vocational rehabilitation. The strategy what is deducted through consisted team as in Table 1, consisted of stages so that mentally retarded children can be educated easily. It consists of stages of content to enable repetitive education as confirmed by the educational goal; of education by stages, explanation of the question, modelling education through videos, rehearsal and summarisation as shown in Table 2. Also we considered self-efficacy for intellectual disabilities. Self-efficacy is the belief to possibility of execution and the organisation of the procedure needed to achieve the task and make the decision.

Table 1. Content design strategy

Component parts	Design strategies
Text	• Using mono colour on the background for e xact information transfer, no glimmering text • The size of educational text has to larger th an the main title
Sound	• Sound effects are important for identifying i ncorrect answers in the 'Let's solve' section • There should be similar sound effects in the

	simulation about using tool
Image	• A character is needed which can attract interest in the subject • The side menu should disappear to allow the separation of the subject's focus during education • Need a real picture or similar animation of a hammer and a claw hammer, which is a main educational area of educational contents program
Video	• Need to provide synchronised on-camera narration about the information in the video
Etc	• Need to be able to practice with the training aids for the maximum educational effect after learning from the digital textbook. • The feedback about wrong answers should be very clear

Table 2. Education-step configuration in contents

Component name	Configuration description
What would you like to learn?	• Educate about the text what will be educated in subject time • Learning content such as a form of scratch card lottery
Let's learn	• Consist of naming, order of use, watching videos and education on safety • Showing the order of use separately in stages • Modelling education through video
Let's solve	• Solving questions and providing explanations in educated content
	• Repetitive education of content of what has been learnt by O/X quizzes, choosing one of three items, and listing the order of use; through questions and explanations
Let's make full use	• Learning through a rehearsal system
Let's summarise	• Review of the content

A conceptual diagram of vocational education for intellectual disabilities is shown in Figure 1. That rehearsal functions is available to measure student's behaviour our system through optical sensor and pressure sensor can be detect student's rehearsal and has been communicated between contents and Bluetooth module.

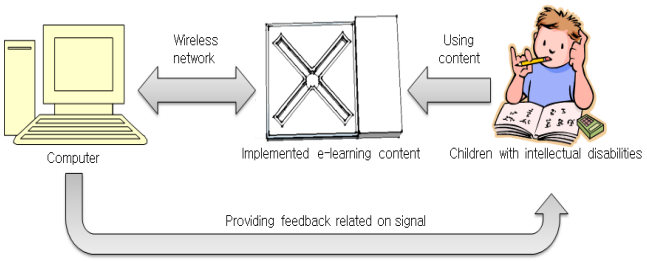

Figure 1. Concept of E-learning content

3 System building

The system with the rehearsal function provides a signal through a Bluetooth module from the content to the computer system, and then the computer provides a simulation in response to each signal. At the present time, the computer simulation on offer is departmentalised like in Figure 2. That is an image brought up in a real simulation.

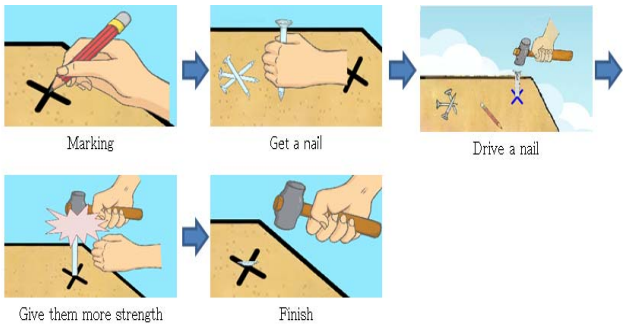

Figure 2. Subdivision category of E-learning content in the program

The content was designed with a width and height of 210mm, to have the feel of using a real tool and have enough space so a battery on the outside could be easily changed. Figure 1 presents the system concept and Figure 3 is a real picture of the apparatus developed and Table 3 lists the device's specification.

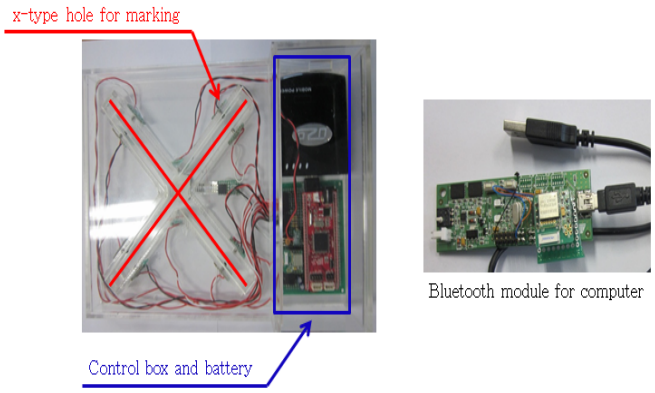

Figure 3. Developed E-learning device

4 Result

In this study, an effective E-learning system is developed as an E-learning system for intellectual disabilities rather than existing E-learning systems suitable for normal students. In accordance with 3 specialist opinions, we made real size when students take this system. In addition, it is assumed that this system have part of each operation was organised to refine and repeat so if the system is used for a student with intellectual disabilities the education effect will be increased. If the developed system upgrade for design like a real tool, the result of the education is thought to be more helpful in the field of vocational rehabilitation.

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Faculty's Awareness and Challenges of E-learning in TAIF University

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***Abstract*: In this paper, we present a review on the E-Learning process in AL-TAIF University, KSA. We discuss the current status at the college including infrastructure and faculty members and provide an overview about eLearning challenges AL-TAIF University faced. The results indicated that there exist challenges in exercising e-learning at the College for teaching and learning.**

***Keywords*: E-Learning, Challenges, Higher Education.**

I. Introduction

Globalization has become real in the current century, and it is generally agreed that advancement in Information and Communication Technologies (ICT) provides opportunities for competitive advantage in various sectors, such as e-economy, e-business and e-education.

The educational sector is one which allows for adjustment to the strategy for providing better services to learners. Information Technology (IT) in education helps to provide modern, efficient, effective and cost-effective alternatives to teaching and learning, called e-Learning.

Stockley (2003) defines e-Learning as the delivery of learning, training or educational programs via electronic means. Nowadays e-Learning is considered as one of the most important learning models in education, business, and the public sector (Cho, Park, Jun Jo, Wook Jeung, & Lim, 2009).

The Sloan Consortium's Annual Report (Allen & Seaman, 2007) showed the recent state of online learning in United States higher education. There were approximately 3.5 million students enrolled in at least one online course in the fall of 2006. That represents a 10% increase in the number of the students taking online classes over the number reported in the previous year. This increase encourages universities and colleges to offer online courses and programs (Allen & Seaman, 2007). Another study, which gathered data on the number of employees working around the world, reported that e-Learning helped those employees to learn while working and to improve their preferences (Masie, 2008).

Overall, e-Learning was ranked as the second most frequently used learning tool in the workplace (Cho et al., 2009).

Taif University is one of the modern Saudi Universities King Abdullah Bin Abdulaziz ordered to establish. The University established in 2006 with numerous colleges. One of these colleges is the College of Management that has an initiative to apply eLearning mode. The College of Management has four Computers laboratories. These laboratories have defiantly led to improved teaching and learning processes, to some extent. The laboratories equipped with the essential software and hardware, such as computers, printers, scanners, and Microsoft Word, Excel, PowerPoint, and Access; however, there is no internet connection that is to be considered as a core of the eLearning. Hence, In this paper, the researchers will extend their research to identify the infrastructure challenges Taif university face, as well as challenges faculty face regard eLearning

II. Purpose of the Study

The aim of this research project is to explore and provide an overview about eLearning challenges AL Taif Univerity faced. These challenges have been criticized to two different type that are: 1- Faculty members Challenges 2- Infrastructure Challenges.

A. Research Questions

- What are some of the challenges faced by the faculty at Al Taif University in using elearning services?
- What are some of the infrastructure challenges faced by Al Taif University in using elearning services?

III. Literature Review

In the last decade researchers had found that there are negative attitudes toward online education models along with the positive attitudes. These negative attitudes are found in education institutions among faculty, students, and parties involved in online education. Hence, education institutions should consider the negative attitudes, and aim to address them in advance. Otherwise

online education may not be as effective as it could be.

Gammill and Newman (2005) found that a majority of faculty were not using Web Based Instruction (WBI), and that a low level of WBI implementation was associated with:

- The nature of course content, which means not all classes are good for the online model.
- Lack of institutional support.
- Lack of enough release time for online course development and revisions.
- Unreliable technology.
- Lack of incentives for teaching online.

Based on these findings, the researchers concluded that if the education institutions implement policies, road maps, and support, the future will be brighter for WBI.

(Carrol-Barefield, Smith, Prine, & Campbell, 2005; Hislop and Atwood, 2000) found that faculty had negative attitudes toward online education since it requires more time and effort to develop a course and teach it than traditional courses. In light of this finding it is important that adequate institutional support for the design and development of online courses is provided to ensure successful adoption of online education.

Boggs and Pirani (2003) cite a number of e-Learning challenges faculty very often face:

- Lack of knowledge to design courses with technology.
- Lack of confidence to use technology in teaching.
- Lack of technology knowledge.
- Inconsistent platform, tools, and software.
- Maintaining passion to learn technology.
- Network and software crashes during classes.

After analyzing those challenges, the researchers found that the most significant challenges education institutions are the faculty lack of knowledge to design courses with technology and lack of confidence to use technology in teaching. Figure(1) shows this analysis.

IV. Research Method

In this study, The sample size of the study is 20 lecturers. The survey is performed on random sampling, all of them are male. The lecturers were from different departments. The lecturer participants provided quantitative data through a questionnaire.

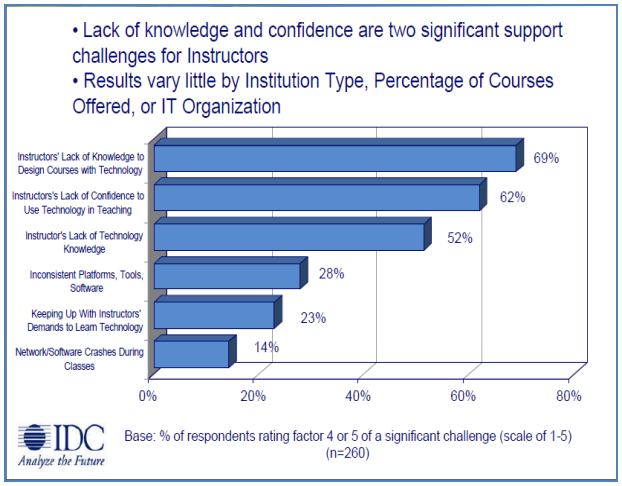

Figure (1): Significant Challenges

The questionnaire were categorized into two parts. Part one was designed to measure the readiness of the faculty members and the college (infrastructure). In the second part, was designed to measure prevalence of technology and the percentage success of applied e-learning. The questionnaire were designed with five numerical values (1 -5).

A. *Results*

The research questions deal with access internet, awareness, competence or expertise and challenges. The findings are presented in this order.

No	Question	Yes	No
1	Do you have a computer in your office?	67%	33%
2	If, Yes do you access to the internet from your office?	58%	42%
3	Do you have an Email?	100%	0%
4	Is a computer available in the classes?	0%	100%
5	Is a internet connected to the classes ?	0%	100%
6	Do you use the computers for teaching your students?	42%	58%
7	Do you know what is E-learning ?	100%	0%
8	do you use any e-learning software in your teaching	80%	20%

Table (1): the Part one questions for Faculty member's

No	Question	V Good	Good	Average	Poor	V Poor
1	What is the level of readiness of the lecture halls for the application of e-learning?			33%	67%	
2	What is your assessment of the strength of Internet in the university?	17%	25%	42%	17%	

Table (2): the Part one questions for Faculty member's

Computers and Internet

There are many practical difficulties in implementing elearning programs in universities due to lack of resources (Mahmud and Gope, 2009) . Computers and Internet connectivity are the most important requirements for e-learning. The study showed that more than half of the lecturers (67%) had a computer in their office; and only 58% can access internet from his office; but all of them had an Email; 42% use computers for classroom teaching (see Table 1). On the other hand, students can access to computers approximately two per week because of limited availability. Most of the faculty members (58%) use a traditional method for teaching and learning.

Computer Expertise

The survey revealed that (as shown in figure 2) most of stuff members had a very good expertise in using computers (67%) and the Internet (75%). In addition, 92% of stuff members considered that they had a good or above (very good) level of competency in using computers for teaching. In general, most of the lecturers believed they knew how to use computers and are quite familiar of utilizing all resources available on the web.

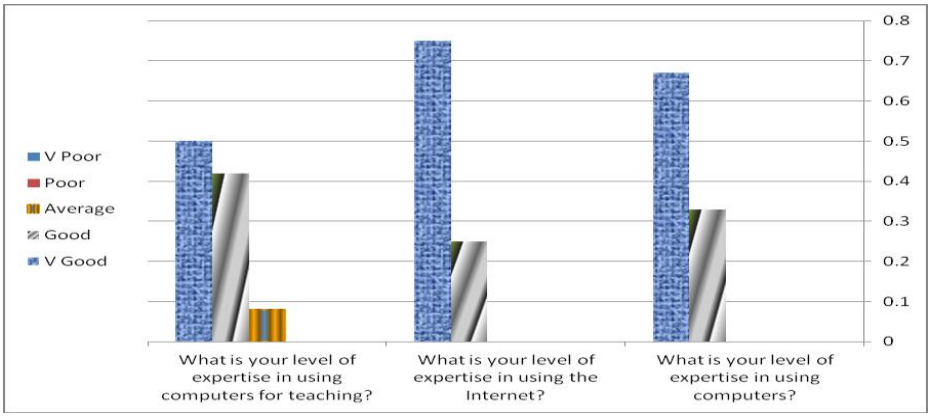

Figure (2): Perceptions of Computer Expertise.

Challenges Faced by Stuff Members

The lecturers' responses were that there problems in applying e-learning represented in Lack of readiness of the lecture halls and Weakness of the Internet. As per our survey, the Internet connection is slow as 59% of the lecturers raised this issue, see table(2), and All lecturers have agreed on the lack of readiness of the lecture halls.

Lack of awareness and interest

Generally there is still a lack of awareness and interest among the faculty members. According to the survey, most of the respondents fall in the group of average knowledge in e-learning. Figure 3 shows the interest level about e-learning among respondents of the survey.

The study showed that the opinion of the faculty members varied in the extent of successful implementation of e-learning in the university.

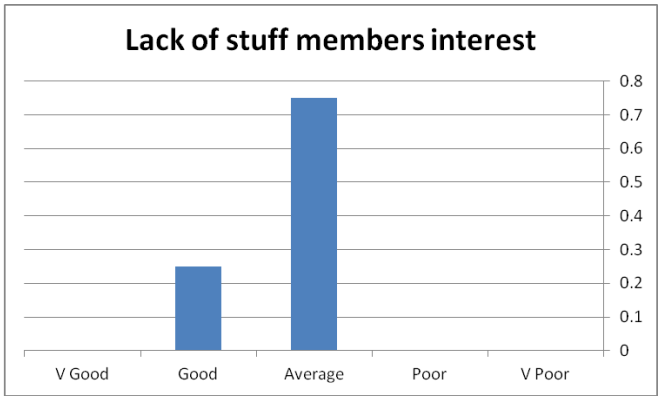

Figure *(3)*: Stuff members interest.

Figure 4 show that, 33% of faculty members see that the successful implementation of e-learning, where 66% believes that the probability of successful implementation of e-learning is weak.

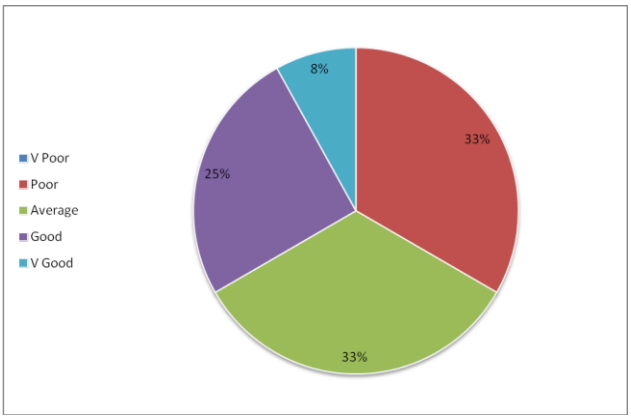

***Figure** (4):* assessment of the success rate of applying e-learning at the university

I. CONCLUSION

According to the study, The results indicated that there exist challenges in applying e-learning at the College for teaching and learning. It is necessary to take initiatives to overcome problems related to technological. There are many practical difficulties in implementing e-learning programs in university due to lack of resources such as The lack of computers in the classroom, slow strength of Internet and other resources at university. Improve the computer laboratories and halls lecture are one of the major important thing that must do in the university.

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SESSION

NOVEL APPLICATIONS AND STRATEGIES

Chair(s)

TBA

Cross Media Publishing of MediaWiki Content

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***Abstract*—Wikis are excellent tools for distributed authoring, knowledge management and collaboration. Even for inexperienced users the used markup syntax is easy to understand and tends not in an obstacle to participate in the authoring process. Widely used in universities, enterprises and communities, Wikis represent a web based content management system for collaborative working and authoring. In many situations users want to have the content of a Wiki or selected articles available in different types of media other than the web based online version. This is the domain of cross media publishing systems being able to create several output formats from one single source. In this paper we present a module of the cross media publishing framework openFuXML to integrate Wiki content and render it to different output formats.**

I. Introduction

Wikis have become a widely used tool in the Internet, universities, schools and enterprises since their invention in 1995 with a significant impact on society with *Wikipedia*. A impressive increase of Wikis as a platform for collaborative knowledge sharing [1], ranging from some loosely connected articles up to vast databases with hundreds of thousands of articles and dense connections between these, has taken place during the last ten years.

In the area of education, projects like *Wikibooks* or *Wikiversity* are taking advantage of the community to produce textbooks, course materials or curricula to support and organize educational activities.

The impact of Wikibooks in the textbook industry is described in [2] in the context of community processes. It is stated that communities working on Wikibooks are currently only loosely connected and mostly unorganized; nevertheless these communities are capable to produce reasonable results under these conditions.

Especially with hyperlinked articles and semantic links between these Wikis are a significant step forward from collections of printed material, although traditional Wikis only provide the direct view on one article. Often a user wishes to combine several articles or include articles in his own content and produce a document with a consistent layout: A project manager wants to compile a dossier with several CVs available as individual articles, a tourist wants to create an individual sightseeing guide of several points of interest available in Wikipedia or an author who wants to include a Wiki article in his document or compile a document from several Wiki articles. In general there are several situations where users want to make a snapshot for a collection of articles with a specified revision, e.g. a release version of a software documentation or report and provide this as a printout.

After deciding to create the document containing several Wiki articles, authors are confronted with the question how to do this effectively. The simplest way of integration ("Copy & Paste") is sufficient for single articles. For content structures basing mainly on Wiki sources with dozens of articles, this becomes a cumbersome task, even more if this must be repeated after changes of content in the future. This paper introduces a module of the cross media publishing framework *openFuXML* [3] doing this automatically by converting Wiki articles into XML and utilizing the framework to create high quality textbooks (PDF), web pages (HTML) or ebooks (EPUB) from the same content repository.

The remainder of this paper discusses the related work in Section II. Section III introduces the cross media publishing and authoring framework *openFuXML* and is followed by discussion of integration Wiki content from a technical point of view in Section IV. Section VI presents results and ends with an overview on future work.

II. Related Work

While we are not aware of other work extracting content from Wiki to XML with the objective to apply cross media publishing systems for ebook or high quality textbook production, several approaches exist to access and process content stored in Wikis.

General work in extracting information from unstructured content [4], extracting lexical knowledge [5] from Wiki articles as well as using natural language processing systems for Wiki content [6] has been carried out.

A wide range of bots or bot frameworks exist for automatic or semi-automatic content editing of Wiki text. This includes tasks such as spell checking, link checking or finding duplicates or disambiguation in the database.

Plugable rendering engines are also related to our work. E. g., the Wiki markup rendering engine *Radeox* is proposed in [7], this project aims to provide a generic translation of wiki markup written in Java. The engine *VersoWiki* is implemented in PHP and allows the transformation of Wiki markup to HTML and back. Common features of other PHP based engines like *PmWiki* or *TextWiki* are the usage of regular expressions and HTML as the primary output format.

Notable work was undertaken in [8] to create a data interchange format for page content of *MediaWiki*. A Document

Type Definition (DTD) is proposed (and implemented) to describe the page content, however this is only done for meta information like revisions, dates etc. The content itself is not transformed into XML.

Also notable is the built-in function "Printable Version" or "Add Page to Book" of *MediaWiki*. While the first function creates merely a HTML page without navigation elements, the second function allows users to create a PDF containing several articles. These generated PDF documents lack of customized tables of content, and other editorial elements like lists of figures, tables or index registers. The image quality is equal to the screen resolution only and formulas are created (with poor quality) as images. While these shortcomings may not be recognized by inexperienced users, they will soon realize that the content cannot be modified, reordered or extended. These serious restrictions for the creation of different output format are addressed in this paper.

III. The CMP Framework openFuXML

A. Cross media publishing

Cross media publishing (CMP) describes a publishing process that creates different types of media (e.g. books, cd-rom, web pages, e-books) from one single source ("single source publishing"). The content is managed and stored in a media independent manner, text elements are often managed using the Extensible Markup Language (XML). Images are available often in the source format, *openFuXML* maintains two different formats: (i) a scalable vector format (Encapsulated Postscript (EPS) or Scalable Vector Graphics (SVG)) optimized for printing or further processing and (ii) a raster image (Portable Network Graphic (PNG)) for screen output.

Using this concept of a single source, a cross media publishing process is able to render the content automatically for different types of target formats. This results in both a flexible and cost efficient way to store and maintain content repositories, since only a single repository has to be managed – thus avoiding redundancies of the same content for different media types.

B. History

The cross media publishing framework *openFuXML* became accessible in February 2007 and was initially presented at ED-MEDIA 2007 in Vancouver [9]. The development process started at the University of Hagen, Germany, in 2003, when a new development of a genuine cross media publishing system was agreed upon following extensive evaluation of existing systems. None of those was assessed suitable for publishing learning material with enriched interactive components in the multimedia format HTML or to provide high quality for printing press with the economical constraint to author and publish hundreds of courses cost efficiently. The development project received funding until 2005 and was then continued by the Department of Communication Systems and the Center for Development of Distance Teaching of the University of Hagen. The publishing system *openFuXML* is available as open source software with a GPL licence in the CampusSource Software Exchange and SourceForge.net, while the hosting of the sources migrated to SourceForge.net in 2008. The migration to SourceForge.net enables external contributions to the development process and to apply the system with its latest enhancements and features [3].

C. Media Concept

The authoring framework *openFuXML* [9] offers *structural* and *formatting* elements as well as *editorial* elements (see Figure 1) which are well known from other word processing systems: common structural elements like sections, paragraphs or lists are available as well as visual formatting like bold, italic, verbatim or underline. Different markups like footnotes, marginalia or literature references are supported and belong to the *editorial* elements.

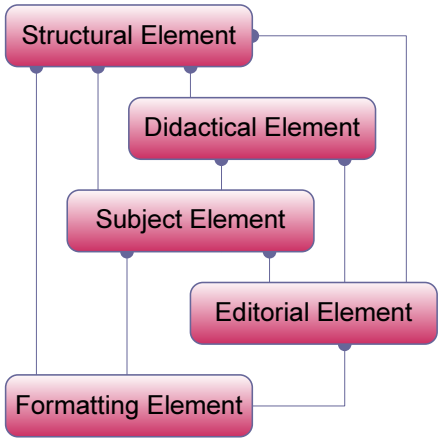

Figure 1. Media Concept of openFuXML

We worked together with professors from different faculties to be able to offer special *subject* environments for particular target groups such as mathematicians, lawyers, social scientists, engineers and computer scientists. The available *didactical* elements cover a wide range of concepts, e.g. examples, hints, exercises and solutions, author information, prerequisites and learning objectives.

IV. The openFuXML Wiki Engine

A. Wiki Markup Transformation

Listing 1 shows a simple Wiki article only containing a few headers on different levels. Knowing the rules of applying different levels of headers with the symbol "=", one directly understands the structure.

Listing 1. MediaWiki markup

```
==The openFuXML Wiki Engine==
===Wiki Markup Transformation===
====Wiki Example====
====openFuXML Example====
```

The transformation of this Wiki markup to XML is shown in Listing 2 and described in detail in [10]. The hierarchical and semantic representation in XML is much more complex, but it's advantages can easily demonstrated. If one wishes to

include the Wiki article in Listing 1 into a pre-defined sub-section, all header depth levels need to be modified manually. In XML (Listing 2) the `section` element can directly be inserted (or referenced) within another `section`.

Listing 2. MediaWiki markup transformed to XML

```
<section>
    <title>The openFuXML Wiki Engine</title>
    <section>
        <title>Wiki Markup Transformation</title>
        <section>
            <title>Wiki Example</title>
        </section>
        <section>
            <title>openFuXML Example</title>
        </section>
    </section>
</section>
```

The *Content Transformation* process includes text and media objects. If source images are available as Scaleable Vector Graphic (SVG), this format is converted lossless into EPS and used for the PDF output rather than just copying low quality bitmap images. Mathematical expressions are extracted from the "alt" tag and thus available in Latex notation for further processing. The output of this step are different content objects, mostly articles (`ofx:section`) with text, images, links and references.

B. Template and Macro Transformation

The definition of templates and environments is a sophisticated way for users and operators of Wiki servers to customize the layout of the pages. On the one side this is the worst-case for external rendering or transformation engines, because users are free to define whatever they want in these templates and the actual presentation is often done in conjunction with CSS. On the other side, there is semantic information in the form of key-value pairs available. Obviously, the rendering engine needs to understand these information to be able to render it in the right way.

Beside a generic *Template Transformator* mapping the key-value pairs to a simple table, users a free to decide how a template will be processed. In the configuration file a unique transformation class can be chosen for each template. The outcome of this transformation class may either a valid XML document with the namespace of the authoring framework or a intermediate XML format with an arbitrary namespace which is translated in further processing to a *openFuXML* valid document.

V. Content compilation

A. Structure Definition

All references to external Wiki content are defined inside the container element `wiki:content`. The most important elements are `wiki:page` and `wiki:category`:

- `wiki:page` This element represents an article (a Wiki page), which will be inserted at this position. The child element has to be a `ofx:section`, the optional attribute `transparent="true"` will insert the content of the article at this position and not create a own section with the complete article.
- `wiki:category` All articles tagged with the given category are summarized. Either as individual sections or compressed a synoptical table.

Document structures are defined in XML with the *openFuXML* authoring framework. Listing 3 (with partly omitted XML namespaces) shows an example of such a definition.

Listing 3. Example of XML structure definition

```
<?xml version="1.0" encoding="UTF-8"?>
<ofx:ofxdoc>
  <ofx:metadata>
    <title>HelloWorld</title>
  </ofx:metadata>
  <ofx:content>
    <section source="text/introduction.xml"/>
    <section>
      <title>Use Cases</title>
      <wiki:content>
        <page name="Category:Use_Case" depth="0"/>
      </wiki:content>
      <wiki:content>
        <category name="Use_Case">
          <section/>
        </category>
      </wiki:content>
    </section>
  </ofx:content>
</ofx:ofxdoc>
```

The document has two top-level sections:

- The section **Introduction** demonstrated the inclusion of a XML document as a external source. The directive will be completely replaced by the content in the external document.
- The section **Use Cases** starts with the content of the Wiki page `Category:Use_Case` and is followed by all pages labeled with the category `Use_Case` as individual sub-sections.

B. Content Compilation

The structure definition document is the source for the process of *Content Compilation*. In a couple of steps, all external MediaWiki servers are contacted and the defined articles are locally stored for further processing.

1) Since all container elements can be defined as references (with `external=true` and a `source` attribute), the root document is parsed and all external content elements are merged into the root document.
2) The document at this stage contains the complete *local* content. In this step the document is parsed for *external* `wiki:content` Elements (see Listing 3) and the element is replaced by a *local* (external) content element pointing to a file.
3) Depending on the configuration (*never*, *always* or if the Wiki page is *updated*), the Wiki page is requested from the server and saved as Wiki markup.
4) The Wiki markup is transformed to XML, this step is explained in Section IV-A.
5) The newly created external elements are merged into the root document.
6) References are processed with customizable strategies for internal and external links.

The resulting XML document contains all content information and can be processed in the rendering engines for cross media publishing. Depending on the target format and it's configuration, editorial elements like tables of content, figures or lists are available. Didactical and subject elements can be generated by individual *Template Transformators*. The process of content compilation and cross media publishing is outlined in Figure 2.

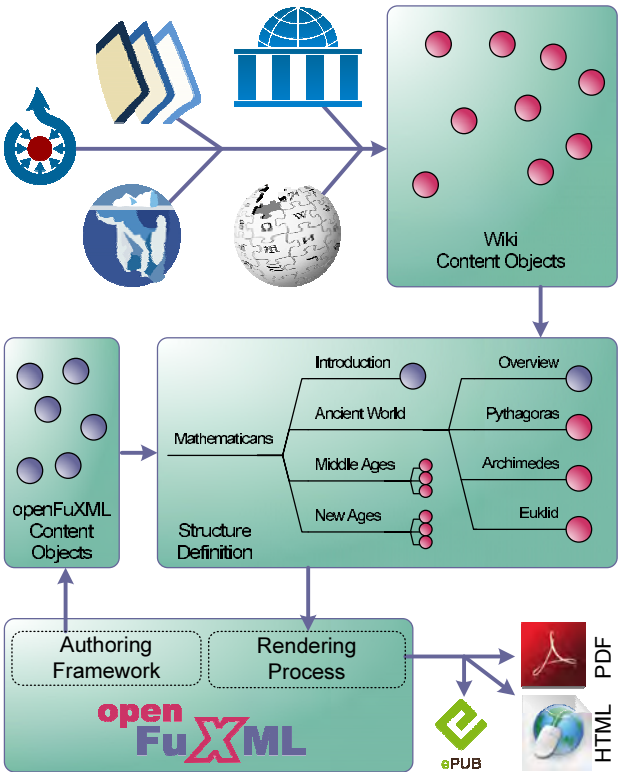

Figure 2. Content Compilation with openFuXML

C. Content Structuring

A general issue for all tools and algorithms trying to transform a collection of hypertext documents into a linear book is the ordering of different pages in the book. Let's assume the root page `R` of the hypertext collection points to pages `A`, `B` and `C`, and they respectively point to pages `A1`, `A2`, `B1`, `B2`, `B3`, and `C1`. Should pages ordered in depth first fashion `R`, `A`, `A1`, `A2`, `B`, `B1`, `B2`, `B3`, `C`, and `C1` or in a breadth first fashion `R`, `A`, `B`, `C`, `A1`, `A2`, `B1`, `B2`, `B3`, `C1`?

Event with this simplified example it's easy to find arguments for and against each of the strategies, with additional links e. g. from `A1` to `B2` or `A1` to `B2` to `C2` to `A1` both strategies will fail.

One solution implicitly used in Figure 2 is a manual ordering. This is implemented for the `wiki:page` and `wiki:category` directives.

A collection of hyperlinked Wiki articles can be described as directed graph with an ordered pair $G = (V, E)$ with V as a set of elements called vertices or nodes, and E a set of ordered pairs of nodes called directed edges.

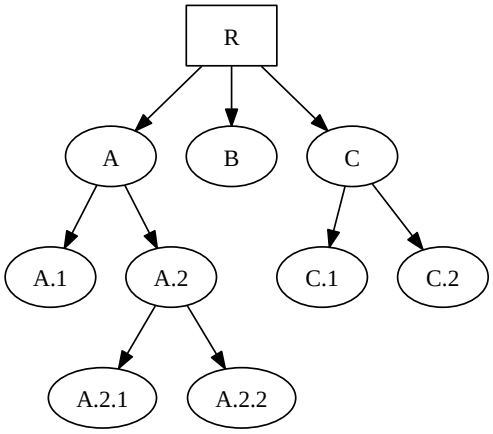

Figure 3. Tree structure of a textbook

A textbook can be interpreted as a special case of a graph $G = (V, E)$ with $|V| = n$ nodes and $|E| = m$ edges called *Tree*. A node is equivalent to a section or subsection and a edge represents the relationship "is parent of". The additional constraints (i) there is exactly one path between two nodes, (ii) G is (minimal) fully connected with $m = n - 1$ and (iii) G is (maximal) acyclic (i. e. the no cycle at all) describe a tree [11] shown in Figure 3.

Type	Nodes V	Edge E
Wiki	Article	has a reference to
Textbook	(sub)section	has subsection

Table I
CHARACTERISTICS FOR SELECTED COUNTRIES

This theoretical descriptions reflect our intuitive understanding of the structure structure of a textbook and wiki articles and is summarized in Table I.

The required structure[1] for a textbook and the graphical representation of a *tree* is outlined in Figure 3.

Figure 4 shows an example of linked hypertext documents. With the graph metrics *in-degree* and *out-degree* it's possible to identify the node `A` as a root node and `F` as a leaf. But with this information it's not sure if `F` should be a child of `A` or `D`. Cyclic links (shown with `B`, `D` and `E`) must be detected and resolved during the transformation to a tree-like structure.

A couple of algorithms and heuristics are implemented to support users with the compilation of hyperlinked articles to textbooks. The directtive `wiki:page` supports the attribute *depth* to specify the number of links which should be followed during content processing. Another metric is the distance to manual defined root elements d_R. This is demonstrated in

[1]Of course this structure does not restrict the usage of *internal* references by authors "see section x.y"

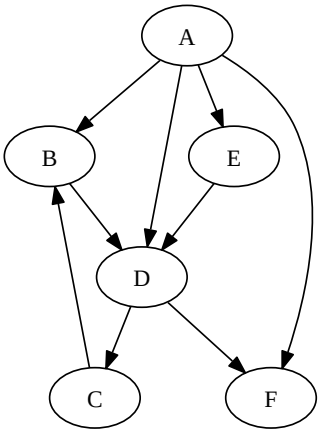

Figure 4. Hypertext documents

Figure 5: The node C might belong to A or R2, but the algorithm will attach it to R2 because $d_{R2,C} < d_{R1,C}$.

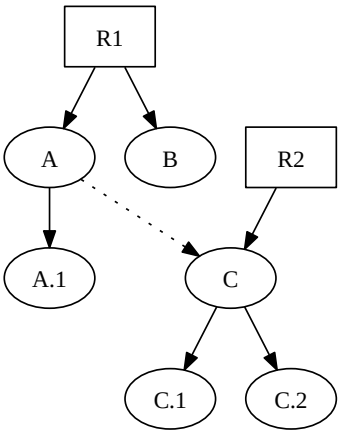

Figure 5. Minimization of root distance d_R

Wiki pages can be labeled with meta-information like *categories*. If this information are available a clustering algorithm can be applied trying to cluster all pages with the same meta-information to the same parent. The user can specify a ordered list of key-words to give them a high priority for the algorithm.

Without semantic information the local clustering coefficient c_i [12] can be used, The connections of all neighbors of node i to all possible connections among each other is represented by c_i, a high c_i for hyperlinked articles suggests that articles with common neighbors tend to be neighbors, too.

VI. Conclusion and Future Work

This approach combines the advantages of both environments: the simplicity of markup and authoring of Wikis and the flexibility of structured XML content objects for cross media publishing. The system is successfully tested to process a internal knowledge management Wiki, a Wiki for software development documentation and learning materials created in a distributed authoring process. It allows authors with basic IT knowledge to participate in the development process directly with the Wiki. Editors can work with the XML based authoring framework and directly include single articles, multiple articles or a selection of articles based on categories. The resulting document can be processed by the cross media publishing system *openFuXML* and rendered to HTML, PDF or EPUB. Based on XML, a transformation to other schemas, like *DocBook* or individual formats is possible.

Beside Wiki markup itself, the processing of custom templates is the most important step for reasonable results. Future work will focus on templates processing, creation of generic transformations and a repository for custom transformation classes, e.g. for templates used in *Wikipedia* or individual user generated templates.

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Equipping the public primary schools in Puebla: the case of the enciclomedia system in the state of Puebla, Mexico.

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Abstract- *The primary school system in Mexico is affected by serious shortfalls in the installation of related information and communication technologies resources in the teaching-learning process. This lack of resources has an impact of the context of the digital divide as well as in joining the knowledge society. The present article will deal with the outfitting of classrooms with the enciclomedia system in the 5th and 6th grade in the State of Puebla. It will demonstrate important findings, demonstrating the deepening digital divide between the state capital and the rest of the counties in this state. In fact, the furthest (300 km far away from Puebla city) the less primary school equipped with the enciclomedia system. We will also demonstrate the resource distribution by school-type and inhabitants. Another finding is the influence in resource distribution by political party. This study should provide public policy decision-makers with valuable information for the apportionment of resources in all counties of the State of Puebla.*

Keywords: public policies, primary schools, information technology, resource distribution, political party.

1 Introduction

Various studies have demonstrated the importance and the impact of diverse material resources and equipment of different types [1] to improve efficiency, the learning process and teaching results [2]. According to the Director of UNESCO, Mr. Koichiro Matsura, in his discourse delivered on the 19th of December 2007, "…the information and communication technologies have the power to increase learning access, especially for vulnerable communities in remote areas…", additionally,"…these new technologies can help governments to monitor, manage and apportion educational services in a more efficient way…" he acknowledges information and communication technologies as a basic tool to close the digital divide [3] between cities and countryside, as defined by Inclán [3] as well as between nations.

The basic public educational sector in Mexico is one of the least favored with respect to the use of information technologies which is unacceptable if the digital divide is to be closed [4]. It is undeniable that in a nation of well-educated citizens there is a profound contribution to the development of a knowledge-based society [5], of a more just and participative society. However, insufficient availability and utilization of information and communication technologies, the low budget increases in educational resources [6] and the inefficient use of available resources [7] are characteristic for the Mexico educational system, which still has not completely manage to appropriate information and communication technologies in spite of the presence of approved programs by the UNESCO as in the case of the enciclomedia system, the program of Physics Education with Technology and the Program of Mathematics Education with Technology whose objective is to incorporate the use of information and communication technologies in the teaching of physics and mathematics in secondary public schools.

This paper will try to portrait the current situation in Puebla´s primary school system with respect to the inclusion and use of the information and communication technologies as an educational tool in teaching and learning process, especially the use of the enciclomedia system in the 5th and 6th grades of primary schools since very few publications have touched on the problem and have seldom taken it into consideration as a factor in educational quality improvement. Consequently, there has been negative impact on productive tasks and the creation of new forms of social interaction in Mexico which could be the foundation of understanding the importance which information and communication technologies has in today´s education [8].

The initial step of this paper is to offer an exploration of the operation of the Mexico educational system, thereafter information related to the enciclomedia program, the equipping of classrooms for the 5th and 6th primary grades between the 217 counties of the State of Puebla with this tool will be presented. A model will be developed with the objective of analyzing the impact of the number of systems in relation to the localization of primary schools, according to total population numbers per county and per school modality (state, federal, indigenous and indigenous shelter. Finally, conclusions will be offered.

2 Literature review

The Mexico educational system is based on the General Educational Law which, in turn, is based upon Article 3 of the

Mexican Constitution. In it are established the general provisions, organization and general structure of the Mexico educational system. In the institutional framework are basic education, middle schools and higher education, each with its different levels and modalities.

In primary education, three modalities are recognized: the General Primary School (urban and rural), the Indigenous Primary School and the Community Primary School. Primary education consists of a 6 year cycle and is obligatory for all mexicans. For purposes of this paper, general state, federal state, indigenous and indigenous shelter schools in the 217 counties of the state of Puebla will be dealt with.

During the schoolyear 2005-2006, approximately 32 million students were enrolled in the Mexico School System in all of its different levels, types and modalities in 230 000 education centers. The largest number of students, nearly 25 million, were enrolled in basic education (secondary and primary schools) this also includes secondary schools for the working population. This level represents 80.4% of total student enrolment in 92.3% of the school installations (214,394).

14,548,194 students were enrolled in primary education (13,371,543 in public schools and 1,176,651 in private schools) in 98,045 schools (90,896 public schools and 7,149 private schools). 5,979,256 students were enrolled in the secondary education system, (5,531,111 in public schools and 448,145 in private schools) in a total of 31,667 schools (28,246 public and 3,766 private). At the high school level a total of 3,658,754 students (2,924,529 in public schools and 743,225 in private schools) attended 12,841 schools (7,590 public and 5,257 private).

The efforts to create a wide infrastructure coverage at the different education levels has been impressive but still not sufficient during various federal administrative periods [9]. For example; 90% of the recourses destined for the education sector in 2006 were for current operation costs and only the small remainder went forward investment and innovation.

Various studies offer information with respect to the impact of the quantity and quality of educational recourses used [10]. In this context, in a study covering the year 2004 education inequalities in Mexico [11] it is pointed out that the use of some inputs are related with the yield, as was the case of the use of computers in spanish and mathematics courses where the impact was positive.

In Mexico´s National Development Plan for 2007-2012 it is acknowledged as well that there are still lags in the educational system such as the lack of opportunities to access to quality education as well as in advances in technology and information. Therefore, the Plan establishes a collection of objectives and strategies to foment development. Objective number nine: "Elevating the quality of education postulates a series of considerations to achieve this objective which is designed to comply with a combination of strategies. Strategy 9.3 recognizes that educational methodologies must adapt themselves to a changing world to assure the integration of knowledge through new information technologies. Respectively, strategy 9.4, objective 10 and strategy 10.1 describe the importance of the apportionment of resources in an efficient and equitable manner (through our model we will demonstrate that the apportionment of resources in the State of Puebla for equipping classrooms with the enciclomedia system is done differently) to reduce regional inequalities, modernizing and broadering educational infrastructure.

The stated objective of the National Development Plan recognizes the necessity of spurring development and utilization of new technologies in the educational system to permit the integration of the students into the knowledge society. Therefore, strategy 11.1 has been designed specifically to reinforce the use of new technologies in the teaching process and in the development of abilities in the use of information and communication technologies starting at the basic education level.

In this same context, the State Plan for the Development of the State of Puebla 2005-2011, recognizes the necessity to broaden educational infrastructure to guarantee equal opportunity of access to and continuance in the system for all Puebla citizens. Consequently, at the administrative level effective deconcentration is fundamental in establishing an integral administrative modernization program which contemplates efficiency in planning structure and the operation of the department. In the diagnosis of the Primary educational level it was established that deteriorating infrastructure still prevails and that there is scarcity of resources.

For its part, the National Institute for the evaluation of education (INEE), an organization created in Mexico for the evaluation of quality in the Mexico educational system has conducted various studies [24] [25] [26] [27], which reveal the state of school resources available in the matter of information and communication technologies for primary and secondary schools, plus physical space, teaching aids (which includes the availability of computer science teachers) the number of computers and/or other electronic devices, study programs and financial resources.

In the context of the above, we acknowledge that the current educational policy of the Mexican government has evolved, passing from being an indicator of social welfare to being a product adapted to serving that which determines the new political and economic order [12]. As shown, the technological revolution is an element which has obliged nations to adapt their public policies [13] in light of this factor and educational policy [14] it cannot and must not be disregarded in this context that the educational context has changed [15]. The democratization of education, for its part, appears to be part of the objective of the new economic policy with the eagerness to reduce social inequalities by bringing education to all corners of nation [16].

Emphazing just how much attention must be paid to the incorporation of information and communication technologies

in education, various programs of Mexico´s federal government (Ernesto Zedillo, Vicente Fox and Felipe Calderón) have acknowledged its importance and consequently programs like enciclomedia (during the administration of Vicente Fox) were created for basic education. That is to say, the investment which the government must make in order to adopt new information technologies in the educational sector is essential [13] and not to be delayed [17]. The assignment of this resource must be made in such a way, that it does not contribute to the broadering of social inequalities. In that, special care must be taken in deciding which order and how the government will employ this resource and where it will come from [16].

The focus of this paper is the primary school and the incorporation of information and communication technologies through the enciclomedia program in the classroom. Information and communication technologies have been incorporated in the primary school in different ways around the world as well as in its different levels [18] [19]. Some schools have established laboratories and/or computer rooms, multi-media rooms and/or audiovisual rooms, computers and/or audiovisual equipment in the classroom [20] with the intent to have equipment which helps the educational community to develop abilities to compete in the marketplace and have better working conditions in the future [16]. This new equipment suggests an organizational modification of school centers [15], curriculum modification as well as in the process of teaching and learning [21] and of the teaching topics and their transmittal [22].

Enciclomedia is an educational strategy which originated in 1998 and consists of a system of articulated resources which, through digitalization of textbooks and the incorporation of various multimedia resources like videos, photos, maps, graphs, encyclopedias [3] and electronic blackboards [18]. Enciclomedia has linked its lessons in order to contribute to the qualitative improvement of education in public schools in Mexico and is now totally linked to fulfill the educational objectives. It is an innovative way of using technology in the school and thereby can contribute to overcome current issues in education in Mexico. For example, teachers can consult ENCARTA to disspel any doubts that may have arisen among the students during class or the teachers can flesh out the information they are imparting to the students about pre-hispanic cultures with videos of the principal archaeological zones, students can also find interactive excercises on mathematics among others.

The gradual incorporation of information and communication technologies into the classroom , the modernization of pedagogical practice, the production of new educational materials are characteristic of this system.

Enciclomedia began to be used in classrooms of the 5th and 6th grades of primary schools of the 2003-2004 schoolyear and has still not reached its end. At present, it consists of two stages: in the first stage (school year 2004-2005) 21,434 electronic blackboards were installed in classrooms in 7,211 schools as well as in 548 teacher training centers. 670,062 students in the general primary system, 15649 in the indigenous primary system and about 25,000 teachers have benefitted from the enciclomedia system. In its 2nd phase, school years 2005-2007, 150,000 electronic blackboards have been installed in the same number of schoolrooms in Mexico [23].

3 Objectives,variables, hypothesis and data

3.1 Objectives

One of the factors which affect the broadering of the digital gap in developing countries is the way in which educational resources are distributed in public schools. The objective of this paper is to analyze the relationship between the equipping of classrooms with Enciclomedia in the 5^{th} and 6^{th} grades of primary school in the State of Puebla and its geographic location, its modality, the size of population and political party that governs every county in the state of Puebla.

3.2 Variables

3.2.1 Numeq (Number of classrooms equipped with Enciclomedia)

Numeq has been selected as a dependent variable relative to the number of classrooms of the 5th and 6th grades of Primary Schools in the State of Puebla equipped with Enciclomedia.
The independent variables in their different modalities which will be considered are:

3.2.2 Primest (State Primary School)

This variable refers to the State Primary modality in the State of Puebla. It is a dummy type of variable because the presence of the State Primary in the database is expressed with a 1 and the other modalities with a 0.

3.2.3 Primfed (Federal Primary School)

This variable refers to the Federal Primary modality in the State of Puebla. It is a dummy type of variable because the existence of Federal Primary in the database is expressed with a 1 and the other modalities with a 0.

3.2.4 Primindi (Indigenous Primary School)

This variable refers to the Indigenous Primary modality in the State of Puebla. It is a dummy type of variable because the existence of the Indigenous Primary in the database is expressed with a 1 and the other modalities with a 0.

3.2.5 Quinto (Fifth Grade of Primary Education)

This variable refers to a fifth grade Primary School without reference to any modality in the school system in the State of Puebla.

3.2.6 Sexto (Sixth Grade of Primary Education)

This variable refers to a sixth grade Primary School without reference to any modality in the school system in the State of Puebla.

3.2.7 Distancia (Distance in km. Between the City of Puebla and the surroundings counties)

This variable refers to the existing distance in kilometers between the Capital City of the State Puebla and its counties.

3.2.8 Totescuelas (Total number of schools)

This variable refers to the total number of primary schools for all the municipalities of the State of Puebla

3.2.9 Habitantes (Inhabitants)

This variable refers to the total of inhabitants for all the municipalities of the State of Puebla

3.2.10 pan (political party, national action party)

This variable refers to a political party named pan

3.2.11 pri (political party, institutional revolution party)

This variable refers to a political party named pri

3.2.12 prd (political party, democratic revolution party)

This variable refers to a political party named prd

3.3 Hypothesis

H1 = The number of Enciclomedia sets depends on the distance between the capital city of Puebla State and the municipalities.
H2 = The number of primary schools depend on the distance between the capital city of Puebla State and the remaining counties.
H3= The number of Enciclomedia sets depends on the total of inhabitants for all the counties of the State of Puebla.
H4 = The number of primary schools depend on the total of inhabitants for all the counties of the State of Puebla.
H5 = The number of Enciclomedia sets depend on the distance, inhabitants, federal primary school, state primary school and indigenous primary school.
H6 = The number of Enciclomedia sets depend on the distance, inhabitants, fifth grade, federal primary school, state primary school and indigenous school.
H7 = The number of Enciclomedia sets depend on the distance, inhabitants, sixth grade, federal primary school, state primary school and indigenous school.
H8 = The number of Enciclomedia sets depend on the political party PAN and state primary school.
H9 = The number of Enciclomedia sets depend on the political party PRI and state primary school.
H10= The number of Enciclomedia sets depend on the political party PRD and the state primary school.

3.4 Data

The State Coordination of Distance Education of the Ministry of Public Education of the State of Puebla in Mexico (CETE-SEP) provided us with a database which contained the following information of the State of Puebla: County name and its localities (these data had to be verified individually to correct errors with respect to names and number of localities referred to), the number of classrooms equipped with Enciclomedia in the fifth and sixth grades of Primary School (2532 school rooms is the total of the sample), school modality (Federal Primary, State Primary, Indigenous Primary).
Herby item, this database displays 3 levels of Enciclomedia classroom equipment. The two first levels contain the information of equipment in Enciclomedia classrooms for fifth and sixth grades of Primary School in different stages (I and II) and the third level (III) has information of equipment for the first grade of Secondary. In this paper only level II of equipment for fifth and sixth grades of Primary School for the years 2005 and 2006 will be dealt with.
Added to the database mentioned above, are added three more variables. The first variable was the distance in kilometers existing between the capital of the State of Puebla and the 216 counties in the rest of the State, the second variable was the number of inhabitants in each county of the State of Puebla and the third variable refers to the political party that governs every county of the State of Puebla.

4 Descriptive statistics

4.1 Descriptive statistics

In table 1 there is a complete data description of this research. The number of observations is 217 that correspond to the total number of counties. The maximum classrooms equipped with enciclomedia systems are 650 and the mean corresponds to 27.67 enciclomedia sets per county. The average of state primary schools equipped with enciclomedia sets per county is 2.3 while in the federal primary schools are 6.5.The sixth (16.33) grade primary schools are more equipped with enciclomedia sets than the fifth grade (11.33). The total number of primary schools in the state of Puebla is 366 and 71% are equipped with enciclomedia sets. Finally, there are more federal primary schools than state primary schools or indigenous primary schools.

Table 1

Numeq	217	27.67742	48.81178	1	650
Primest	217	2.359447	4.852435	0	66
Primfed	217	6.506912	8.389875	0	78
Primindi	217	2.608295	5.337544	0	38
Albindi	217	.1935484	.5085881	0	3
Quinto	217	11.33641	22.31181	0	301

Sexto	217	16.3318	26.54435	1	347
Distancia	217	120.2719	66.03538	1	300
Habitantes	217	24803.75	103242.7	426	1485941
Totescuelas	217	19.51613	32.60369	1	366
Porcenciclo	217	.7177419	.2259649	.07	1

5 Model, methodology and results

5.1 Model

The following equations are the proposal models to prove the hypotheses postulated earlier:

Model H1

$$numeq = \beta 0+\beta 1 distancia \quad (1)$$

Model H2

$$totescuelas = \beta 0+\beta 1 distancia \quad (2)$$

Model H3

$$numeq = \beta 0+\beta 1 habitantes \quad (3)$$

Model H4

$$totescuelas = \beta 0+\beta 1 habitantes \quad (4)$$

Model H5

$$numeq = \beta 0+\beta 1 distancia+ \beta 2 habitantes+ \beta 3 primest+ \beta 4 primfed+ \beta 5 primindi \quad (5)$$

Model H6

$$numeq = \beta 0+\beta 1 distancia+ \beta 2 habitantes+ \beta 3 quinto+ \beta 4 primest+ \beta 5 primfed+ \beta 6 primindi \quad (6)$$

Model H7

$$numeq = \beta 0+\beta 1 distancia+ \beta 2 habitantes+ \beta 3 sexto+ \beta 4 primest+ \beta 5 primfed+ \beta 6 primindi \quad (7)$$

Model H8

$$numeq = \beta 0+\beta 1 primest+\beta 2 pan \quad (8)$$

Model H9

$$numeq = \beta 0+\beta 1 primest+\beta 2 pri \quad (9)$$

Model H10

$$numeq = \beta 0+\beta 1 primest+\beta 2 prd \quad (10)$$

5.2 Methodology

The methodology that we follow is with a linear regression by ordinary least squares was utilized in such form as to permit arriving at the relationships.

5.3 Results

5.3.1 Hypothesis 1

In table 2, there is a relationship between the number of enciclomedia sets and the distance between Puebla City and the remaining counties. The furthest (300 km far away from Puebla city) the less primary school equipped with the enciclomedia system.

5.3.2 Hypothesis 2

The results of the equation for H_2 are predictable. The furthest (300 km far away from Puebla city) county the less primary schools. It can be said that there are some counties that are not consider in resource distribution.

5.3.3 Hypothesis 3

In table 4, we can demonstrate that the counties with more inhabitants deserve more equipped classrooms with enciclomedia system.

5.3.4 Hypothesis 4

In table 5, we can demonstrate that the counties with more inhabitants deserve more primary schools.

5.3.5 Hypothesis 5

The number of Enciclomedia sets is related to the distance, the number of inhabitants and the school modality.

5.3.6 Hypothesis 6

Table 7 demonstrates that the number of enciclomedia sets depends on the distance, inhabitants, fifth grade and school modality. But if we compare table 7 with table 8 we can assume that fifth grade it is likely to receive more enciclomedia sets than sixth grade.

5.3.7 Hypothesis 7

Table 8 demonstrates that the number of enciclomedia sets depends on the distance, inhabitants, sixth grade and school modality. But if we compare table 8 with table 7 we can assume that sixth grade it is likely to receive less enciclomedia sets than fifth grade.

5.3.8 Hypothesis 8

In 2005, the president of Mexico emerged from the Pan (political party). In table 9 we demonstrate that the counties of Puebla who were governed by the Pan were the most favored with more enciclomedia sets in state primary schools. We can assume that because the other two important political parties (PRI and PRD) were not as seen on tables 10 and 11.

5.3.9 Hypothesis 9

In 2005, the president of Mexico emerged from the Pan (political party). In table 9 we demonstrate that the counties of Puebla who were governed by the Pan were the most favored with more enciclomedia sets in state primary schools. We can assume that because the other two important political parties (PRI and PRD) were not as seen on tables 10 and 11.

5.3.10 Hypothesis 10

In 2005, the president of Mexico emerged from the Pan (political party). In table 9 we demonstrate that the counties of Puebla who were governed by the Pan were the most favored with more enciclomedia sets in state primary schools. We can assume that because the other two important political parties (PRI and PRD) were not as seen on tables 10 and 11.

6 Conclusions

The National Development Action Plan of México has included within its action iniciatives, the incorporation and use of information and communication technologies in the education sector, particularly for the basic education, with the proposal of introducing the student to the Knowledge society. In table 1 it can be seen that there are a larger number of Federal Primary Schools equipped with Enciclomedia in the State of Puebla with 78, while in the Puebla State Plan for Development no mention is made of information and communication technology in the education sector and it can be seen that only 66 State Primary Schools are equipped with Enciclomedia. As Stiglitz [16] has indicated, the assignation of this resource must be made in such a way as to not contribute to the widering of the social inequalities, wherefore special care must be taken in deciding which order the government apply this resource, as well as from which sources it will come, so that the way in which this resource is distributed to primary schools in the State of Puebla does not contribute to the broadering of the digital gap between Federal Primary Schools and State Primary Schools.

It can be said in Table 2, that the farther away any of the 216 counties are from the State Capital, the lower the number of Primary Schools with Enciclomedia equipment, this point is particularly important for decision makers in so far as in equipping classrooms with Enciclomedia, without regard as to what might be the motive for why the most distant Primary Schools are less equipped, the end result is that these areas have less access to information and communication technology, and from that we can conclude the State Plan for Development in Education and the National Plan for Development in Education are not pursuing the same objective, at least in the incorporation of information and communication technology in Primary Schools but also in the number of primary schools (Table 3). But at the same time, government realizes that counties with more population should have more enciclomedia sets and more primary schools (Table 4 and 5 respectively) and also considering the school modality (Table 6).

On the other hand, we can also say that, considering the distance between the Puebla county and the 216 remaining counties, inhabitants and school modality the equipment with Enciclomedia is always better in the fifth grade of Primary School that in the sixth grade of primary (Table 7 and 8 respectively).

Finally, the federal government supports with better conditions to those counties that are governed by the same political party instead of an equal resource distribution as seen on Tables 9, 10 and 11. Identifying the reasons for why resources are been assigned in this manner is not the object of discussion in this paper. We are focused here on the non equitative distribution to the State Primary School.

7 Appendix

Table 2

Numeq	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
Distancia	-.080403	.0501123	-1.60	0.110	-.1791773	.0183713
_cons	37.34764	6.872129	0.000	23.80227	23.80227	50.89301

Table 3

Totescuelas	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
Distancia	-.0017374	.0336719	-0.05	0.959	-.0681068	.064632
_cons	19.72509	4.61759	4.27	0.000	10.62355	28.82663

Table 4

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Habitantes	.0004458	.0000107	41.54	0.000	.0004247	.000467
_cons	16.61935	1.137204	14.61	0.000	14.37785	18.86085

Table 5

Totescuelas	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Habitantes	.0002518	.000013	19.37	0.000	.0002262	.0002774
_cons	13.27114	1.377363	9.64	0.000	10.55628	15.98601

Table 6

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Distancia	.0185955	.0066365	-2.80	0.006	-.0316778	-.0055131
Habitantes	.0002575	9.95e-06	25.88	0.000	.0002379	.0002771
Primest	1.557303	.1994933	7.81	0.000	1.164047	1.950558
Primfed	1.932526	.0672025	28.76	0.000	1.800052	2.065
Primindi	1.53002	.0817752	18.71	0.000	1.368819	1.691221
_cons	3.286567	.9355803	3.51	0.001	1.442285	5.130849

Table 7

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Distancia	-.0027105	.0017057	-1.59	0.114	-.006073	.0006521
Habitantes	.0000416	4.64e-06	8.98	0.000	.0000325	.0000508
Quinto	1.521979	.027439	55.47	0.000	1.467888	1.576071
Primest	.8314287	.0522132	15.92	0.000	.7284996	.9343578
Primfed	.8869413	.0254021	34.92	0.000	.8368654	.9370172
Primindi	.6044331	.0266038	22.72	0.001	.5519882	.6568779
_cons	.4073765	.2426693	1.68	0.095	-.0710034	.885756

Table 8

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Distancia	-.0003178	.0026013	-0.12	0.903	.0054458	.0048101
Habitantes	4.37e-06	8.19e-06	0.53	0.594	-.0000118	.0000205
Sexto	2.213923	.0633518	34.95	0.000	2.089036	2.33881
Primest	-.8282123	.1026	-8.07	0.000	-1.03047	-.6259545
Primfed	-.8315854	.0831979	-10.00	0.000	.9955954	-.6675755
Primindi	-.5136757	.0663764	-7.74	0.000	.6445252	-.3828262
_cons	.1547881	.370232	0.42	0.676	-.5750594	.8846355

Table 9

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Primest	8.930321	.3135358	28.48	0.000	8.312307	9.548335
Pan	5.913869	3.36002	1.76	0.080	-.7091045	12.53684
_cons	4.917124	1.938702	2.54	0.012	1.095728	8.738521

Table 10

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Primest	8.962982	.3127285	28.66	0.000	8.346559	9.579405
Pri	-6.610156	3.095273	-2.14	0.034	-12.71128	-.5090273
_cons	10.5202	2.492424	4.22	0.012	5.607356	15.43305

Table 11

Numeq	Coef.	Std. Err.	T	P>t	[95% Conf. Interval]	
Primest	8.930548	.3163948	28.23	0.000	8.306899	9.554197
Prd	-1.505451	5.861216	-0.26	0.798	-13.05856	10.04766
_cons	6.717266	1.766975	3.80	0.000	3.234361	10.20017

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The Human Element: Investigating the Insider Threat

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Abstract - *Statistics show that most crimes are committed by individuals known to the victims. In the computing industry, we can draw a parallel to that and show that most computer crimes involve trusted insiders. There have been numerous models proposed for analyzing and mitigating the insider threat problem. However, there has been relatively little effort to collect viable scientific data to support detection and prevention models that can be uniformly applied across different organization. The dynamic nature of the problem and the fact that it involves a human element makes it an immensely difficult problem to solve. One of the immediate problems with researching this issue is that there is no single concise definition of what exactly constitutes the insider problem. In this paper, we investigate the prior work in this field and discuss some additional thoughts that are relative to current research in terms of defining the insider threat.*

Keywords: insider threat, organizational security, human element

1 Introduction

The insider threat has proven to be one of the more complex issues in information security. The complexity starts with the industry's inability to define and agree on a clear and consistent definition of who is considered an insider, and what exactly constitutes an insider threat. The lack of a standard and precise definition hinders research in this field, and makes it difficult for organizations to implement solutions that were devised using a definition that differs from the definition that the organization itself uses. Additionally, most research will stop short of using extensive scientific data to prove or disprove the efficacy of any one approach. There needs to be more extensive and long-term research done, in order to gather scientific data for proper analysis of proposed techniques. One of the problems, as pointed out in [1], is that such data is hard to come by without full cooperation of organizations that are vulnerable to the insider threat. While most organizations acknowledge the risks they face from insider attacks, most are also hesitant to disclose data on any such risks or incidents that may have occurred. It is difficult to assess the nature of insider threats without ongoing large-scale real-world case studies. An additional hindrance to research is that the definition of an insider differs across organizations, as does the risk posed by such people or entities that are deemed to be insiders. One of the underlying issues is that what is considered an insider is relative across different organization or industries. As such, there is no one ideal and consistent definition that is both concise and universally applicable. In general terms, most research will agree that an insider inherently has privileged access. For scientific research, we require a more precise definition that also encompasses the entire scope of the problem so that conceptual models can be uniformly applied across different organizations. That is an ideal situation, which most likely is not attainable if we can make a sufficient argument that the definition is relative.

Another important point to note is that most research efforts focus specifically on the technical aspects of the insider threat, as well as just malicious insiders. In defining the insider threat, more consideration must be given to non-malicious insiders, as well as the non-technical aspects of the problem. Non-malicious insiders would be those individuals who inadvertently disclose information. An example would be an individual whose company laptop containing proprietary information is stolen. While there is clearly no malicious intent in such an incident, as well as it not being a purely technical issue, the risk is as severe as a disgruntled former employee who steals the same laptop. Credible data on the occurrence of insider attacks, if it was readily available, would likely show a high percentage of insider attacks being non-technical in nature, such as the stolen laptop example.

The insider threat vulnerability has been known for decades, and yet there still exists a huge disparity in the research efforts in this field. The lack of a universally accepted definition is one of the root causes of this problem. Nonetheless, there have also been huge strides made in developing solutions that aim to prevent, and mitigate the issue, such as intrusion and extrusion detection systems. The ultimate goal of research in this area is aimed at prevention, detection, and response. Both technical and non-technical measures must be employed to effectively combat the insider threat. Prior research has developed many conceptual models thus far, but few practical models that are proven to be effective. The efficacy of conceptual models has been difficult to measure due largely to lack of data and lack of cooperation from the business world.

2 Related Work

2.1 Defining the Insider Threat

The insider threat has existed since the dawn of the computing age, and will be with us for the foreseeable future. However, it has only been in the last two decades that the seriousness of the issue has been recognized in relation to the ever growing computing infrastructure. As technology continues to advance at a rapid pace, so does our dependency on the technology. Because our information infrastructure has become such a critical and valuable asset, people have inevitably determined that the systems could be compromised for some sort of vested interest. Insiders have the broadest reach into an organization's system, and so they naturally possess a very real and elevated risk of violating security policies as they relate to information systems. In 1999, the RAND Corporation initiated a research effort to develop an agenda to enact policy changes with regard to the insider threat problem. This also coincided with a similar effort by the Department of Defense to direct research efforts with regards to the insider threat problem. In its research paper, the RAND Corporation cites work by CERT together with the US Secret Service to investigate the motivations of convicted insiders. The general principle was that to attempt to predict and prevent the problem, a thorough understanding of the human element of such crimes, as well as what motivated the crime in the first place, must be attained. The far-reaching spectrum of the insider threat problem presents a huge challenge in doing comprehensive research on every aspect of the problem. Additionally, the data collected by these research initiatives cast some level of doubt on the significance of the problem. Although it can be surmised that the problem is very real and very significant, the supporting data is lacking in many aspects. In the RAND research, there were doubts cast about the credibility of data supporting the significance of the threat. Such doubts were fueled by results of a survey that showed different results in two successive years, and suggesting that the data may have been skewed by influence from vendors pushing solutions that are aimed at the insider threat, as well as by the unwillingness of organization to reveal details of breaches from insiders. The goal of the approach explored by the RAND research was to examine the nature and magnitude of threats, and to use technology to suggest appropriate responses. The paper introduces a taxonomy framework to distinguish different aspect the insider threat problem, and then describes articles from three research groups that explore methods of responding to threats.

The first major hurdle in researching the insider threat problem is that there is no clear and consistent definition of the problem. In a 2008 paper, Matt Bishop and Carrie Gates, set out to do just that. Their paper aims to define exactly what an insider is in a concise and consistent manner that is universally applicable. The argument is made that the lack of a consistent definition makes it difficult to perform appropriate research on this topic. Further, it is argued that the lack of a consistent definition results in varying definitions devised by researchers to conform to their research data sets and goals, rather than the other way around where the research is focused on an unbiased definition of the problem. As a result, it is often the case that the results of different research on this issue are not easily applied across different domains simply because of the inconsistency in defining the issue. The definition presented by Bishop considers an insider with reference to a set of security policies, and violation of either those policies or access controls that enforce those policies. The definition proposed presents a non-binary approach where recognition is given to different degrees of "insiderness" with respect to the access they have to certain resources. The authors contend that most research is done on the premise of a specialized definition, rather than a more broad and far-reaching definition of the problem. For example, in [3], the authors give a definition of the insider as individuals who currently or at one time had trusted privileges within a secured system. This definition is more or less binary, which is contrary to what is proposed in [5]. The threat in [3] is further described as the harmful consequences of activities carried out by insiders, whether by malicious intent or disregard for policies. In other words, attackers are either insiders or non-insiders. In [4], the insider is defined as an individual with legitimate access and knowledge of an information system, a broad but vague definition at best. In [9], the implied definition is of a person who intentionally violates security policies of computer systems within their organization. In [8] the authors contend that while the definition of an insider is not agreed upon, there is more conformity as to what an "insider threat" is. This paper subsequently defines the insider threat as encompassing both malicious and non-malicious, and altogether undesirable risks from people with privileged access. So there is a subtle but important distinction regarding the definition of an "insider" as opposed to the "insider threat".

[3] Proposes that there is no clear line that should be drawn to determine insiders versus outsiders. In [7], Matt Bishop further expounds on the definition of the insider threat. In this paper, the authors present the idea of an Attribute Based Group Access Control (ABGAC) mechanism, which sounds conceptually similar to the Group Based Attributed Access Control presented in [5], except with a different name. As in [5], the ABGAC is a generalization of Role-Based Access Control (RBAC), and assigns rights based on general attributes rather than defined work roles. In determining the structure of the ABGAC, and namely to define the different attributes, and groups, the authors present the concept of different layers of a unifying policy hierarchy. This hierarchy allows analysis of a security policy based on what is ideal, feasible, configured, and instantiated. The argument is that while an all-knowing "ideal oracle" can understand abstract concepts such as the intent of a user, and control access based on such information, a real configured and instantiated system has technical limitations that prevent such in-depth decision making when granting or denying

access. The authors content that the discrepancies between these layers are areas that give rise to vulnerabilities in processes and protocols that insiders can exploit. In identifying access attributes, and grouping protection domains, this model aims to give an assessment of the degrees of risk associated with each group of insiders. The basic premise is that not all insiders are alike, and based on these groupings, and organization can analyze and prioritize the insider threat so that implemented controls can focus on those insider groups that pose the most risk. Additionally, it comes down to an analysis of where the most risk is based on the associated costs not to mitigate those risks.

2.2 Detecting and Preventing the Insider Threat

Detection has been one of the major issues of the insider threat problem. If the threat is not detectable, then there is effectively no means of preventing it. In a 2011 paper [2], Jung-Ho et al, describes a framework for a defense system to prevent the insider threat. Most preventative strategies suggested by research are based on methods of detecting the malicious behavior of insiders, whether intentional or unintentional. In [2] the authors explore a framework for a defense system consisting of three modules whose main goals are prevention by the use of monitoring techniques. The authors propose the use of an attack tree model whereby they can identify the paths of potential risks to monitor, and make comparisons with normal activity to discern abnormal activity that may be indicative of misuse by an insider. The authors acknowledge the difficulty in defining what constitutes an insider, and they approach the insider as having malicious intent, thus the title of the paper. No consideration is given to the threats posed by insiders without malicious intent, however. The methods described first establish a baseline of what could be considered normal behavior within the confines of the security policy. Usage activity is monitored at different layers of the framework, and deviations from normal activity are then flagged as potential malicious threats. The first module in the framework is the information checker which grants connection based on the user profile as well as logs of previous or current activity which may have been flagged as malicious. The second module is the behavior checker which uses the attack-tree to monitor behavior and flag any potential malicious activities which may pose risks or deviate from normal activity. The third module is the resource misuse monitor which monitors the pattern of usage for different processes that the user may normally execute, and makes a decision on whether the pattern is malicious if it deviates from the norm. This framework basically comes down to behavioral analysis. The problem, of course, is that behavioral analysis in itself is not enough to effectively detect and prevent insider attacks.

In [8], the author again takes a behavioral approach to detecting insider attacks. The author starts off by rightfully acknowledging the issues abound in this field, as it relates to our understanding of the issues and subsequently our ability to handle the issues. The author also proposes user profiling as a means of predicting insider threat, while also pointing out the potential legal implications that such practices could cause. As for detecting insider threats, he describes methods that use behavioral analysis to alert on insider attacks based on deviation from normal activity of a user. Finally, the author presents several suggestions on what steps should be considered when responding to actual insider attacks.

In [4] the author presents a similarly layered approach for prevention, detection, and recovery from insider attacks. The goal is to achieve comprehensive security by adopting a holistic approach to the problem where all aspects of a system are analyzed, rather than just the technical aspects. An attack classification scheme is developed by extending an existing taxonomy that largely focuses on computer attacks. The author further describes the idea of the Attack Surface, which describes the various means by which someone could access the system, and the Impact Zone, which describes boundaries and constraints for levels of access. These ideas are put together to formulate a strategy of defense against insider attacks. The resulting approach proposed is a three-layer approach consisting of Social, Logical, and Physical layers. By analyzing the progression of attacks through these layers, defenses can be employed to mitigate the problems of insider threats.

CERT published a technical note in October 2011 which presents an analysis of findings from studies on 86 particular insider threat cases that found a pattern of insiders stealing information within 30 days before being terminated. At the time of the writing, the CERT Insider Threat Center database contained more than 600 documented cases of insider attacks from which researchers showed that fraud was the motive behind most attacks. This paper was specifically focused on theft of intellectual property and in determining a pattern to develop a rule that could be used in a log indexing application that is used to detect insider attacks. The goal was to determine a signature for such insider attacks that could be used to detect, and possibly prevent future attacks from being completed. This is similar to the concept in malware detection where known bit patterns, or signatures, are used to detect malware. An example of such an analysis is described in the publication using the Splunk log indexing application.

As opposed to other research efforts cited in this paper, the CERT research uses real world data to assert their findings and to develop a robust rule that is shown to work. This is unlike the theoretical detection frameworks explored thus far from prior research. In 2009 CERT also published what was the third edition of a comprehensive guide for security professionals with practical guidance on measures that can be implemented to prevent and detect insider threats [12]. The guidance draws on insight from research on real world data gathered in the CERT's insider threat incident database, and also builds on guidance from previous releases

of the same publication. The guidance presented is a result of research on these documented incidents, and shows that most incidents are a result of insiders seeking financial gain, business advantage, or simply sabotage. Such examples show that there continues to be progress in this field as more real world data is collected and analyzed in an effort to detect and ultimately prevent the insider threat.

In [6] we also see an example of real world data being used to develop detection mechanisms that employ simple application of best practices as a first step in preventing security vulnerabilities from being exploited by an insider. The article describes real-world cases of insiders subverting the security policies at their place of employment and causing damaging consequences. The authors propose that insiders can be stopped with stringent layered security composed of policies, procedures, and technical controls. The latter part of the article presents a list of 13 best practices that can be implemented in an effort to mitigate threats from insiders. This is similar to the guidance given in [12]. While there are obvious limitations to the list of security practices, it is certainly not intended to be an exhaustive and comprehensive list. Instead, it identifies the problem and presents solutions to start analyzing and dealing with the problem.

Of course, part of the problem in collecting real world data is that organizations are often hesitant to disclose such data or allow collection of such data in fear of backlash from customers or shareholders if the data collection reveals previously unknown exploits by insiders. In [6] extent of the insider threat problem is even put into question. This is partly because of conflicting statistics and reports that sometimes even show a decline in insider threat. Part of this doubt is that statistics are sometimes made to fit into a research or the agenda of a security vendor, so they may massage the data in their favor and perhaps curtail the true extent of the problem.

One aspect of the problem that is not given enough attention is the need for more effective and proper response to insider security violations. After detecting and hopefully preventing an attack, there needs to be responsive measures taken to ensure that the threat is effectively mitigated. In [8] the author makes a point to describe the importance of responding effectively to an insider threat based on the nature of the threat. Most models presented by research focus on prevention and detection. Accepting that this problem will most likely never go away, it is imperative that an organization is prepared to respond to an attack so that it is effectively contained and eliminated if possible, while considering all aspects of the attack including technical and non-technical aspects. One problem that could arise with the behavioral analysis detection method is that it can produce many false positives if not properly implemented.

3 The Human Element

It must be acknowledged that there is much to be desired in research into the insider threat problem. The difficulty of the problem is such that few advances have been made that point to a comprehensive solution. From our investigation into the research on this problem, an abundance of technical solutions have been found, but little in the way of solutions with regard to user education and other approaches that appeal to the human element of the problem. For example, one long term study could draw much conclusion from looking at insider issues between one company that pushes user education in this regard, and another company that does not put any priorities on user education. In [9] the authors specifically address the issue of insiders intentionally violating security policies of computer systems within their organization. The paper presents two case studies in their analysis of computer crimes committed by insiders. In one case study, an employee manipulated the accounting systems in order to produce false profits that would allow him to be awarded huge bonuses. In the other case, an employee was able to manipulate the accounting system as well, but his motives were quite different and he did not personally gain from those actions. Both cases are presented to illustrate the different motives for insider attacks, but the root of the problem in most cases boils down to elevated and unmonitored access by trusted individuals. In analyzing the technical controls, the authors also prescribe that informal measures such as awareness training and education are essential in mitigating these issues.

In [10], the authors specifically explore the psychological aspects of the insider threat. The paper presents ideas on understanding the psychology of malicious insiders, and contends that such understanding is crucial in understanding how to mitigate the risks from insider attacks. They present summaries from several case studies where trusted insiders have violated security policies. This is done to demonstrate the critical nature of the problem, as well as to analyze the different motives behind insider attacks. The authors suggest that many of these incidents boil down to human problems that cannot simply be solved with technological solutions. The research described in this paper is an effort to formalize the psychological profiles of insiders who violate security policies, in an effort to understand the personalities, motives, and circumstances that give rise to such actions. The goal is to establish user profiles that can be applied to business practices such as job application screenings, and management of prospective or current employees. This paper explores an important non-technical area which has not been given enough attention. While it may not be enough to predict future insider attacks based solely on a psychological profile, it is a tool that can be considered in the larger scheme of things, and in addition to other technical and non-technical methods of measuring threats. One of the drawbacks, as pointed out in [8] may be the legal ramifications of actually using such methods. While it may be

more acceptable in governmental/military setting, as was the focus of the research described, the dynamics of such methods may prove much different in corporate settings.

4 Conclusion

We have explored the general issues and proposed solution to the insider threat problem. The most striking issue within the problem is that there is no clear definition of precisely what the insider threat problem really is and who is or is not considered an insider. The insider threat problem has been listed on the national Hard Problem List for many years as an issue that ought to take priority in current research. Despite this, there has been relatively little progress in devising universally applicable models for effectively and efficiently mitigating this risk. Reasons for this stem from the complexity of the problem as well as the lack of available scientific data. A universally applicable definition of what is encompassed in the insider threat and what constitutes an insider has been a major hurdle in solving the issue and making significant research progress. We have seen that CERT, in particular, has continued to collect and analyze data and the fruits of their labor is shown in the guidance and research publications they have produced on the topic. Still, there exist many areas of void as it relates to the research into the insider threat problem. Future work must also place emphasis on the non-technical aspects of the problem such as user education and public relations responsive measures. Additionally, mitigating measures must be properly implemented to optimally reduce, if not totally avoid, the risk from the insider threat.

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Prototyping SMS Services for Medical Prescription Adherence

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Abstract – *Barriers to medication adherence among patients have been shown to have significant impact on service quality and cost in the healthcare system. To minimize this impact, many in the healthcare industry are highly interested in supporting prescription adherence among patients. They believe that information technology in general, and mobile technology in particular, can help in developing medical practices that can be highly conducive to high rates of prescription adherence by enhancing communication between patients and healthcare providers. To this end, a number of pharmacy management benefit companies plan to adopt SMS communication to reach their customers given the wider acceptance of SMS messaging among mobile phone users. However, most of these pharmacies are reluctant to purchase service agreements from SMS aggregators without a complete understanding of user, service and business requirements related to SMS messaging. Hence, many are in dire needs for prototypes of SMS servers that can help them define and refine these requirements before committing to costly agreements with SMS aggregators. This paper describes such a prototype for a pharmacy benefit management company located in the southeast of the United States.*

Keywords: Mobile technology, Prescription adherence, Short message service, SMS aggregator, Pharmacy Services.

1 Introduction

Adherence is defined as the extent to which patients take medications as prescribed by their healthcare providers. A 2001 survey showed that although 62% of physician office visits generate a prescription, these prescriptions are not always adhered to [1, 2]. Poor adherence tends to be serious among patients who suffer from chronic diseases since these diseases require long-term treatments (e.g., HIV infections, hypertension, asthma, diabetes, heart disease and psychiatric illness). This is even more critical considering that 75% of all health expenditures in 2000 went to care for individuals with chronic illnesses although these individuals represent only 45% of Americans [3, 4]. In fact, non-adherence to prescribed medication is responsible for 10% of hospital admissions and 25% of nursing home admissions. It is estimated that the healthcare system in the U.S. incurs a cost of $300 billion annually due to non-adherence to essential medications. Patient surveys about non-adherence reveal an array of barriers to adherence such as costs of drugs, forgetfulness (e.g., it is practically difficult for a patient to remember to take medication several times a day), lack of clarity in the purpose of treatment, perceived lack of medication effect, debilitating side effects (e.g., for some professionals such as doctors, lawyers, professors and writers, the side effect of taking anticonvulsant drugs can interfere severely with abstract thinking), complicated regiment, lack of clarity in administration instructions, physical difficulty in handling medication (e.g., opening containers, handling small tablets), and unattractive formulation (e.g., unpleasant taste). According to the World Health Organization, increasing the effectiveness of adherence interventions may have a far greater impact on the health of world populations that any improvement in specific medical treatments [5]. For healthcare providers such as hospitals and insurance companies, strong adherence can lead to improved performance, which in turn can generate financial incentives for these providers. Providers can use improved performance as a metric to determine whether their services meet the expectation of their customers or not. Today, most people own a cell phone. It is conceivable to design mobile applications with user-friendly interfaces to help interested users in restoring their good health. Considering the current advantages of mobile technology and its communication facilities, it is clear that this technology can be exploited to help people learn to live healthy. In addition, it can be used effectively to personalize the therapy offered to a given individual considering his/her needs. To do so, a mobile application can be readily conceived as a medication adherence management tool on the go for the patient.

2 Prescription Adherence in Managing Pharmacy Benefits

For pharmacies, strong adherence can lead to a volume increase in prescriptions refills as well as access to patients who were otherwise invisible to drug manufacturers for marketing promotions. Of special note is the importance of employers and pharmacies in augmenting adherence if both stakeholders collaborate in designing smart pharmacy benefits. These benefits can increase prescription use without impacting overall drug expenditures in the healthcare system. Most pharmacy benefit management companies prefer to use Short Message Service (SMS) messaging to communicate with their customers considering its simplicity and wider acceptance [6]. However, these companies lack a suitable

infrastructure of information technology to do so. They can solicit the services provided by SMS aggregators by negotiating a cost-effective service level agreement with these aggregators that meets the requirements of SMS communication between the pharmacy and its customers. Worse yet, most pharmacies do not know what requirements must be taken in consideration to insure a successful message service with their customers. These requirements can be related to user interaction with the service, characteristics of the message service, and requirements related to business criteria as shown in Table 1.

Table 1. SMS service requirements.

Category	Requirement
User	• Number of messages per hour or day • Appropriate delivery time of messages (before midnight) • User responsiveness to messages • Sequence of messages in prescription adherence scripts • Suitability of interaction with prescription script messages
Service	• Message sending (batch, number of retries, queuing, etc.…) • Retrieving messages • Checking delivery of message status • Error and exception handling • Logging and tracking • Service configurability • Data storage (messages, customers, message traffic, etc.…)
Business	• Number of short codes • Provisioning of short codes • Type of network connections to the SMS gateway • Transactions per day • Transactions per second • Message content

In the absence of well-defined requirements, a pharmacy benefit management company might make its best effort to purchase a service package with an aggregator only to realize later that the purchased package does not satisfy the requirements of its SMS communication with its customers. There is always a risk of over- or under-shopping for these service packages. Hence, it becomes reasonable for such a company to develop a prototype of an SMS service in order to define and refine these requirements. Such a prototype can be used as an exploratory tool for developing requirements that can be used as guidelines to purchase the most suitable service package from an aggregator. In this context, a pharmacy benefit management company located in Florida, USA decided to build an SMS server prototype to generate such requirements. This paper describes the architecture and design of the prototype of this SMS server.

3 SMS Service Architecture

Although the pharmacy benefit management company mentioned above did not have a complete understanding of requirements in each category, it opted to base the design of the message server on the following requirements:

- *Self-Containment*: The message server must contain all the computing resources it needs to separate its responsibilities from those of the software applications of the company.
- *Logging*: This capability is needed to keep track of various events taking place between the software applications and the message server. The purpose of this tracking is to help the company determine the most important user, service and business requirements.
- *Error Handling*: This capability is need to record all errors and exceptions between the SMS gateway server of the network service provider and the software applications of the company. Recording these errors can provide a rich perspective on the reliability of the service offered by the network service provider.
- *Configurability*: This capability allows the benefit management company to manage the message service in different ways in order to explore requirements that are not clearly understood in normal operating conditions of the message server.

Based on these initial requirements, the architecture of the message server has been developed and refined over several iterations to include the following components as shown in Figure 1:

- *Front Interface*: This interface provides methods that can be called by the software applications of the pharmacy benefit management company to perform tasks related to communication with its customers via SMS messages.
- *Message Database*: This database is a persistent store sued to record sent messages, received messages, errors and exceptions generated during SMS message exchange between the software applications and customer cell phone.
- *Message Server*: This server is a process that runs continuously to record all the events related to SMS communication between the software applications the customers such as sending message, retrieving reply messages and checking the delivery status of sent messages.
- *Data Access Layer*: This layer consists of dynamic libraries responsible for passing data from and to the message database on behalf of the front interface, the message server and the back interface.
- *Back Interface*: This interface provides methods to the message server for sending messages, retrieving messages, and checking the delivery status of sent message via the application programming interface (API) of the SMS gateway of the network service provider [7].

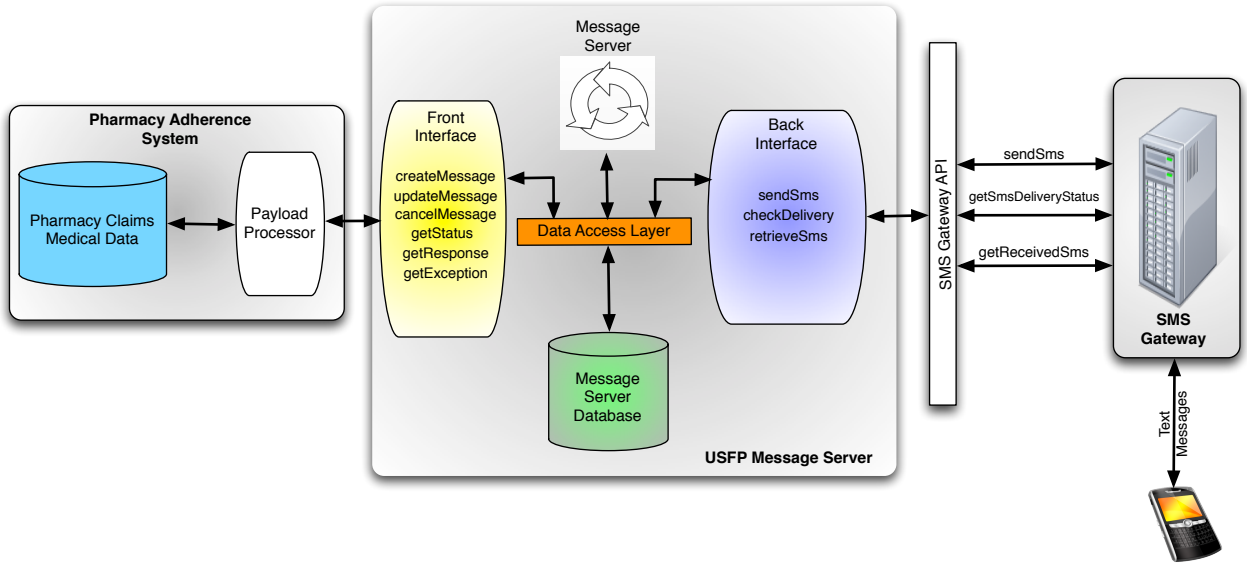


Figure 1. Architecture of the message server.

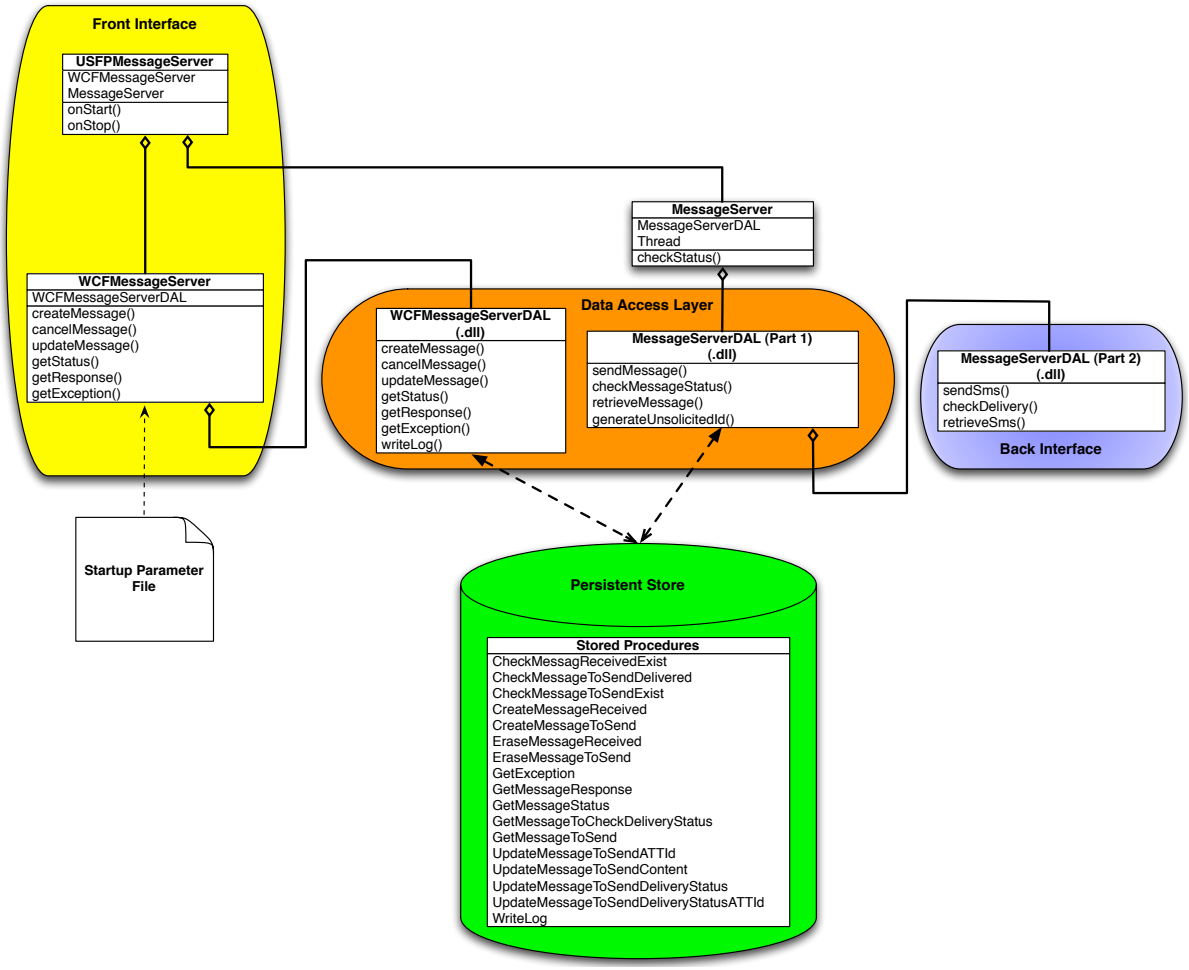


Figure 2. Class mapping on the architecture of the message server.

4 SMS Server Implementation

The architecture shown in Figure 1 was used to derive a class hierarchy for implementing the components seen in the architecture. This hierarchy was implemented using C# on .NET [8]. Figure 2 shows the classes of the message server.

The Front Interface
The front interface consists of the WCFMessageServer and MessageServer classes. Table 2 summarizes the methods of these two classes.

The Message Server
The message server consists of the MessageServer class. This class spawns a thread responsible for calling repetitively the sendMessage, checkMessageDelivery and retrieveMessage methods in the MessageServerDAL class. These repetitive calls are performed as long as the number of transactions does not exceeded the maximum number of transactions allowed per day by the network service provider. Most network service providers impose limits on the number of transactions completed between a company server and their own SMS gateways based on the service level agreement purchased by the company in need of SMS services. It is meant by a transaction any call to the SMS gateway server of the network service provider.

The Data Access Layer
The data access layer consists of the WCFMessageServerDAL and the first part of the MessageServerDAL classes. Table 3 summarizes the methods of these two classes.

The Message Database
The message database consists of the following tables:

- Table of messages to send: This table contains records of the messages that need to be sent to the SMS gateway.
- Table of received messages: This table contains records of received messages. These messages are reply messages sent by customers are replies to messages sent by the pharmacy benefit management company.
- Message table: This table contains records of messages generated for events that took place while the message server is in operation. These events can be errors, exception or log entries recording specific tasks completed by one of the classes in the message server.

In addition to these tables, this database stores a number of procedures shown in Figure 2.

The Startup Parameter File
When the message server starts, it needs to upload several parameters for proper functionality. These parameters are:

- Database connection settings: These are the settings necessary for the server to establish the connection with the database. They consist of the location path of the database and its security settings.
- Short code: This is the code assigned by the network service provider to the customer. This code is used to address SMS messages coming to or leaving from the servers of the pharmacy benefit management company.
- Endpoint send address: This is the URL address to which messages must be sent as required in the SMS gateway API.
- Endpoint receive address: This is the URL address to which message must be received as required in the SMS gateway API.
- Number of transactions per day: This number is fixed by the network service provider based on the service level agreement purchased by the pharmacy benefit management company.
- Number of transactions per second: This number is fixed by the network service provider based on the service level agreement purchased by the pharmacy benefit management company
- Transaction counter: This is a software counter generally initialized to 0 unless specified otherwise at startup time.

These parameters are stored in a file that is used by the message server during startup to load these parameters.

5 SMS Communication via the Message Server

Communication between the pharmacy benefit management company and its customers intended to enforce prescription adherence mostly of scripted dialogs between the company and its customers. The dialog below illustrates a simple adherence communication session between the pharmacy and a customer named DuPont.

Sending A Reminder Message To The Customer
In the first step, the pharmacy sends a message to Mr. DuPont to remind him to take his medication as shown in Figure 3. Before the message is forwarded to the SMS gateway, it is inserted in the tables of messages to send in the database. Figure 4 shows that the first entry is the entry of this message in the table. This entry shows that this message has reached the cell phone of Mr. DuPont since its delivery status has been automatically updated to 'DeliveredToTerminal'.

Receiving A Reply From The Customer
After customer DuPont receives the reminder message, he replies affirmatively by sending a "Yes, I did." reply message as shown in Figure 5. As soon as the message server receives a this reply, the reply is immediately inserted in the table of received messages as shown in Figure 6. The reply is passed back to the software applications of the pharmacy.

Sending An Acknowledgement To The Customer
When the pharmacy receives the reply message, its script dictates that it sends an acknowledgment to the customer as

Table 2. Front interface classes and methods.

Class	Method	Description
USFPMessageServer	onStart	It starts the Windows service.
	onStop	It stops the Windows service.
WCFMessageServer	createMessage	It calls the createMessage method in the WCFMessageServerDAL class by passing a message object.
	cancelMessage	It calls the cancelMessage method in the WCFMesssageServerDAL class by passing a message id.
	updateMessage	It calls the udpateMessage method in the WCFMessageServerDAL class by passing a message object.
	getStatus	It calls the getStatus method in the WCFMessageServerDAL class by passing a message id.
	getResponse	It calls the getReponse method in the WCFMessageServerDAL class by passing a message id.
	getException	It calls the getException method in the WCFMessageServerDAL class by passing a start and end dates.

Table 3. Classes and methods of the data access layer and back interface.

Class	Method	Description
WCFMessageServerDAL	createMessage	It calls the CreateMessageToSend stored procedure to insert each message in a batch of messages if the message does not already exist in the table of messages to send in the database.
	cancelMessage	It calls the EreaseMessageToSend stored procedure to remove the message from the table of messages to send and EraseMessageReceived stored procedures to remove the message from the table of received messages.
	updateMessage	It calls the UpdateMessageToSendContent stored procedure to update the message contents in the table of messages to send in the database.
	getStatus	It calls the getStatus stored procedure to obtain the status of a sent message from the table of message to send in the database.
	getResponse	It calls the getMessageResponse stored procedure to extract the reply messages from the table of received messages.
	getException	It calls the GetException stored procedure to extract exceptions between two timestamps from the table of exceptions.
	writeLog	It class the WriteLog stored procedure to write relevant information to the messages table about an event taking place while the message server is in operation.
MessageServerDAL (Part 1)	sendMessage	It extracts the messages that need to be sent from the table of messages to send and calls the sendSms method in the MessageServerDAL class.
	checkMessageStatus	It calls the checkDelivery method in the MessageServerDAL class for each message whose status needs to be checked from the table of message to send.
	retrieveMessage	It calls the retrieveSms method in the MessageServerDAL class to retrieve reply messages from the SMS gateway.
MessageServerDAL (Part 2)	sendSMs	It creates a connection to the SMS gateway and calls the sendSms method in the SMS gateway API in order to send a batch of messages.
	checkDelivery	It creates a connection to the SMS gateway and calls the getSmsDeliveryStatus method in the SMS gateway API in order to check the delivery status of a batch of sent messages.
	retrieveSms	It creates a connection to the SMS gateway and calls the getReceivedSms method in the SMS gateway API in order to retrieve a batch of reply messages.

shown in Figure 7. Before the message is forwarded to the SMS gateway, it is inserted in the tables of messages to send. Figure 8 shows that the second entry is the entry of this acknowledgement message. This entry shows that this message has reached the cell phone of Mr. DuPont since its delivery status has been automatically updated to 'DeliveredToTerminal'

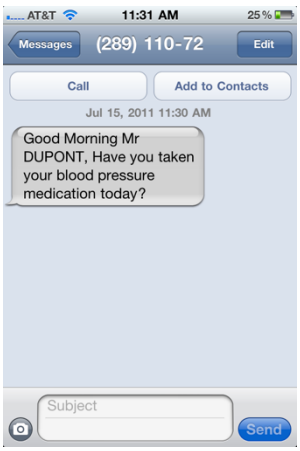
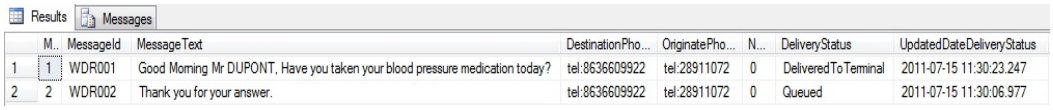


Figure 3. Reminder message to Mr. DuPont.

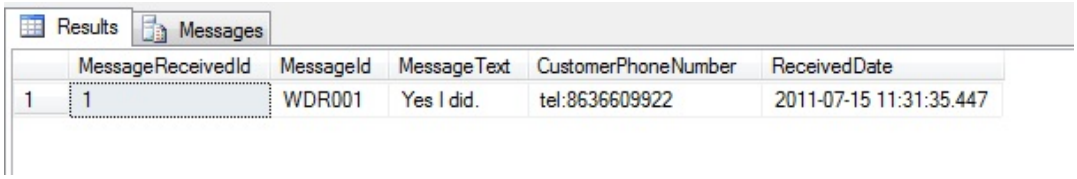
Figure 5. Rely message from Mr. DuPont.

Figure 7. Acknowledgement message from the pharmacy.



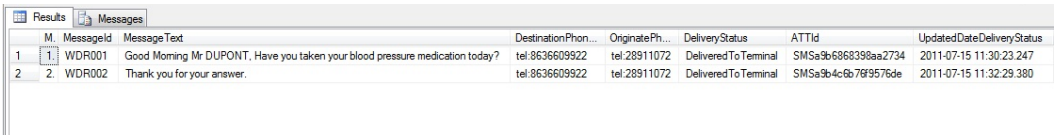
	M..	MessageId	MessageText	DestinationPho...	OriginatePho...	N...	DeliveryStatus	UpdatedDateDeliveryStatus
1	1	WDR001	Good Morning Mr DUPONT, Have you taken your blood pressure medication today?	tel:8636609922	tel:28911072	0	DeliveredToTerminal	2011-07-15 11:30:23.247
2	2	WDR002	Thank you for your answer.	tel:8636609922	tel:28911072	0	Queued	2011-07-15 11:30:06.977

Figure 4. Contents of the table of messages to send.



	MessageReceivedId	MessageId	MessageText	CustomerPhoneNumber	ReceivedDate
1	1	WDR001	Yes I did.	tel:8636609922	2011-07-15 11:31:35.447

Figure 6. Contents of the table of received messages.



	M..	MessageId	MessageText	DestinationPhon...	OriginatePh...	DeliveryStatus	ATTId	UpdatedDateDeliveryStatus
1	1.	WDR001	Good Morning Mr DUPONT, Have you taken your blood pressure medication today?	tel:8636609922	tel:28911072	DeliveredToTerminal	SMSa9b6868398aa2734	2011-07-15 11:30:23.247
2	2.	WDR002	Thank you for your answer.	tel:8636609922	tel:28911072	DeliveredToTerminal	SMSa9b4c6b76f9576de	2011-07-15 11:32:29.380

Fig. 8. Contents of the table of message to send.

6 Conclusion

This paper presented the prototype architecture and implementation of an SMS server intended to help a pharmacy benefit management company to define its SMS service requirements. These requirements can be used to shop for a service level agreement from an SMS aggregator that is highly suitable to the needs of the benefit management company.

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Building a Defensible Virtual Environment

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***Abstract* — As the scope and utilization of virtual technology continues to grow, so does the importance of securing that technology. Virtual technology is now relied upon to support production level environments, and with that increased reliance on virtual technology comes an ever increasing need to ensure that these virtual environments are built and maintained with security as a primary concern. Companies can no longer afford to treat virtual environment security as an afterthought. Virtual environments present several security concerns which are unique to their specific nature. It is imperative that companies and administrators understand these concerns and implement proper measures to deal with these unique issues accordingly. Additionally, virtual environments often have the same security concerns as regular hardware environments, but the unique nature of the virtual environment requires that these well known security concerns be addressed in new ways. The intent of this paper is to identify the various areas of security which are of concern in virtual environments and to provide recommendations on how best to address these concerns.**

Keywords: hypervisors, security, virtual environment, Virtual Management System, virtualization, VMWare

I. INTRODUCTION

A. Background

Computer virtualization is a hot topic in the technological industry. With companies striving to reduce costs and increase efficiency and agility, the adaptation of virtualization is no surprise. Virtualization has many applications, some of which include hardware consolidation, resource distribution, application or system sandboxing, and increased supportability and flexibility. Although virtualization is not a new concept, it is only within the past few years that it has really seen widespread acceptance and utilization.

A survey conducted by Zenoss in 2010 shows that nearly 95% of participant's organizations make use of virtualization in their environments, with over 40% stating that virtualization is their preferred server deployment method. It is important to note that virtualization is no longer a "lab only" or "development environment only" technology. 70% of participants state that their organization uses virtualization in production environments. [1]

With virtualization receiving such widespread use, we cannot afford to ignore the security of virtual environments. It is imperative that the virtual infrastructure be protected and secured with the same rigor that is used to protect traditional hardware systems. In addition to the more traditional security considerations such as policy enforcement, access control, auditing capabilities, traffic monitoring, intrusion detection systems, firewalls, and anti-virus/anti-malware systems, virtualization presents new and unique security challenges that are difficult to address without specialized tools designed for virtual environment security.

Among the chief concerns that administrators of virtual environments face are visibility into the virtualized devices, communication throughout the environment, data segregation, access restrictions, accountability, and integrity. Due to the dynamic nature of virtual environments, all of these considerations must be addressed in a manner which allows persistent and reliable enforcement of security policies. There is a growing market for tools which address these security concerns, and while it is still a relatively new field of development, there are many reliable tools which help to achieve the goals of information security.

While there will be mention of specific software vendors and products, the goal of this paper is not to evaluate the effectiveness of those products; but rather to evaluate their functionality as a means of identifying the different aspects of securing a virtual environment. This paper will provide information which will help identify areas of concern, as well as provide recommendations on how to build a defensible virtual environment.

B. Relevance of Information

There exists a wealth of information regarding virtual environment security. Unfortunately, there also exists a vast amount of misleading information on this same subject. Often times the information is misleading simply because it is outdated, and thus easily misinterpreted when evaluated in a current day context. Other times, the information may be misleading as a result of the perspective of the author.

As with most emerging technologies, many vendors create products to address new and specific concerns with regards to that technology. These vendors conduct research and provide statistical information supporting the need for their product. While this information is typically correct and accurate when provided by a reputable vendor, it is nevertheless presented with some bias. As a result, the concern which is addressed by the advertised product may be over-stated or over-generalized to make the product more desirable to a larger consumer base.

With the abundance of outdated and/or biased information, it can be difficult to obtain a consolidated understanding of relevant and applicable security concerns

for today's virtual infrastructure. It is nearly impossible to properly implement security measures for a new technology without first gaining an understanding of the security risks. And while understanding the risks is important, it is equally as important to understand how to address those risks.

In spite of – or perhaps because of – the overabundance of information available on the topic of virtual security, it can be extremely difficult to find relevant and thorough information which addresses the security of a virtual environment as a whole. Often times the problem will be described in great detail, but no vendor-independent solution will be provided. Other times, a solution will be implied but little consideration will be given to understanding the root problem. Even when a problem and solution are presented in an appropriate manner, it often only addresses one specific aspect of virtual security. It can become a frustrating matter to research and understand the various aspects of virtual environment security.

This paper will identify the primary security concerns of a virtual environment without bias and with respect to relevancy, taking into consideration the fact that the technology and implementation of virtual environments has evolved since its initial resurgence and that it will continue to do so as the technology changes and grows. The security concerns addressed will be presented in a cause and effect manner so that the reason behind and need for the various security recommendations can be understood.

II. What is Virtualization?

Virtualization is not a new concept. Virtualization was initially developed in the late 1950s and early 1960s, but was deemed obsolete through most of the following two decades due to a lack of flexibility and an inability to adapt to the computing demands of the time. Virtualization as we know it today didn't reemerge as a driving technological force until the mid-1990s [10]. Since then, the application and varied use of virtual technology has continued to grow at a rapid pace.

Fundamentally, virtualization is the separation of a request from the underlying physical delivery of that request [9]. Typically, this refers to the separation of a request or instruction sent by an operating system from the underlying physical hardware of the computer. Virtualization has many implications, and although the virtualization of an entire operating system may be the most common, virtualization can also be applied to the processing of a single program or application. Another common use is the virtualization of resources such as storage, CPU, or network resources.

Virtualization functions by placing an abstraction layer between two points of communication [5]. This virtualization layer may reside between the hardware and the OS, as with Operating System and Resource virtualization, or it can be between an application and the OS, as seen with application virtualization. This abstraction layer is responsible for controlling communication between those two points. Since the abstraction layer, rather than the requesting process, has control over the resource, the abstraction layer can partition use of that resource as desired; effectively hiding the raw resource from the requesting process.

A. System Virtualization

System virtualization is one of the more well known types of virtualization in use today. It provides a complete system platform which is capable of executing a full Operating System independent of the underlying hardware. The two primary methods of implementing this type of virtualization can be referred to as Hosted and Native [9]. One of the more well known hosted environment products is VMWare Player. ESX Server is an example of a Native, or Hypervisor, environment.

Hosted System virtualization implements the virtualization layer as an application. This application is installed and runs on top of a Host Operating System. The virtualization application then serves as the abstraction layer between the physical hardware and the Guest Operating Systems which it hosts. Hosted System virtualization allows for a wide range of hardware virtualization, effectively showing the guest systems whatever hardware configuration is desired rather than the true underlying hardware.

Hypervisor system virtualization implements the abstraction layer closer to the actual hardware. The hypervisor runs directly on the physical hardware, and in effect serves as the operating system. The hypervisor then controls communication between its guest operating systems and the underlying hardware.

B. Virtualization Techniques

Regardless of the architecture used, several methods of virtualization have been developed to address the issue of properly trapping and translating communication between the operating system and the underlying hardware.

Full Virtualization is a method in which the guest operating systems are completely decoupled from the hardware [9]. No modification of the guest OS is required. VMWare offers a Full Virtualization implementation.

Paravirtualization is a method in which the guest operating system is modified slightly to allow it to be virtualized. Xen offers virtualization solutions which utilize paravirtualization.

Hardware assisted virtualization is relatively new technology in which the physical hardware is designed to support virtualization, bypassing the need for the trap and translation methods utilized in Full and Para virtualization. Intel and AMD released the first generation of hardware assist features in 2006 [9].

C. Other Types of Virtualization

In addition to System Virtualization, other widely used implementations of virtualization include Application Virtualization and Resource Virtualization.

Application Virtualization functions by implementing an abstraction layer between the application and the underlying operating system. This allows greater control over what the application can access, providing benefits to both efficiency and security.

Resource Virtualization is used to manage resources such as CPU, Storage, and Network bandwidth. It can be used to aggregate resources, making several small hard drives appear as one large drive, or allowing several CPUs to function as one supercomputer. It can also be used to isolate, partitioning a large drive into smaller segments for individual use.

III. Virtual Environment Security

A. Current State of Virtual Environment Security

While virtualization may have been around for quite some time, the security of virtualization is a relatively new field of technology.

Due to the fact that virtual security is relatively young, it has become a prime target for attacks. Attackers know that the security aspects of virtual environments may be underdeveloped and that organizations and administrators deploying those virtual environments may be inexperienced. As a result, virtual environments become a very attractive target. The fact that a virtual environment provides a single point of entry and/or a single point of failure only adds to that attractiveness.

Virtual management systems have experienced several security issues including flaws in the fundamental architecture as well as flaws in software design [10]. While patches have been released to address these problems, it stresses the importance of maintaining the devices and software responsible for hosting and controlling the virtual environment.

Aside from architecture and design flaws, there are security concerns that present themselves as a result of the way that a virtual environment functions. Virtual environments communicate in a manner which may not be detectable through traditional traffic monitoring means. Virtual devices may also interact in ways that are vastly different from traditional hardware devices [2]. These are not security concerns resulting from flaws or bugs, but rather they are security concerns resulting from the very nature of the designed intent of how virtual environments work. An understanding of virtual technology is required to ensure that these security concerns are properly addressed. In some cases, the built-in functionality of the virtual environment is insufficient to achieve the security goals of an organization, and so new technology is required.

Virtual environments also introduce an entirely new group of security concerns related to deployment and design. Without proper restrictions and procedures in place, improper use of a virtual environment can present numerous issues such as improperly patched or improperly maintained systems, unintended denial of service, breach of confidentiality, lack of integrity, and lack of verifiable authenticity. It is important that proper policies and procedures be established and maintained to ensure that these types of security concerns are addressed.

Since virtual environments present a desirable target for attackers, and because virtual environments introduce a wide variety of new and unique security concerns, it has become increasingly important that administrators develop a solid understanding of these concerns. It follows that it is also important that virtual environments be designed and deployed with these unique characteristics in mind.

B. Visibility and Transparency

The dynamic nature of virtualization can make it difficult to keep track of devices in the environment. Virtual guests can quickly be moved, copied, created, or removed. As with most aspects of security, it is important to identify the assets that need to be managed and secured. For this reason, it is important to implement a process for establishing and maintaining a map of the virtual environment.

At a minimum this map should include details about the host machines such as physical location and hardware capabilities, as well as which guests are hosted on each machine. Depending on the environment other details may be necessary such as network zones, applications running on each machine, and resources allocated to each guest. In small environments, a map with these details can be maintained manually using a Visio diagram or something similar. Larger environments may find the use of more automated discovery and mapping tools beneficial. Products such as VMWare vMotion are designed specifically for this purpose. Other "virtual suite" products such as Reflex Virtual Management Center often include discovery and mapping tools which also provide status information for the virtual environment.

Status information is another key element in maintaining the overall stability (and thus, the security) of an environment. If availability is a concern, it can be very helpful to have a tool which monitors the status (online, offline, suspended, etc.) as well as the resource utilization (CPU, Memory, Network) of devices. Small environments can make use of the built-in monitoring and trending features of most virtual management products, while larger environments can make use of automated tools such as VMSafe. This data can be used to redistribute load and resources to maximize efficiency and ensure consistent availability.

Another important aspect of device mapping is software inventory. When looking at the "big picture" overview, it may be easy to forget that some of these devices represent fully functional operating systems; complete with security holes and bugs. Maintaining a list of installed and running software complete with version and patch level information will go a long way in helping to secure a virtual environment. In some environments it may be appropriate to leverage normal software and patch management capabilities to keep the virtual devices up to date. Others may benefit from software inventory tools which integrate with the virtual environment and keep track of the pertinent information.

C. Policy Configuration and Management

The security policy of the virtual environment is a key aspect of security. It is responsible for enforcing aspects of security including user privilege, network access, and change management. User privilege management can be as basic as defining who is allowed to access the virtual management environment, or it can be more granular to the level of defining who is allowed to take specific actions on a specific host or guest. Since most virtual host tools allow full access to its guest systems by default, it becomes increasingly important to restrict access in sensitive environments. Actions such as setting up new virtual guests, starting/stopping/suspending guests, and cloning/copying guests should be restricted to only those specific users which require those privileges.

Network policy configuration ensures that each virtual guest is appropriately segmented and isolated. There are various methods that can be used to achieve this goal – some of which will be discussed in the next section – but whatever the method, it is important that a policy management system is in place to enforce the policy and uphold the segmentation.

Change management ensures that only authorized users can perform changes, and it also ensures that only authorized changes can be performed. If any machine can be cloned at any time, this compromises authenticity since that machine is no longer unique, and it becomes difficult for a user to validate that they are interacting with the system that they think they are interacting with. On a similar note, if any machine can be rolled back or restored to a previous state, integrity may be compromised. It becomes difficult to rely on the integrity of that system when the state can be so easily altered. The dynamic nature of virtual environments makes change management a critical security measure to maintain integrity and authenticity.

Another aspect of change management is patch management. A patch management policy can be useful for standardizing and automating patch management within a virtual environment. A solid patch management policy can increase the efficiency of delivering security patches and help to ensure full and expedient coverage.

It is important to note that policy enforcement must take place at the hypervisor level to be effective. This ensures that virtual devices are covered under policy regardless of the state of the device.

Scalability is a must when it comes to security policy management. Because virtual environments are so dynamic, it is of key importance that the security policy be both persistent and scalable. Scalability ensures that the policy can grow along with the environment, creating new policy groups as necessary and allocating resources appropriately. A persistent policy is one that actively applies itself to any new systems that come online. This ensures that there is no chance of an admin forgetting or neglecting to set up the security policy when standing up a new virtual system. It also ensures that the policy remains enforced on the system regardless of the state of the system.

D. Traffic Analysis

Arguably one of the largest security gaps in a standard configuration virtual environment is the inability to analyze "intra-VM" communication; that is, communication between the host and the guests as well as communications between guests. When thinking in terms of a single host, this may seem somewhat irrelevant; however, this security issue expands exponentially when it comes to a clustered environment using virtual switching which supports hundreds of hosts and thousands of virtual devices.

Traditional network monitoring tools are designed to provide visibility and alerting capabilities on network traffic traveling through an environment. On a virtual host (or virtual switch) that traffic never actually makes it to the physical network. Instead, that traffic is all handled internally, effectively making it invisible to traditional tools monitoring traffic across physical wires.

Fortunately, several solutions are available. One solution which may be useful is to utilize port groups and the built-in functionality to allow those port groups to run in promiscuous mode. An IDS device would be connected to the promiscuous port group while other virtual guests are connected to other port groups. This allows the IDS device to monitor intra-VM traffic while preventing guest system from monitoring other guest's traffic. While this may be a feasible solution for a small environment, larger environments may require a more robust solution.

Several vendors now offer infrastructure-level monitoring products. These products integrate at the hypervisor level which allows accurate and efficient monitoring of all traffic in the virtual environment. Most products are agentless – that is, there is no requirement to install an agent on each virtual device – which allows them to run with little impact to the virtual environment. Regardless of which approach administrators choose to implement, it is important that some form of intra-VM traffic monitoring is established to ensure that network security policies are properly enforced.

E. Reporting and Auditing

As with traditional security systems, auditing and reporting capabilities must be integrated with the security policy. Important events such as altering the state of a virtual guest, access requests to sensitive data, and specific network activity should be recorded to provide an audit trail. Such an audit trail may be useful in the event of a security incident, or even an outage due to misconfiguration. It is often helpful to be able to retrace the activities leading up to an event to better understand the what/how/who/when of an occurrence. Potentially high impact events should be reported on as well as recorded. Reporting typically involves some form of automated messaging, most likely via e-mail, page, or text messaging.

Most tools which provide a security feature also come with built in auditing and reporting capabilities. However, it is up to the administrators of the system to correctly configure those capabilities. It is important to restrict your auditing and reporting to only those events which are of value, as over-recording can make it difficult to extrapolate

any useful data. It can also leave your system susceptible to log flooding which is a security risk in itself.

Some additional common events which may be helpful to audit/report on are: high volume authentication attempts, unexpected shutdown, unauthorized deletion, unauthorized rollback, abnormally high resource use, access requests to sensitive data, unexpected inbound or outbound traffic, detection of potentially unwanted software, deviations from expected configurations and changes to policy settings.

IV. Conclusion – Summary of Recommendations

The security needs of each environment are distinct and unique. However, there are many basic principles which are useful to follow in almost all scenarios.

Visibility into the virtual environment is a basic security need. It is easy to neglect or forget about little used devices, particularly in a virtual environment. As such, having a well maintained map of the virtual environment with as much detail as is feasible lays a solid foundation for securing an environment. A Microsoft Visio map can be used for smaller environments, while administrators of larger environments may wish to use an automated discovery and mapping tool such as VMWare vMotion.

Along with visibility goes transparency. Transparency provides insight into key details of the devices in a virtual environment such as status, resource usage and installed software. VMSafe is a great example of a tool which provides granular detail. Greater transparency allows for easier patch management. Patch management should be automated as much as possible to ensure that devices have the latest supported security patches. In addition to the traditional enterprise patch solutions such as WSUS or SCCM, the virtual world brings a new flavor of patch management which allows the host to maintain patching of virtual guests. VMWare vCenter Update Manager is one example of a virtual patch management application.

Access controls should be designed to restrict access to potentially harmful actions such as turning off, deleting, cloning, creating or reverting a virtual guest. Access to guests from a host should also be restricted on a per-user or per-zone basis, depending on the design of the environment. Change management should be enforced through access controls to ensure that only authorized users can make changes, and that only authorized changes can be made. This helps to ensure both the authenticity and identify of virtual devices. Most virtual management products have built in access control features which work well when configured properly.

Because intra-VM communication is handled by the host internally via virtual switching, the need to monitor communication between virtual guests is a concern unique to virtual environments. Perhaps the most straightforward solution is to implement a product which is specifically designed to monitor this type of communication. Products such as Catbird vSecurity and Trend Micro Deep Security provide network monitoring capabilities.

All aspects of the security policy must be scalable and persistent. As virtual devices are created, moved, reverted to old snapshots, and cloned, the security policy must continue to apply to those devices. Key events related to the security policy should also be recorded and, in some cases, reported. This includes access control events, change control events, status change events, network events, and events relating to software inventory or system configuration. Virtual security suite products such as Reflex Virtual Management Center provide scalable and persistent policy enforcement along with auditing and reporting capabilities. Reflex's product integrates policy enforcement at the hypervisor level, ensuring that devices are protected and monitored, even when in an inactive state.

With all of the advantages that virtual environments provide, it is no surprise that they are being implemented in an ever expanding capacity. As users and companies move to virtualize more critical aspects of their infrastructure, it is imperative that securing these virtual environments is more than an afterthought. The recommendations outlined here will go a long way in setting the foundation for security in a virtual environment. However, each environment is unique and thus has unique needs. There are numerous tools and resources available to help achieve security goals. It is important that administrators and security professionals leverage those resources to better understand the risks associated with virtualization and utilize that knowledge to plan and deploy defensible virtual environments.

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College Students' Intrinsic and Extrinsic Motivations for Online Game Playing

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Abstract - *This purpose of this study was to explore college students' motivations for playing online games based on intrinsic and extrinsic motivation orientations. A total of 20 college students with heavy online game playing experiences in Taiwan were selected to receive a semi-structured interview. A content analysis was used to analyze the interview transcripts. The results found that intrinsic and extrinsic motivations played different roles in college students' online game playing. The students tended to contact online games first time for extrinsic motivations but keep on playing online games for intrinsic motivations. In addition, students' preferences on types of online games seemed to be related with their motivation orientations. Therefore, this study suggests that online game designers and curriculum developers should notice the different roles of intrinsic and extrinsic motivations and put them into the design for learning. Also, the individualizations of game-based learning should consider the relationships between students' preferences of game types and their motivation orientations. Further research should emphasized on examining the impacts of intrinsic and extrinsic motivations on students' online game-based learning as well as investigating the role of students' game preferences played in their learning via online game playing.*

Keywords: intrinsic motivation, extrinsic motivation, online game, motivation orientation

1 Introduction

Prior studies have already identified the motivations for play in online games. For example, Yee [1] surveyed 3000 MMORPG players and categorized the motivations into three major components including achievement (e.g. advancement, mechanics and competition), social (e.g. socializing, relationship and teamwork) and immersion (e.g. discovery, role-playing, customization and escapism). Chiou and Wan [2] interviewed ten adolescents' motivations for online game addictions and concluded with five dimensions: for psychological needs, as everyday focus, interplay of real self and virtual self, as compensatory or extensive satisfaction, and for self-reflections. Most of the related research [3-9] correlated the motivations with addicted or heavy players' experiences, psychological needs, personalities, attitudes and values. Little research has discussed the motivations for online game playing with connections of the motivations for learning from a relatively more positive perspective to carefully draw out the potential motivations that could be merged into students' online learning.

As motivation is a multidimensional and multilevel construct [10], a wide variety of definitions are discussed and used in educational psychology research. According to Deci and Ryan's [11], to be motivated means to be moved to do something and motivation can be distinguished into intrinsic motivation, extrinsic motivation and amotivation [12]. Their construct argues that intrinsically motivated learning can be defined as the drive to learn. This drive is based on the *satisfaction* and *pleasure* of the activity of learning itself. Vallerand and Bissonnette [13] further divided intrinsic motivation into three types of purposes: intrinsic motivation to understand something new; intrinsic motivation to accomplish something; and intrinsic motivation to experience stimulation. Therefore, intrinsically motivated learning is often involved with learning for interests, curiosity, fantasy, stimulation and achievement. On the contrary, extrinsically motivated learning refers to learning for some *external rewards* [11] such as for money, fame, positive feedbacks and even social interactions. Amotivation concerns a state of lacking any intention to act or learning.

Since intrinsic motivations are highly engaged with the drive to learn actively and continually, identifying the roles of the intrinsic and the extrinsic motivations played in online game playing may be contributed to the literature in support of using online games to help students learn. Therefore, this study examined students' motivations and experiences for playing online games based on Deci and Ryan's [11] framework of intrinsic and extrinsic motivations by conducting in-depth interviews of college students with heavy online gaming experiences.

2 Methods

2.1 Subjects

A total of 20 college students in Taiwan were subjects

used for in-depth interviews in this study. The sample was selected from a pool of 97 college students receiving a questionnaire about their online gaming experience. In order to select experienced online game players, the criteria used for the selection was playing online games more than 10 hours per week. Finally, the subjects were consisted of 16 males and 4 females. The average age of the subjects was 21.1 and their experience of online game playing was 5.3 years in average. Their weekly time spent in playing online games ranged from 12 hours per week to 39.5 hours per week, with an average of 23.6 hours per week.

2.2 Interview

A semi-structured interview was used in this study. The framework of the interview was based on the following stems of questions: (1) Under what circumstances do you begin to play online games? When, where and why? (2) Why do you keep on playing online games? (3) What types of online games do you prefer to play and why? Each of the subjects was interviewed individually by a well-trained interviewer. The time for the interviews ranged from 28 minutes to 44 minutes with an average of 32 minutes. The interviews were recorded and transcribed for data analysis along with the interviewer's notes. A content analysis was used to analyze the interview transcripts.

3 Results

The context analysis of the interview transcripts was based on Deci and Ryan's [11] construct of intrinsic and extrinsic motivations in which the intrinsic motivations involve with interests, curiosity, fantasy, stimulation, achievement and psychological needs while the extrinsic motivations deal with external rewards, feedbacks and social interactions. Themes were then developed in order to identify the roles of intrinsic and extrinsic motivations for playing online games based on the three interview questions and summarized below.

3.1 Motivations for the first contact of online games

The results of students' motivations for their first time playing the online games are summarized in Table 1.

According to the subjects' responses to the first set of interview questions, five motivations have been identified and categorized into intrinsic and extrinsic motivations: curiosity & interest and psychological need belong to the intrinsic motivations; social interaction, work requirement and bore are included in extrinsic motivations. The data showed that, for the first contact of online games, only 4 subjects played for an intrinsic motivation, while 16 subjects played for an extrinsic motivation in which a half of the subjects (10/20) played for social interactions like invitations from friends. That is, most of the subjects played online games for *extrinsic* motivations in the first time and the major reason was due to social interactions.

Table 1: Motivations for the first time playing of online games (N_I : number of intrinsic motivations, N_E: number of extrinsic motivations)

	N_I	N_E	Subject #
Curiosity & interest	3		1, 10, 19
Psychological need	1		4
Social interaction		10	2, 3, 5, 8, 12, 14, 16, 17, 18, 20
Work requirement		1	15
Bore		5	6, 7, 9, 11. 13
Total	4	16	

3.2 Motivations for the continual contact of online games

The results of students' motivations for continuing playing the online games are summarized in Table 2. According to the transcripts for subjects' responses of the second interview question, six motivations were finally identified and categorized by intrinsic and extrinsic motivations: Curiosity & interest, competition & achievement, fantasy & imagination and stimulation belonged to the intrinsic motivation; social interactions and boring were grouped into the extrinsic motivation. Table 2 revealed that, regarding the reasons of continuing playing online games, 12 subjects kept playing for intrinsic motivations while only 8 subjects kept for extrinsic motivations. In addition, curiosity & interest (7/20) became the most major reason for students' continual play replacing the social interaction (6/20) reason. In brief, the majority of the subjects kept on playing online games for *intrinsic* motivations and several extrinsically motivated students had transferred their motivations from extrinsic orientations to intrinsic orientations.

3.3 Preferences of types of online games

The results of how students' play motivations interact with their preferences of types of online games are demonstrated in Table 3. Transcripts of students' responses to the third interview questions provided insights of students' preferences of types of online games. The most popular game was Role Playing Games (RPG, N=10) followed by Real Time Strategies (RTS, N=6) and First Person Shot (FPS, N=4) games. It is clear, in Table 3, that students with curiosity,

Table 2: Motivations for continuing playing of online games (N_I : number of intrinsic motivations, N_E: number of extrinsic motivations)

	N_I	N_E	Subject #
Curiosity & interest	7		1, 9, 13, 14, 16, 18, 20
Competition & achievement	3		2, 17, 19
Fantasy & imagination	1		4,
Stimulation	1		5
Social interactions		6	3, 6, 7, 8, 10, 11
Bore		2	12, 15
Total	12	8	

competition and social motivations most preferred RPG, RTS and FPS online games respectively. This means that students who preferred playing RPG games enjoyed experiencing new feelings by playing different roles in online games; students who preferred playing RTS games liked to complete tasks and gain achievements by competing with others in online games; and students who preferred playing FPS games enjoyed the social interactions with others in online games.

4 Discussion

Based on the above results, intrinsic and extrinsic motivations played different roles in college students' online game playing. First of all, college students tended to be motivated extrinsically to play online games for the first contact, especially for reasons of peer social interactions. However, the intrinsic motivations seemed to be the main drives to keep the students on continuing playing the games, in which their curiosities and achievements became the main factors for the involvements. This finding suggested that extrinsic motivation such as social interaction could benefit students' first try to learn via online games. This suggests that game designers should integrate extrinsic elements like collaborative learning groups or virtual learning community into game design for attracting students to play and learn. Moreover, if the game designers or curriculum developers want to keep students playing for learning, then it would be important to consider how to integrate intrinsic elements such as curiosity, interest, competition, achievement and fantasy into the game designs. Learning tasks involving role playing, adventure explorations, task completions with challenges and team work competitions may be potential to achieve this goal. However, the transfer between motivations for playing and for learning is still needed in further research. More studies are needed for examining students' motivations and attentions paid to learn or to play while playing online games with instructional purposes.

Table 3. Game preferences and motivations of continuously playing

Preferences	N	Motivation (N)
1. Role Playing Game	10	Curiosity (6), Social (2), Fantasy (1), Bore (1)
2. Real Time Strategies	6	Competition (3), Curiosity (1), Social (1), Bore (1)
3. First Person Shot	4	Social (3), Simulation (1)

Secondly, this study found that different types of online games seemed to satisfy students with different motivations. For example, RPG games satisfied students motivated by curiosities and interests; RTS games favored students who enjoyed competitions and achievements; and FPS games attacked students who were motivated by social interactions. This provides feedbacks for game designers to develop online games with learning purposes for individualizing the learning context in order to satisfy individual needs based on their motivation orientations. Future research are suggested to design different types of online games for the same learning purpose and examine the impacts of types of online games on students with different motivation orientations.

5 Conclusion

Intrinsic and extrinsic motivations played different roles in college students' online game playing. Game-based learning designers should consider how to integrate learning elements associated with these two categories of motivations to improve students' learning via online game playing. In addition, different types of online games seemed to satisfy students with different motivation orientations. Future research should examine the impacts of the interactions between game types and students' motivation orientations on students' learning.

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Auto-Assign: An Implementation to Assign Reviewers using Topic Comparison in START

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Abstract - *START ConferenceManager [1] is a Web-based conference management system facilitating the management of papers, reviewers, and reports. A task conference managers frequently perform is assigning reviewers to submitted papers. This may be done manually in START, however, an effective program to automate this process is lacking. The reviewer assignment problem has been written about several times, often presenting methods which rely on large collections of previous publications and other textual data. Very few consider cases for which this data is unavailable. We have designed a Web interface which automates reviewer assignment using data already available in START. Our program determines reviewer suitability by semantically indexing collections of papers of the same topic over key words, and then builds a cosine similarity matrix. Each paper may then be matched to reviewers of various types of expertise. This paper describes these methods in greater detail and their results.*

Keywords: assignment, expertise, topics, matching, semantics, Excel

1 Introduction

The START ConferenceManager [1] system, produced by Softinc.com, is a Web-based interface for managing conferences. All steps of the management process are meant to be handled by the system including receiving paper submissions, forming committees, and reviewing papers. Two existing features of the START system include the storage of reviewers and papers in a database. Conference managers are able to add reviewers to the conference and committees, storing the reviewer's username, password, and contact information. Similarly, paper submissions are stored in the START system with necessary fields for submission ID, title, and topic. The storage of this data is useful if a conference manager wishes to manually assign reviewers in the system to submitted papers.

The process of matching paper submissions to reviewers is automated to an extent in the START system [1]. Beginning with a "seeding" algorithm, managers can tell the system a minimum number of reviewers they would like to assign to each submission. This system will then randomly assign reviewers, providing a base assignment to work with. Assignments initially made by this algorithm are, of course, not optimal. A bidding system does exist, however, allowing reviewers to log in to START and bid on papers they may be interested in reviewing. Managers of the conference are able to view these bids while making decisions regarding reviewer placement. Following the optional seeding and bidding to assist them in the assignment of reviewers, managers then must manually place reviewers to each paper. The present method of assigning reviewers to paper submissions lacks in many ways. Firstly, the assisted seeded assignment does not utilize any method of matching reviewers to papers based on any specific criteria or fields of interest. Bidding is helpful, if every reviewer were to log in to the system and participate in the bidding process. However, this may not always be the case. Similarly, neither feature effectively automates the process as managers must always make the majority of assignments manually.

A solution to this problem would need to provide managers with a way to automatically assign reviewers to papers with minimal input, hence, avoiding the problem of having to manually do so. The solution must also fill the void in the START [1] system of assignment in which the topics of papers and expertise of reviewers are not considered [2]. Conry [2] describes how reviewer assignment is a two-part problem. First, programs must find the suitability of reviewers to papers to assure a degree of expertise on behalf of the reviewer [10]; methods previously devised to assure quality matches were made often involved expert finding via mining large corpuses of publications or the web [8]. Second, the program must use the measures of suitability to fairly distribute the reviewers amongst the papers, often by casting the problem as a minimal cost flow, bipartite graphing, or linear programming problem.

The lack of data and functionality within a conference management system is one of many reasons data required by other solutions may be unavailable. Not all systems provide an easy way to obtain reviewer bids, previous publications of authors and reviewers, etc. For these reasons, we propose a solution different from those proposed by other works to solve the reviewer assignment problem. The program we propose, Auto-Assign, is meant to automate the assignment process without the use of large corpuses of publications or need to access web-based resources. Auto-Assign fills a void existing

in the START ConferenceManager [1] in which paper topics and reviewer expertise are not considered during assignment. Our program uses Excel spreadsheets containing paper submission information (provided by START) and simple spreadsheets containing reviewer information such as their name, primary expertise, and secondary expertise. The task is enhanced by modeling the topics of papers to other topics in order to find the most suitable subtopics for papers of a given topic. Reviewers of a larger variety of expertise may then be considered in the assignment process for papers of a given topic.

2 Related Work

The reviewer assignment problem presents many hurdles for those developing an automated solution and, hence, many approaches exist in an attempt to attenuate one or more of these challenges.

One aspect of reviewer assignment that requires attention is to determine whether or not a given reviewer is a suitable match for a given paper. Works focusing on this aspect often look to the mining of corpuses of works to discover topics and expertise of papers and reviewers respectively. Dumais [4] and Ferilli [5], for example, used Latent Semantic Indexing (LSI) to discover reviewer interests and paper topics by modeling reviewers and papers over words mined from abstracts. Other works have used a combination of reviewer and paper aspect modeling to better match reviewers to papers, such as Karimzadehgan's [9] publication which uses probabilistic LSI. These approaches were improved upon by Mimno and McCallum [10], who used an Author-Persona-Topic model to better represent reviewers as experts in a greater number of topics by using multiple abstracts of potential reviewers. Another approach taken by Goldberg [6] and Taylor [15] was to use collaborative filtering to leverage bidding systems and remedy the scarcity of data that often exists as reviewers often only bid on a few papers. Their approach involved comparing reviewers who had bids in common and guessing what papers they may have also bid on. These approaches, while improving upon finding suitable reviewers, commonly require large collections of previous publications which may be absent in some systems for a variety of reasons. Similarly, larger efforts on the part of conference organizers are required to fulfill the requirements of these programs; however, time is a scarce resource for many organizers.

Another aspect of reviewer assignment often studied is the optimal distribution of reviewers to papers, with suitability given, under various constraints. When assigning reviewers to papers, the balance between optimizing distribution while maintaining fairness can be problematic. Many constraint-based programs attempt to balance reviewer work load, ensure sufficient reviewer expertise per paper, and still maximize some measure of total matching quality. This problem can be solved by linking it to a convex cost flow problem, as described by Tang [14]. Other approaches cast the problem as a linear programming problem, like that proposed by Taylor [15]. Both approaches are among the most preferred as they guarantee an optimal solution.

3 Method

The START ConferenceManager [1] provides a simple way to access paper submission data by allowing its users to export this data as Excel spreadsheet files. This data includes the papers' submission ID's, titles, summaries, and topics (selected from a fixed set of topics). Unlike previous methods described, Auto-Assign would use this basic data and a simple reviewer spreadsheet to automatically find suitable reviewers and distribute them amongst papers. The primary focus of this program is to determine what reviewers amongst those provided would be most suitable for each paper. In a traditional constraint-based program, a reviewer may have only had preference over another if the paper's topic was an element of their set of expertise, and if this factor did not distinguish any two reviewers some sort randomness must be used during assignment. Papers, however, may be represented by a number of subtopics other than that assigned by the author; these subtopics could then be used to more effectively find suitable reviewer assignments and, hence, reduce reliance on randomness. To do so, our proposed method is to model topics over words provided by paper summaries or titles and then, using this language model, determine the similarities of various topics to one another. These similarities are then used as a means of determining what reviewer expertise may also be suitable for a paper other than that of the given paper topic.

3.1 Extracting Reviewer and Paper Data

As Auto-Assign aims to match reviewers from set R to papers in set P, therefore, this data must be obtained. Using exported files provided by START, users are first required to upload two Excel spreadsheets: one file containing paper submissions and one containing reviewer information. These files are simple tables that contain one entry per row with data organized in relevant columns. The first row of each spreadsheet must, however, contain the title of each column. Once uploaded, Auto-Assign extracts the data from each spreadsheet as a matrix. The first row of this matrix is used to create selectable options that allow the user to indicate which columns to use for displaying matched reviewers to papers, extracting paper topics and reviewer expertise, and as textual representations of papers for modeling as described later in this paper. The remaining m rows of the reviewer matrix are used to build set $R = \{r_1,\ldots,r_m\}$, a set of m reviewers; similarly, the remaining k rows of the paper matrix are used to build set $P = \{p_1,\ldots,p_k\}$, a set of k papers. The general layout of these files can be seen in figure 1.

	A	B	C
1	**Reviewer**	**Primary Expertise**	**Secondary Expertise**
2	#1	Artificial Intelligence	Programming Languages, Compiler
3	#2	Computer Architecture and VL	Image Processing & Pattern Recogr
4	#3	Programming Languages, Com	Database, Data Warehousing, Data
5	#4	Programming Languages, Com	Other
6	#5	Other	Artificial Intelligence
7	#6	Programming Languages, Com	Artificial Intelligence
8	#7	Image Processing & Pattern Re	Computer Architecture and VLSI;Ar
9	#8	Database, Data Warehousing, I	Programming Languages, Compiler
10	#9	Other	Programming Languages, Compiler
11	#10	Image Processing & Pattern Re	Computer Architecture and VLSI;Ar
12	#11	Artificial Intelligence	Image Processing & Pattern Recogr
13	#12	Programming Languages, Com	Image Processing & Pattern Recogr
14	#13	Computer Architecture and VL	Artificial Intelligence

Figure 1: Sample reviewer spreadsheet

3.2 Modeling Suitable Expertise

As paper topics, reviewer primary expertise, and reviewer secondary expertise are selected from the same set of categories $C = \{c_1,\ldots,c_q\}$, with q categories, paper topics can be modeled and compared to one another to estimate the best subtopics for which suitable reviewers may have an expertise in. The process used by Auto-Assign is as follows:

1. Extract a textual representation of all papers and combine these representations for all papers of the same topic.
2. Model each available topic as a distribution over words, excluding common terms.
3. Determine the similarity between topics based on their distributions.

3.2.1 Topics and Expertise

Each paper in the data provided by the START system may only have one topic, hence, given a paper $p_i \in P$, the topic of this paper can be denoted $T(p_i) \in C$. Reviewers, however, may have primary and secondary expertise in a variety of categories. Therefore, given a reviewer $r_j \in R$, their primary expertise may be denoted $E_p(r_j) \subseteq C$ and their secondary expertise may be denoted $E_s(r_j) \subseteq C$.

3.2.2 Latent Semantic Indexing

To achieve a topic-topic comparison, hence finding suitable subtopics for papers, the words that represent papers of given topics are extracted and used to build a term-by-topic matrix that is later used to find topic similarity. Similar to Latent Semantic Indexing (LSI), this approach attempts to leverage the existence of latent meaning in the summaries and titles of paper submissions by weighing the importance of keywords in documents. By constructing what is known as a Term Document Matrix (TDM), the semantic structure of documents can be uncovered via LSI [13]. This matrix requires the extraction of key words from documents, the counting and weighting of these terms for each document, and then the single value decomposition of the resulting matrix. Auto-Assign uses a modified version of LSI.

Once obtained, summaries or titles (as defined by the user) are extracted from the paper submissions. From these summaries, the words that composed them were used to construct a count matrix. These words, however, were filtered of a defined list of stop words (common words such as: *the*, *is*, *of*, *to*). Rather than representing each paper in the TDM, though, each "document" was a topic that occurred at least once in the corpus of paper submissions, and all papers of that given topic were counted as one "document." The count matrix, then, represented how many times each word occurred in all papers of given topics.

	c_1	c_2	….	c_q
w_1	0	22	…	2
w_2	12	3	…	5
…	…	…	…	…
w_x	6	14	…	8

Figure 2: Sample count matrix

To more effectively measure the relevance of words to given topics, Term Frequency Inverse Document Frequency (TF-IDF) was used to weigh each word count for each topic. The TF-IDF value for a word w can be calculated by

$$\text{TFIDF}_{w,d} = \left(\frac{f_{w,d}}{f_{*,d}}\right) * \log\left(\frac{|D|}{f_{w,D}}\right) \quad (1)$$

where D represents a corpus of documents, $f_{w,d}$ represents the number of times the word occurs in document $d \in D$, $f_{*,d}$ represents the number of words in document d, $f_{w,d}$ represents the number of documents in the corpus a word occurs in, and $|D|$ represents the number of documents in the corpus. The value provided by TF-IDF describes how relevant word w is to document d, where a document is actually a compilation of papers of the same topic in Auto-Assign. A higher weighted score is generally given to terms that occur in a smaller groups of topics, designating greater significance; words common to many topics, though, will have much lower scores [11].

3.2.3 Topic Similarity

A weighted TDM gives the program a semantic look at the content contained in the summaries or titles of papers of various topics; since every topic has a corresponding value for each word in the same set of words, this matrix can be used to compare topics. Each column of the TDM can be thought of as a vector representing a given topic and its position in the same geometric space whose dimensions represents key words. Two topics can be considered "similar" if the angle between their vectors is very small, hence, cosine similarity is chosen to measure topic similarity [3]. Cosine similarity, given two topic vectors $\overrightarrow{c_a}$ and $\overrightarrow{c_b}$ from the TDM, can be calculated by

$$sim(\overrightarrow{c_a}, \overrightarrow{c_b}) = \cos(\theta) = \frac{\overrightarrow{c_a} \cdot \overrightarrow{c_b}}{|\overrightarrow{c_a}||\overrightarrow{c_b}|} \quad (2)$$

and a value between 0 and 1 will be found. As the angle

between two vectors approaches 0 the cosine similarity value will approach 1; therefore, a cosine similarity close to 1 designates two very similar topics. A *qxq* cosine similarity matrix Q of topics over topics can be constructed to designate the similarities between topics. This matrix will be a symmetric, square matrix with all 1's on its diagonal since a topic is exactly similar to itself.

3.2.4 Matching

The purpose of these cosine similarities is to uncover other categories (topics) for which reviewers may have expertise in that would present suitable assignment. For example, suppose during the assignment process a paper p_1 has topic c_1, however, no reviewers exist with primary or secondary expertise in c_1. We know, though, that topic c_1 is most similar to c_2 from our cosine similarity calculations; we also know that reviewer r_2 has primary expertise in this category and reviewer $r_5$has secondary expertise in c_2. Auto-Assign would assign reviewer r_2 to paper p_1. So, rather than randomly assigning the given paper a reviewer from the pool of seemingly unqualified applicants, we have found a more suitable match without relying on chance.

The process of matching each paper to *n* reviewers, where *n* is the number of reviewers per paper as decided by the user, uses the above process to find the most suitable reviewers from those remaining in the available pool. Ultimately, a *kxn* matrix, *A*, of paper-reviewer assignments is determined. Auto-Assign completes assignment under the following constraints as well:

$$\sum_j A_{i,j} = n_r \ , \forall i \quad (3)$$

$$\sum_i A_{i,j} \leq n_p \ , \forall j \quad (4)$$

The first constraint above indicates that for all papers in the assignment matrix *A*, there must be n_r assignments, whose value is equal to *n* as determined by the user of the program. The second constraint requires that no reviewer may be assigned to more than n_p papers. This value is determined to be equal to

$$n_p = \left\lfloor \frac{n*k}{m} \right\rfloor \quad (5)$$

where n is the number of assignments per paper, k is the number of papers, and m is the number of reviewers. When deciding between available reviewers to assign to a paper on any given iteration, the reviewer with the highest total expertise match will ultimately be chosen.

$$Exp(r_j, p_i) = W_P \sum_x Q_{T(p_i),E_P(r_j)_x} + W_S \sum_y Q_{T(p_i),E_S(r_j)_y} \quad (6)$$

The total expertise score $Exp(r_j, p_i)$ of reviewer r_j given paper p_i is the sum of the cosine similarities between the paper's topic $T(p_i)$ and each primary expertise of the reviewer $E_P(r_j)$ multiplied by the weight W_P given to primary expertise matches over secondary (in this program $W_P = 1$). Added to this score is the similarity between the paper's topic and each secondary expertise of the reviewer $E_S(r_j)$ multiplied by a weight W_S (in this program $W_S = 0.5$).

3.3 Design

Auto-Assign, using the methods above, was designed to be a Web interface, much like the START ConferenceManager system. The increasing popularity of Web-based applications over software and consistency with START made this an obvious choice. After downloading the paper submissions Excel spreadsheets from START, users could use Auto-Assign to assign reviewers from another spreadsheet to papers in this file. Auto-Assign uses an interactive form that works asynchronously to separate the filling out of said form into three distinct steps:

1. Uploading paper submission information
2. Uploading reviewer information
3. Selecting the desired number of reviews per paper

After each step is completed, the user is able to edit the form inputs if errors indicate to do so, or matching results will be displayed. The architecture for Auto-Assign is as follows:

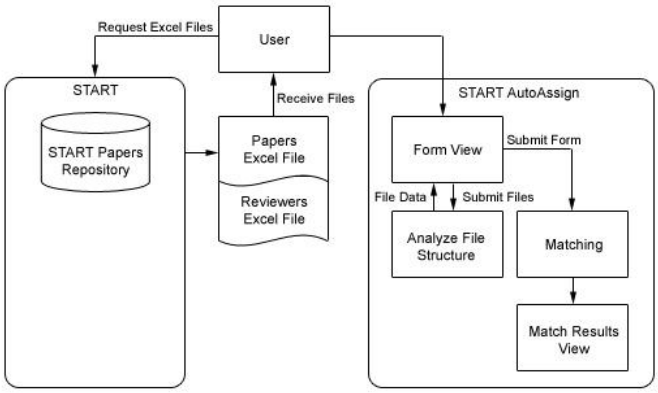

Figure 3 : Auto-Assign architecture

4 Results

The Auto-Assign system was tested on a sample of 213 papers and 25 reviewers. Each paper submission possessed one of 33 potential topics. Reviewers, however, had at least one primary expertise and up to two secondary expertise. Each reviewer was correctly assigned to a maximum of 35 reviewers with all but three reviewers being assigned to this maximum load, and each paper was assigned to exactly 4 unique reviewers. Reviewer assignment, as stated previously, relies on indexing collections of words from papers of various topics; the test was conducted using paper titles and paper summaries as sources of words.

Based on the matching results and derived cosine similarity matrices, the intuition that a larger collection of words provides a more descriptive set of comparisons was validated.

Using summaries as the corpus to be mined resulted in a cosine similarity matrix with fewer 0 entries and a higher average cosine similarity than in that resulting from using paper titles as a corpus. Similarly, standard deviation of total similarities per topic vector was less in the summary derived cosine similarity matrix. These results describe how a larger collection of words describing each paper and, hence, topics allows Auto-Assign to define topic similarity in greater depth. There does exist, however, a tradeoff when mining a more descriptive set of words for each topic: while more topics have non-zero similarity to other topics, the range of similarities decreases, meaning topic similarities became closer together. Summaries caused the cosine similarities between each topic to a given topic to vary less while titles, however, made some topics stand out as much clearer suitable subtopics over others. So, while more descriptive sources of words like paper summaries provided a larger list of subtopics for each topic, a less lengthy source such as titles provided more clearly defined rankings. Logically, this result makes sense as titles are intended to be the shortest description of a paper that still captures the prevailing topics covered by it. Titles, hence, carry the most important distinguishing words for each paper.

5 Conclusion

Using data provided by the START ConferenceManager [1], Auto-Assign is able to automate the reviewer assignment process by utilizing the topics and expertise of papers and reviewers, thus filling a void in START. While many existing methods for other systems require access to large libraries of publications or participation of reviewers in bidding and/or ranking, Auto-Assign finds suitable reviewers without such stringent requirements. The use of information retrieval methods allows the program to predict suitable paper subtopics for which reviewers may have expertise in by clustering same-topic papers and indexing them over words from their summaries, abstracts, or titles. Results from tests of 213 papers and 25 reviewers demonstrate the effectiveness of topic comparison and the existence of a coverage-clarity trade-off between mining titles versus summaries. Auto-Assign's easy-to-use web interface makes it a potential solution for any system, like START, which exports paper and reviewer data as spreadsheets. It could be extended, though, by allowing users to upload paper and reviewer data in formats other than .xls files. Similarly, the program could be enhanced via the exportation of matching results in the spreadsheet format. With the ubiquity of spreadsheets in basic data management and the popularity of web-based solutions over tradition software, Auto-Assign's current features and potential improvements would make it an ideal solution for reviewer assignment automation.

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Reverse Poverty: An Automated Recycling Reverse Vending Machine

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ABSTRACT

As grateful as we should be for the development of science and the advances made in technology which triggered the rapid growth of the human race in all manners, we are overlooking a very crucial problem that is threatening our very existence; the environmental crisis. We face the effects of poverty such as hunger, AIDS, malaria, etc. It is difficult to fully comprehend the complexities and implications of poverty. In order to really support those who live in poverty, we must try to come up with an innovation, something never been attempted.

In this paper, we present Reverse Poverty which uses reverse vending machines (input machine) that accept used empty biodegradable items. The generated money from the accepted recycled material will be automatically forwarded through our software to the output machine. Underprivileged people could then log to vending machines (output machine) in set locations and collect food for free.

Categories and Subject Descriptors

J.0.1 [Business and Education]

C.0.0 [Hardware/software interface]

General Terms

Design, Hunger, Poverty, Environmental Sustainability, Algorithms, Experimentation, Languages, Programming.

Keywords

Computer Science, Environment, Poverty, Recycling.

1. INTRODUCTION

Recycling, recovery and reprocessing of discarded materials for use in new products rely on basic phases of recycling, such as collection of waste materials to allow their processing or manufacture into new products, and the purchase of those products, which may then themselves be recycled. Typical materials that are recycled include iron and steel scrap, aluminum cans, glass bottles, paper, wood, and plastic. The materials reused in recycling serve as substitutes for raw materials obtained from such increasingly scarce natural resources as petroleum, natural gas, coal, mineral ores, and trees. Recycling can help reduce the quantities of solid waste deposited in landfills, which have become increasingly expensive. Recycling also reduces the pollution of air, water, and land which are caused by the immoral disposal of waste [2][5].

About 25,000 people die every day of hunger or hunger-related causes, according to the United Nations. This is one person every three and a half seconds. Unfortunately, it is children who die most often. Yet there is plenty of food in the world for everyone. The problem is that hungry people are trapped in severe poverty. They lack the money to buy enough food to nourish them. Being constantly malnourished, they become weaker and often sick. This makes them increasingly less able to work, which then makes them vulnerable to poverty and hunger. This downward spiral often continues until death for them and their families [4][8].

This paper examines some problems related to poverty. It then explores the architecture and design of Reverse Poverty. The paper, next, discusses Reverse Poverty as it is used. Finally, the research closes with an overview of related work and further enhancements.

2. BACKGROUND

2.1 Current Situation

2.1.1 Statistics about Recycling

According to The Public Recycling Officials of Pennsylvania, for every ton of paper that is recycled, the following are saved:

- 17 trees
- 275 pounds of sulfur
- 350 pounds of limestone
- 9,000 pounds of steam
- 60,000 gallons of water
- 225 kilowatt hours
- 3.3 cubic yards of landfill space

Almost every hour, nearly 250,000 plastic bottles are dumped. It is not surprising that plastic bottles constitute close to 50% of recyclable waste in the dumps. Aluminum is one of the easiest and fastest elements to recycle. Aluminum cans can be recycled and reused within 60 days. Recycling aluminum saves money, energy, and manpower because preparing aluminum products from pure metal consumes close to 100 times the power required to recycle aluminum. If all aluminum produced is regularly recycled, the energy saved is enough to light up a medium-sized city for close to five years [9].

2.1.2 Survey

We conducted a survey among people in Kuwait (via Twitter and Facebook) to understand their knowledge of current events in Kuwait and the World. 61 people have submitted their answers to our survey. By building diversity in our survey, we have selected people from different age groups, gender, and educational background. The results were as follows:

- The majority think that Kuwait does not have a healthy environment.
- For the question "Where do you throw an empty can/bottle?" most of the people said that they would throw it in a trash can since there are not enough recycling bins.
- 94.55% of the people who took the survey believed that there are not enough recycling bins.
- People showed that they actually care about the 25,000 people who die of hunger everyday.
- 96.37% were surprisingly interested in a project that saves the environment and people from hunger.

The accumulated results from the survey showed that the people are actually aware of the problem and they are willing to help.

2.2 Solution

Reverse Poverty uses reverse vending machines that will be distributed in public places. People will start contributing and instead of receiving money from the reverse vending machine, people will protect the environment and raise awareness through social networks, advertisement, and word of mouth. The recycled materials will be delivered to a recycling company and we will receive money from the company. The collected money will allow us to provide food for underprivileged people to reduce hunger. Distributing vending machines around the world will initiate the "End of Poverty" revolution. In addition, Reverse Poverty is a project that aims to create a better environment and saves underprivileged people only by recycling, collecting the cost of recycled items, and spreading awareness. Furthermore, one important issue we address is raising awareness among people that don't understand the importance of recycling and how it helps the environment. Participants will gain awareness of environmental needs at the same time as they help to take the pressure off the environment and helping us respond better to biodiversity loss and climate change while fighting global poverty. As a result, undernourishment could be alleviated, and most nutrient-depleting illness could be prevented and/or controlled [6].

3. Reverse Poverty DESIGN

3.1 Use Case

Figure 1 shows the Use Case diagram of Reverse Poverty. The project has three main users:

- Contributors can both register and deposit the recycled material or deposit without any registration.
- Underprivileged people can login via access cards then take a meal if it was provided for them.
- Administrators will be looking after the software that controls the flow of the whole process starting from collecting the money to providing food

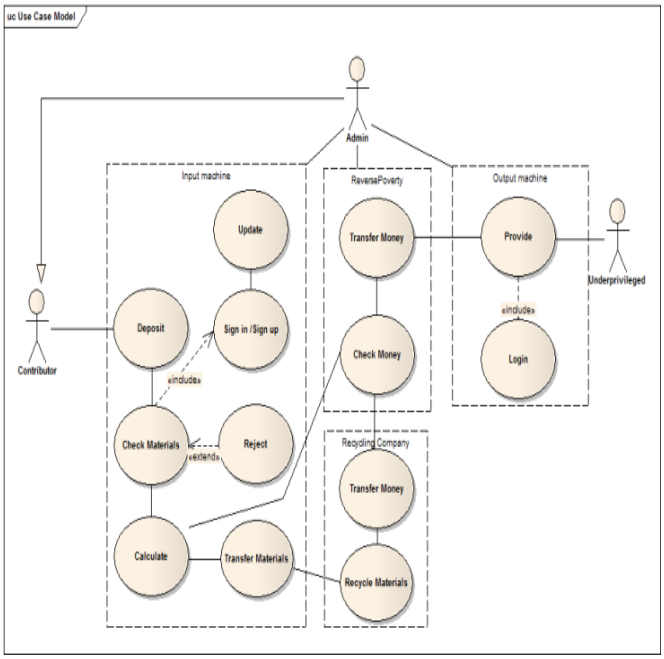

Figure 1: Use Case diagram of Reverse Poverty

3.2 Architecture and Major Components

Figure 2 shows the overall architecture diagram of Reverse Poverty. The diagram includes three layers, the input machine, the software, and the output machine.

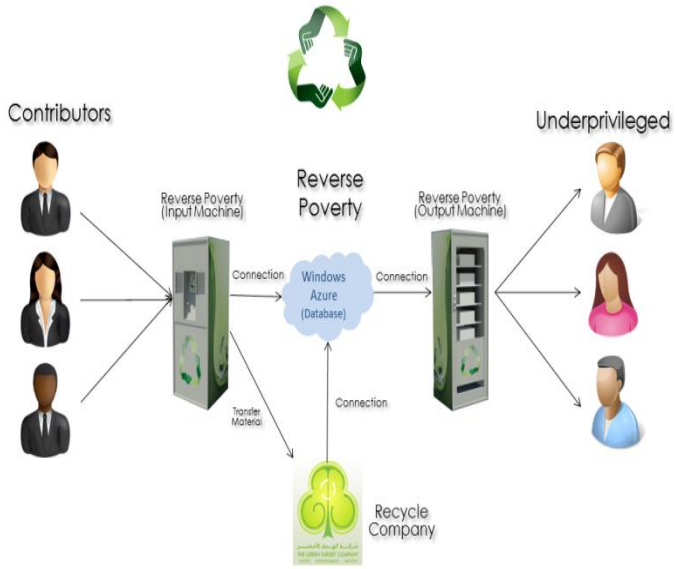

Figure 2: Architecture Diagram of Reverse Poverty

3.3 Used Software Resources

- Microsoft Visual Studio 2010 Professional Edition: it is a powerful IDE that ensures quality code throughout the entire application lifecycle, from design to deployment.
- C#: C Sharp is the programming language that we have used in the creation of Reverse Poverty.
- Microsoft Windows 7
- SQL Server
- Mobile Devices: they will be used for contributors to check their profile and for underprivileged so that they can be notified when a meal is ready for them to collect.

3.4 Activity Diagram

Figure 3 shows the Activity diagram; we can see the process of Reverse Poverty. The user will be prompted to scan the barcode of the material that will be deposited. The input machine receives the recycled material to examine them and either reject or accept the material based on the validity check that we have created. We created a simple algorithm that calculates an approximate cost of the recycled material based on the costs we have received from The Green Target recycling company. Then the user is prompted to sign in or sign up so we can update the account. After that, the material will be transferred to the recycling company. Reverse Poverty's software now receives the money collected from the recycling company and it will be transferred to the output machine where the underprivileged will be notified to collect their meal by using a barcode that is written on an access card that they have.

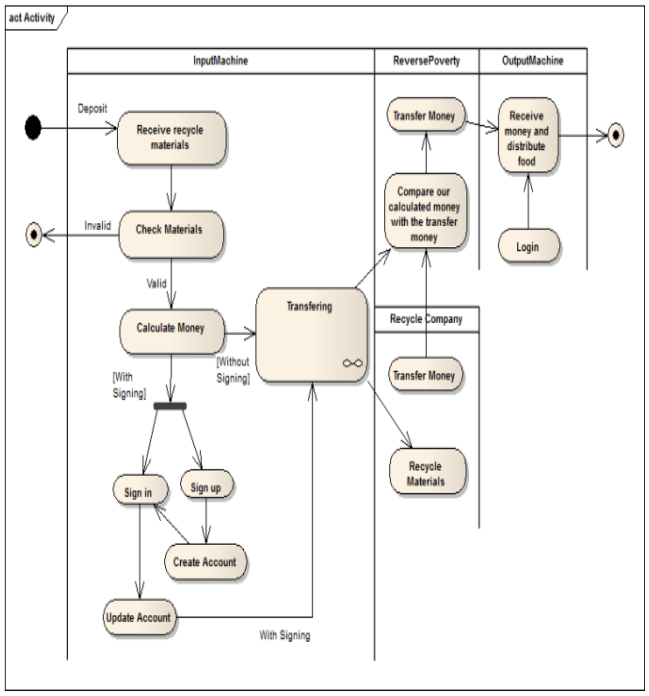

Figure 3: Activity diagram of Reverse Poverty

3.5 Major Classes

Figure 4 shows the relationships among Reverse Poverty project's 5 main classes. First is an InputMachine class that controls everything related to contributing. In addition, a Material class assigns the different types of material that the Reverse Poverty "Input" machine accepts. Furthermore, ReversePoverty class that represents our software appears alongside a RecycleCompany class, which will control the process of receiving the materials, processing them, receiving the money back from the Recycling Company, which is The Green Target, then provide food for the OutputMachine class. Finally, as it is shown in Figure 3, the OutputMachine class will verify whether the underprivileged people have food provided for them or not.

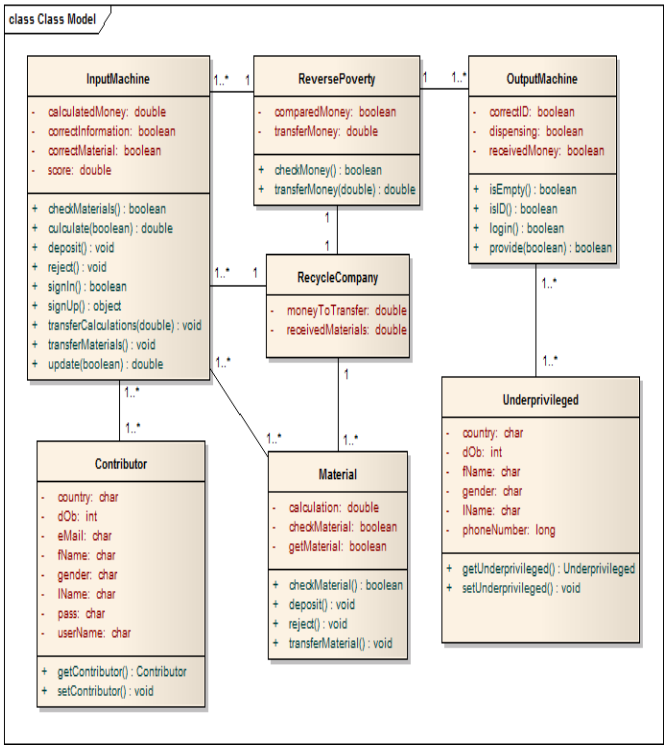

Figure 4: Class diagram of Reverse Poverty

4. USING Reverse Poverty

4.1 Scenario 1: Contributing

Figure 5 shows the sequence diagram of the contributors using the Input Machine.

- Contributors will start with depositing the materials using a barcode reader we installed and the barcode number of the material.
- If the material was valid, the software will ask them to sign in or sign up to connect them with their profile.
- An update will occur on the contributor's profile depending on the deposited materials.
- The money will be calculated and the material will be transferred to the recycling company.

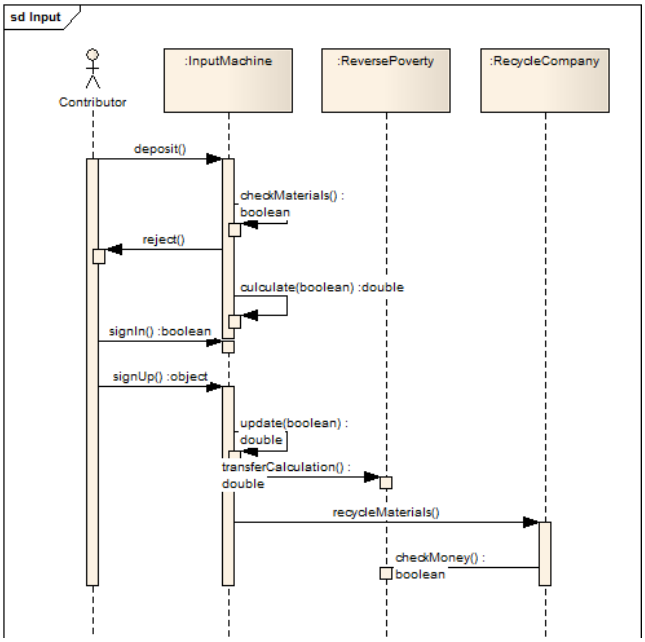

Figure 5: Sequence diagram for using the Input Machine

Figure 6 shows the home screen in the Input Machine. The users will have the choice of signing in, signing up, or contributing without registration.

Figure 6: The "Home" screen of the Input Machine.

4.2 Scenario 2: Registration an Underprivileged and Checking their Profiles

Figure 7 shows the sequence diagram for an underprivileged person using the Output Machine after being registered in the software. This basically illustrates how an underprivileged person is able to check for the availability of an outcome for him/her.

What we will explain is how an underprivileged person will be registered and checks if there is a meal available or not.

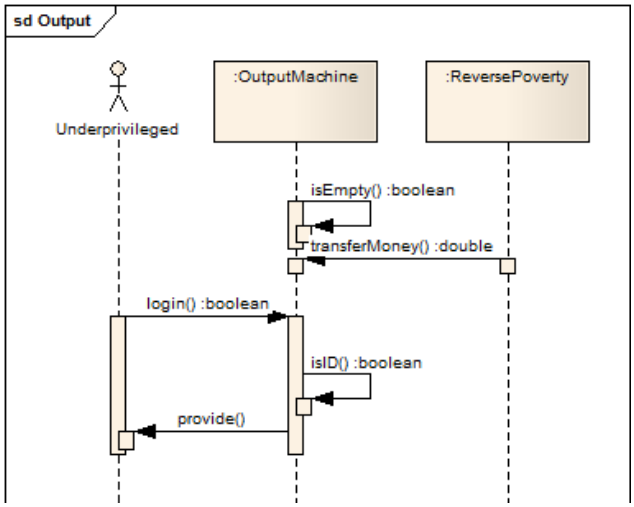

Figure 7: Sequence diagram for using the Output Machine.

Figure 8 shows the home screen in the Output Machine. A member of Reverse Poverty will have the authority of registering an underprivileged person to be part of our project.

Figure 8: The "Home" screen of the Output Machine.

4.3 Assessment

The following images in figure 9 are our first prototype to Reverse Poverty. Showing on the left is the input machine and on the left is the output machine:

Figure 9: First prototype

Some of the people left comments after the trials we have conducted to evaluate Reverse Poverty. These are some examples of the comments they left:

- "This would be a great idea to help the environment and the needy people at the same time."
- "I would definitely be part of this project to save our environment and underprivileged people. The success of such kind of a project will help us to live in a better world."
- "I am an environment lover and the fact that Kuwait and Kuwaiti's in general don't care enough about recycling is a huge disappointment. Any project which spreads awareness or participates in recycling and creating a better environment I would proudly be a part of...."
- "If there were proper education early on about the importance of recycling and the great effect it has on the environment, then people would be more inclined to recycle than to just throw trash elsewhere. Also, we don't have a lot of recycling bins here in Kuwait, so the only option is trash cans most of the time. Thank you and good luck!"
- "to be honest everyone could help in recycling but the problem in Kuwait is that there are no recycling bins around nor any recycling known project because for example millions of cans/bottles are being thrown out every day if we had the privilege of having those recycling boxes then we have helped…"

5. SIMILAR WORK

5.1 PepsiCo's Dream Machine

PepsiCo's Dream Machine recycling initiative, created in partnership with Waste Management, was developed to support PepsiCo's goal of increasing the U.S. beverage container recycling rate from 34 percent to 50 percent by 2018. According to research conducted by Keep America

Beautiful, only 12 percent of public spaces are equipped with recycling receptacles, highlighting the clear need for greater public access to recycling bins. Since the Dream Machine launch on Earth Day 2010, PepsiCo has formed partnerships that will make the kiosks available in a number of highly trafficked public locations across the U.S. However, the aim for this project is to focus on helping the environment only, but with Reverse Poverty our goal exceeds their imaginations [1].

6. Business Viability

6.1 Calculations

In our research after we have checked with a well-known recycling company and a Charity Commission, we have found the following:

- 1 ton of plastic bottles equals to 20 KWD
- 1 ton of steel cans equals to 70 KWD (According to The Green Target Company")
- A meal per day equals to 0.015 KWD
- A meal per year equals to 5.400 KWD (According to Direct Aid")

According to XE - Universal Currency Converter, 1 KWD is equivalent 3.57718 USD.

6.2 Costs and Benefits Analysis

Next is a costs and benefits analysis based on the calculations we have collected. All the numbers are in Kuwaity Dinar.

All prices in KD	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Costs:						
Input Machine	500	500	500	1,000	1,000	1,000
Output Machine	500	500	500	1,000	1,000	1,000
Network	300	300	300	300	300	300
Food		600	600	600	600	600
Total Costs:	1,300	1,900	1,900	2,900	2,900	2,900
Benefits:						
cans	-	840	1,680	2,520	3,360	4,200
bottles	-	240	480	720	960	1,200
Total Benefits:	-	1,080	2,160	3,240	4,320	5,400

The following is the cumulative costs and benefits:

Years	0	1	2	3	4	5
Costs	1300	1900	1900	2900	2900	2900
Cumulative Costs	1300	3200	5100	8000	10900	13800
Benefits	0	1080	2160	3240	4320	5400
Cumulative Benefits	0	1080	3240	6480	10800	16200

Finally, in Figure 10 we have calculated a payback period analysis. The payback period is 4 years.

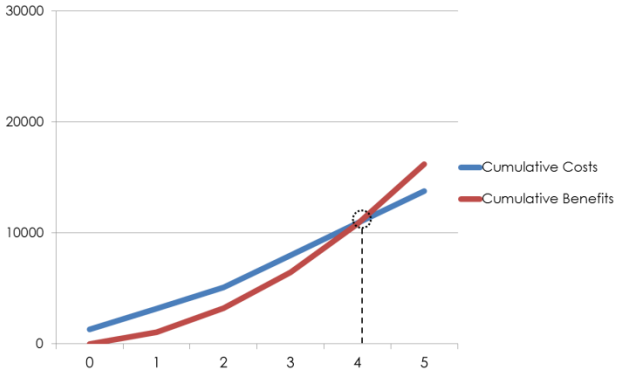

Figure 10: Payback period graph

7. CONCLUSION AND FUTURE WORK

Regarding Reverse Poverty's future, we would like to start to expand the recycled materials such as adding paper and glass. In addition, we would like to add educational resources and medicine as an outcome to the underprivileged. Finally, we would like to grow to be globalized (worldwide).

In this paper, we presented Reverse Poverty which is a Project which attempts to improve the lives of people in our community, country, and world by addressing the very serious environmental and economic challenges that confront us only from recycling and the cost of recycled items. Now, we need to ask ourselves, why is it important for us to fight Global Poverty? It is because of that sense of interconnection, combined with the need to preserve human dignity. In addition, where does the end of poverty begin? It begins with each of us. It begins here and it begins now! Hunger could virtually disappear. Undernourishment could almost vanish, and most nutrient-depleting illness could be prevented or controlled. At the same time, it would take pressure off the environment, helping us respond better to biodiversity loss and climate change.

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Towards One Person, One Vote via Real-Time Voter's Registration and Identification

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Abstract - *The transparency and trustworthiness of any electoral process and their result is what characterized it to be free and fair. Although many voting systems exist, yet the voting systems does not guarantee one man one vote, nor ensures that the vote is cast by an authentic person. This results to discrepancies like chain voting, multiple voting, and impersonation emanating from multiple registrations during the electoral process. When these exist, the trustworthiness and the integrity of our elections are threatened and compromised resulting to failures or corruption of the democratic process. To stop these forms of elections fraud, voters need some form of identification in a real-time mode beginning from the registration exercise. Our objective is to propose a form of voter's registration and identification that ensures that one person votes only once. In this paper, we propose a solution of dealing with the problems during elections through the use of real-time registration and identification of voters utilizing RFID and biometric technologies.*

Keywords: Elections, Election frauds, Registration, Identification, Democracy, RFID

1 Introduction

Since the 17th century, elections have been the standard mechanism by which modern representative democracy has functioned. Elections constitute government initiated process that provides citizens with a service decided by a vote. It is seen as a viable decision making mechanism through which democracy can be empowered. The end product is always the election result. To have an acceptable result, it is thus crucial to organize elections in an unbiased and fair way devoid of manipulations [17]. This is because the public can only gain confidence in the electoral system if it is based on transparently fair, strong procedures and working methods [1][11][20]. One way to achieve this is when some form of Information and Communication Technologies (ICTs) tools are employed.

The application and impact of ICTs on electoral processes, particularly the electronic voting (e-voting) systems have been beneficial. These systems have improved efficiency in the voting process as evidenced in many developed nations. Winners of elections and the entire general public are usually pleased with the outcome if it is sufficiently transparent, accurate, free and fair, though it is more challenging to persuade the losers (and their supporters) that they lost [7]. Countries such as the US, UK, France Russia, Brazil, France, India, etc. have already deployed e-voting widely [7][20].

Despite the benefits associated with the use of e-voting systems, that is, increased public confidence and participation in the political process, greater convenience in terms of voting time and location, reduced cost, access to people with disabilities, etc.[8][20], modern election systems still suffers large scale election frauds called voter's frauds. The nature of theses frauds is particularly, the problems of voter's authentication and verification and his/her eligibility to vote. The voting system does not pledge that the vote is cast by an authentic person or one person, one vote. This gives way for foul practices in the electoral process like chain voting [12], multiple voting, ghosts voting or impersonation. When voting systems of this nature exist, the trustworthiness and the integrity of our elections are threaten and compromised [4]. These will in turn results to failures or corruption of democracy [5].

In order to rid our elections of doubts and opportunities for fraud and failures [13][14][15][16] the systems has to be made more transparent, trustworthy, accurate and reusable. One way to achieve this is through real-time registration and identification of voters. This approach will ensure that an eligible voter vote only once. The objective of this paper is to propose a form of voter's registration and identification that ensures that one person votes only once in an election.

Therefore, in this paper, we propose a solution of dealing with the problems in the voting system through the use of real-time registration and identification of voters during election. The system makes use of radio frequency identification-based (RFID-based) voter's card. We also discussed benefits of the system in general. These are discussed in subsequent sections.

2 Challenges in Modern Electoral Systems

One of the major issues facing modern electoral system, particularly, e-voting is having substantial public confidence in the electoral process as well as its results [20]. The system

is faced with huge amount of flaws worsen by programming errors [8]. It introduces new sets of risks, doubts and opportunities for fraud and failure and the technologies used are not as safe, trustworthy, dependable, etc [7]. Most of these issues have already been reported in the US being mostly caused by the Direct Recording Electronic (DREs) voting machines [4]. The situation showed a number of system deficiencies such as confusing ballots, registration mix up, systems failure on election day, software bugs preventing votes being recorded, hard to use interfaces, recount impossibility, mistakes in polling place operations, and even absentee ballot problems that caused the losses of millions of votes [4][7][8][17]. These recorded problematic situations have reduced public confidence and trust on the democratic process world wide. It has also brought about a global trend of moving away from e-voting and widespread criticism.

In addition, the voting systems at large do not guarantee that the vote is cast by an authentic voter or one person voting only once. This therefore create avenue for frauds in the electoral process like multiple voting and impersonation. With systems of this nature, the trustworthiness and the integrity of our elections can be undermined with the side-effects of failures or corruption of democracy [5]. It is based on this pitfall we proposed a system of real-time registration and identification.

3 The Proposed Approach

Our approach is based on the need to ensure that one voter vote only once in order to rid doubts and failures' opportunity in our elections. This solution is based on real-time registration and identification of voters before being allowed to vote. The system consists of real-time registration, RFID-based voter's card that utilizes the electronic product code (EPC) [10][17][18] and the biometrics technology for finger prints, etc. for real-time identification.

The layout of the polling station and path of a voter in the proposed system is shown in Fig. 1. The application of this election approach will go along way to reducing voter frauds during elections that have since threatened the integrity of our elections. Basically, our system tends to offer an electoral system that is reliable and transparent with minimum or no possible fraudulent practices. That is, provides authentication and verification of the voters, preventing multiple voting or impersonation, allows for audit and recount of votes anytime and anywhere and pave way for reusability of the election assets [9][17].

4 Overview of the System

The proposed system combines a number of existing modern systems of voting ideas in an innovative way, with motivating new variations – RFID and biometric technology. The system components are discussed below.

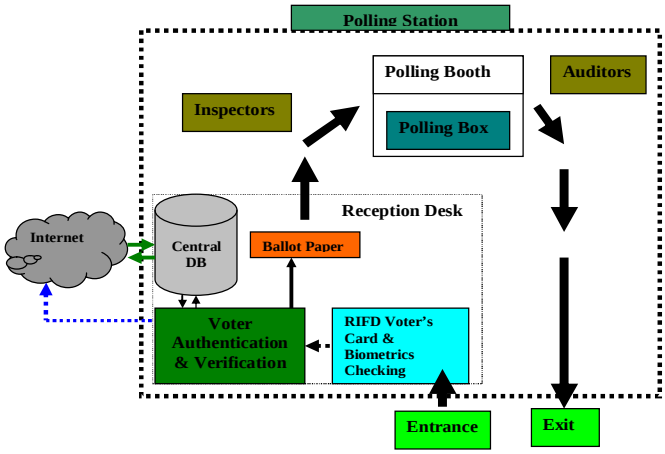

Figure 1: Layout of the polling station and voter identification process

4.1 The Voter's ID Card

The voter's card is the identity card (ID card) received after being registered as eligible electorate for voting purposes. The proposed voter's card is RFID-based, having a tag that stores the unique code (EPC) for a particular voter's information in the central database. The card is just a standard ID card designed with simplicity and convenience with the passport photograph of the holder appearing on the front side of the card (See Fig. 2). This card can serve a dual purpose like voting card, national ID card etc., and is reusable in subsequent elections.

Figure 2: Voter's ID Card Sample

4.2 The Central Database

We propose a central database where all voters' information collected during voter's registration exercise will be stored. For countries with already existing central database, this will be an added advantage. For those without existing one, the central database can be created during voter's registration exercise by capturing the necessary information. This database can also serve a dual purpose. That is, it can be made available to other sectors of government and non-governmental organizations (NGOs) in a read-only mode.

4.3 Network Connectivity

For the effective operation, we propose a fast network access to the central database in order to store and retrieve voter's information within milliseconds without compromising registration and voting time respectively. Preferably, a wireless local area network (WLAN) is required to connect devices (i.e. mobile readers/PC and Biometric) at several pool station to the central database. Though security is an issue at this point, issues of security attacks will be addressed later.

4.4 Real-Time Registration of Voters

This is the first and crucial exercise in any election process where voter's information can be captured for storage and onward use. In most countries, there has been a culture of multiple registrations or one person registering for another during the exercise at different locations. This is as a result of lack of security measures to identify and track them down during registration exercise. In short, the system does not guarantee that one person registered only once.

With the challenges faced by our modern electoral systems, voter's registration has to be conducted in a way that ensures one person, one vote. This can be achieved through the following procedures:

Step 1: Data collection

At the registration centre, voter's information can be collected through the use of Mobile PC equipped with AIDC (Automatic Identification and Data Capture) technology like the biometric technology. These systems will be connected directly and wirelessly to the central database during the registrations exercise. The mobile PC will be used to collect the Names, Sex, DateofBirth, Height, PlaceofBirth, Blood Group, Permanent home address and Nationality, etc [17]. On the other hand, the biometric technology will be used to collect Fingerprints and Passport photograph of the voter.

Step 2: Data Management

During the course of the registration, all information collected from a voter will be recorded, updated and store in a real-time mode into the central database. The biometric information (i.e. Finger prints) stored in the database will make it impossible for someone to register/vote twice even with a different voter's information or at different places. (See Fig. 3).

Step 3: Card Issuance

At the end of the registration exercise, perhaps, after a month the RFID-based voter's card will be issued to all registered individuals. The RFID tag on each card will have a unique EPC code which will be used to query the central database on a real-time mode to provide fast and reliable identification of the potential voter.

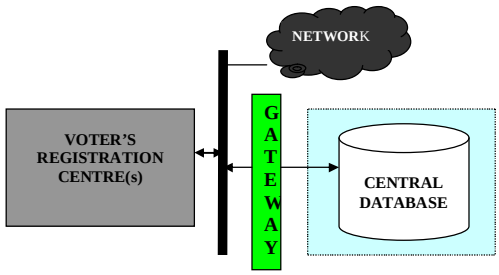

Figure 3: Real-Time Voter's Registration

The essence of the real-time registration is to ensure that a voter has only one voter's card and vote only once. For instance, if a voter has finished registering in one center and decide to go to another center to register, his/her information in the national database can be used to track he/she down and be denied registration immediately.

5 Activities at the Polling Station

5.1 Real-Time Identification and voting

The first operation at the polling station is simply the real-time identification process. In this process, each voter will be individually identified against the information stored in the central database on a real-time mode. The operations within the system are simply authentication and verification [17] (see Fig. 1).

As a voter enters the polling station with his/her RFID-based voter's card, the card is scanned with the RFID mobile reader by an electoral official. Simultaneously, the fingerprint scanner will be used to authenticate the voter (that is, providing two-layer security to voter's information). Upon valid authentication, specific information collected or documented about the voter during registration will display on the mobile PC. The information expected is just the voter's photograph, Name, Age, Place/Date of registration and Voting status. The voter is then allowed to vote independently with the voting status changed from **0** to **1**. On the other hand, upon invalid authentication, the person is sent out of the voting place without been allowed to vote. Voting can take any strategy either the traditional approach or through the use of voting machine.

5.2 At the End of Voting

At the end of the real-time identification and probably voting, the ballots are collated depending on the strategy utilized (manually or electronically) and the results computed. Winners are announced following the outcome.

This approach permits auditing and recounting to be carry out if need arises. With this, the number of voters who actually voted will be compared with the number of votes obtained in order to put falsification of figures/results under check. The information in the central database provides a means to check for discrepancies before results are officially announced.

With this process in place, the general public (i.e., winners, supporters and international communities) can have full confidence in the electoral system since it is based upon transparently fair, robust and working method [9]. This will surely protect the integrity of our elections.

6 Discussions

Our proposed form of voter registration and identification will set a simple and clear standard for protecting the integrity of our elections if implemented. This will be more advantageous in developing countries where impersonation, multiple registrations and voting is the order of the election. In most countries, proxy voting, multiple registrations and voting are serious problems that sometimes lead to anarchy and failure of democracy. Situation like this tends to undermine the integrity of our elections and even threaten democracy at large. Elections have to be conducted in a transparent manner and results generally accepted by the public. One way to achieve these is by the use of real-time registration and identification of voters.

With the implementation of this approach, lot of benefits can be derived. These benefits are highlighted as follows. Firstly, the approach promotes re-usability of tools. That is, RFID-based cards can be re-used in present election as well as in subsequent ones. With this, huge savings can be promoted or made on the part of the government in terms of time, effort and cost of procuring sets of new tools [9]. Secondly, RFID-based voter's card can be use as national ID card and in any other identification capacity. This will be an added advantage especially for countries where national ID card never existed. It will help to eliminate any forms of impersonation or criminal activities. Lastly, with our proposed approach, national central database can be implemented especially where central database never existed also. This will rid the wastage of resources in creating and procuring new ones every time the need arises. The national central database will as well provide supports to other sector of government (e.g. the national population census etc.) and the NGOs.

With the mode of operation of this proposed approach, there are lots of factors that might impede its implementation or operation. We perceived resistance to change could be one of such factors [17]. This could manifest due to selfish/conflicting interest to continually committing election frauds. Another inevitable impediment is security attacks which could be physical or logical. Lastly are maintenance issues of not regularly maintaining the database. We believe this will be a difficult task except during registration exercise.

7 Conclusions

In this paper, we presented ideal ways to curb election frauds during elections. We proposed the real-time registrations and identification of voters before they are allowed to vote. Many voting system exist but failed to pledge that the vote is cast by the right person. Our approach takes a simple and clear approach to protect the integrity of our elections- ensuring one man, one vote in an election. It uses RFID and biometrics technologies to enable real-time registration and RFID-based card for unique identification of voters in order to eliminate voting frauds relating to multiple registrations, multiple voting, impersonation, etc. The approach will offer electoral system that is transparent, trustworthy and reusable.

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SESSION

FORM FOLLOWS FUNCTION: WORKING IN E-LEARNING ENVIRONMENTS

Chair(s)

Dr. Jon Cabiria

Connectivist learning environments: Massive open online courses

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Abstract – *For most of human history, knowledge had a long and stable shelf-life. With the ubiquity of advanced computing, information, and the knowledge it generates, has a much sorter half-life, often measured in months rather than generations. Educators are hard-pressed to meet the knowledge demands of students, who are no longer content to engage with traditional learning pedagogies. Not only must content delivery options evolve, so to must the learning paradigms. A connectivist learning pedagogy was proposed as a means to address the effect of technology on learning environments by placing the emphasis on the student-information relationship rather than the student-teacher relationship. Concurrently, the introduction of massive open online courses, in which very large numbers of online students participate in the same course at the same time, offers an interesting test to the connectivist pedagogy, in which the learning context, bolstered by technology, is given greater prominence.*

Keywords: MOOC, connectivism, massive open online course

1 Introduction

In 2008, an educational experiment was conducted based upon a proposed learning theory and which was freed from traditional concepts. This theory, Connectivism, looked at how new technologies disrupt the learning process by shifting the dynamic of *teacher-to-student* to one of *student-to-information*, and how knowledge acquisition becomes a collective process that helps each student personalize her or his learning needs [1]. This approach was explored through an online endeavor described as a Massive Open Online Course (MOOC). In a MOOC, thousands, even hundreds of thousands, of students can participate in the same course, at the same time, and in an environment that provides multiple, even redundant, learning tools and resources [2]. Working within a topical framework and guided by a facilitator, students would devise their own learning process and seek out information to augment their own learning needs, in addition to the core content provided in the course resources. They would gain support and guidance from each other through formal forums and self-generated, informal study groups. In the few years since the 2008 inaugural MOOC course, several MOOC schools and private businesses have launched, with the belief that the world is witnessing the birth of a new force that will predominate education within just a few decades [2]. This article will review Connectivism and the MOOC phenomenon, as well as note some significant issues that will need to be addressed going forward if MOOC is to become a viable learning option.

2 The half-life of knowledge

For much of industrialized history, including the very recent past, education was a matter of learning the basics in order to get along in society, and to develop a skill or trade to provide for one's self and one's family. Formal learning often ended when school did. Informal, task-specific, as-needed learning took over. Historically, the pace at which society and jobs changed or evolved was often very slow and could be paced over generations. Knowledge had stability and longevity. Educational systems where also rather stable and long-lasting.

This has now all changed. With the advent of computers, the Internet, and mobile technologies, the creation of new information and increased need for it has exploded exponentially [3]. Social changes seem to be occurring daily, and some job skills can be outdated by the time they are taught. The what, when, where, why and how we learn have evolved into something rather unstable, and with a short shelf life. Vaill noted "Learning must be a way of being [in an attempt] to try to keep abreast…(p. 42) [4]. Keeping abreast of information generation and degeneration has become a paramount activity. In the 21st century, information creates knowledge of dubious long-term value. The 'half-life of knowledge' describes how knowledge becomes obsolete over an increasingly shorter period of time while, concurrently, new information doubles every 18 months [5]. Educators are faced with the task of trying to deliver current, useful content that keeps pace with the instability of information growth, information demand, and information decay.

3 Approaches to learning

"Learning" has many definitions but it is basically a process of change. For Driscoll [6], it is persistent change as a result of interactions with the world. This particular perspective aligns well with learning theories found in behaviorism, cognitivism, and constructivism. In behavioral

learning, the learning process is essentially unknowable and hidden from conscious awareness. As a result, we should be less concerned about the internal learning process and focus on what is observable, specific, and oriented toward change [7]. Cognitivism is also an internally oriented exploration. It attempts to define various constructs and mental maps as it traces the path of stimulus to response, while describing learning processes through abstractions, symbols, and metaphors [8]. It looks at how the learner eventually gives meaning to information based on the prior knowledge and perceptions of the world in which the information resides.

Behaviorism and cognitivism both approach knowledge as existing outside of the learner, which then becomes internalized. Conversely, constructivism is a process in which the knowledge already residing within the learner is altered and expanded upon as new information is added. In essence, the learner uses already-existing pieces of knowledge to construct new meaning. This information is turned into new knowledge, which is unique to the individual [6].

These three learning theories, behaviorism, cognitivism, and constructivism, made sense when the modes of learning where more linear, and the connections between information were more limited. In an age of advanced communication technologies, however, the sources of learning have become more matrixed, and information is expansive, fluid, and networked. To address these paradigm shifts, a new learning theory was proposed.

4 Connectivism

In today's environment, learning is a process of connecting people to each other, and to information resources [9]. A triadic relationship between the teacher, the learners, and the information is nothing new; however, with the advent of new communications technologies and distance learning endeavors, the addition of *context* forms a new quartet relationship. This learning quartet – teacher, learner, information, and context - has, at its heart, a participatory element in which the student takes a much more active role in deciding when and how to learn, what to learn, and how to construct and apply the knowledge that comes of it.

This less-formal approach is described in Connectivist Learning Theory [10]. Connectivism recognizes that information is incredibly fluid, resides in multiple locations, and is often highly disorganized [1][10]. The learner has needs beyond basic skills, which are highly individualistic [11]. The learner wants, first, to discover how to effectively find information; next, to discern its value; then, decide how and where to store this information; and finally, what meaning to give this information as it is turned into useful knowledge.

We can easily link Siemen's connectivist principles with Weller, an expert in virtual learning environments, who noted that e-learning is a matter of connections between people and connections between information resources [9[. Siemens developed a set of connectivist principles that allow for the influence of new technologies and rapidly changing information needs [12]:

- Learning and knowledge rest in diversity of opinions
- Learning is a process of connecting specialized nodes or information sources
- Learning may reside in non-human appliances
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning
- Ability to see connections between fields, ideas, and concepts is a core skill
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Context has become an important factor in how learning occurs. This next section looks specifically at the context of a MOOC learning environment.

5 Massive open online courses

The evolution of the educational context is fairly easy to track because it runs a parallel course with emerging technologies. In the second half of the 20th century, in particular, there had been exponential growth of information delivery options [5]. These options have become more refined and more advanced in the 21st century. Mail-order and TV educational options were supplanted by Internet-based learning. Desktops and laptops became online classrooms. Recently, mobile technologies and social networking sites entered the learning environment, further reinforcing a connectivist notion of learning as context-sensitive and relying on multiple sources connected to each other. Classrooms and information sources became accessible through smartphones, and are now in virtual spaces. In this digitized learning environment, the role of the teacher becomes relegated to a facilitative and administrative position, in which content is merely suggested within a general topical framework [13]. The focus on teacher capacity - that is, how many students can a teacher effectively manage - becomes an irrelevant issue. Automation of content

delivery, automation of student activity tracking, and automation of assessment and feedback, all dissolve the barriers of human capacity, opening the way for limitless class sizes. This automated context is not only about the technologies involved that technologies make possible [2].

Massive Open Online Courses were conceived by Stephen Downes, currently with the National Research Council of Canada, and George Siemens, currently with Athabasca University, as a means to address information overload, respond to student demands for relevant learning experiences, incorporate technological advancement, and reduce costs of education (for both students and schools) [10]. This proposed online learning environment would incorporate any number of students, content sources, and content delivery options (real and virtual), limited only by the capacity of the technologies and associated costs [10].

The first MOOC class, in 2008, consisted of 2,300 students, and was sponsored through Manitoba University, Alberta, Canada. Siemens and Downes suggested that the paradigm of tightly controlled learning processes needed to be re-evaluated in a manner that opened up learning networks, allowing students to customize their learning experiences within a loosely designed framework [14]. This framework looked at information resources as content clusters that surrounded a topic, from which students could sample content while adding to and discarding from it according to their own needs and goals. In essence, the course was a 'destabilized' [15] 'uncourse' [16] that enabled students to develop personal perspectives about information. Part of the process of personalization was in achieving meaningful connections with other students who played an active part in each other's learning adventures [17].

5.1 How MOOCs work

The components of a MOOC system include any combination and permutation of the following: Teachers, students, information (topic and related content), and context.

⇒ Teachers
Facilitate the learning process through the identification or creation of relevant content, establish the primary means of communication among students and with teachers and/or teacher's aids, administer assessments based on general or specific learning objectives.

⇒ Students
Anyone who has an interest in learning about the topic. Students can be enrolled in a formal degree program, or they might just wish to learn for purposes outside of a degree program. Students who are merely curious and with no specific goals are also welcomed.

⇒ Topic
The main reason-for-being of the course. The topic is explored through the connectivist quartet of student, teacher, content, and context. The topic is infused throughout the learning network rather than existing in a centralized repository. It is narrow enough to provide focus but broad enough to allow expansive exploration.

⇒ Content
Exists in a variety of locations and formats and is accessible through a variety of technological and social means.

⇒ Context
The technologies, people, and networks that are part of the learning environment. This can include online social networks, mobile technologies, traditional information sources, various types of information delivery systems, types of communication systems, stated objectives and expectations, and the group culture that forms every iteration of the course.

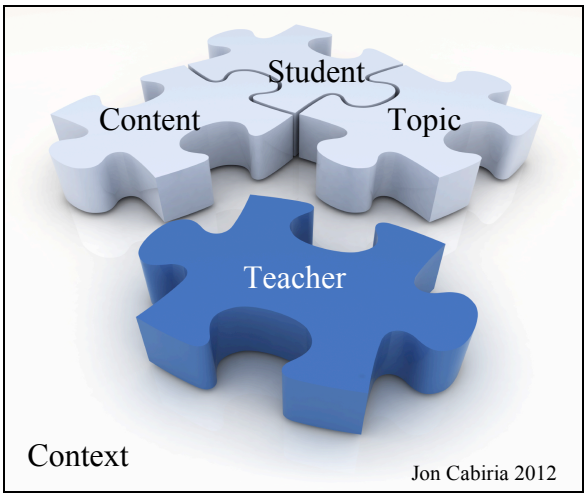

Figure 1: Components of a MOOC system

Students in a MOOC environment are given resources that serve as jumping off points rather than endpoints. Much like a person exploring links on websites, the student may follow a trail of information, guided by her or his interests related to the topic [18]. Forums are set up for students to interact with each other as they explore general areas of interest, offer support and additional resources, and form special interest groups in order to explore topics more deeply. The goal is to create a community of learners who bring personal resources and perspectives to those offered by the teacher, and to embark on a journey of discovery that is personalized, yet includes other students [2][10][11]. A course can be set up in weekly modules or may have no time frame at all, and can include videos created by the teacher and others, links to content, lists of additional materials, websites devoted to student and technical support forums, and accessibility to all of this through various computing devices over wired, wireless, and cellular networks. Conversations, information discovery, and sharing may occur in the class forums, in social networks, and in virtual worlds – at the choice of the student. The keyword in a MOOC system is *flexibility*. The following table (Table 1) breaks down the common elements of a MOOC learning environment.

Table 1: Elements of a MOOC learning environment

Type	Purpose
Sources	• Instructor-created o Video files o Audio files o Text documents • Existing Content o Websites / Online databases o Traditional Libraries o Students' own content collections • Content is expansive, giving students a foundation upon which to explore, to select relevant information, and to add to it with their own discoveries • Content is shared and discussed – teacher-to-student and student-to-student • Groups may form around special interests related to the main topic
Communications	• Texting, chat, and e-mail • Voice o Cell phone/ landline o VoIP • Online forums o Course workspace o Support forums o Student forums o Instructor online office forum o
Technologies	• Desktop / laptop computers • Smartphones • Netbooks • Gaming
Context	• Online forums • Virtual worlds • In-person • Other virtual spaces
Learning management systems	• For the aggregation and display of course content • For the listing and monitoring of students • For administration of assessments © Jon Cabiria 2012

5.2 Current MOOC initiatives

During the past four years, experimentation with MOOCs has increased, especially among a few high-profile non-profit universities and with private, for-profit businesses [2]. Massachusetts Institute of Technology, Stanford University, University of Illinois, University of Michigan, University of California – Berkeley, Georgia Institute of Technology, Udacity, Udemy, and MOOC-delivery conduit, Coursera, are the current leaders experimenting with this connectivism learning model. They have sparked interest among students of all ages and skill levels, indicating that students are seeking something that might be more relevant to their lives and learning goals.

In late 2011, Peter Norvig and Sebastian Thrun created a MOOC Artificial Intelligence course for Stanford University. It was delivered in 44 languages, to students in 190 countries. It ran concurrent with a for-credit course of enrolled Stanford students and, at its peak, had 160,000 registered students participating at the same time [19]. The positive experience of this endeavor prompted Norvig and Thrun to create a for-profit MOOC university called Udacity, launched in February, 2012. Stanford continues to role out a series of new MOOC courses that have evolved beyond technology-related topics to include courses such as Human Anatomy and Entrepreneurship [20].

5.3 Considerations

The primary characteristics of connectivism and, thus, of a MOOC are autonomy, diversity, openness, and interactivity [21][22][23][24]. Sense of presence, a cognitive requirement to help maintain interest and motivation, should also be added to these characteristics of connectivism [25]. However, these characteristics also bring limitations to the learning experience. There is reduced structure in a pure MOOC course, which can become a demotivating factor for students used to, or requiring, firmer guidelines with measured milestones [11]. Additionally, while the support forums provide assistance for issues, they can quickly become unwieldy and inefficient when searching for the right answer to a problem, especially one that is rather unique or, as is often the case, when the student does not know how to phrase the question [2]. There are also issues regarding assessment, in that the potential for cheating is increased and assessments have little value to anyone other than the student [2].

There are also limits to student participation in a MOOC learning environment. Students must have some proficiency in the use of computer and Internet technologies, search strategies, and basic functioning of forums. Students also need to be self-motivated and have a high tolerance for structural ambiguity [26]. While some initial MOOC endeavors are multi-lingual, the language of choice at the moment is English. Additionally, MOOC learning will lend itself more favorably to students with high critical thinking skills, simply because they are primarily responsible for

searching, aggregating, and validating relevant information for their own purposes rather than for the purposes of the accrediting body [2]. Students are also responsible for accessing and creating their own content in a variety of formats and for communicating it to other students. Their knowledge of the intricacies of how networks operate – in the case of MOOC, between student-to-student, resource-to-resource, and student-to-resource - would be helpful in being able to negotiate the complexities of the learning environment [27]. Finally, the learning environment itself needs to provide a sense of presence that will be compelling enough to keep the student involved in the learning activities [25]. These three basic challenges – critical literacy, learner autonomy, and sense of presence – are the cornerstone of a successful MOOC endeavor that not every student is capable of achieving [28][18][29][30]. We can note that of the aforementioned Stanford Artificial Intelligence course of 160,000 students, only 23,000 made it to the end and graduated: A rate of 14% [31].

Connectivism, as a new learning theory, also seems to have some issues worth noting, including the difficulty in isolating unique features that are not already existent in other learning paradigms. For instance, many of the social and cognitive learning theories already have a long history that show how people learn through observation and social modeling [32][33][34][35] and through collective or community efforts [36]. Current learning theories are sufficient, although Connectivism does present an interesting pedagogical viewpoint, and notes a shift of power from the teacher to an autonomous learner [37].

6 Conclusions

It is clear that educational approaches in the technological age are in a transitional stage with regard to information retrieval, storage, and use. Additionally, educators must grapple with different ways of employing learning pedagogies to assist students in converting that information to knowledge. Considerations of constantly evolving technologies and their associated costs, as well as demands for relevant learning experiences that encompass formal, informal, and personalized goals, are causing reevaluation of current learning theories and principles. Connectivism, with its emphasis on the matrixing of human and technical networks, appears to be an interesting learning paradigm, especially in light of the emergence of MOOC learning environments.

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How Instructors Can Better Create a Sense of Community in Online Environments

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Abstract – *Online learning environments are becoming increasingly important in higher education. Nearly one third of higher education students will take at least one online course, and there were over six million students taking an online course in 2010. With this increased emphasis and prevalence of online learning, distance educators must learn how to create successful learning environments for student success. In an online environment, technology is the primary enabler of community and must be used effectively. Often, course designers and instructors rely heavily on discussion boards with posed questions to develop community and interactions. However, multiple technologies should be integrated, with the pedagogy of the course design and the sequencing of activities deliberately planned. Additionally, the role of the instructor is more than as observer or caretaker. Student profiles (e.g., prior experience and learning style) must be developed and used. This paper proposes a simple practice with an integrated approach to create a sense of community in an online environment with pedagogy and learning theory, sequenced activities integrating multiple technologies, the instructor's role, and student profiles.*

Keywords: online learning, community, pedagogy, discussion boards,

1 Introduction

Online learning environments are becoming increasingly important in higher education. Nearly one third of higher education students will take at least one online course, and there were over six million students taking an online course in 2010 [1]. With this increased emphasis and prevalence of online learning, creating effective learning environments is critical for student success, as successful teaching and learning occurs best in a healthy community of learning.

A distance education learning community is not defined as simply an online course with students and teachers. A formal learning community is composed of teachers who facilitate and validate students' construction of understanding and learning while ensuring opportunities for further learning [2]. Community is both inherent and integral to many aspects of a student's life, and community should be created in distance education environments to provide a familiar foundation for both teachers and students [2].

It is the entirety of the participants, the virtual environments, and the interactions that create and maintain a sense of community. A holistic view of current technologies and techniques for creating a sense of community in an online class should be constructed since interpersonal relationships contribute to the success of online students [3]. These relationships contribute to the learning environment, and Tyler first outlined the importance of the student's environment on successful learning [4]. Knowles, Holton, and Swanson added that adult student's approach to learning has a social nature, which affects learning [5]. For many students, the effective creation of a sense of community is essential in an online environment [6].

To help instructors create a sense of community, there are multiple techniques and methods available. Unfortunately, course designers and instructors often rely heavily on discussion boards with posed questions to develop community and interactions. However, multiple technologies are available which should be driven by the course pedagogy. Additionally, the role of the instructor is more than simply as facilitator, and the student profiles (e.g., prior experience and learning style) for each class must be taken into account. Instructors should consider an integrated approach of these four components shown in Figure 1 when designing and conducting an online course to create opportunities for community.

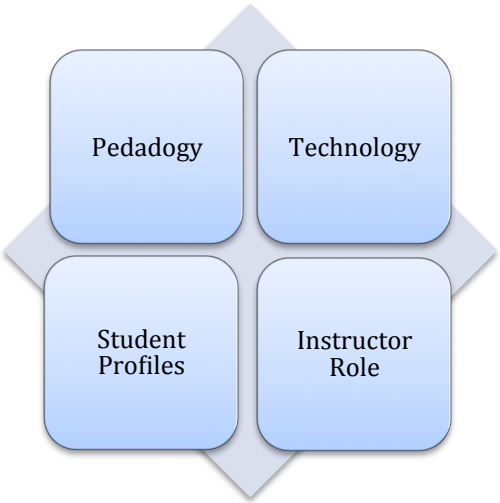

Figure 1: Primary Contributing Factors to Online Learning Communities

It is not a simple task to create an online community, and planning is required to be successful [7]. To answer the question of how instructors can better create a sense of community in online environment, the course pedagogy, student profiles, the use of technology, and the instructor's role can be defined in a practice. The instructor is key to this planning and implementation.

2 Pedagogy

When examining the creation of an online learning community, pedagogy and learning theories serve as the foundation with respect to communities of learning. Learning is associated with connections to others and is a social activity [8]. While not specifically directed at online learning, this notion reinforces that learning takes place within the usual activities of life, of which communities are typically a major component. However, distance and online learning have a unique aspect of the teacher-student relationship because of their relationship distance, defined as the activities that occur between teacher and student [6]. These interpersonal interactions can be considered a transactional distance. Transactional distance is more critical than physical distance, and there are many examples of face-to-face environments where there is a great distance between teacher and student [6]. Likewise, transactional distances in an online, distance environment can be shortened. Creation of community can positively impact transactional distance.

Support for pedagogy should be the primary reason for technology and course design for any educational environment. In online collaborative learning, group activities and interactions are required and need to be supported. Otherwise, an online course that does not provide support for these interactions is simply a web site of information [9]. Admittedly, a course on multiplication basics might not require substantial interactions, but any course requiring the development of critical thinking skills or desiring long-term transfer must strive to maximize student interactions. Support for student interaction for both student-student and student-instructor enhances a sense of approachability, familiarity, and comfort. Thus, instructors need to be mindful of the role of pedagogy for their course.

There are a number of well-established theories in the literature on learning theory with respect to social learning and community. Tyler's seminal work *Basic Principles of Curriculum and Instruction* laid a foundation for the importance of a learning environment. In this work, Tyler stated that the teachers must have an understanding of the interests and backgrounds of their students in order to be effective and predict what methods will work best [4]. In a distance environment, creating a healthy and vibrant community must be a conscious effort by the instructor.

Interactive and active discussion boards establish a circle of learning where students quickly begin to recognize each others' voices and unique personalities [6]. In a smaller community, such as those often found in an online class, members need acceptance and must build trust to contribute freely and express opinions without concern from fellow students' or teachers' criticisms [10]. However, a community cannot be created and sustained simply by participation of its members [9]. Thus, discussion boards are critical, but must be more than a passive participatory (i.e., read-answer question) activity, and the instructor must monitor, encourage, and discreetly participate to ensure community is achieved and maintained.

There are many perspectives to be examined concerning communities of learning. These include trending of recent learning theory towards cooperative learning for both constructivist perspective and the expanded need for students in today's global workforce to work in teams. Students must develop group interaction skills in this environment. Lang and Evans outlined several collaborative learning instructional methods such as setting goals and outcomes, role-playing, problem solving, team investigation, and group team building exercises [10].

Recent literature for learning communities includes communities of practice. Wenger provided a social theory and framework that incorporated significant value to the student's need for a sense of community. He offered four components as part of learning: 1) meaning where "learning is an experience," practice where "learning is doing," community where "learning is belonging," and identity where "learning is becoming." This theory illustrates that, in a community of practice where learning is shared and occurs over time, a sense of community is an integral component [11].

2.1 Constructivism in online learning

Many modern learning theories are primarily based on constructivist theory. Constructivism is where students create meaning instead of receiving information [12]. The pedagogy of knowledge creation versus direct instruction is an important consideration in the need for the formation of online communities. Content in an online course is not the sole domain of the course designer or instructor, as students produce content as well in an active learning environment [13]. In fact, the very foundation of healthy online learning communities is where content is created dynamically as part of the learning process [9].

There are several teaching strategies for constructivist methods including exploration of multiple perspectives, collaborative learning, and social negotiation [12]. Developing real world tasks in meaningful contexts creates the act of transfer in constructivism [9]. This combination establishes the importance of a connected learning community. Knowledge is not transmitted but rather co-constructed, and interactivity in an online course contributes to knowledge transfer and the willingness of students to stay engaged and complete the course [9]. While absolute measurements and specific assessments can be difficult, there are several indicators of the successful creation of an online community that relate directly to constructivist theory. These are active personal communications, interaction with course materials, and collaborative learning where student-to-student interactions dominate [9].

2.2 Collaborative, cooperative learning

In constructivist theory, the trend towards cooperative learning supports the expanded need for students in today's global workforce to work in teams. Students must develop group interaction skills in this learning environment. Several instructional methods for collaborative learning include setting goals and outcomes, role-playing, problem solving, team investigation, and group team building exercises [10]. All of these activities require students to work together, and

the mechanics of this task are not as much of an issue due to many technology solutions and collaboration built into most learning management systems (LMS). However, the challenge is the requirement that students work together even if they have never met, might not ever meet, and potentially come from significantly different backgrounds and cultures.

3 Technology

Technology is a primary enabler in an online educational environment. Technology options include asynchronous discussion boards, email, social media, synchronous chat, wikis, blogs, video, audio, and audio/video conferencing. Many of these technologies are packaged in a commercial LMS, such as Blackboard, and are available in many shareware LMS offerings, such as Moodle. Course designers and instructors need to understand both how and when to integrate these technologies in their practice.

Garrison and Anderson dispelled the myth that technology is merely information transportation and delivery mechanism and can, if utilized correctly, potentially redefine our approach to learning [2]. However, one particular challenge with using technology is the potential lack of planning and coordination of diverse technologies to create a sense of community. One key issue is that instructors may or may not have technical skills and access to tools to enable additional capabilities outside the LMS. In some instances, institutions have policies restricting such exploration of additional methods.

One common technology used to implement and create a sense of community is the online discussion board. Lang and Evans noted the purpose of discussion is to stimulate critical thinking and analysis and to affect student attitudes [10]. There is considerable treatment of discussion boards in the literature that illustrate their place in creating a community. Implemented and managed properly, these communication streams can become the lifeblood and center of energy of the class [6]. Further discussion board best practices include having students discuss relevant experiences in their first posting. Instructors should strive to develop a first discussion post question that is both enticing and intriguing, in which students want to participate and not miss out [6].

One example of technology, which can directly impact community, is synchronous communication. While the timing of student participation varies, the use of synchronous technologies recorded for asynchronous use is possible and may provide substantial benefit. For example, students may develop a sense of community from asynchronous viewing of classmates' synchronous presentations and interaction. At a minimum, students' faces and personalities can be seen and discovered from those interactions. Chat rooms with multiple participants can be used to conduct real-time discussion and foster social interaction between students and the instructor [14]. Directed use of a chat room where teachers initially lead discussion and gradually turn over discussion to students has been shown as the single best tool for creating community [7]. Thus, an integrated approach beyond discussion boards should be considered with each technology assuming a specific role.

When considering the use of technology, sequencing of activities needs to be planned. Instructors and course designers should view technology usage in courses as scaffolding for a community. For example, if all students in a master of business program have extensive experience in video conferencing, this technology might be more appropriate for an icebreaker instead of a more traditional discussion board post. However, if the students are older digital emigrants with little experience in an online environment, discussion boards posts can be a better starting point because of ease of use.

3.1 Social media in online environments

There are many potential technologies available in social media. In online education, an E-Learning classroom is similar to a social network [15]. Tools such as blogs have been used for years, and they can become a personal portfolio, a shared knowledge creation space that extends outside the immediate virtual classroom [15]. The use of tools and technology like this is known as E-Learning 2.0 [15], which is a reference to the more broad Web 2.0, which, among other things, defined the latest World Wide Web iteration as a place where users create their own content, not only visit formally structured sites [16].

The concept of a personal learning environment (PLE) is emerging as a supplement to formal learning traditions and technology found in learning management systems (LMS) [13]. A PLE is composed of a variety of tools including social media that allow a student to create a personal space for their own meaning making to support constructivist pedagogy.

The tools available today are mostly outside the traditional LMS. These are social networking sites such as Facebook and Twitter, Blog sites, Wikis, a variety of photo sharing sites such as Flickr, and video sharing sites such as YouTube and Vimeo. All these sites are free for students and offer a variety of tools, privacy settings to control access, and experiences. Note there is some amount of technical ability students and instructors must have to fully utilize these tools.

The main concern for the integration of social media is access, student usage, and student willingness to participate. Privacy concerns may override a sense of participation where students do not have a Facebook account, do not want teachers to follow them on Twitter, or do not want to participate in a public venue for their learning experiences. In all cases, the inclusion of attitudes and preferences can be integrated into the student profile creation for online instructors to assist in determining their students' desires and attitudes. Institutional policies also must be reviewed, updated, and communicated to ensure privacy issues are observed.

3.2 Integrating technologies into practice

Multiple technologies are also needed because trust, a key component to establishing social relationship in an online environment, is best developed with multiple communication methods [17]. It is important to integrate these communication channels into the course design and assignments. While this may be supported easily in the virtual classroom, students

might still have to be encouraged and instructed both on the mechanics of using a tool as well as when it is appropriate to use the tool.

While it is important to have a written discussion board assignment early in a course [6], it needs to be followed by another event such as a synchronous class meeting to concretely create a sense of community and improve student-student interaction. Community creation and social conversations can fail if no activity is established after the initial icebreakers in a discussion board [17]. Threaded discussions alone do not ensure a course can create a sense of community as students often visit to make a single, required post [7]. This necessitates the examination of many different communication methods and activities in concert with discussion boards. Finally, integration of other technologies to create a sense of community can be found in the advantage of synchronous meetings in the contribution to team building and interactions, including future class interactions [18].

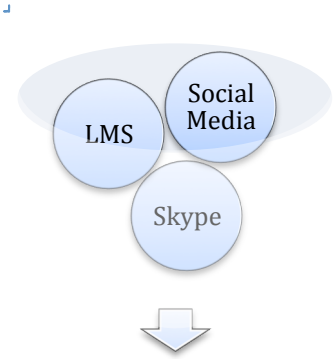

Figure 2: Multiple Technology Types

Valiathan proposed a competency-driven model for corporate training, which breaks down the role of technologies in an ordered and logical fashion [19]. For example, email is used to make assignments for mentors, sharing grades or comments, and resolving questions. Discussions occur in both asynchronous discussion boards and synchronous chat sessions. There is an area for practice and recognition of a space for community development (e.g., forums or Wikis) [19]. While the specifics of this model do not need to be strictly emulated, it is important that a deliberate model be considered for a practice, and it should be reviewed and adjusted for each class.

4 Student Profiles

A factor critical to creating online communities is student profiles. A profile is composed of the student's experience and motivation and is directly linked to the ability for that student to succeed in the online course [20]. Teachers in a face-to-face environment come into contact with their students often. While this does not ensure or necessarily even enhance their knowledge about these students, they do receive visual cues, have the opportunity for informal conversations, and have potential for brief exchanges to learn about their students. Teachers in a distance, virtual class need other methods to develop knowledge about their students. This can be accomplished in the online environment by exploring their students' background and skills in order to provide the best opportunity for learning and transfer.

In a distance environment, student profiles impact both the classroom and interactions. The contribution students can make to a community is that they can become a source of learning themselves [5]. Different pedagogical approaches can be made if the student contribution is taken into account. For example, activities such as a discussion board provide experiential learning, which is amenable for these types of students and their contributions to the overall experience [5]. Multiple intelligence theory informs the need for multiple interactions and teaching methods to support students' varying intelligences [21]. Thus, there is not a single method or approach that provides a best experience or potential for online community, and understanding student profiles can enhance an instructor's effectiveness.

The student profile in an online environment should not be defined simply by the speed of their broadband, browser version, and computer expertise. While these are often important, it is more important to know a student's background in both the subject field and life-experiences. It is also important to learn about the students' desires and goals for the course or larger program if applicable. All these factors lead to a motivation that is critical for participation in creating a sense of community. An instructor must invest the time and use several techniques to determine this information, and then create an aggregation of the student profiles to understand the underpinnings of community development. Information gathering can range from private email communications, discussion board self-introductions, and access to social media sources such as a student's Twitter account or Blog.

One issue for instructors when considering community-building activities is that characteristics of many students that make them good independent students may also contribute to a lack of socializing tendencies. Additionally, many students pursue online education because of the anonymity and lack of face-to-face meeting environments, although this may be less of a factor as online courses expand across the broader education landscape. Instructors can use online tests or surveys for learning styles, discussion board questions, or synchronous activities to obtain this information. Finally, creating student profiles and examining them in a class aggregate will assist instructors in handling issues that might arise during the course, such as learning difficulties or student conflicts.

5 Instructor Role

There is a rich amount of literature on practices for teachers in online educational environments. Explicit recommendations for online educators do typically direct instructors to concentrate on priorities for promoting and developing a sense of community. These consist of, among others, encouraging and fostering student engagement and

empowering students themselves to create the community-building process [9]. Also, it may be more important what instructors ask their students to do than anything they can do themselves [22].

There are unique aspects to teaching in an online environment. Primarily, communications are different in both style and method. The spontaneous verbal and non-verbal cues face-to-face teachers see daily are not available [23]. Clearly, the lean channels of communication and asynchronous nature of online communities present challenges [17]. The instructor must develop, plan, and replace key interactions that achieve the same goals as face-to-face interactions [23]. The creation of a social presence requires many ongoing activities and is not a single effort [2].

Interaction strategies should be considered and reviewed for each incarnation of each class. Instructors can modify the online course to add or remove activities, or offer alternate assignments after the aggregated student profiles are known or if special needs arise for an individual student. Much like a face-to-face classroom, alternatives are important to personalize the learning experience, which improves student performance [6].

In addition to student-centered, constructivist environments, the distance between the instructor and the student should be measured. Distance is meant to be a measurement, somewhat metaphorical, of the distance between the instructor and student in communications and connecting. Instructors need to reduce this transactional distance and build a relationship between themselves and their students. For example, this distance can be reduced if the teacher personalizes approaches used [6]. This requires that the instructors learn more about their students from their profiles and make modifications to the course.

There are three main roles an instructor can assume. First, an instructor can be a passive facilitator, responsive to questions and help, but not be engaged in the class. Second, an instructor can be an active participant with comments on discussions and contributing his or her own materials and opinions. Thirdly, an instructor can take a middle role where participation occurs when needed to create and maintain momentum for community creation.

The role of the instructor as merely a facilitator to an online classroom is not sufficient. The instructor must take an active role in the process of creating and sustaining a sense of community. In order to effectively understand their students' intelligences and learning styles, instructors need to learn as much about the student profile as possible to foster the community. Conversely, a dominant presence can be counter-productive to encouraging conversation and interactions.

Finally, a key aspect to instructor role is behavior modeling. Teacher modeling of a social presence is critical for the establishment of the community [2]. Some teachers view themselves primarily as facilitators and do not participate actively, which may negatively impact student participation particularly at low points in the course.

6 A Practice for Course Designers and Instructors

A community of learning can be described in a theoretical foundation as collaborative interactions, student-centered activities in a social context, student creation of content, and technology. It is important to plan activities in this foundation and sequencing is critical to maximize effectiveness [24]. Course designers and instructors need to understand the total environment of students, course materials and subject, and technology available to determine the proper sequence. For example, one session might need to concentrate on technology first, then socialization, and then pedagogy [24].

The most important task for online instructors is to create, foster, and sustain activities that promote and strengthen student and instructor engagement. This can be accomplished with a practice that contains the following components: 1) selecting the correct pedagogy and appropriate activities, 2) understanding and using multiple technologies with a proper sequencing, 3) learning and using student profiles, and 4) modeling of an active but not dominating instructor. These steps are shown in Figure 3.

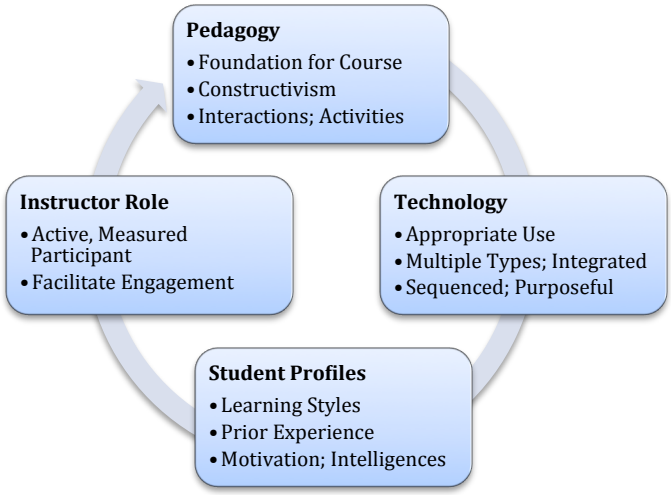

Figure 3: Continuous Steps for a Practice

Selecting the **pedagogy** is important in any educational activity. Learning activities and assessments to support pedagogy and community building should support pedagogy. In the online environment, where the desired pedagogy is often cooperative learning, community-building activities should be focused on building a team and creating an environment where participation flourishes. The three considerations for pedagogy are 1) foundation for course, 2) constructivism, and 3) interactions and activities.

A practice in an online environment must address **technology** planning and execution. Given this context, a critical element of a practice is to create mutual engagement opportunities for the participants [11]. Discussion boards can and should serve as feedback for discovery by the instructor to

better understand a student's profile, learning style, needs, and background. Therefore, an instructor must plan wisely how to maximize multiple modes and communication channels and have an understanding of using multiple technologies with a proper sequencing. If the instructor is not the course designer, then he or she must thoroughly review the course prior to teaching it and investigate technologies available to properly prepare for community activities. The three primary considerations for technology are 1) appropriate use, 2) multiple types, integrated, and 3) sequenced and purposeful.

One critical component of a practice is that it must incorporate a formal understanding of the **student profiles**. These profiles are composed of biographical data and previous education and experiences. Instructors must encourage and require participation to observe and learn students' learning styles and intelligences. The three primary considerations for student profiles are 1) learning styles, 2) prior experiences, and 3) motivation and intelligences.

The **instructor role** is critical for any practice. Today's online instructors need to make the effort to understand their students and continually examine all aspects of the experience that affects their learning [3]. Instructors are not simply cheerleaders or casual observers and assignment graders. They must also model appropriate participation and behavior as a community participant and leader. They do not dominate or even lead conversations or activities, but they must ensure the community thrives and students participate to maximize their learning. The primary considerations for the instructor role are 1) active, measured participation and 2) facilitator of engagement. The main instructor role is to facilitate interactions to enable community and knowledge construction. This final role of the final step is perhaps the single most important part of a practice.

This practice offers recommendations for instructors to create a better sense of community and interaction in an online environment. Teachers in a traditional face-to-face classroom learn about their students and create a positive learning environment with interactions and community. Online instructors should be no different. They also need to be cognizant of the need to create a sense of community for their students. The desired pedagogy, the use of technology, student profiles, and the instructor's role in a practice must be planned, executed, evaluated, and continually improved.

7 Conclusion

Successful teaching and learning occurs best in a healthy community of learning. Instructors can greatly affect the development of this community. However, there do not seem to be standard practices defined to address pedagogy, technology, student profiles, and the instructor's role. Thus, a practice has been described to ensure learning and transfer can be supported with a strong sense of community.

Technology is the primary enabler in an online environment and is now widely available with asynchronous and synchronous options. Instructors need to understand both how and when to use these technologies in a practice. When considering the use of technology, sequencing of activities needs to be planned as well. Instructors and course designers should view technology usage in courses in the same realm as scaffolding for a community.

The role of the instructor as merely a facilitator in an online classroom is not sufficient. A more involved instructor is required to ensure the activities support the desired pedagogy, so the student feels a supportive environment and a sense of belonging. The instructor must take a more active role in the process of creating and sustaining a sense of community. In order to effectively understand students' intelligences and learning styles, instructors need to learn as much about their students' profiles as possible.

The most important task for online instructors is to create and sustain activities that promote and strengthen student and instructor engagement. This can be accomplished with a practice that contains the following components: 1) selecting the correct pedagogy and appropriate activities, 2) understanding and using multiple technologies with a proper sequencing, 3) discovering and using student profiles, and 4) modeling of an active but not dominant instructor. The formality of this practice or a similarly rigorous practice can help instructors create a better sense of community in an online environment.

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Wikipedia: How Instructors Can Use This Technology As A Tool In The Classroom

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Abstract - *Wikipedia is not often seen as an important resource for study, education, and learning. Frequently there is negative connotation linking Wikipedia to student research. Yet the reality of the matter is that Wikipedia is the first site that students frequent when exploring a topic. Wikipedia is the largest encyclopedia (on or off line). It shows up on the first page of a search engine for 99 percent of the searches. And while not 100 percent accurate all of the time it rivals textbooks with its accuracy and surpasses textbooks when it comes to correcting the mistakes. So why is Wikipedia, one of the premier information resources in the world, not being used in the classroom? There is research to support the engagement and the collaborative environment produce by working with wikis. This paper will explore the use of Wikipedia in the classroom as it assists in building relevant e-learning environments.*

Keywords: Online learning, Wikipedia, technology, community, pedagogy, teaching

1 Introduction

"Today we live invested with an electric information environment that is quite as imperceptible to us as water is to a fish" ~Marshall McLuan" [1]

March 13, 2012, Encyclopedia Britannica announced that after 244 years of publication they would no longer be offering a print version set of their compendium [2]. Once considered the authoritative source and an important first stop for students researching and educating themselves on a topic, the printed encyclopedia has become a dated, if not obsolete, reference. Online information repositories have replaced the gold-embossed reference books that had once held a prominent place in the home, the most popular being Wikipedia. This online encyclopedia has become the *go to site* for students and the public in general. Fraught with criticisms by academics on the quality of information Wikipedia still achieves better success on content quality control than most other online content, is the largest encyclopedia in the world (on or off line), offers free access, maintains over 100 thousand contributors, and delivers more than 16 million articles in 260 languages [2].

Instead of criticizing students for looking to Wikipedia when exploring a topic the savvy and innovative educator can use Wikipedia as a tool in the classroom. By having the students create content and contribute work to Wikipedia students can not only understand issue s surrounding producing fair and accurate information but also begin to understand how information is constructed and disseminated and the role technology plays in facilitating the digital network. New initiatives are being introduced where traditional classroom writing assignments instead become Wikipedia article submissions. By creating assignments designed as Wikipedia submissions students are able to hone their critical thinking skills, integrate their technology skills with writing skills, collaboration, further refine their understanding of accurate information on references, and contribute to the general knowledge on a topic and the digital economy.

2 Engaging with technology

Students use Wikipedia more than libraries [2]. Ninety-nine percent of Wikipedia pages rank in Google's top ten search results [2]. It is the 6th most visit site and is available in more than 250 languages [2]. Wikipedia's usage continues to climb annually by 29 percent while current numbers are around 5.7 billion visits per year [2]. Those staggering statistics make it impossible to ignore Wikipedia and certainly make it a source worth exploring for educational purposes. And for the folks that claim Wikipedia is not a credible academic source, in comparison to college level text books, Wikipedia is 98 percent as accurate (and certainly a lot more portable) [2]. Those errors are caught by Wikipedia within hours. The open source nature of Wikipedia allows for those changes to occur quickly [2]. That is not the same for errors found in textbooks. Those errors need to wait for the next edition of the book before they will be repaired. More and more academics are using Wikipedia to check facts and find reference citations of the seminal articles in a particular area of research. Wikipedia can be considered a principally accurate and comprehensive information source.

Engaging with technology in the classroom can motivate students, facilitate learning, appeal to multiple intelligences, and address a variety of learning styles [3]. By engaging in publishing software such as wikis the student is able to contribute information to the content and interact with fellow classmates. Students learn or further refine how to create a

literature review with analysis and criticism offered from a much wider audience than that offered by classroom and teacher. The writing has to be clear and succinct enough to not only be useful to the Wikipedia audience but understandable. The student needs to be able to summarize and fit the information database format. Long winded unnecessary prose is then naturally weeded out. Instead of taking a passive role by just observing the information the student is able to jump in and actively explore, question, edit, and react. The Wikipedia readership plays a vocal and active role with feedback. This forces the student to be ready and able to defend their work.

There is a shift in education moving from lectures and books to various media platforms including mobile technologies, tablets, and other technological supports for digital content. Flipped classrooms, massive open online courses, and other new classroom formats are changing the flow and expectations in how we learn. We can now learn at anytime and anywhere. John Seely Brown, while being interviewed by the MacArthur Foundation on interest-driven learning, reminds educators that much more time is spent outside of the classroom than is spent in it [4]. The key is to "weave together all the naturally occurring resources—libraries, planetariums, museums—so they fit together" [4]. The same can hold true with using Wikipedia. Students are weaving both the course curriculum and their learning within the classroom together with the vast informational tools and collective knowledge on the Internet. Technology becomes the backdrop of the learning that is taking place.

Modern day economic trends, globalization, as well as other factors are mandating the need for significant changes in education. Employers are requiring workers be able to engage with advance technology, collaborate in online environments, problem-solve, and be adaptable. The paradigm shift is pushing education into an uncharted direction [5]. The challenge now is learning the new grammar.

Wikipedia has the potential to become a true game-changer; a disruptive technology. Thornburg says there have only been three disruptions in the history of education: the phonetic alphabet, mass-produced books, and networked computers [6]. Like any disruptive technology it takes time to replace the older technology. Wikipedia is continually evolving and with the dense knowledge base, millions of hyperlinks and intricate patterns Wikipedia is redefining knowledge territories [1]. It is shifting our concept of society, culture, and art in "displays of convolution, multiplicity, and interconnectedness" [1].

3 Wikipedia as a pedagogical tool

"Wikipedia is always present in the classroom—whether it's invited to attend or not." ~Edward Erikson [7]

Wiki technology has been used as a tool for teaching and learning. Known for both the collaborative features and active learning engagement wikis are now considered a valuable tool in online education. Major learning management software systems (e.g. Blackboard) include a wiki tool. Researchers have found that using Wikis as a teaching tool promotes collaborative learning abilities as well as reading and writing skills [8, 9, 10]. Hazari, North, and Moreland looked at the pedagogical value of Wiki technology [11]. Wikipedia is one of the most popular websites and can offer both teachers and students unique opportunities. With new initiatives through Wikipedia's *Wikipedia Education Program*, the digital encyclopedia is in the perfect position to be uses as a teaching tool worldwide [12]. Wikipedia can fundamentally change the classroom culture and create a culture where reflective and innovative practice is valued.

Wikipedia provides students with an inside view of what kinds of things happen in academic discourse. The students learn about scholarship and are given the chance to further explore their topic through actual debate with the scholarly community [4].

3.1 The critical analysis

"But if you open up the history, it's like peering into the backroom of the Britannica. You begin to see the debates, what knowledge is still being contested, what knowledge is stabilized. It's a great source for learning and witnessing competitive argumentation (a limited form of scholarship) in practice." ~John Seely Brown describing Wikipedia [4]

The vast volumes of information generate just by Wikipedia demands the need for information literacy and advanced analytical skills. By becoming a creator of the content the student becomes even more keenly aware of how the content makes it way to the site. Anyone is able to edit an article in Wikipedia. It is the perfect place to teach the tools of critical thinking. Wikipedia has experienced criticism through the years. But it does seem to fill a need. Wikipedia meets the current day mandate of having information at our finger tips immediately when we need it and in the format we want it. Some instructors have banned their students from using Wikipedia. But with thoughtful engagement and taught media literacy students can approach Wikipedia with skilled analysis, extracting critical information and discounting that which is questionable.

Students learn to understand how Wikipedia works and how the edit page provides the historical perspective of how the information on the page has evolved over time. Yes, the tools and approach for using Wikipedia is different than Britannica (the hard copied bound books of the long time published English-language encyclopedia). Wikipedia sometimes requires sleuthing the history pages to see when and how pages have been altered. Or students go to other sites for fact checking to substantiate what they have found on Wikipedia. In other words, students do not assume statements on Wikipedia. They use Wikipedia as a spring board to focusing

and concentrating their efforts. If student does not know anything (or very little) about the topic starting with Wikipedia allows for a baseline in which to formulate questions for a search.

The concern with Britannica and other printed versions of encyclopedias is usually more related to the timeliness of the information—is it current or not? Have facts changed over time? [4]. Where Wikipedia holds strength is in the initial phase of research; when a student is still formulating ideas and coming up with their approach on a topic. Students can find links to seminal articles on the topic, find primary researchers in the field to direct their searches in academic databases, and grasp a general idea of the subject.

Wikipedia does have limitations. Those limitations as well as its strengths as an information source make it fertile ground for fine tuning skills in critical analysis as well as media literacy. Since most of Wikipedia's articles end up on the front page of a Google search (a full 99%) educating students on web search skills and how to discriminate accurate information from erroneous material is critical [13]. Wikipedia is an excellent place to start.

Writing for a Wikipedia entry or addition to an already existing Wikipedia article allows the student to take a look at their work from a different perspective. Instead of an assignment completed to fulfill a requirement and destine exclusively for the eyes of the professor the post becomes a living document with a global audience. The work is no longer the singular effort and manuscript of the student. Others can jump in and edit. A volley of posts can ensue over a particular subtopic or phrase. The student comes to understand controversy, different perspectives surrounding a topic, or definitive research in the field; much more so than they would in a traditionally assigned research paper. Not only does the student become more engaged and immersed in the topic but their work is up for more internal scrutiny. If a student has overlooked something or minimized their efforts in the process it is more readily discernible. For example dead text in Wikipedia, "*this is text w/no citation"*, is an easy and obvious way for both faculty and student to know the work is not complete. The student has not cited their sources. The student learns to be concise in their writing and to link to good sources [14].

The newly refined critical analysis skills developed while working and creating content in Wikipedia can then be used to assess the credibility of websites in general [15]. In this way students come to better understand the technology behind Wikipedia, the inner workings, and how to interact with website technology in general.

Students can go to an article and find the linked references at the bottom of the page. Have the students check the sources for accuracy. Is the source site reliable? Might there be bias? What type of website is it (educational, organizational, a business, a blog)? Have the students follow the information literacy three steps:

1. Find/access/locate
2. Evaluate/discern/judge
3. Use/communicate/produce [16]

With the prevalence of blogs and other self-publishing platforms now more than ever there is a need for means for accessing credibility.

3.2 Publication

Wikis allow the student to openly express their thoughts and opinions while gaining a sense of empowerment. The process for actually posting in Wikipedia is relatively simple. The student creates an account in Wikipedia, selects an article, and then adds their information. This adds to the student's motivation to learn and engage with the material. The Engagement Theory, often touted as the pedagogic structure for technology-based learning, positions meaningful student engagement in learning activities is achieved through interaction with others [17]. Three core elements are essential: collaborative team, project-based, and an authentic focus [17]. Technology facilitates the interaction as the group works on a task.

By getting the students involved in the creation and/or editing of Wikipedia they are completing useful research. They begin to see what is involved in information creation and how sources are checked. They will also see how quickly their publication post to Wikipedia can be edited by another. This learning both immersive and relevant is more likely to have a greater educational impact on the student than the learning exchange that go into the creation of a standard research paper.

One of the biggest complaints against Wikipedia (that anyone can contribute to its pages) ends up being one of the strengths for using posting to Wikipedia as assignment [18]. Students might like the idea of publishing an article. Not only does it provide the student with a novel approach to an assignment but also offers the chance to contribute to the scientific community. By assigning a Wikipedia article or an update/addition to a Wikipedia article students are able to take on a different perspective to research writing and maybe have a little fun in the process. The student can also see how their work goes beyond the classroom impacting and benefitting a much larger global audience. Despite Wikipedia's 16 million articles there are still topics that have not been addressed and/or are in great need of additional research and content [2]. Students can also critique or edit where needed other articles posted on Wikipedia.

There is a freeware visualization program tool associated with Wikipedia. Pathways, a MacOS X software, allows the user to keep track of the paths of links visited on

Wikipedia. Graphical network of nodes are created based on the articles visited [19].

4 Co-Constructing

Using Wikipedia as a repository or posting site for student research writing has already resulted in numerous high quality new articles as well as articles that are substantially improved. Davis, a teacher, classroom technology blogger, and founder of the flat classroom project, has used Wikipedia in her classroom. She instructs her students that "global collaboration is about co-creation" and that today's global economy demands we learn this skill [14]. The successful leaders of the future learn how to create together. Wikipedia is a great tool for refining this skill.

5 The six stages

Hayes breaks online crowd-sourcing into six different categories: Active, blended, lived, trusted, contributed, and co-created [20]. Although Hayes is speaking specifically to transmedia storytelling the concept is still applicable here. The first stage, *active*, participants are relatively passive. They watch but only contribute minimally (use the "like" button to show support). The next stage is the *blended* stage. At this point they take content from the group and work on revisions possibly posting to other sites. They are still focus in a support role and not generating any of their own personal content. The third kind of crowd-sourcing stage is *lived*. At this stage there starts to be more direct engagement with others. Questions are asked and direct contact might be made. The fourth stage is the trusted stage. Participants in the fourth stage are acknowledged by the core group and trusted with important information. Fourth stagers are taken into the trusted circle. The next category, the fifth stage, is the contributed stage. In this level there is engagement in dialogue, contribution on projects, and they are giving and receiving feedback. The final stage is the co-created stage. In this sixth stage it is a "democratic, self-perpetuating, and balanced creation" [20]. Everyone does their job and the end result is a "true blending of talents". Hayes cautions that in reality it is very difficult to reach this stage. Group structure and rules as well as a framework are crucial [20].

The social and community intelligence created through crowdsourcing not only is an emerging research field but also has the capacity to reveal human behavior patterns, social interactions, and community dynamics [21].

6 Collective Intelligence

The terminology collective intelligence is based on the idea that there is a shared and often elevated intelligence that results out of collaboration. In Gestalt like understanding, the collective intelligence is greater than the sum of all of the individual knowledge of the group. There is also an assumption that the collective brainpower takes problem-solving ability of the group to a higher level of complexity and ability. Wikis is a great tool to facilitate online collaboration and the medium ripe to support collective intelligence initiatives. Jenkins agrees noting not only the contribution of the members to the pool of collected knowledge but the pedagogical scaffolding that can occur in the collective online environment [11]. Neal states, "Instructors should consider an integrated approach to creating a sense of community in an online environment" [22].

7 It is all about the connection

Wikipedia consists millions of hyperlinks that weave an intricate pattern. Wikipedia as a network connects a wide diversity of people. This connection facilitates the exploration of cultures and perspectives. The information exchanged as well as the connections formed through Wikipedia fundamentally changes society. For the collaboration on Wikipedia to occur a sense of community needs to exist [23].

Students can observe firsthand how the Wikipedia community interacts with content. As the critical audience edits the students' content a dialogue ensues and often results in an integrative collaborative piece. Pallof and Pratt agree that collaborative activity is valuable tool in digital classroom [23]. They state that student collaboration is particularly important in the online environment because it promotes:

- Development of critical thinking skills
- Co-creation of knowledge and meaning
- Reflection
- Transformative learning [24]

8 Conclusions

Using Wikipedia in the classroom as a learning tool offers a wealth of benefits to the student. The student can further develop their media literacy skills, hone their critical thinking skills, and integrating technology skills with writing skills[1]. Instructors need to not only think about tools to support learning but tools to support community and engagement. Collaboration thrives in communities and cultivates the collective intelligence. Wikipedia is an innovative tool for the classroom and catalyst for community development.

Data collection and access to information is easier than ever. While it is often said that all this information, technology, the Internet, and computers are taking us away "from the physical world and social interaction. Quite the opposite. Computers, through data, visualization and

interfaces can bring us closer—and that is certainly is something to look forward to" [1]. It is time to embrace Wikipedia as an important information provider and one of the innovative learning tools in the educators' toolbox.

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Sophisticated Learning Technologies: Leveling Education for Autism Spectrum Students

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Abstract *- Neuro-Education technologies that teach empathy are powerful evidenced-based interventions targeted for autism spectrum conditions (ASC). Effective technologies improve social competence in students with ASC, and ultimately, their quality of life. Clinical studies show these technologies meet two criteria. First, best-in-class educational and therapeutic interventions are inspired by neuroscience research to address this empathy disability, and at the same time exploit the student's hypersystemizing strengths. Second, best-in-class interventions create learning environments that integrate all three Narrative Game-based Learning Objects (NGBLOs). Specifically, these technologies are steeped in learning, gaming and narrative theories. The first two combine traditional pedagogic methods with state of the art gaming approaches, while the power of story transports students to the world of emotions. The Neuro-Education Empathy-Enhancing Technologies (NEETs) concept is introduced to describe sophisticated interventions. The author calls for further research into NEETs that teach the art and science of empathy.*

Keywords: Autism, empathy, Neuro-Education, imitation, social learning

1 Introduction

Educational visionaries have long predicted the powerful role neuroscience and technology would play to promote social learning at the neural level [1-5]. These scholars called for research into applications that could engage children in collaborative, constructive and interactive learning environments [2, 3]. They envisioned computer-based technologies and behavioral interventions that would effectively address the most pressing learning needs of today's students and tomorrow's workers [5-8]. All students, and particularly those with an empathy disability, must be equipped for group collaboration, interactive engagement, frequent feedback, and real-world, meaningful connections through imitative learning [2-9].

Media psychologists envisioned new learning cultures and outlined several cultural competencies that are required attire for this new participatory culture [2, 3]. The new collaborative learning cultures is where youth are "messing around," "geeking-out," and "hanging-out" in highly participatory spaces- a collective where people belong in order to play along and learn [4]. In order to develop social competence, students must be outfitted with emotion recognition skills, [5, 6, 7]. Today's collaborative workplace demands competencies in the skills of play, performance, simulation, collective intelligence, judgment, transmedia navigation, and negotiation [2, 3].Concurrently, the U.S. Secretary of Education, Arne Duncan, declared the state of education a national public health crisis [4]. At the same time, autism emerged as a major public health concern in the United States and began to tax the educational, medical and social services systems [4]. The state of California funded $34 million for a new research and treatment center for autism called the Medical Investigation of Neurodevelopment Disorders (MIND) Institute [4]. However, these challenges are of great concern to over 80 nations across the globe [10].

In response, the International Mind, Brain, and Education Society has launched several initiatives [4]. So begins the story of the birth of a new research discipline called Neuro-Education. This interdisciplinary approach to learning models the very collaboration required to integrate the collective fields of education, psychology, neuroscience, and cognitive science. The aim is to better understand how we learn and how we can construct better teaching methods, policies and curricula [4].

2 Neuro-Education and Empathy-Enhancing Technologies (NEETs)

This paper will highlight research from the above Neuro-Education disciplines and introduce the concept of Neuro-Education and Empathy-Enhancing Technologies (NEETs). These educational and clinical interventions are specially designed to teach empathy skills to children known to be neurologically impaired in social competence, namely those diagnosed with autism spectrum conditions (ASC) [7-10]. The author argues that scientifically sophisticated interventions meet the NEETs best-in-class criteria when they are inspired by Neuro-Education research, and when the technology's design incorporates all three of the Narrative Game-based Learning Objects recently introduced in the Technology-Enhanced Learning field [4-6]. Specifically, NEET interventions are steeped in gaming, learning and narrative theories [7-11].

Although there is no shortage of nifty applications for individuals with ASC, there is a paucity of theoretically sound, empirically tested and purpose written solutions marketed specifically for empathy education in populations with ASC [12]. Neuro-Education interventions are designed with a solid foundation in all three of the NGLOBs [11]. Specifically, the NGLOBs map to the three effective approaches that teach social skills to youth with ASC.

The three domains are first, storytelling, or the use of stories as instruments for suspenseful knowledge transfer. The second domain is the use of game theory and gaming, or providing a playful learning environment where interaction and exploration are dominant. The third critical domain is learning, here knowledge transfer is reinforced with pedagogical assessments of learning success, and include reward systems and intrinsic motivational systems to engage players [11]. At the end of the yellow-brick lesson plan, NEETs provide evidence-based learning outcomes with improved emotion recognition and social competence [7-10].

2.1 Testosterone trouble

Many psychiatric conditions are identified more frequently in males that females. These include attention deficit hyperactivity disorder (ADHD), early onset persistent anti-social behavior, specific language impairment, dyslexia, and autism [14]. More boys than girls have pervasive developmental disorders that land along the autism spectrum disorders. Anorexia, depression and anxiety disorders don't share a male bias, causing researchers to explore sex-limiting factors behind sexually dimorphic aspects of cognition and behavior [14]. Specifically, the "extreme male brain" (EMB) theory of autism proposes an etiology of specific sexually dimorphic traits fueling a stronger drive to systemize, rather than empathize [10]. It expands the empathizing-systemizing (E-S) theory originally described by Hans Asperger. The empathizing-systemizing (E-S) theory of autism, identifies typical psychological sex differences [10]. And hypothesizes that females on average have a greater tendency to empathize (or relate to other's feelings, and to respond empathically with a socially appropriate behavior) in contrast to a stronger male drive to systemize (analyze or create rule-based systems, abstract or literal). Scientists do not have conclusive evidence about whether it is environmental, hormonal or genetic factors are behind the higher male incidence of ASC. However, recent research supports evidence arguing that prenatal exposure to testosterone might be related to later development of autistic, or "extreme male brain" traits [9,10,14].

2.2 The problem of empathy

The autism spectrum conditions (ASC) are neurodevelopmental disorders recognized by severe social communication problems, "obsessions" or an extremely narrow range of interests, along with the need for sameness, and repetitious behaviors [6-10]. As a neurological condition identifiable in infants, autism symptoms vary tremendously along a wide spectrum of clinical severity. What stands out behaviorally are the socio-emotional and communication deficits, with a particularly palpable absence of empathy [8-10]. Hence, the ASC fall under the umbrella of "empathy disabilities" [6,9,10].

Since the macro ability to empathize is underpinned by micro skills such as emotion recognition, individuals with ASC are also recognized by severely impaired social communication and emotional abilities. All along the empathy bell curve, this empathy disability presents itself every where a toddler turns [6-10]. These kids struggle in three domains: social, communication, play and imagination. Cognitively, they tend to have rigid and narrow interests or "obsessions." For the higher functioning individuals with ASC, such as with Asperger's Syndrome, this is typically in the very lawful or highly systemized academic domains like math, all the sciences, physics and technology [13].

3 Sophisticated technologies

What is meant by "sophisticated technologies?" NEETs are psychologically and neuroscience sophisticated technologies designed for students with ASC. They are not merely cool gadgets and nifty applications. These are carefully designed products grounded robust theory and years of research that meet the NEETs criteria outlined in this paper. Designers will have operated from the Narrative Game-Based Learning Objects (NGBLOs) approach.

The NEETs are Neuro- Education inspired and gaming, learning and narrative theory steeped. The game theory helps engage the student with things they like best, and motivates them to improve their level of expertise. The power of narrative transports students to a world of emotion. They will author stories or act them out, or have their robotic pet act them out, or they will read them or view them- via any media that can captivate the learner story. Specifically, the intervention's story line transports ASC students to the emotional world of faces, friends and feelings [7-10,14].

In addition, sophisticated NEETs, will teach students about the causes and consequences of feelings [9]. Finally, effective solutions propose clear learning objectives that are targeted specifically for an ASC population. In other words, these are educational and clinical interventions that teach empathy and improve an individual's mind reading, emotion recognition skills and emotional intelligence, or Empathy Quotient (EQ) [7-10,14].

The manufacturer should clearly identify which of the 412 emotions are taught. For example in *The Transporters DVD*, 15 specific basic and "intermediate" complex emotions are taught. If schools, hospitals, pre-schools and day care centers have screened it and use it as a therapeutic intervention, or the solution has won reputable awards, these are additional indicators of an effective and evidence-based intervention. For example the animated series The Transporters was nominated for a BAFTA in the Children's Awards Category in November of 2007 [14].

3.1 PETS

Researchers from the Advanced Computer Studies at the University of Maryland partner with children as their fellow researchers and have published fascinating results. They used a methodology called cooperative inquiry alongside of their authoring application (story telling environment) called PETS [15]. They use an interactive robotic pet as a story-telling platform to teach emotion recognition and appropriate expression. PETS stands for a Personal Electronic Teller of Stories, and is a robotic story telling environment designed for elementary school age children.

Each PETS kit holds a box of fuzzy stuffed-animal parts and the My Pets software, a variety of methodologies for story construction [15]. The application includes a robotic companion, a library of story starters, and all the parts needed to build a robotic animal or pet. PETS1 was the first intergenerational design team to partner with children who assisted in the design of the robot. PETS is an innovative educational technology designed for typically developing elementary aged children. It seeks to inspire collaborative learning and narrative skills. This authoring application is best described with a compelling example of the story written by a seven year old child [15]. The title is *Michelle*:

"There once was a robot named Michelle. She was new in the neighborhood. She was HAPPY when she first came, thinking she would make friends. But it was the opposite. Other robots threw rocks and stick. She was SAD. Now no one liked her. One day she was walking down a street, a huge busy one, when another robot named Rob came up and asked if she wanted to have a friend. She was SCARED at first but then realized that she was HAPPY. The other robots were ANGRY but knew that they had learned their lesson. Michelle and Rob lived HAPPILY ever after. No one noticed the dents from rocks that stayed on Michelle." [15].

This narrative illustrates the immense power of story to teach and transport students to the world of emotion where sometimes feelings and change make the world a huge scary place full of uncomfortable feelings.

3.2 The Transporters

The Transporters is a multi-media animated broadcast series was specially created for children with ASC who have trouble reading faces, feelings and making friends [9]. It was supported with funding from the UK government and designed by a team of clinical psychologists, film and technology experts. Professor Simon Baron-Cohen, the Director of the Autism Research Centre at the University of Cambridge, is one of the experts who was involved in establishing the educational goals of *The Transporters* intervention [9]. These include: to familiarize children with the human face and increase the amount of time that they spend observing faces; to introduce children to emotional concepts; to teach that emotions have causes and consequences; and to illustrate diversity in the way characters react differently to the same situation. In terms of the NGBLOs, and NEET criteria, *The Transporters* has traditional pedagogical assessment tools, including quizzes after each episode and a detailed guide and discussion book parents can use to reinforce learning. Gaming rewards are built into the program when a child answers a question correctly. If the question is answered incorrectly, the narrator asks the question again until the correct answer is given. There are also gaming levels built in for an easy or hard quiz. The DVD utilizes storytelling to teach learning objectives design to help the children identify the causes of certain feelings [9].

In one study, s group of children with ASC watched the DVD for one month, for at least 15 minutes a day. During that short time, the researchers found evidence that the children made significant progress in expanding their emotion recognition skills. This same group also "caught-up" with typically developing children. Also, there is evidence this intervention teaches emotion recognition in such a way that children do generalize the learning to other faces in their real world, besides just the faces of the trams and trains.

ASC kids are enthralled with vehicles, because they move predictably. They don't move unexpectedly off schedule, and for no apparent reason, particularly trams and trains. The opposite of faces and feelings and friends. The strategy was to engage children with ASC and help them learn about emotions, as one of the fundamental precursors to developing the ability to empathize.

For kids who do not naturally prefer to look at faces (they move unpredictably), *The Transporters* creates a learning environment where real faces are "grafted" on to cool vehicles. Suddenly, real faces become interesting through 8 friendly characters. The primary aim of the designers is to help children (even those without autism) to learn to recognize the causes and consequences of emotional expressions. Although scientists have identified 412 complex emotions we grown-ups are supposed to know, *The Transporters* limits the selection by focusing on teaching the main 15. These include: (alright pop quiz, quick, close your eyes and name at least ten to win fabulous prizes): afraid, angry, ashamed, happy, sad, excited, disgusted, jealous, joking, kind, proud, sorry, surprised, tired, and unfriendly.

Infants and toddlers who grow-up with the neurodevelopmental challenges of ASC, are believed to be about 1% of the population in the UK [14]. They begin life with severe social difficulties that are disabling, and we know that social competence level predicts the eventual quality of life for individuals with ASC. As early as pre-school they lose friends in the sandbox, they get kicked off the bus in middle school and by high school they are expelled from the conventional classroom. Hence, an early detection and public health education approach to ASC is the only one that really makes sense.

The important conclusion is that emotion recognition difficulties found in ASC are not insurmountable, particularly when there are NEET interventions available like those discussed in this paper. Until the United States government

funds such interventions for families with toddlers, academic and health care institutions may want to consider placing these tools in the waiting rooms and hands of mental health professionals, teachers, parents, pediatricians, residential treatment centers and psychiatric hospitals. While Americans quibble about the prevalence rates of ASC here in the states, should we not consider even a temporary borrowing of these evidence-based tools in the interim and capitalize on interventions like *The Transporters*?

The research indicates these are powerful empathy teaching tools designed to help vulnerable children and families get transported safely to our big, busy world of emotions. Charlie, Sally, Jennie, Barney, William, Oliver, Dan and Nigel are waiting [9, 10]. These friendly faces truly make learning feelings fun. Seriously.

3.3 Mind Reading

Teaching empathy, and its prerequisite skill-emotion recognition, certainly is not an exact science. However, scientists have done their homework. They have developed taxonomy of 412 complex emotions and identified 24 groups or families of emotions that are universal across the world [8,16]. Their mission was to scientifically explore the best approaches to teach emotion recognition to individuals with ASC.

These "emotion experts" have identified the "look" and "feel" of the "top 100" complex emotions, as well as the six basic emotions. They have integrated the long-term research from the field of Technology-enhanced Learning and incorporated the three critical domains required for any successful educational project. Namely, *Mind Reading* uses story-telling, gaming and learning theories to motivate and engage students with ASC [8,16]. For example, the Game Zone offers 5 interactive games for just plain fun. It includes a variety of "collectables" to earn as rewards and build a collection of various items. This capitalizes on the strong systemizing drive in the ASC brain, the typical "obsession" with a narrow and limited range of interests [8,10,14,16]. *Mind Reading*, is an interactive guide to emotions that contains brief film clips, photos and audio recordings of 412 distinct human emotions. [8,10,16].

This taxonomy of emotions bundles our extremely wide range of feelings into 24 "families of emotions," such as the Angry Group, the Sad Group, and the Happy Group, etc. In the game zone section of this software there are six different levels that distinguish each emotion according to when it is typically recognized whether in early childhood (Level 1), or developmentally in between (Levels 2, 3, and 4), or adulthood (Levels 5 and 6). Cambridge University researchers conducted follow-up studies with adults with Asperger's Syndrome (considered on the high-function end of the autism spectrum). The study participants who used the DVD for two hours a week for 10 weeks improved their emotion recognition skills, vocabulary and assessment scores [9,10,14].

This clinically tested digital education game (DEG) creates a learning environment specifically designed for teaching emotion recognition skills. *Mind Reading* has been studied by researchers to see if the learning could generalize to their real world settings with improved behaviors [8,10,14]. La Cava and colleagues evaluated the effects of this computer-based training on 4 boys with high-function ASC, aged 7 to 10 years. Like the adults, the boys used the computer program for 10 weeks, and they were also provided guidance by a tutor. These children showed improvements not only in their emotion recognition assessment scores, but also in their day-to- day interactions with peers. However in this line of research, the researchers need to conduct further studies to evaluate the unique contributions of the *Mind Reading* program and the interactions of the intervention in conjunction with tutor-aided training [8, 14].

3.4 Robota

Applying assistive technologies in behavioral studies has helped enhance the educational development of children with impaired communication and social cognition skills [10,17-19]. The Robota robots look like a human infant and have been used in studies to investigate their ability to assess children's imitation learning skills. Also, researchers are exploring the ability of Robota to teach low-functioning children with autism simple coordination behaviors that reinforce learning via the imitation play game.

The emphasis of Robota as both an educational and therapeutic medium has long-term clinical research that informs the design and use of robots for the rehabilitation of children with ASC. *Robota* has been included in longitudinal studies, conducted at the Hospital of La Salpetriere and the University Pierre et Marie Curie, that investigate the use of predictive interactive machines as a means to elicit imitative behaviors in children with autism [17,18].

Robota dolls are humanoid robots. They were developed as interactive media toys, learning environments and rehabilitation applications-all part of project AURORA (AUtonomous RObotic Platform as a Remedial tool for children with Autism). Robota and similar autonomous mobile robots are designed for remedial use to encourage children with autism to practice and increase the important pre-requisite skills to social behaviors [17,18,19]

For example, infants with autism exhibit less eye-contact, joint attention, approach and imitation games. Robots used in non-verbal children with autism showed delight and preference for interacting socially with robots in comparison to interacting with their peers and care givers [17,18,19]. The research indicates that use of robot-assisted therapies for children with ASC will stimulate the frequency and types of pro-social behaviors more so than other interventions. To date, these studies have revealed that children with autism, even those who are nonverbal and who have cognitive delays, are able to spontaneously imitate simple, as well as complex and novel sets of coordinated actions. Moreover, several of these children are capable of recognizing that they are being imitated and use this observation as a means of communicating with others, while the longitudinal studies

aim at exploiting these elementary skills to help a child learn the causal relationship of his/her actions on others' behavior [17,18,19]. Robot –assisted autism therapy has been encouraging as researchers have observed that children with autism exhibit some specific positive and social behaviors that they exhibit when interacting with robots, however not when they are engaging with peers, caregivers, and their therapists [17,18,19].

3.5 LEGO Therapy

One final intervention that meets the NEET criteria for showing a strong research base documenting its effectiveness is LEGO play therapy [20, 21]. ASC kids are very attracted to 100% lawful systems, including building materials such as LEGO [8, 10, 20, 21]. LEGO is a very predictable and highly structured toy that children with ASC really enjoy. Therefore, it consistently motivates and engages children with ASC to learn the LEGO club rules, level up, and learn their empathy education lessons.

Group and individual narratives are experienced with game-based reinforcers and specific learning objectives that clearly aim to improve their social competence. This is literal practice growing those neural circuits involved in joint attention, collaboration, impulse control and emotional regulation. Through imitative learning, they are likely growing their mirror neuron social learning circuits [6,7,10, 20, 21]. Long-term follow-up studies of LEGO play therapy document three fascinating findings [20, 21].

The first is that children with ASC do improve their social competence significantly compared to a no intervention group. Specifically, the scientists measure increases in the frequency with which they initiate social interactions, and the duration with which they maintain any social interactions. Secondly, this is one of the few interventions identified in the ASC literature with strong evidence that the empathy education generalizes beyond the lab and out to the play ground and lives of the participants. Historically, achieving generalization of learning or knowledge transfer into the real world of these kids has been problematic.

The third important finding from long-term LEGO therapy research is particularly powerful [20, 21]. The generalization of learning mentioned earlier is measurable when ASC children decrease and replace their maladaptive behaviors with those that are more socially appropriate and relationship enhancing. The maladaptive behaviors that shift fall in the social difficulties domain. Lack of reciprocity (no turn taking, no dialogue, just monologue), difficulty reading other people's emotional expressions via faces, voices and posture, atypical eye contact (either staring too long and invading your personal space or little to no eye contact), and difficulty mind reading (understanding or empathy for someone else may feel), temper tantrums, teasing or bullying, showing lack of respect, lying, cheating, stealing, defiant or extremely negativistic, and too physically aggressive [10, 20, 21].

Historian Lynn Hunt proposes that the amount of empathy a culture embraces changes with time. Cultures have not always valued empathy [22]. Hunt argues that as the 17th century French people became engrossed in the new media of their time, like the popular novels *Julia* and *Clarissa,* their brains changed chemically. Gradually, as readers were transported by stories of women who strove for autonomy, Hunt believes, and neuroscience supports this hypotheses, that stories changed their brains. This in turn resulted in the growth of empathic perspectives and eventually the 18th century birth of human rights. If Hunt is correct, then this is not the first time in human history that technology and narrative found the perfect dance partner in empathy, and changed us for the better.

4 Conclusion

Educators in a position to purchase tools that meet criteria for NEET can draw on the wisdom gleaned by researchers in the field of Neuro-Education. To identify sophisticated NEET, three questions need to be answered in the affirmative. First, does the science the Neuro-Education purview: is the product built on good brain science? Second, best in class interventions are those where the designers designed the tool to capitalize on the power of story, as well as the latest gaming and learning theories, which includes assessment of knowledge mastery. In particular the intervention outlines a clear learning object to enhance empathy such as with increased emotional vocabulary.

Ultimately, these interventions are built on years of research. They are designed to provide individuals with AS practice collaboration, improve social competence. Ultimately, the intervention will help them grow and stretch their empathy brain circuits. Affective computing, cognitive neuroscience, biomedicine, clinical behavioral science studies, and robotics are some of the academic domains with dedicated research centers and teams leading this research.

By now, best-in-class have long-term studies to back their findings. They have been tested on real children and families who live with the chronic and severe stress of this pervasive social and behavioral challenge. Desperate and tired parents are vulnerable to the latest "hype." Therefore, it is crucial to consult with international or national autism research organizations as well as the professional literature to identify any scientific evidence of effectiveness [8].

Educational technologies that teach empathy are pivotal to evidence -based interventions that target autism spectrum conditions (ASC). This paper has argued that the most sophisticated interventions are those that effectively improve socio-emotional cognition in individuals with ASC. These technologies will meet two important criteria. First, they are inspired by Neuro-Education disciplines in order to address the neural bases of a student's hypo-empathizing, or hypersystemizing tendencies. Second, best-in-class interventions create a learning environment that integrates each of the three NGBLOs. Specifically, they are steeped in learning, gaming and narrative theories. The first two combine traditional pedagogic (assessment) methods with state of the

art gaming approaches. Storytelling approach transports the learner to the world of meaning and emotion. Since social competence predicts academic success and ultimately the quality of life for students with this empathy disability, there is an urgent need for further research and development of these sophisticated technologies that promise to teach us the art and science of empathy.

Conflict of interest statement
The author has no conflicting interests with any persons, products, organizations or interventions discussed in this paper.

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SESSION

NOVEL ALGORITHMS AND APPLICATIONS: E-LEARNING, E-BUSINESS, EIS, AND E-GOVERNMENT

Chair(s)

Prof. Hamid R. Arabnia

A Study on Internet Communication Anonymity using Crowds and Onion Routing

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Abstract - *The internet community is changing and evolving as most of the world comes on-line. Encryption only conceals the information that is being said but not who is talking to whom. Compromised computers on the internet will be able to track all communication passing through it. This information alone can be used to one's advantage or disadvantage. Today onion routing and crowds are the most commonly used anonymous communication networks in order to avoid these problems. They protect the users from threats on the internet like timing attacks, eavesdroppers, malicious collaborators and cookies. In this paper, routing and crowds will be explained and their performance will be analyzed. A survey was conducted to gain insight as to which of these two networks provide better protection against the aforementioned threats. Based on the responses received from this survey, we have concluded that onion routing outperforms crowds in preventing various threats, and users prefer using onion routing over crowds.*

Keywords: onion routing, crowds, anonymity, Internet, networks

1 Introduction

Use of the internet is growing very rapidly and so are cyber criminals. There are many kinds of businesses and activities that depend on the internet for their daily transactions. During these transactions, there is a need to exchange personal information; users have to be very careful while revealing their information because it is possible for an observer to track their online transaction and grab the required personal information. Due to these threats, reliable communication on the internet is very desirable. Even if the message as encrypted, the eavesdroppers can gather information about the IP addresses of the sender and receivers systems. It is also possible to collect information regarding the size of the message that is being exchanged and the time taken to exchange the message. Encryption alone does not completely provide privacy to the users.

Anonymous communications [12] prevents all of these threats and are very useful when users don't wish to reveal their identity. Onion routing and crowds are two of the anonymous protocols which allow anonymous communication between the sender and the receiver. We will discuss how these two anonymous protocols work, in which aspects they can provide anonymity, and also the degree to which they can provide anonymity to the sender and the receiver. The features and aspects in which these protocols provide anonymity will be explained and compared in detailed to get a better idea as to which of these two protocols is better.

2 Background Study

2.1 Anonymous Communication Tools

2.1.1 Crowds

Crowds had undergone much research. Crowds, designed by Aviel D. Rubin and Michael K. Reiter [6], introduced the concept of blending members or users into the crowds of computers. It is designed to keep the communication among the users private by routing them randomly among similar users. However, crowds have some drawbacks which were discussed by Reiter and Rubin [5] and also by Wright, Adler and Levine [14]. In 1998, an attack was discussed about the crowds in which powerful attackers can degrade the anonymity of a paper by Reiter and Rubin. A similar attack was described by Syverson [9] for onion routing. Similarly, the protocol for crowds over the internet is described by Clay Shiels and Brian Neil Levine [13]. Later in 2002 the degree to which crowds can provide anonymity to communications over internet is measured by Diaz, Seys, Claessens and Bart [15]. A paper by Wright, Adler Levine and Shiels describes how anonymity can be degraded due to the attacks of corrupt members published a paper called An Analysis of the degradation of Anonymous protocols [16].

2.1.2 Onion Routing

Onion routing was developed by Michael G. Reed, Paul F. Syverson, and David M. Goldschlag[15]. Later, an implementation of the onion routing was developed, which works by relaying all the communications on a network of systems [16]. An IO-automata model for onion routing was discussed by Feigenbaum, Johnson, Syverson [8], while Reed, Syverson, and Goldschlag described how onion routing worked in bidirectional and how the connection were established in Anonymous connections and onion routing [13]. Syverson, Tsudik, Reed and Landwehr made an analysis on security of onion routing and also described the current security goals of onion routing security [2]. Later, Chaum

described how communication through emails can be sent without being traced or revealing the identity of sender and receiver [4].

Many works were completed regarding onion routing and crowds and the issues related to providing anonymity by these protocols. This paper focuses primarily on distinguishing the issues related to providing anonymity and the degree to which it is by crowds and onion routing.

2.2 Anonymity Threats

Threats to a user's anonymity on the Internet are numerous, however, a few primary concerns exist. Timing attacks occur when the time taken to execute a program can be estimated by the attacker. Time taken is directly proportionate to the size of the input. So when an attacker can estimate the time for a message to be transmitted from sender to receiver, the attacker can estimate the size of the input which can eventually lead to the revelation of the message content. Timing attacks can also lead to the estimation of the initiator; if the time taken to send a message is really short then the initiator would probably be one of the receiver's predecessors. An eavesdropper is an attacker who listen to others conversation without their knowledge. In these networks, if a member becomes compromised he/she will listen to other member's conversation in a group. Even if the eavesdroppers fail to get the message, they can manage to get the internet protocols address of the sender and receiver. Malicious collaborators are the collaborators of the group which are compromised and find the path of the servers and through which path the message has been transmitted. They cannot find the address of the receiver or sender and cookies are used for authentication.

3 Crowds and Onion Routing

3.1 How Crowds Work

Crowds is an anonymous protocol which can hide the source of the message, ie, the initiator. In the crowds network, the users collaborate together so that the request to the server could be made from any of the users in the crowds. Users who wish to remain anonymous run a special proxy to strip information from the rest of the users and a jondo [5], by which the users are represented on their computers. The initiator of the request knows a symmetric key that exists between the initiator and every jondo. The proxy creates a connection to the local jondo for forwarding a request to it. The jondo on that machine forwards the request to another jondo, which is randomly selected by the hip-hop process. Generally, a jondo will have no idea about the initiator of the request. For transmitting the request, the initiator sends a packet containing a random path ID and the IP address of the responder and then the request is encrypted using a key which is shared by the next selected jondo.

The users receiving the path with new ID decides whether to send the request to the next selected jondo or to the responder based on the probability of forwarding. When the packet of the request reaches the responder, it gives a reply and the reply packet is sent to the initiator in the same path. In

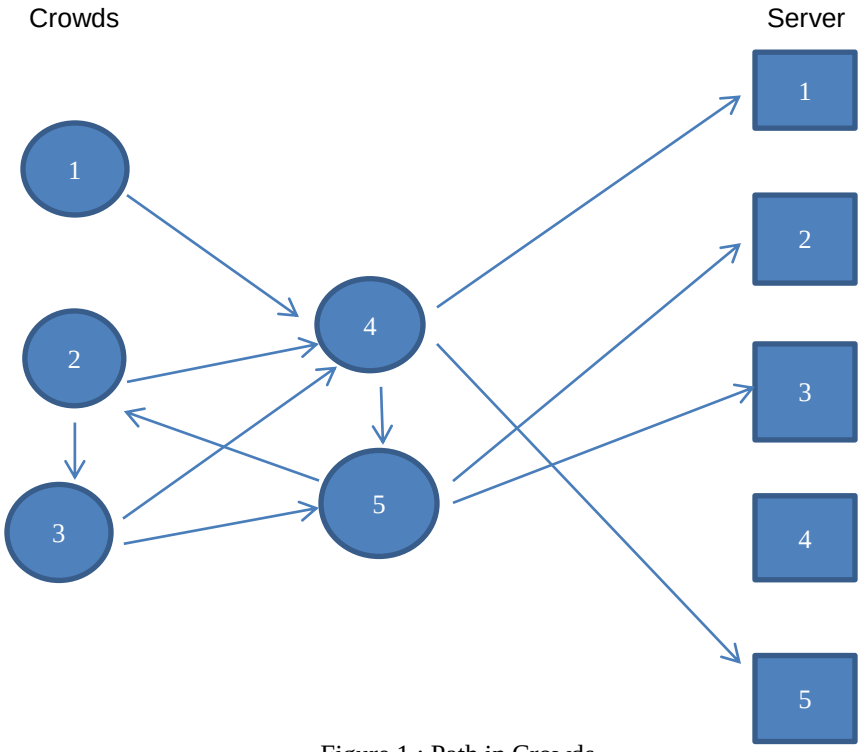

Figure 1 : Path in Crowds

order to have an uninterrupted communication between the jondos, coordination is required between them. This coordination will be provided by the blender, which is a single server responsible for the management of the users.

The user starts the jondo on a local machine [3]. An automatic procedure is triggered then so that the local jondo is informed about the current members in the crowds and vice versa. If this process is successful, then the newly joined jondo can send a request to the web servers and its identity is not revealed either to the server or to the other members. In crowds, each request is transmitted from the user's browser to the final server through the jondos. To assign the next jondo for the path, the jondos will have a set which contains a list of all jondos including itself. The jondo will select one of the jondos in the set in random order. Figure 1 explains how the path is taken, which in this figure are 1 -> 4 -> server, 2 ->4 -> 5 -> server, 3 -> 5 -> server, 5 -> 2 -> 3 -> 4 -> server. In the crowds protocol the request will not be changed during all the hops of the path, so the jondos will not know whether its predecessor jondo initiated the request or just forwarded it. Subsequent requests generated by the same jondo follow the same path and the server's reply is forwarded along the same path in the reverse. When the originating jondo received the message the information is delivered to the browser. The path will be modified only if the jondos fail or if new jondos join the group.

3.2 How Onion Routing Works

An onion routing network is connected through a series of proxies that communicate with encrypted channels that transmit the request to the responder. A series of encrypted layers contain the request, these layers are stripped away along the path to the responders at the proxies. The initiator of the request sends the request by selecting a path via the other onion routers to the responder. Along the path for each onion router, a layer of connection setup packet, which have IP addresses and the encryption key of the next onion router, is built by the initiator. The inner layer contains the data and the responder ID [2]. All of the outer layers have to be decrypted for reaching the data and the responder's ID. As each router gets the packet, it strips away a layer from the onion by decrypting it with its key; decrypting the layer will uncover the routing instructions for that router and the encrypted instructions for the rest of the routers in the path. When the packet leaves the router, it strips away a layer using its symmetric key so that it is not recognizable as the same packet. The last router strips away the last layer and forwards the packet to the responder. The initiator requests are forwarded along the same route of onion routers. The initiator must generate a response onion and forward it along with the request, and the responder then stores the reply in this onion and encrypts it. The response is sent to the last router along the route, which will forward the data in the same path in the reverse order of the initiator.

Anonymous connections that are built via onion routing are mixes [4]. Mixes are more like store and forward machines, which accept constant length messages from various sources. After receiving the messages, cryptographic transformations will be done on them and then will be forwarded to the next destination.

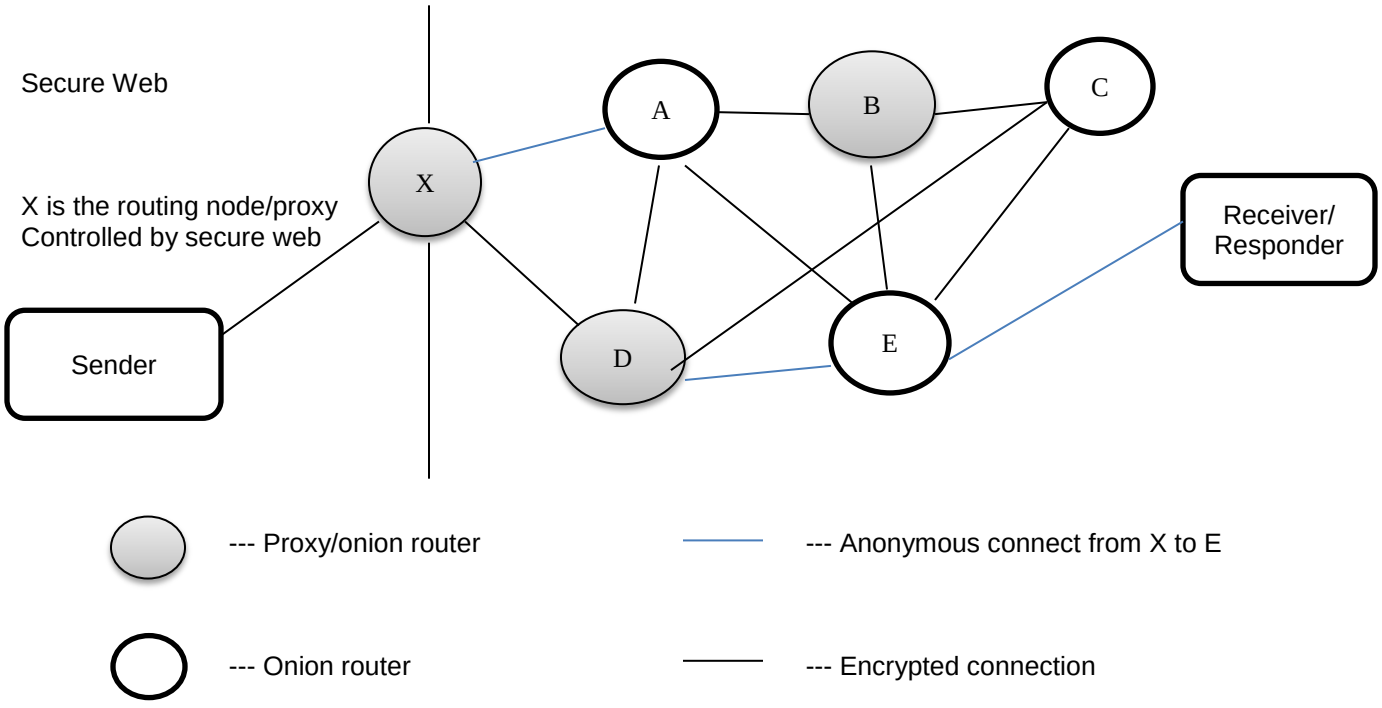

Figure 2 : Onion Routing Network

Bit patterns or the size of the messages will be used by the mixes to track that message. Since routing takes place among a large number of mixes in the networks, identifying the sender and the receiver is challenging. The messages could be stored for various amounts of time waiting for enough messages to be mixed together by the mixers. Core onion router is developed to forward the data in real time, which checks mixing. Large amounts of traffic will be able to advance the protection of real time mixes.

4 Research Objectives

1) The first objective of our paper is to compare the degree to which Onion routing and Crowds provide protection against threats like malicious collaborators, eavesdropping, timing attacks, and cookies.
2) The second objective of our paper is to determine which of these two products is most preferred by customers and why.

5 Method

In order to achieve the first objective of our paper, i.e., to determine the degree of threats that occur in onion routing and crowds, we developed a survey to be completed by qualified individuals. We selected four dangerous threats that play a crucial role in the performance of crowds and onion routing, and they include: malicious collaborators, eavesdropping, cookies and timing attacks. The survey we created can be found in the following link:

http://www.surveymonkey.com/s/W7LZQ79.

This survey was given to graduate students from various universities with technical and computer backgrounds, and was also given to software and computer professionals working for various organizations. We managed to get their emails with the help of student organization of their respective universities and company websites. The survey can be seen in figure 3.

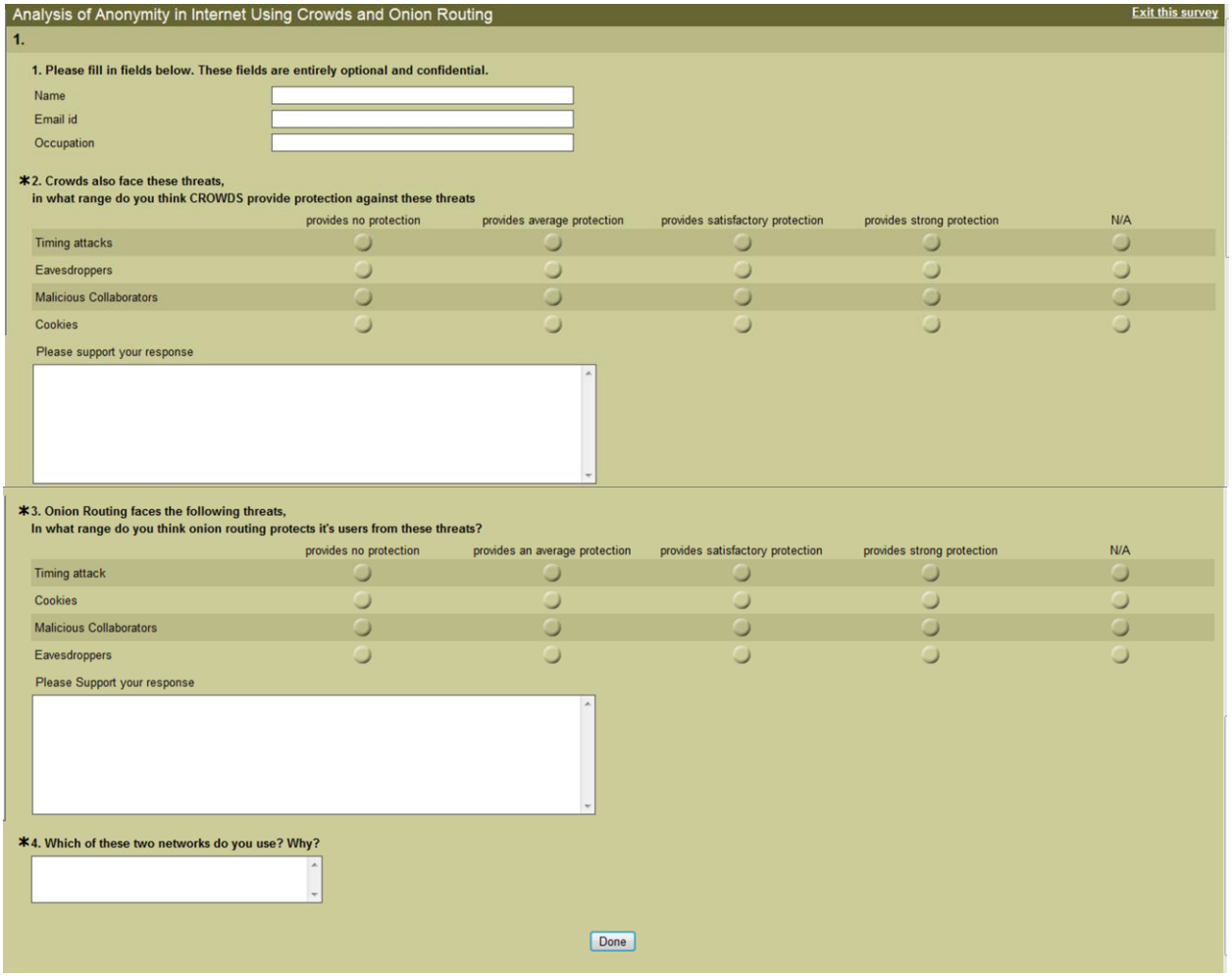

Figure 3 : Online Survey

6 Empirical Study

In order to investigate which tool is most preferred by users, and the reasons that lay behind this preference, the following research questions will be answered:

RQ1: How effective are the Anonymous Communication Protocols? This question is answered by considering the protection provided by them; by avoiding four threats like malicious collaborators, timing attacks, cookies, eavesdropping.

RQ2: Which tool is best suited for users? This question is based on the occupation of the users. Based on their occupations, the degree of usage and the complexity that can be determined.

6.1 Variables and Metrics

The two variables used in this study for comparison is onion routing and crowds, while the metrics used for comparison are timing attacks, malicious collaborators, cookies and eavesdroppers.

6.2 Survey Pattern

We created a survey which contains a questionnaire about the products. Figure 3 is the image of the survey that was sent to different institutions and organizations. We have sent emails to different institutions and organizations such as Eastern Michigan University (U.S.A), Central Michigan University (U.S.A), George Mansion University (U.S.A), University of Kentucky (U.S.A), MVP Health Care (U.S.A), University of California (U.S.A), University of Idaho (U.S.A), Southern Illinois University (U.S.A), and International Business Machines(IBM) (U.S.A).

6.3 Survey Pattern

The research objective of this paper was obtained by analyzing the responses that were collected after sending the survey to these universities and companies. Based on the results, we compared the degree to which these networks will provide protection against the threats, malicious collaborators, cookies, eavesdroppers, and timing attacks. In our results, we will discuss how we determined which tool is better based on the responses we received. We will also discuss which network is most preferred by the users and why. It is also possible to analyze the data to determine if any improvements are required for the networks. We will represent all the results obtained in a graphical form.

The analysis of the networks is based primarily on how they face one of the eavesdropping, timing attacks, malicious collaborators, cookies threats. The reason for choosing these threats is because all these threats play a vital role in the performance of the networks and to provide protection to the users.

7 Results

Based on the 61 responses to our survey, our research concluded that onion routing is best for providing privacy to the users when compared to crowds, based on survey analysis. The following is a graph that explains the range of protection provided by these networks. The difference in the range demonstrates the superiority of one network over the other.

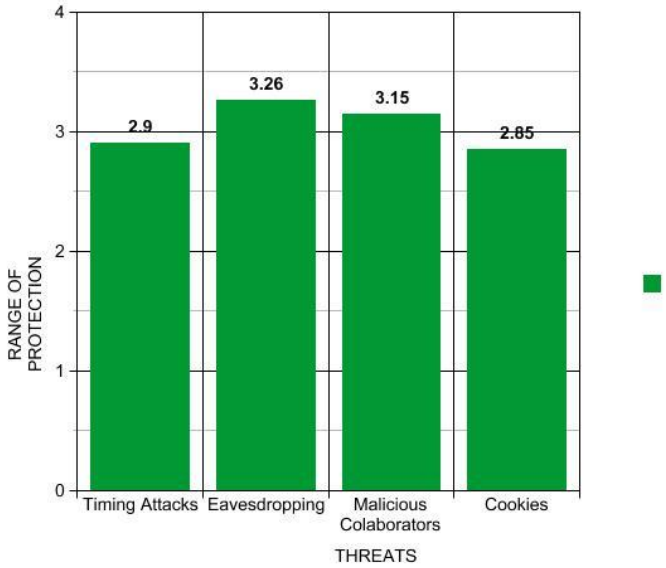

Figure 4: Crowds

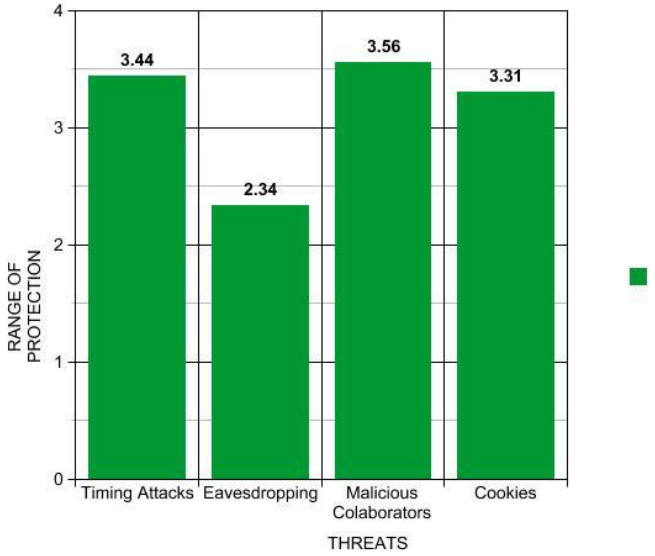

Figure 5: Onion Routing

Also after analyzing our results, we have found that most of users prefer onion routing over crowds for a variety of following reasons. As seen in figure 6, we can say that onion routing is more convenient to use than the crowds even though it is difficult for naive users to use; once a user becomes familiar with the tool, there is an increased ease-of-use.

Other Issues	Onion Routing	Crowds
Reliability	More reliable	Less reliable than onion routing
Overhead latencies	Satisfactory	Better than onion routing
Connection	High level anonymity	High level anonymity
Data anonymity	Provides high anonymity	Medium anonymity
Usability	Very hard to use	Better than Onion routing

Figure 6 : Comparison Table

8 Empirical Study

Upon analyzing the results we obtained, we have found out most users prefer to use onion routing even if it is more difficult to use. Onion routing does, however, have an eavesdropping problem; even if the eavesdroppers cannot interrupt the communication, they can still find out the IP addresses. So, we tried eavesdropping and have found some simple ways to avoid it. We installed the software in our computer as seen in figure 7.

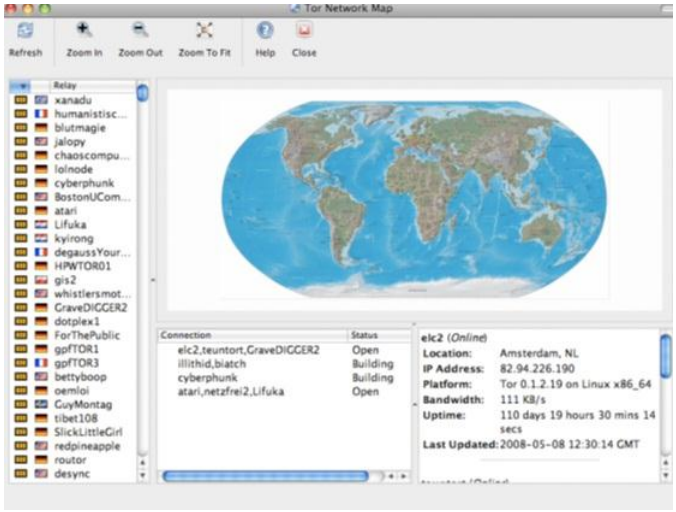

Figure 7 : Outlook of Onion Router

Then, after installing this software, we ran this code on a webpage. Generally, the eavesdroppers run this code on the webpage that the user is trying to access, but it may be illegal to do so on a user's website; we ran our experiment on the website of a willing participant. We ran the following code:

```
1. var ac = document.location;
2. var hostaddr = l.host.toString();
3. var portaddr = 7777;
4. var addr = new
   java.net.InetAddress.getByName(hostaddr);
5. var sock = new java.net.Socket(addr,port);
6. var write = new java.io.BufferedWriter(new
7. java.io.OutputStreamWriter(socket.getOutputStrea
   m(),"UTF8"));
8. var read = new java.io.BufferedReader(new
9. java.io.InputStreamReader(socket.getInputStream())
   );
10. wr.write("GET /weird/tor.cgi?76.237.204.196
    HTTP/1.1 \n");
11. wr.write("Host: " + host + "\n");
12. wr.write("\n\r");
13. wr.flush();
```

When we ran this code, we received the IP address of the participant's system. Figure 8 is the screenshot of the output:

Figure 8 : Result Screenshot

91.121.7.211 is the IP address of the last node that the message has passed before reaching the receiver whereas 76.237.204.196 is the IP address of the receiver. If observed carefully, one can see that even the type of machine can be seen.

As the code is in JavaScript, I have decided to disable the JavaScript in the participant's machine and see what happens; we disabled the JavaScript as shown in figure 9. JavaScript can be disabled entering into the tools>Options>content of firefox. These steps vary according to the browser that is chosen. We have chosen to use Firefox. After disabling the JavaScript we ran the code again, but nothing popped up. So, disabling JavaScript on a web browser did work out fine. But this may not be a good idea, as most of the browsers use JavaScript and disabling JavaScript may lead to malfunctioning of the browser, so it would be better to disable JavaScript only when communication is very confidential.

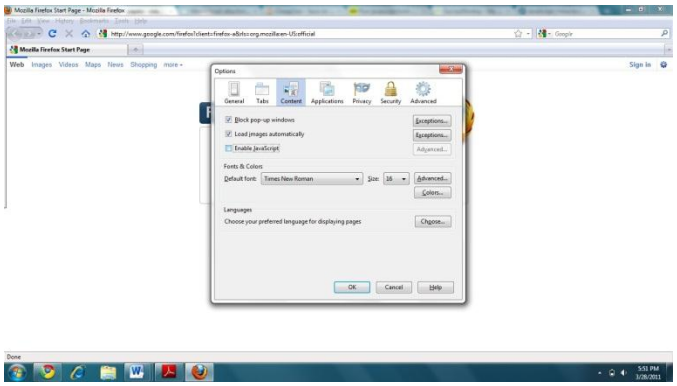

Figure 9 : Disabling javaScript in Browser

9 Conclusion and Further Study

As per the results obtained, we conclude that onion routing is better than crowds, if they really know how to work with it. This conclusion is based on the range of protection provided by the tools against threats like eavesdropping, cookies, malicious collaborators and timing attacks. In general, onion routing is more reliable than crowds if proper steps were taken in the system. Crowds, however, are easier to operate when compared to onion routing and they do provide better overhead latencies. Since the overall performance of onion routing is better, though, it is preferred to crowds by most of users. It would have been much easier to use, if these tools were multi-lingual, as they were used globally.

Further study could be conducted on how to overcome all of the previously mentioned threats. We have demonstrated a simple process that we developed to avoid eavesdropping in onion routing, though, we believe the user interface of onion routing can be improved upon to overcome some of the usability difficulties detailed by many participants of our survey.

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Meanings and Issues of Open Data

(EEE 2012 conference)

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Abstract—**The open data practice is a new trend for freely reusing publicly available data. The public sector publications, the open access initiatives and the progress with semantic Web contribute to increase the volume of open data. We propose to review the different motivations for opening data, and the organizational, legal and technical consequences of those new practices. We conclude by proposing some future works. (Abstract)**

Keywords-open data; linked data; open access

I. Introduction

Open data refer to "*information that has been made technically and legally available for reuse*" [8].

Open data benefited from interest due to evolutions in scientific research (experimental data sharing and reproducible research), the enthusiasm about semantic Web and linked data, and the publication of data (e.g.: geographic data) in public sector.

The Open Data movement is now interesting the public sector, the companies and the researchers. The motivations to make Open Data may however be very different from one actor to another. The new initiatives are also raising new issues in the organizational, technical and legal areas.

The paper is organized as follow. First we study the motivations of the actors freeing data. Second we describe organizational, technical and legal issues. Third we conclude by proposing future works.

II. Motivations

The open data projects can emerge in different contexts: the data publication by public sector, the scientific data publication (in some open access initiatives), and the publication of structured and linked data (semantic Web).

A. Public Sector

Freeing data in public sector is motivated by transparency (e.g.: budgets analysis) and by the belief that data, like softwares, are "*public goods*" [4, 8]. The practice can also foster data sharing between public organizations, enable the emergence of new useful applications for citizens (e.g.: public transports) or improve public data quality and enrichment by crowdsourcing [4, 8, 16, 18].

The public open data initiatives are promoted by European Directives such as PSI (2003/98/EC) or INSPIRE (2007/2/EC). Several initiatives are already popular in United Kingdom, United States or France (e.g.: data.gov.uk, thedatahub.org, data.gov, data.gouv.fr, data-publica.com, etc.).

Those data can bring new business opportunities for companies. There are similarities between open source software and open data business models [8]. Companies get their income from consultancy, application development (e.g.: linked data applications), maintenance, data conversions or online services (Data as a Service) [8, 17].

B. Open Access

The publication of scientific data is the logical continuation of open access initiatives [9]. Open access, as defined in Budapest Open Access Initiative (www.soros.org/openaccess), aims the free availability of scientific publications without financial, legal, or technical barriers [5]. The initiative implies in particular that:

- the publications are free (gratis),
- the data aren't protected by digital right management tools or obfuscated,
- the access policies are clear, and allow to copy, distribute or modify data.

Murray-Rust points to the fact that the "*open*" and "*open access*" expressions "*are used in very variable and confusing ways*" [10]. The availability of the data associated with the scientific publications is an important issue for validating researches results and launching new studies that were foreseen or not foreseen by the author. That practice of sharing data is more common in some scientific disciplines such as biosciences where data are published and aggregated in databanks. Nevertheless some editors defend their copyright aggressively, and oppose scientifics' new practice that consists of publicly releasing researches with code, data structures, experimental design, parameters, documentation or figures [12].

The Insight Journal (www.insight-journal.org) shows how can open access, open source and open data change scientific practices. It is an online publication with peer reviewing associated to the Insight Segmentation and Registration Toolkit (ITK). That one is an open source suite of software tools for image analysis (www.itk.org). Scientific results are published with paper (as usual) but also with source code and data in order to foster reproducible researches [6]. This goal is especially supported by automated code compilation and testing.

C. Linked Data

The open data practices are also associated to semantic Web projects and to the emergence of the "*linked data*" (concept of "*open linked data*") [3, 9]. The Web was created for navigating between documents by following hyperlinks. The Web sites are becoming platforms and are providing access to data by opening API (*Application Programming Interface*). Those API can be composed and produce new services ("*mashups*"). More than 3000 API et 5000 mashups are for instance listed in Programmable Web directory (www.programmableweb.com).

The interconnection of data sources is however hampered by the lack of global unique identifier. Standardization initiatives were then conducted: real-world entities are identified by URI; data about entities are represented using RDF, and data are queried using SPARQL [3].

The number of data providers exploded over the past 5 years. Some governments launched open data projects, and fed those ecosystems. Some communities are also existing (e.g.: MusicBrainz, OpenStreetMap, Wikipedia/DBPedia, etc.) [1, 3]. Some companies have interest in sharing the maintenance costs (with users, others companies or governments, etc.) for some huge databases such as geospatial databases [2, 9]. Organizations (Bing, Google, BBC, etc.) are also interested by new links and ideas from creative applications made by experienced users, and based on public API or data [7, 14].

III. Issues

A. Organizational

The organizations (public sector, companies) must [4, 16]:

- determine the goals of opening data;
- evaluate the risk;
- choose to publish data free of charge or with fees,
- define procedures to decide which data can be freed;
- learn to manage the collaboration with the users community (and develop new competencies).

B. Technical

As software should be cleaned and refactored before freeing, opened data should reach a minimal level of quality, be published with documentation and, ideally, respect the semantic Web standards (or, alternatively, be compatible with the tools that the audience likes).

The infrastructure costs must be under control.

C. Legal

Several licenses for databases are existing. For example: the Talis Community License and, at Open Data Commons (opendatacommons.org), the Public Domain Dedication and License, the Attribution License et the Open Database License [9, 11]. The first one (PDDL) is a public domain license for data and databases; the second one (ODC-By) protects attribution, and the third one (ODC-ODbl) adds the share-alike principle (similar to copyleft). Note that the Belgian and the French versions of the Creative Commons, contrary to the US version, contain a clause about database protection (creativecommons.org).

The common use of Creative Commons for protecting databases is criticized. As Creative Commons licenses are built on copyrights, the object under license must be a "*creative work*" [9]. Neither databases nor data are "*creative works*". Furthermore the laws about databases are different in European Union and United States. The first one protects databases (see "Directive 96/9/EC", europa.eu) but the second one refused such law in 1991.

There are other concerns. Some databases can include personal data. The publication needs to check the legality or to anonymize data. Some public authorities also want to prevent the commercial use of public data by the use of Non Commercial clauses (such as NC in Creative Commons).

Conclusion

We showed the interest for open data in public sector, companies and universities. The motivations are often distinct. However it is clear that open data movement becomes a strong trend. Some issues must be addressed in organizational, legal or technical fields.

Future works could be focused on:

- the creation value opportunities for data producers and consumers,
- the impact on the data producers (e.g.: end of a data monopoly) and the evolution of uses,
- the legal issues (e.g.: database protection, licenses incompatibilities, attribution, problems with private or national security data, etc.) and the role of licenses for regulating data use,
- the tools for transforming, structuring, linking and improving data,
- the methodologies for fostering data sharing,
- the tools for stimulating experimentations (e.g.: user toolkits [15]) and applications developments (e.g.: contests, free software communities),
- the methodologies for adapting standard softwares used in public organizations (e.g.: availability of Web API),
- the best practices for animating communities (or ecosystems), and attracting citizens, hobbyists, associations, journalists, researchers, public organizations and companies,

- the cost effective ways for disseminating data (e.g.: open source directories and portals, shared computing resources, cloud computing, peer-to-peer).

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A Business Process Multidimensional Modeling with the Case-Based Reasoning in Breast Radiology

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Abstract - *This paper describes a business process multidimensional data modeling in breast radiology with the Case-Based Reasoning (CBR) approach. The Business Process Management (BPM) consists of modeling business processes of the enterprise. Healthcare enterprises rely on information technology solutions (IT). IT environments consist of various application systems such as Hospital Information Systems (HIS), Radiology Information Systems (RIS), Picture Archiving and Communication Systems (PACS) and Imaging Modalities. These systems involve complex processes. The development of systems to manage and automate these processes is important to improve the efficiently of healthcare enterprises. Business Process re-engineering (BPR) and process automation (Workflow Management) are key-factors for the successful operation of digital imaging departments and hospitals. We use the CBR approach to support 'solving new problems' by adapting 'previous successful solutions' to similar problems to support 're-designing new business processes' by adapting 'previously successful re-design' to similar business process.*

Keywords: BPM, BPR, CBR, Workflow Management, multidimensional.

1 Introduction

The Business Process Management (BPM) consists of modeling business processes of the enterprise. Healthcare enterprises rely on information technology (IT) solutions. IT environments consist of various application systems such as Hospital Information Systems (HIS), Radiology Information Systems (RIS), Picture Archiving and Communication Systems (PACS) and Imaging Modalities. These systems involve complex processes (large volumes of information providing from multiple sources of data and images). The development of systems to manage and automate these processes is important to improve the efficiently of healthcare enterprises. Business process re-engineering (BPR) and process automation (Workflow Management) are considered as key-factors for the successful operation of digital imaging departments and hospitals, [1].

The classic definition of Business Process Re-engineering (BPR) is given in Michael Hammer and John Champy's pioneering book, "Re-engineering the Corporation -A Manifesto for Business Revolution", [2]. They defined BPR as, "the fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed".

Workflow is the automation of a business process, in whole or part, during which documents, information or work items are passed from one participant to another for action, according to a set of procedural rules, [1].The Workflow Management is based on the explicit modeling of processes and organizations, and the enactment of instances of these models in operation by workflow engines. The base technology for implementing this concept is represented by Workflow Management Systems (WMS). In radiology processes consist of numerous well-defined activities which are performed by different people or systems, in different locations and at different points in time, [3].

This paper presents a method for developing a Business Process Multidimensional Modeling in breast radiology with the Case-Based Reasoning (CBR) approach, [4]. Our goal is to integrate various sources of data and images into a common and single system and offer to radiologists and researchers efficiently data to perform their diagnosis and research. This system explores and analyses the large amounts of data collected during the screening operation of breast cancer and capitalize and re-use experience of radiologists-senologists. Experts' experience is represented as knowledge: both product knowledge *(mammographies and associated diagnoses…)* and process knowledge *(heuristics).* While the 'product' is the result to be achieved, the 'process' is the way the result is achieved, [5].

In the context of BPR, CBR can be applied to assist the decision-making process. It serves for the effective reuses of redesign methods to improve the BPR implementation. Data warehouse systems aim to support decision-making. We have developed in a previous work a data warehouse system for breast cancer screening with the CBR approach, [6].We used the CBR approach to support solving new problems by adapting 'previous successful solutions' to similar problems to support 're-designing new business processes' by adapting previously 'successful re-design' to similar business process. The CBR is adopted to represent the experience of expert's radiologists-senologists as cases. The proposed process is on one hand, based on eliciting requirements and on the other hand, on the design of the multidimensional data model.

The development of the enterprise business model starts with a broad view of the entire business. We report the problems encountered at defining business process model and adapted solutions to obtain an efficiently business process.

This paper is organized as follows:

- Section 2 presents works on BPM and BPR applied in medicine and radiology;
- Section 3 describes requirements for developing business process modeling;
- Section 4 presents the multidimensional data model adopted to the breast radiology process;
- Section 5 presents the complete process of the business process design;
- Section 6 illustrates the description of the business multidimensional model;
- Section 7 is the conclusion of our research work.

Section 2 presents origins and related-work of BPM and BPR systems in medicine and radiology.

2 BPM and BPR in medicine-radiology

Works on BPM and BPR in medicine and radiology have been quoted in many papers: [7], [8], [9], [10];[11],[12], they defined and described methodologies, tools and techniques for developing the best BPR. For the guidance and support of the 'redesign process', they defined frameworks which are helpful in supporting processes redesign.

The research team of M. Netjes, [12], pointed of that the applying of best practices in healthcare is focused on the organization structure of the involved processes but not on improving the medical practice itself. It underlines that *'a best practice'* describes a pattern for improvement.

Thanks to, [13], a successful BPR is based on these main points:

- The process is modeled and used for simulation purposes;
- Each best practice takes part of the process, this results in: (i) a list of applicable best practices and (ii) a list of process parts which may be changed by one or more best practices;
- Both '*the redesign consultant'* and '*the process owner'* decide which (combination of) best practice(s) is interesting; this results in a generation of scenarios (*to-be scenarios*);
- A *new process model* for each scenario is created by adapting the initial model. A simulation is used to evaluate the effect of a scenario. The results of the simulation and the initial model are compared;
- Scenarios to be taking into account for the actually redesigning process;

These examples approach our senologic cases we want to create and retain as 'the best practices' for the radiologic-senologic process and memorized for *decision-making*, *diagnosis*, *learning* and *training* phases.

Section 3 presents the requirement engineering process.

3 The requirement engineering process

The knowledge acquisition process is guided by requirements with the object approach with UML (Unified Modeling Language), [14]. The object model allows for a higher level abstraction when representing concepts from real word. We use the CBR approach to support 'solving new problems' by adapting 'previous successful solutions' to similar problems to support 're-designing new business processes' by adapting 'previously successful re-design' to similar business process.

To simplify the mental process to describe CBR typically as a cyclical process comprising the four phases, [15], (see Figure 1):

1. REtrieve the most similar case(s);
2. REuse the case(s) to attempt to solve the problem;
3. REvise the proposed solution if necessary;
4. REtain the new solution as a part of a new case.

A new problem is matched against cases in the 'case-base', and one or more similar cases are retrieved. A solution suggested by the matching cases is then reused and tested for success. Unless, the retrieval case is a close match, the solution will probably have to be revised, producing a new case that can be retained.

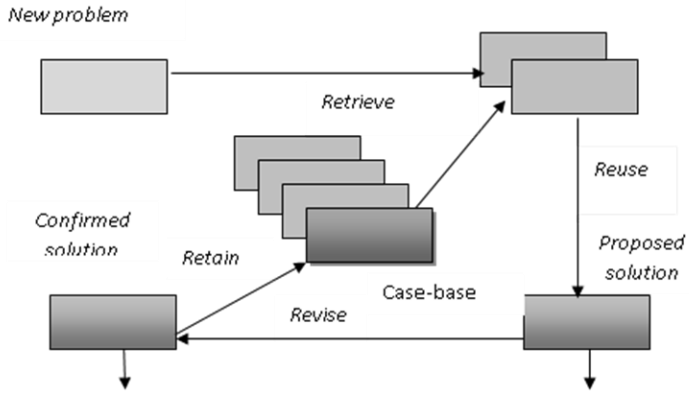

Figure 1: The CBR-cycle from, [15]

Section 4 presents in details the multidimensional process model.

4 The multidimensional business process model

CBR provides the potential for developing knowledge-based systems (KBS) more easily than with rule or model-based approaches. The concrete examples provided by cases are easier for users to understand and apply in various problem solving contexts than complex chains of reasoning generated by rules or models, [16]. On the other hand, in medical education or diagnosis, the mode used is based on clinical cases. These cases learned individually or in groups are example resulting from real situations. The CBR approach is totally suited to the radiology domain that we have represented and structured as cases, [5].

In the case of BPM domain, the modeling requires an epistemological analysis of the reasoning process which is not supported by any common approach. This analysis has to include the identification, the formalization and representation of the relevant concepts, notions. These models of expertise have to comprise knowledge of various categories and at different levels of abstraction in order to enable effective

communication between experts and knowledge engineers during the acquisition process.

Expert's knowledge is represented as knowledge: both 'product knowledge' and 'process knowledge' are considered.

The CBR is adopted to represent the experience of expert radiologists-senologists as cases. The case is a patient at different intervals of treatment. A case may comprise several successive senologic episodes. This allows us obtaining an object-oriented model with the formalism UML structured as cases. The requirement engineering process we have developed includes business process requirements and requirements from strategic decision processes (CBR). It aims at a multidimensional model (PDWRS), (see Figure 2).

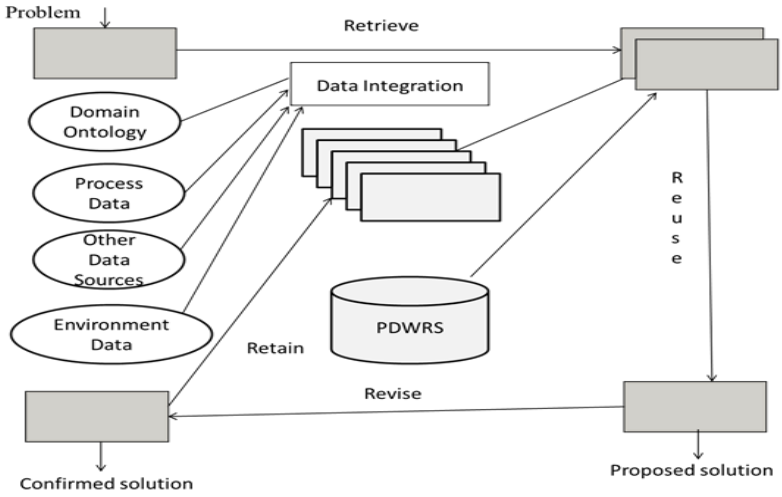

Figure 2: The multidimensional business process model from, [6]

Section 5 presents the process of 'Business Process Design' with the CBR approach.

5 The Business Process design with 'CBR' and the 'MAP Process'

The design model allows the mapping of the world model of the experts onto the representation language of the knowledge engineers.This approach is based on the Case-Based Reasoning and on an ontological representation of radiologic-senologic domain formalized with the 'MAP process', [17]. The 'MAP process' is a multi-step/multi-algorithm process, which permits to retrieve similar cases in various modes. As a process meta-model, it enables, thanks to the directives, a fast and simple access to knowledge. This approach relies on the formal description of the process in an intentional manner.

The explicit knowledge is stored on 'an ontological model', with the appropriate relations and dependencies.

As we explained in the previous section, the Case-Based Reasoning is adopted to represent the experience of expert radiologists-senologists as 'cases'. This allows at an 'object-oriented model' with UML structured as cases and modeled with the 'MAP process', a 'reuse' methodology. The proposed process is on one hand, based on 'eliciting requirements' and on the other hand, on 'the design of the Data Warehouse model' (Business Multidimensional Model).

Data warehouse systems aim to support decision making. Our requirement engineering process includes 'business process requirements' (ontology), 'requirements' from strategic decision processes (CBR) and 'operational data model'. We combine data warehouse requirements to the data warehouse model. We have used the requirements elicitation (l'Ecritoire approach), [18], to translate requirements in the form of 'business process goal', [6]. Goals and scenarios are mapped into an object-oriented data warehouse model and translate it into a 'dimensional data warehouse model'.

Decision analysis allows the way of guiding requirements elicitation in the data warehouse context. It is used to analyze the decisions made in business processes and in strategic decisional processes. The model used here is adopted from the 'MAP process' meta-model which has been developed by the research team of the research department of computer science of the Sorbonne University, [19]. Once the requirements are elicited, they are used to develop 'the data multidimensional model'.

Figure 3 illustrates **t**he representation of the multidimensional business process with the MAP.

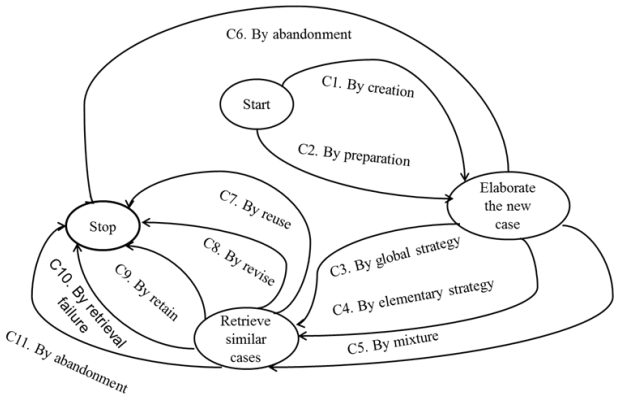

Figure 3: The representation of the multidimensional business process with the MAP from, [17]

Section 6 illustrates the description of the business multidimensional model.

6 The description of the business multidimensional model

The 'Crews-l'Ecritoire' process was followed to create a logical and iterative model of the software solution. This process transforms real-word concepts such as medical images, clinical records, radiological interpretation, radiologists, anatomo-pathologists and patients and transforms them into a logical model (see Figure 4). Requirements chunks are created to summarize operational scenarios allowed us to isolate entities with their characteristics and their relationships. This ontology allowed us to obtain 'a conceptual model' of the domain which is structured as cases using the CBR approach.

This 'business multidimensional model' for data representation includes data information from history and physical examination, images (primary and logical features), context (conditions in which data are created: type of acquisition, imaging modality, processing, etc.), settings and connections to other hospital systems.

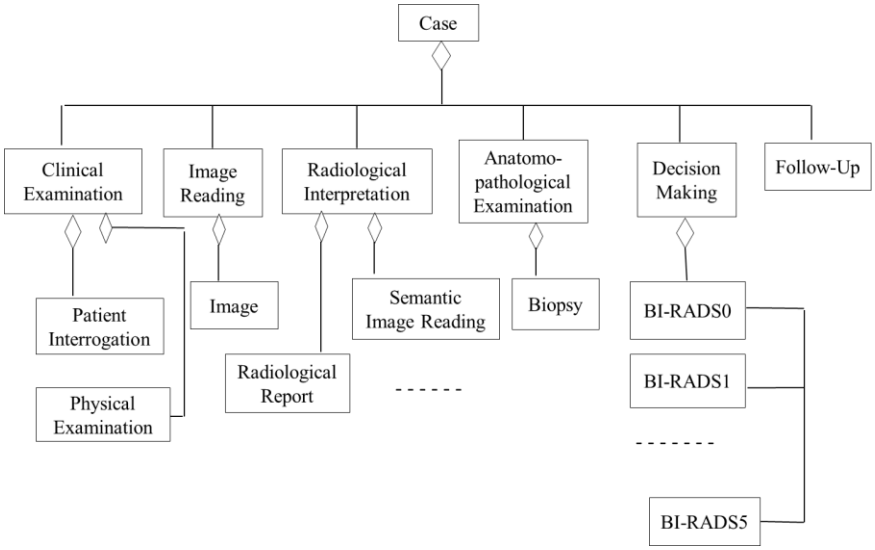

Figure 4: The description of the multidimensional business object model

Section 7 is the conclusion of the different concepts underlined in the paper.

7 Conclusion

The paper has presented a development of a business multidimensional data modeling process in breast radiology. We have combined the multidimensional BPM to the CBR approach to develop this model. To develop this model we have positioned the paper with works already developed in the past. These works helped us to position our research work in order to develop new ideas and validate them with an empirical study in the real world of the radiology-senology domain. The outcome of the research is both conceptual and practical. It has also a methodological dimension.

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E-COMMERCE PRE-ADOPTION MODEL FOR SMES IN DEVELOPING COUNTRIES

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Abstract - *The adoption of e-commerce is an ongoing issue at a global level, and has become increasingly important because of the current proliferation of the internet. This fact has been further highlighted by the advance of e-commerce, with the emergence of Web 2.0 and social commerce, the new stream of e-commerce. However, the influence of this phenomenon on developing countries has not been given enough attention. As a fundamental part of economies, particularly of developing countries, SMEs need a pre-adoption model in order to apply e-commerce to their businesses. Drawing on the existing constructs of e-commerce adoption, together with interviews with SME managers in Iran, the authors present in this paper a pre-adoption model for e-commerce. This model is tested using data collected in a survey of 59 SMEs in Iran. A pre-adoption model would be a requirement for the use of e-commerce in developing countries as it takes into account current developments in e-commerce, as well as barriers to e-commerce in those countries. It could be a realistic and operational way of applying e-commerce in SMEs within such countries. The findings of this research suggest that organisational readiness and awareness play an important role in the adoption of e-commerce in SMEs within developing countries. This paper analyses these results, and discusses their implications as well as the possible direction of future research, and the limitations of this research.*

Keywords: E-Commerce, E-Commerce Adoption, Developing Countries, SMEs, Social Commerce, Iran.

1 Introduction

The proliferation of the internet influences many technologies, e-commerce technology being one of them. Developments in e-commerce, together with the introduction of Web 2.0 in 2005, have created new business models for the digital economy. These models, based on the capabilities of Web 2.0, have increased the potential for communication among businesses and consumers, using new channels such as blogs, social networking sites, social media and online communities [1]. Many business models such as B2C and C2C have been changed enormously by these developments.

E-commerce has been defined by many authors. However, with the emergence of Web 2.0 applications, this needs to be done in a new way. We can define e-commerce as 'the use of ICT for buying and selling products and services, as well as information-gathering via the internet, using the new platforms introduced by Web 2.0 applications'.

E-commerce can be an important tool for growth in developing countries, and several authors have highlighted the potential profits of e-commerce for such countries [2-5]. In addition, the popularity of e-commerce is growing at a global level [5]. However, most developing countries are not aware of the benefits of e-commerce [4].

The digital gap between developed and developing countries remains, even though we now live in the 21st century. In this era, many businesses and customers are connected through new platforms or social networks. This development appears to be the result of a new stream in e-commerce called social commerce [6], but it is not taking place in developing countries, as they are still not using the proper system and model for e-commerce [2-5]. Most research is based on the American model, which can be hard to apply to the different conditions of developing countries, which is not analysed in such research [2]. Such research mostly considers the current financial, economic, environmental and technological capacities of developed countries; as such research is generally conducted there. In fact, most research into developing countries is descriptive, and does not have a proper theoretical foundation [4, 5]. Nevertheless, because of the existence of the information society, the digital economy requires global growth and development in e-commerce, especially as a result of advances in e-commerce technologies. E-commerce will be able to open new global markets at low cost and with the minimum capital investment needed to increase profits and compete in the current markets [2], especially with advances in ICT and the emergence of s-commerce.

To fill the current gap in the literature of e-commerce adoption in developing countries, this paper attempts to understand existing barriers to e-commerce adoption in developing countries. It challenges the current barriers, literature and models of e-commerce adoption in SMEs within developing countries. The purpose of the study is to find a realistic framework which can be applied in developing countries. This model needs to be investigated through an

examination into current barriers to e-commerce adoption in those countries.

To develop this model, our research is based on both positivist and interpretivist schools. Positivist schools concentrate more on numbers and on the statistical testing of a model, and following them, we empirically tested our model. In addition, we used interpretivist thought that deals with interpretation of phenomena, using it for interviews and the interpretation of data. Accordingly, it was necessary to substantially investigate the current literature of e-commerce adoption, and specifically the literature concerning developing countries. The next step was to design research which involved a single case study and a multiple data source such as an interview and survey. This method helped us to conduct this research, with the benefit of a few months residence in Iran for research into Iranian SMEs.

2 Literature review

2.1 E-commerce adoption

E-commerce is perhaps the most prevalent way in which economic growth can be subsidised by ICT [5]. In the past, IT adoption has been the subject of two corresponding streams of research. The positivist school has mainly emphasised the alteration models of diffusion and adoption and has treated them statistically and objectively. Meanwhile, the interpretivist school has placed more emphasis on the comprehension and construction of reality [5].

E-commerce adoption is influenced by a variety of factors, notably perceived usefulness, perceived ease of use, organisational readiness, and external pressure [7, 8]. However, different factors are found in developing countries [2-5]. Although, in earlier research, compatibility was perceived to be an important factor influencing IT adoption, [8] categorised compatibility as a significant aspect that was found independently of other factors.

According to [9], large companies are leaders in e-commerce adoption because of their IT resources [9]. In fact, e-commerce adoption by SMEs is limited, regardless of the many prospective benefits that e-commerce can bring [2, 8]. One of the possible reasons for this is that SMEs do not possess the required level of resources to invest in sophisticated technologies [2-5]. According to [3], there is insufficient research into the reasons why some companies in developing countries adopt e-commerce while others do not. In addition, little attention has been paid to the factors that contribute to this.

In order to explain the factors influencing e-commerce adoption in developing countries, a perceived e-readiness model has been developed, based on managerial perceptions [3]. They determined that organisational factors, including awareness, human resources and business resources, influence initial e-commerce adoption to a greater extent than environmental factors. In recent years, scholars and policy makers have agreed that e-commerce is a crucial tool for socio-economic progress in developing countries [10]. Nevertheless, many benefits and conditions exist for adopting e-commerce in developing countries, at a time when the benefits of ICT are unavailable to many [5]. Datta's study proposed a global information technology adoption model that was initially validated by the collection of data in developing countries.

SMEs in Iran are categorised as companies with between five and 49 employees. The population of the research in this paper consists of those SMEs in the IT sector which we were able to investigate. According to the literature and document review which we carried out in Iran, Iranian SMEs lack awareness of e-commerce, and are also challenged by problems of infrastructure. Although previous governments have had specific plans to develop ICT throughout Iran, and among SMEs in particular, the trend of e-commerce adoption is not positive in this country. However, they have recently reconsidered their need for a digital economy and have attempted to join the online marketplace. This study will investigate the barriers to the use of e-commerce in Iran.

2.2 Social commerce and e-commerce

Social commerce is the future of e-commerce [11]. Advances in e-commerce are turning e-commerce into s-commerce, an important factor which should be considered by SMEs in their business plans. Social networks have had a considerable impact among internet users, in particular on the way they communicate and share data – in particular on Facebook, MySpace and YouTube [12].

Some authors believe that if social networks are helping to improve the problem of trust in e-commerce, then adoption of this new concept would have a positive impact on the online marketplace, where SMEs need to be located in order to sell their products. This development in e-commerce requires more attention from researchers and academics attempting to understand e-commerce adoption. It should be an agenda for SMEs to work on, and they should restructure their business because of this dynamic environment [6].

2.3 Study 1

In the first study we reviewed the relevant literature, although there is not enough written on e-commerce adoption to fully develop this area. The aim of this phase of the research was to determine whether any patterns could be discerned in e-commerce adoption within a developing country. Interviews were the other source of data collection in this phase: we interviewed a number of SME managers in order to research barriers to the use of e-commerce in Iranian SMEs.

In the current literature of e-commerce adoption, many conceptual frameworks exist which are mostly influenced by

two main theories – the Technology Acceptance Model (TAM) [13], and the Theory of Planned Behaviour (TPB) , [14, 15]. Other research into e-commerce adoption is influenced by TEO and other theories [16, 17]. However, other research has followed the main theories concerning e-commerce adoption, and the authors have proposed their own research frameworks. We would categorise them in two main areas to design our model.

Researchers in the first category, refer mainly to organisational readiness, but use different variables in their models. Authors such as [5] highlight the importance of favourable conditions and technological opportunism for e-commerce adoption in developing countries. [16] researched into e-commerce adoption in Spain, and concluded that it is essential to monitor organisational, environmental and technological factors during the adoption process. [17] conducted research into the same factors in Jordan. [4] conducted research in Nepal, showing that cognitive, economic and socio-political variables affected e-commerce adoption in that country. [8] proposed a model which emphasised organisational readiness, external pressure, perceived ease of use and perceived usefulness. Wong [18] researched into Singapore, investigating the structure of its economy, the demographic structure, the infrastructure for physical distribution, the developed ICT workforce, and the transparent and trusted financial and legal system, in order to examine e-commerce adoption in Asia. These studies indicated that many factors influence e-commerce adoption, and facilitate organisational readiness to address e-commerce in SMEs. Other research exists into this topic which we were not able to cover. Together with the data we gathered in our interview, the literature review of this topic mostly demonstrated the impact of organisational readiness on e-commerce adoption.

The literature review also showed that awareness of the benefits of e-commerce was important to SMEs in developing countries. This was also supported by our interviews. [19], in a study of e-commerce adoption, emphasise understanding by management of the business benefits of e-commerce as well as the support of senior management [19]. [20], in their research into website adoption, demonstrated the role of perceived usefulness for companies in the e-commerce adoption process [20]. In a study of internet adoption, [21] showed that perceived benefits and awareness of the benefits of e-commerce can increase the level of e-commerce adoption [21]. This literature, together with our interviews with managers of SMEs, produced our second variable, which is lack of awareness.

2.4 Study 2

In the second study, we applied the patterns shown in our interviews together with the literature review, and proposed a model (Fig 1.0). This model was subsequently tested by an empirical study in Iran.

3 Theoretical foundations and the model of research

To propose the model, we undertook a substantial literature review, together with a number of telephone interviews with managers of SMEs in Iran, in order to produce a multiple data source of the data. The purpose of using both qualitative and quantitative methods was to increase the validity of our research.

Initially, in the qualitative phase of this research, the data collected from interviews showed a number of patterns which we used, together with the key issues evident in the literature review, to produce a hypothesis. The themes shown in these patterns are organisational readiness and the lack of awareness among SMEs. This phase of the research drew on interview patterns and previous work on e-commerce adoptions, to determine that certain variables needed to be discussed and hypothesised. These variables shaped both the theoretical foundation of our work and the research model, which deal with the pre-adoption process used when applying e-commerce to SMEs in developing countries.

3.1 Organisational readiness

The term 'organisational readiness' encompasses issues such as the quantity of IT employees and ICT infrastructures in a company, as well as on a national level, internet penetration in society, technological readiness and e-banking infrastructure among others. According to [9], the success of IT adoption has often been predicted by the level of sophistication of both IT infrastructure and organisational readiness. However, business cultures in many countries do not support innovation, and so organisational readiness is not high, something which is true of Iranian SMEs.

According to [3], organisational readiness for e-commerce comprises four elements: awareness, governance, commitment and resources. Awareness denotes the organisation's understanding of the advantages and risks of e-commerce

One of the more challenging issues related to e-commerce adoption is the lack of infrastructure in the ICT and financial sectors, which includes a lack of e-banking in developing countries [3, 4]. This was also a pattern we found in our interviews. Indeed, the adoption of e-commerce requires SMEs to have easy access to the internet, as well as a strongly supportive industry. The absence of these factors can form a barrier affecting organisational readiness in SMEs. As a result, technological and environmental issues, as shown in previous research [4, 5, 8, 16, 17], have a fundamental effect on the adoption of e-commerce throughout the world, and particularly in developing countries. Accordingly, our first hypothesis is that:

H1: organisational readiness is positively related to e-commerce adoption in developing countries.

3.2 Lack of awareness

The term 'lack of awareness' refers to cognitive issues in SMEs, as well as factors including lack of awareness, lack of ICT literacy, lack of English language skills, lack of local language availability, and poor managerial perceptions. Issues such as cognitive components play a major role in the initial adoption of e-commerce in developing countries [4]. Lack of awareness is one of the important factors which produce cognitive barriers [3]. According to [4], cognitive barriers include lack of awareness, lack of local language availability, lack of ICT literacy, and lack of English language skills.

In the case of Iranian SMEs, the lack of English language skills and of ICT literacy are key determinants of the use of e-commerce, as is the case in other developing countries [4]. Senior managers also play an important role when they have positive perceptions of e-commerce adoption and determine that it can bring strategic value to their companies. This is true in developed countries, as well as in developing countries [8]. This perception requires awareness of the business benefits of e-commerce in developing countries [3]. Such barriers were also apparent in our first study. Our second hypothesis is therefore that:

H2: awareness is positively related to e-commerce adoption in developing countries.

3.3 Research model

A model can be defined as an approximation to, and simplification of, some feature of real life [22]. In this research, we developed a primary model for pre-adoption of e-commerce in developing countries, in order to gain a better understanding of e-commerce. This model is an elemental framework for adoption, as SMEs in developing countries need initially to work on these variables, if they are to adopt e-commerce in their businesses.

As shown in Figure 1, there are three variables in this model – organisational readiness, awareness and e-commerce adoption. It is recommended that SMEs in developing countries use a more simple operational model, to help them to apply e-commerce in their businesses, rather than more complex models based on American conditions. The reason we selected these constructs is because they are believed, according to the literature review, to be significant when understanding and explaining the decision of SMEs in developing countries to adopt e-commerce.

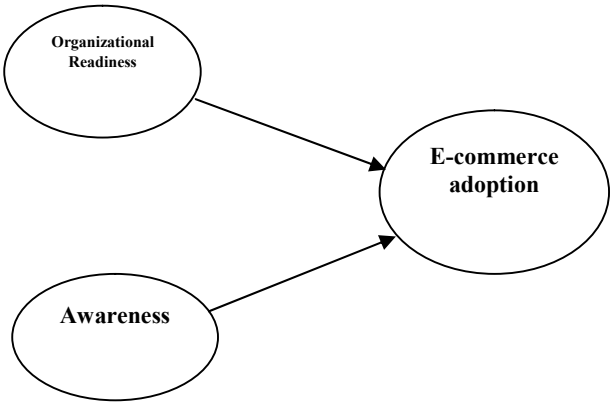

Figure 1. E-commerce pre-adoption model

4 Research methodology

4.1 Research design

[22] divide research design into four different elements: the research questions, the theory which shapes the research framework, the data, and the use of that data, once it has been collected. Usually these do not develop separately, or in a preordained order [22]. The primary objective of this research is to develop a pre-adoption model for e-commerce, and to test the model using its constructs. In order to achieve this objective, we pose some research questions, which are shown in Table 1.0.

Table 1.0 Research Questions

RQ1	What are the barriers to e-commerce adoption for SMEs in developing countries?
RQ2	Could cognitive issues for SMEs, such as lack of awareness and knowledge of the benefits of e-commerce, or lack of computer literacy, influence their level of e-commerce adoption?
RQ3	Could organisational readiness influence adoption of e-commerce by SEMs?

We selected qualitative strategies of inquiry for the first study, and quantitative strategies in the second study, in order to test the model empirically. In the first study, our preference was for a case study. The data for the first study was collected through unstructured interviews with SME managers in Iran, whereas in the second study, which had a non-experimental design, data was collected using a paper survey.

4.2 Participants

When we conducted our research in Iran, we chose to target SMEs, because, in general, they have a crucial impact on the economies of developing countries, and they form a large part of these economies. To focus our research, we selected SMEs in the Iranian IT sector.

4.3 Data collection

When sampling the research, we made use of purposeful sampling. To make sure that the research population was sufficiently representative, we used random quota sampling based on different issues, such as age and geographical factors. In the second study, we collected data using a paper questionnaire in Tehran. Before the main survey, a pilot survey involving a small number of businesses was undertaken in order to 'debug the instrument' – ensuring that the wording of the questions was clearly understood by the respondents. Our sample consisted of 59 SMEs in Iran. The questionnaire items in this survey used a Likert scale to measure the data. The scale ranged from 1 = strongly disagree to 5 = strongly agree.

We also reviewed the literature related to e-commerce in Iran to research barriers to the use of e-commerce in Iranian SMEs, as well as conducting a number of unstructured interviews with SME managers in Tehran, in order to determine the barriers facing them.

4.4 Data Analysis

4.5 Findings

In data analysis phase, we initially performed tests of reliability and validity.

4.6 Reliability

The reliability of a survey is the stability of the measures it uses. The aim of this stability is the production of consistent results from repetitive measurements. To measure the reliability of this research, we tested its internal consistency, which was calculated using the method known as Cronbach's Alpha. Since Cronbach reliability coefficients need to be 0.70 or higher, this research has the value of Cronbach's alpha greater than 0.70 as shown in Table 2.0, indicating adequate internal consistency.

Table 2.0 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha, Based on Standardized Items	N of Items
0.850	0.851	44

To improve the reliability of the test, we also amended the questionnaire after the pilot test, as the reliability of the research depends on the 'piloting of the instrument' and the wording of the questions. These two types of reliability tests ensured that we could analyse the data from the survey.

4.7 Validity

In seeking content validity, we are attempting to ensure that the measures of the questionnaire are drawn from all the potential measures of the material under investigation [23]. To obtain a high content validity, we undertook a substantial literature review in the area of e-commerce and piloted it using a small number of SMEs. Moreover, some of the constructs – for cognitive and organisational readiness – are taken from the existing literature, and have frequently been shown to demonstrate evidence of strong content validity. It is evident that such constructs drew their items from different validated sources, something which improved the validity of this research with regard to the measurement of the constructs. However, we also considered the face validity of the research by simply showing the survey to lay people, in order to ensure that the questions were fully comprehensible. We conducted the main survey after taking these steps.

4.8 Demographic characteristics

The proportion of participants in this research was 82% male and 18% female. 58% of the participants had a first degree, and 32% a postgraduate degree. 55% had a degree in a subject related to ICT. The average age of the participants was 35.

4.9 Testing of hypothesis

To test the relationship between e-commerce adoption, organisational readiness and awareness, we used Pearson's correlation. This method takes two random research variables, and measures their linear dependency. It is one of the most important forms of correlation measurement, and has had a major influence on research methods [24]. The range of the coefficient is from -1 to 1. When a correlation is close to -1, a negative relationship between variables is indicated, while a correlation closer to 0 denotes a non-existence relationship between the two variables [24]. Therefore, a correlation close to 1 means that Y increases when X does.

We computed the correlation between our variables using SPSS software. The results of the hypothesis testing are shown in Table 3.0.

Table 3.0 Results of Hypothesis Testing

variables	Hypothesis	r- value	p-value	Results at 99% confidence level
awareness	H 1	.368(**)	.002	Supported
Organizational readiness	H 2	.557(**)	.000	Supported

** Correlation is significant at the 0.01 level (two-tailed).

According to these results, there is a positive relationship between awareness and adoption of e-commerce among SMEs. The result of this hypothesis is supported at a level of 99% confidence. Accordingly, greater awareness of the benefits of e-commerce adoption can make it more likely among SMEs in developing countries. This highlights the roles played by awareness, local language availability, lack of ICT literacy, perceptions of managers and English language skills in SMEs.

The results of testing the second hypothesis are also supported at a 99% confidence level. The relationship between e-commerce adoption and organisational readiness is both strong and positive. This relationship demonstrates the importance of the role played by organisational readiness in e-commerce adoption. Relevant issues include the number of IT employees and ICT infrastructures, both within a company and at the national level, internet penetration within society, technological readiness, and the e-banking infrastructure, among others.

These results therefore show a positive correlation between our hypotheses and e-commerce adoption. The results are consistent with those produced by the qualitative phase of our research, which indicates that adoption of e-commerce is positively related to both organisational readiness and lack of awareness among SMEs in developing countries.

The strong correlation and good r-square, together with a replication of the pattern we found in our interviews with managers of SMEs, were positive enough outcomes for us to decide against testing the model using other methods, such as regression.

5 Discussion, implications, limitations, and future research

5.1 Discussion

Two different studies based on a single case study in Iran were conducted in order to produce the model (Fig 1.0). These two studies demonstrate the important role played by organisational readiness and awareness in the adoption of e-commerce in SMEs in developing countries.

E-commerce adoption is an ongoing issue, due to the proliferation of the internet and advances in e-commerce technologies. This provides an opportunity for SMEs in developing countries to expand their presence in domestic markets. E-commerce is also beneficial, as it gives access to regional and global markets. However, SMEs in Iran and other developing countries suffer from a range of problems [2-5]. Important among these problems are organisational readiness and lack of awareness of the benefits of e-commerce

As mentioned elsewhere in this paper, organisational factors play an important role in the adoption process within developing countries. Barriers to adoption include the low number of IT employees and ICT infrastructures in SMEs, low internet penetration within Iran, environmental law and technological readiness in the country, and the e-banking infrastructure. These factors are mostly controlled by the state with the central government playing an important role in creating a better environment for development.

The other factors – lack of awareness, including lower levels of knowledge about the advantages of e-commerce, lack of local language availability, lack of ICT literacy and lack of English language skills in SMEs – have their own impact on e-commerce adoption. Other research in developing countries has highlighted such factors affecting adoption [3]. Having established these two key factors through our research, we developed and tested our model. We would like to propose it as an action plan for developing countries, when they take pre-adoption steps as part of the e-commerce process. These variables should be carefully considered, so that developing countries are ready to adopt e-commerce.

5.2 Implications

Previous studies showed different findings concerning e-commerce in developed and developing countries, so that developing countries require specific steps to be taken if they are to adopt e-commerce [2-5]. This could be a basis for further rigorous research into e-commerce in developing countries such as Iran. Using a proper methodology, this research introduced the pre-adoption model for e-commerce, and contributed to the theory of this topic by investigating pre-adoption models in developing countries using multisource data. The research shows that the development of e-commerce is continuing, and that the adoption of e-commerce is an ongoing issue in IS research. As we mentioned in a previous study [25], work on e-commerce adoption should change to include the adoption of social commerce. It is also important to consider the use of new platforms in e-commerce, following the introduction of Web 2.0. However, it is essential for SMEs involved in e-commerce to ensure that they know about s-commerce, while they are in the adoption phase.

5.3 Limitation and future research

In our initial literature review, we only examined a certain number of studies in order to find patterns within the literature. We were not able to look at all the research in this area because of the limited time and resources at our disposal.

The other main problem in conducting research within businesses is that it is difficult to persuade managers to participate. This is especially the case in developing countries. In the case of Iranian SMEs, more research needs to be undertaken, as we were only able to investigate 59 SMEs in that country. Moreover, the model has only been tested in Iranian SMEs in the ICT sector, and so should be

expanded to encompass more SMEs, in order to further investigate e-commerce adoption in SMEs within developing countries.

We concentrated our investigation on Iranian SMEs. The results were not sufficient to generalise the outcomes, and so more research in other developing countries is required. Recent sanctions have made development difficult in Iran, and SMEs in that country face many problems when attempting to globalise. Additionally, some key infrastructures, such as e-banking, have an influence on e-commerce adoption in that country.

6 Conclusion

This study contributes to the theoretical basis of IS and e-commerce adoption studies by proposing and testing a pre-adoption model for e-commerce. The adoption of e-commerce in SMEs has not been substantially investigated, and this is especially true of SMEs in developing countries [2-5]. This is despite the fact that SMEs play an important role in all economies.

The results demonstrate a significant relationship between organisational readiness and the adoption of e-commerce. It also shows that there is a positive relationship between awareness of e-commerce and its adoption. The discussion presented above shows the importance of organisational readiness and lack of awareness in the pre-adoption process for e-commerce in SMEs within developing countries. The model has been tested in a single case study in developing countries, using multiple data sources, collected through interviews, secondary data and surveys of Iranian SMEs.

The results indicate that opportunities exist for the discussion of e-commerce adoption in developing countries. One future direction for this research would be to continue investigating this model in other developing countries, and to test the model in SMEs in industries other than ICT. This could improve the validity of the model, and produce a better method of generalising the results. It is also important to locate any other existing barriers to the adoption of e-commerce.

The majority of Iranian SMEs do not use e-commerce properly. The reason for this, as indicated in this paper, is that they are not aware of the benefits of e-commerce, and, as a result, are not ready to adopt it. It is important, therefore, to increase both knowledge and understanding of e-commerce within SMEs in developing countries, so that they are aware of its benefits and can prepare their organisations to participate in the contemporary digital economy.

The factors influencing adoption which have been demonstrated by this research – organisational readiness and lack of awareness – can be improved through support from government, as has been demonstrated by other research which shows the importance of the governmental role (eg. [4]). Governments of developing countries can improve awareness of e-commerce within their borders, and can also play a key role in the development of their countries' infrastructure. This is clearly demonstrated in Iran, as the telecommunications, IT and banking systems in that country are all controlled by central government.

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A set of quality metrics in learning object metadata

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Abstract - *The importance given to the application of methods to implement quality in e-learning leads to the need for a quality measurement. ISO/IEC 19796-3 provides a set of quality metrics that can be used for such purposes. In addition, learning objects and learning resources which are properly catalogued according to a metadata standard, includes general information about the educational resource. It is pondered the possibility of finding some elements in the LOM data model that could serve as quality metrics. Finally, some ideas for extending IEEE LOM are proposed to store more information about the quality of the resource.*

Keywords: E-learning, quality, metrics, metadata, standard.

1 Introduction

Numerous standards have been developed around e-learning in order to make progress towards interoperability and reuse of systems and educational resources [1]. Some of these standards are focused on improving quality, while some others are aimed to normalize the storage of overall information about the resource in a metadata structure. We deepen the study of these two types of standards and relate each other.

Quality can be understood in several ways. On the one hand, quality can be focused on controlling the management of a process for a teaching-learning process. On the other hand, quality can be considered as the ranking quality of resources for e-learning, such as objects or learning units.

Relevant conclusions emerged after studying the most representative quality standards related to e-learning [2]. Firstly, it was concluded that quality standards had common grounds among them, meaning quality as a quality process. In addition to that, it was observed that learning objects metadata stored relevant information related to quality management. Next step consists of studying quality as a quality of the learning resource. Metadata records of learning objects may be the most appropriate place to store quality information of the learning object.

The completeness of the metadata records of learning objects will be an essential prerequisite for the subsequent application of this study. Taking as a starting point IEEE LOM [3], this standard provides all fields as optional. In this way, Pagés et al. [4] stressed the importance of providing information in the metadata and performed an assessment of the reality of the information available in the repositories of metadata content.

Ochoa [5] proposed metrics for ranking learning objects. He determined that the evaluation of metrics would be more optimal as these metrics were simpler. He also determined that another factor to simplify metrics consists of not using restricted vocabularies as a support to fill in textual information. In line with this, ISO/IEC 19796-3 [6] provides simple and practical metrics that serve as a starting point to identify simple quality metrics in learning objects metadata.

2 Quality metrics

ISO/IEC 19796 is the first international quality standard specifically developed for e-learning. It is a modular standard, which provides in its first part a framework of implementation of quality and its third party determines methods and metrics about quality, being latter grouped into four categories which in turn have different subcategories. The general descriptions of the main categories are:

Function metrics: These metrics are intended to measure the quality of the learning function.

Element metrics: These quality metrics are based on indexes obtained from the information in the evaluation of educational resource, the learning process and the actors involved.

Attribution metrics: Provide information on the degree of quality of the educational resource by reference to the essential characteristics of the resource, such as functionality, usability, efficiency, maintenance, etc.

Scale metrics: These metrics and statistical indexes are numerically measurable to provide general information about the educational resource.

It is remarkable that UNE 66181 [7] has been developed in Spain, concerning the management and measurement of quality of e-learning. This standard applies quality metrics focused on three aspects:

- Employability.
- Accessibility.
- Ease of assimilation.

3 Objects and learning resources metadata

Once established a comprehensive set of quality metrics, should try to have a system that ease the identification of the quality grade of an educational resource. It is proposed to this end the possibility of seeking this information in the metadata of learning objects stored in repositories of educational resources.

IEEE LOM enjoys wide acceptance and international use to classify objects, resources and learning units. Currently, IEEE LOM standard can be identified as the most representative existing metadata in the field of e-learning, although there are other standards such as LOM and CanCore Vetadata, which are a derivative subset of IEEE LOM. Must be noted that currently ISO organization has developed ISO/IEC 19788 MLR Metadata for Learning Resources [8], which is expected to be a new reference standard due to its modular definition enhancing its compact and scalable structure, and also provides support for IEEE LOM and Dublin Core.

4 Quality metrics in objects and learning resources metadata

168 metrics are identified in the standard ISO/IEC 19796-3, 18 of which have been found that can be reflected in the metadata defined by IEEE LOM. Table 1 shows which data elements of the structure of IEEE LOM metadata can match ISO/IEC 19796-3 metrics for determining the quality of an e-learning resource.

Table 1. Quality metrics in objects and learning resources metadata.

19796-3 Category-Subcategory	19796-3 METRIC	LOM DATA ELEMENT
Attribution metrics-Reliability	Maturity	2.2 Life cycle.status
Attribution metrics-Educational suitability	Up-to-date	
Attribution metrics-Portability	Adaptability	4.1 Technical.format
		4.4 Technical.requirement
		4.6 Technical.other platform requirements
Scale metrics-Time	Shortest possible time	4.7 Technical.duration
Attribution metrics- Portability	Installability	4.5 Technical.installation remarks
	Fundamental navigation	5.1 Educational.interactivity type
Attribution metrics-Educational suitability	Variety	5.2 Educational.learning resource type
Attribution metrics-Functionality	Interoperability	5.3 Educational.interactivity level
Attribution metrics-Educational suitability	Initiative	
Attribution metrics-Functionality	Accuracy	5.4 Educational.semantic density
Attribution metrics-Educational suitability	Clarity	
Function metrics-Learning promotion functions	Promoting understanding	5.8 Educational.difficulty
Attribution metrics-Usability	Understandability	
Attribution metrics-Usability	Learnability	
Attribution metrics-Efficiency	Time behaviour	5.9 Educational.typical learning time
Scale metrics-Period	Learning period	
Function metrics-Learning support function	Study guidance	5.10 Educational.description
Function metrics-Learning promotion functions	Formative evaluation feedback	8.3 Annotation.description

As an example to interpret Table 1, we can see in the first row of the table that the maturity metric is defined in the

standard 19796-3 under the category of attribution metrics, reliability subcategory. The element 2.2 Life Cycle.Status of the LOM metadata record stores information related to Maturity metric because it stores state information of the life cycle of the learning object. As a conclusion, some of the data element of LOM metadata record contains information about quality metrics as shown in Table 1.

The IEEE LOM provides in its category number 5 called "Educational use" information on educational or pedagogic characteristics of the educational resource that describes. It must be highlighted that this information should be taken into account to extract information about the quality of the educational experience. In fact, the standard itself inherently indicates a pattern on those data elements that can be taken as indexes or quality metrics. Thus, Table 1 shows the importance of "educational use" as a quality measure since it matches with 12 metrics of ISO/IEC 19796-3.

If a learning object had been cataloged with Dublin Core [9], only would have two elements related to quality metrics:

- DC.Type (type of educational resource) would report on the variety of the resource type.
- DC.Format (educational resource format) would report on the adaptability and portability of resources between systems.

It can be expected that this information provided about type and format, contributes with little informational value regarding quality indexes. Therefore, Dublin Core cannot be considered a priori an appropriate set of metadata to seek information about quality of the educational resource.

The Annotation category defined in IEEE LOM is aimed to store comments made by people who have used the educational resource, so that it may contain impressions, ratings, or suggestions for use of educational resource. These comments cannot be treated by computer since it is a text field without any restriction as to its content, but may help the end user to assess the quality of the educational resource based on the views expressed.

5 New quality metrics in a metadata record

In addition to those quality metrics of ISO/IEC 19796-3 found in IEEE LOM, we should not forget the existence of other standards that can complement the metadata structure with more indexes: UNE 66181 standard is the first approach to the measurement of e-learning in Spain. CWA 15661 standard [10], in which content there can be found a guide to help on decision-making to choose educational supplies, includes a proposal for general information for educational resources called LST Profile. Table 2 shows that UNE 66181 complements ISO/IEC 19796-3 with rates of employability,

Table 2. UNE 66181 and CWA 15661 complementing ISO/IEC 19796-3 and IEEE LOM

UNE 66181	**ISO 19796-3**	**IEEE LOM**
Empleability (market demand)		
Empleability (certification)		
Accesibility	X	
Ease of assimilation (interactivity)	X	X
Ease of assimilation (tutoring)	X	
CWA 15661		
Information on the provider		X
General information on the e-learning supply		X
Overall organisation of the e-learning supply		X
Technology		X
Information on enrolment and administration		X
Digital learning contents/resources used in the learning supply	X	X
Face to face learning on virtual classrooms events (tutoring)	X	
Collaborative learning/interaction between learners		
Learner support	X	
Assessment of the learner	X	

and CWA 15661 contains information on employability, mentoring and evaluation not covered by IEEE LOM.

According to Table 2, proposals of indexes to be included in the metadata records of educational resources that add value in a measurement of quality are: accessibility, employability, tutoring and evaluation.

The quality index of employability, tutoring and evaluation take effect when the educational resource is a compendium of: learning object with the contents and learning materials, assessment exercises on the content and tracking student training. This group represents a higher level of abstraction to a simple learning object, which on the one hand presents an improvement in providing greater integrity to the subject, but otherwise you lose granularity to facilitate reuse in another educational context.

These metrics are described in the sections below.

5.1 Accessibility

Karampiperis and Sampson [11] conducted a study of possible extensions to IEEE LOM in several categories. The result of their work presents new information to include in the LOM metadata record with information about accessibility. Given the metrics defined in ISO/IEC 19796-3, accessibility is a concept for measuring quality, because it defines metrics such as navigation display, screen display, consistency of appearance and icons operation, etc.

UNE 66181 also includes accessibility as a fundamental parameter to be measured to determine the quality of e-learning. For this purpose, if a learning resource is in compliance with certain levels of requirements of the UNE 139801:2003, relevant information to determine the e-learning quality will be providing.

It is feasible to include in the IEEE LOM metadata record information regarding learning object accessibility rating (referred to within the field 9.1 Purpose), so that the metadata record is presented as a place to contain implicitly information on the degree of accessibility of the resource.

5.2 Employability

While the accessibility and ease of assimilation metrics defined in UNE 66181 are similarly defined in ISO/IEC 19796-3, it is not the same with the metrics of employability. Hence UNE 66181 complements the set of quality metrics with two proposals: market demand of the field, as well as the obtaining certificate having completed training.

5.3 Tutoring

UNE 66181 includes the functions of mentoring as a factor to take into account in assessing the degree of assimilation in training, and also occurs in CWA 15661, which includes concepts of mentoring information in its proposal. IEEE LOM only includes a brief review of information related to publishers or agents of the resource, but nothing about mentoring.

5.4 Evaluation

The concept of assessment is considered by ISO/IEC 19796-3 as a quality metric. Likewise, CWA 15661 provides, on the profile to find educational supplies, the category “student assessment” as a proposal for metadata related to the assessment.

6 Conclusions

It was observed that LOM metadata record include function and attribution metrics defined in ISO/IEC 19796-3. Therefore it is possible to find useful information for measuring the quality of educational resources in the event that their metadata compliant with IEEE LOM and are appropriately completed.

It is proposed to include information on accessibility, employability, tutoring and evaluation in IEEE LOM in order to have relevant information to an assessment of quality educational resource. In particular, accessibility metric is considered as an essential to the quality measurement; IEEE LOM however does not include information of this facet, which can be a significant lack of IEEE LOM.

IEEE LOM allows the creation of application profiles to suit different socio-cultural and demographic environments. Similarly, it would be possible to enlarge IEEE LOM including quality indices. It is also desirable that the items of IEEE LOM metadata record related to quality concepts were required to be completed to increase the chances of achievement in the exploitation of educational resources metadata.

As a further line of work scheduled beyond the current analysis of quality indexes and metadata, it is planned to carry out a system of quality assessment based on a subset of metadata. Merlot content repository can be the starting point for retrieving educational resources and metadata. Although it is far from reaching a satisfactory rate of completion in the metadata, it contains a greater number of educational resources filled with metadata compared to other repositories such as Ariadne or Maricopa [12] [5].

7 Acknowledgements

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E-Learning: Way Forward for Mathematics in Middle Schools

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Abstract: *With growing demand for e-learning to meet the needs of a vast population in India, this Pilot Study was undertaken to see how e-learning or online learning (ON) would compare with face-to-face (F2F) learning. Mathematics was chosen as a subject, because it is a dreaded subject, especially in the government schools. This Pilot Study was limited to subjects from just one government school and the instructional material for them was designed keeping in mind cognitive principles. Attempt was made to increase intrinsic motivation and make the experience stress-free for the learner. The Pilot Study is weak in its statistical analysis, given the small sample size, but throws up a lot of possibilities for further research. The mean scores of ON learning are better than that of F2F, yet the t-distribution analysis is split on which of the two is more effective, given the complexity of the learning task.*

Keywords: Pilot Study, E-learning, Cognitive Load Theory, Constructivist and Instructivist, Intrinsic Motivation**.**

1 Introduction

In today's knowledge-based society, there is need for deeper learning which occurs through creative thinking, problem solving, analysis, and evaluation, rather than recall of facts and procedures according to Bates (2000) as cited in [9]. This is precisely what e-learning tries to address when teaching a subject like mathematics.

Administrators and policy makers especially in a large country like India, see the scope of e-learning to: (a) Reach a broader student audience, (b) Handle shortages of certain skilled personnel, (c) Meet the needs of students unable to attend on-campus classes, (d) Involve outside speakers who would otherwise be unavailable, (e) Link students from different social, cultural and economic backgrounds, (f) Cope with a rapidly expanding population.

2 Evolution of e-Learning

Distance Education was born out of 'On Campus Learning' and took various forms. Nipper (1989) as cited in [1], proposed the model of "third generation distance learning". It's historically linked to developments in technology with the first generation distance education being print-based correspondence. The second generation was where the learner had print material integrated with the radio, television, audio and video cassettes. The third generation was *hypertext* supported by teleconferencing with audio and video facility. To this Taylor, (2001) as cited in [1], adds the "fourth generation," offering the learner flexible learning with internet accessible courses and the "fifth generation," with online interactive, multimedia and internet based access to web resources. In latter generations there is growing degree of learner control, two way communication, group oriented processes with flexibility in learning.

3 Three Pointers for e-Learning

3.1 Democratization

This increases access to education especially to disadvantaged people like: farmers, women, etc. One of the first meaningful experiences of distance education was Anna Eliot Ticknor's *Society to Encourage Studies at Home* by mail, according to Agassiz (1897/1971); (Bergmann, 2001), as cited in [4]. It was in her words an attempt "to encourage devoting some part of every day to learning." It was regardless of class or geographical boundaries and was open to any person that wanted to participate.

3.2 Liberal Education

It was believed that education should be: (i) Opportunistic learning, which can be delivered Just-In-Time, on demand by the learner, (ii) Substitute for On-Campus Learning for knowledge and answering critical questions. (iii) The medium and the message of educational innovation can be taken advantage of, (iv) It can be a bottom-up approach with the faculty initiating

scholarly articles, designing a virtual laboratory, having asynchronous discussions or hosting course websites.

3.3 Educational Quality

As of now interaction seems to be the yardstick for comparing face-to-face learning (F2F) with Online learning (ON) or e-learning. The face-to-face learning has the advantages of: social interaction, prompt feedback, engaging activities, institutional flexibility, and adaptation to individual needs. In the opinion of Harper (1886/1971) as cited in [4], online learning could claim the advantages of F2F learning and thus be the best form of delivery.

Also Chase (1916) as cited in [4], states that online learning is: individual teaching, with autonomous learning and a student's psychological needs being appreciated, thus making for better quality.

4 Mixed Response to e-Learning

4.1 Dillon & Gabbard (1998), as cited in [6] reviewed empirical studies in which hypermedia was used to present course material. Based on eight studies, they concluded that the amount learned from a hypermedia environment or from standard text on paper shows little difference in measures of comprehension. However, tasks that needed rapid searching through a large amount of information, the hypermedia showed some advantage.

4.2 Sitzmann, et al., (2006) as cited in [8], found that across all studies, the results indicated Web Based Instruction (WBI) was 6% more effective than Classroom Instruction (CLI) for teaching declarative knowledge. WBI and CLI were equally effective for teaching procedural knowledge.

4.3 Richard Clark (1983, 1994) as cited in [8], is one of the greatest critics of e-learning or WBI and he claims that newer, technologically based instructional material is not superior. He criticized media effectiveness research on two grounds: (a) Most studies fail to institute experimental controls sufficient to rule out alternative explanations for group differences, (b) Most prior studies have failed to isolate instructional attributes that are unique to a single medium, for instance learner customization.

4.4 Cobb (1997), as cited in [8], refutes Clark, and claims that WBI does have advantages. He argues that certain delivery media reduces the cognitive demands placed on learners, and media should be chosen to maximize cognitive efficiency, allowing learners to spend less time mastering the material.

5. Dropout Rates in e-Learning

A worrying factor for e-learning is the dropout rate. McLaren (2004) as cited in [5], says that the dropout rates from online learning courses are documented around 25% to 40%, as compared to 10% - 20% in on-campus courses. Again, Zielinski (2000), as cited in [5], reported for online training centers that more than 50% of learners dropped out compared to only 10% in standard on-site training. However, there could be factors like: demographic characteristics, locus of control, student's motivation, academic abilities, etc., which also contribute to the high dropout rates.

6. Use of Technology in Learning

The potential for improving learning through technology, especially using e-learning has not yet happened in India at the elementary level. Very often at the higher levels of learning the approach is technology-centered and not learner-centered for want of expertise, or costs. According to Mayer (2005b), as cited in [2], "designs that are consistent with the way the human mind works are more effective in fostering learning than those that are not". Hence e-learning has untapped potential especially in rural India.

There are cognitive roadblocks to learning but these can be overcome according to Brunning et al.(2004), as cited in [2]. They revolve around *attention* by (a) increasing the amount of attention while on a task, (b) decreasing the amount of attention to a task, (c) limiting the attention to important and relevant information to be learned. E-learning can bring the learner to pay effective attention to the task on hand.

7. Cognitive Load and Learning

Cognitive Load Theory (CLT), as cited in [2] is a learning theory, used to bridge the gap between instructional principles and knowledge of human cognition. Its assumptions are: (a) cognitive tasks are carried out in the working memory. (b) working memory is limited in capacity, (c) the working memory is only capable of processing a finite amount of information at any one time, (d) The working memory has visual and auditory processing channels, (e) The long-term memory (LTM) has efficiency and unlimited capacity which can be leveraged to enhance the working memory capacity. (f) Schemas held in LTM, which allow multiple elements of information to be categorized as a single element require less working memory, (g) Cognitive load can be reduced by automation, which allows schemas to be processed automatically rather than consciously.

While the goal of CLT is the reduction of preventable load on working memory through the structuring of information, not all types of cognitive load is bad according to Clark et al (2006), as cited in [2]. There is (a) Extraneous Load which comes from information that is irrelevant and results in longer learning time, (b) Intrinsic Load, which is caused by the natural complexity of the information that has to be processed, (c) Germane Load which is effective load that helps to enhance learning.

Hence while designing the e-learning material for the Pilot Study, care had to be taken to reduce the extraneous load that would interfere with learning, embed carefully the intrinsic load, breaking it down into manageable steps, and punctuate the material with germane load, to sustain the interest of the learners and offer a degree of challenge.

8. Cognitive Requirements

Cognitive requirements for e-learning from resource-rich environments include (a) Identifying and refining questions, topics, or information needs (metacognition), (b) Monitoring the effectiveness of search results and strategies and refining them when unproductive (metacognition, procedural knowledge), (c) Monitoring the fine details of a project, remaining focused on the forest or broader purpose without getting lost in the trees (comprehension monitoring), (d) Integrating information coherently from a variety of sources (reasoning).

9. K-12 Education and e-Learning

Kristmundsson (2000), as cited in [3] rightly states that for the first time in the history of education, it cannot be assumed that teachers are ahead of their students in a particular field. He says they do have the advantage of helping learners convert information into knowledge.

Frechette (2002, p. xvii) as cited in [3], refers to another aspect of the Web in stating that "the traditional role of the teacher as the 'fountain of knowledge' must be reconsidered as massive amounts of information are readily accessible on the Internet….With the continued emergence of new technologies, learning will be less about knowledge residing in the head and more about learning the pathways to knowledge." We see that the role of the teacher is as a mere facilitator of knowledge.

Aspects of the students that were evident in the e-learning Pilot Study were: (a) prior knowledge – this was evident in the Pilot Study, for students lacking the concept of the number line found it difficult to add or subtract in algebra. (b) attitude – if they had a positive attitude, they were keen on coming up with solutions for themselves rather that skipping the exercise. (c) gender – the observation of the technical assistant in the laboratory was that the females were keen on getting the task right, while the males were keen on completing the task at the earliest. (d) age – since the range of age was from 11 to 16 years, there was no great difference in how they went about the learning tasks.

10. Two Perspectives of Learning

There are two perspectives of learning for the design of educational multimedia applications, namely (i) Constructivist and (ii) Instructivist according to Tse-Kian, K.N. (2003), as cited in [9].

Key Principles of the Constructivist and Instructivist view of teaching and learning are: (a) The Constructivist view is learner-centered perspective treating learners as individuals, while the Instuctivist view is teacher-centered dealing with group learning, (b) The former encourages student independence in learning, while the later makes for student dependence on the teacher, (c) The former has the teacher as facilitator and guide, while the later has the teacher as instructor, (d) The former has the learner and facilitator engaged in collaborative learning experience, while the later has the teacher in control and in a position of power, (e) The former has the learner constructing the knowledge in his own individual manner, while the later has learners passively getting knowledge from the instructor, (f) The former is concerned about the process of learning, while the later is concerned about the acquisition of facts, (g) The former has a curriculum design that makes for exploration, while the later has a design that's structured and directed to a fixed goal, (h) The former encourages higher order thinking skills while the later is concerned with recall of facts, making for surface learning, (i)The former makes for open-ended-learning-environment (OELE), while the later is directed instruction.

Keeping the above principles in mind, care had to be taken while designing the software for the Pilot Study, that the learning outcome would result in learners being Constructivist and not Instructivist. .

11. Intrinsic Motivation - 4 Strategies

Four strategies that help intrinsic motivation are: (a) challenge, (b) curiosity, (c) control and (d) fantasy, that can play a role in the instructional design of web-learning, according to Pintrich & Schunk (1996); Malone and Lepper (1987) as cited in [10]. They can complement each other in enhancing and sustaining students' intrinsic motivation.

(a) Challenge: Learners who achieve challenging goals feel that they are becoming more competent and are apt to set new, even more challenging goals, a process that serves

to maintain intrinsic motivation according to Pintrich & Schunk (1996). In the Pilot Study, the level of challenge increased with each lesson, whether it was in algebra or geometry.

(b) Curiosity: It is a response to any novel and extraordinary idea that drives students to discover. Malone and Lepper (1987) distinguish between sensory curiosity and cognitive curiosity. Both of these were employed in the design of the material for the Pilot Study, with color, animation and the element of surprise.

(c) Control: A Learners' intrinsic motivation may be enhanced if activities can provide a sense of control and allow learners to direct their own learning performance. Malone & Lepper (1987) made two suggestions for promoting the sense of control in computer-based instruction environments: (i) allow learners to control instructionally irrelevant aspects of an activity, (ii) provide limited choices concerning other variables. This played a very important part in motivating the e-learners during the Pilot Study, because they could revisit any of the slides they wanted and work at their own pace.

(d) Fantasy: A fantasy environment is defined by Malone & Lepper (1987) as an environment that evokes mental images of physical or social situations not actually present or in some cases not possible. This particular aspect wasn't incorporated in the Pilot Study.

12. The Pilot Study

12.1 Parameters

The Pilot Study was undertaken in a government-aided school in India which offered mathematics. The school was in a semi-urban location, and the medium of instruction was the local language, Bengali. The students belonged to families of a lower income group, most of whom were first-generation learners. There were 20 students in all that participated in the pilot study, comprising of 7 females and 13 males. They were from classes 7, 8 and 9 with ages ranging from 11 to 16 years.

12.2 Reasons for the small sample size

The reasons for the small sample size in the study were: (a) The school authorities were unknown to the experimenters, (b) The total strength of the individual class in the given school was small, (c) The regularity of the students could not be assured and hence the school authorities picked students that were regular, (d) The school authorities discontinued regular classes for the duration of the pilot study. (e) The computer laboratory had a limited capacity for each child to work on an individual computer.

12.3 Pilot Study hoped to examine

The Pilot Study hoped to examine how the students exposed to two modes of learning, found any of the modes to be more effective, measured in scores that reflected that they had mastered basic concepts in mathematics. The two modes of learning were: (i) Face-to-Face Learning (F2F), wherein the students learnt the subject matter from a teacher physically present, using talk-and-chalk, (ii) Online (ON) Learning, wherein the identical subject-matter was taught through colorful Power Point Presentations with recorded voices of a male and female teacher, with limited animation.

12.4 Other Factors Kept in Mind

The subject-matter covered basic algebra and geometry using the local language. To help the subjects have control over the pace at which they learnt provision was made for navigating through the slides. The number of slides did not exceed eight, keeping in mind the appropriate cognitive load of the subject-matter being learnt. There was a step-by-step progression in the material, and the changes in the subsequent steps were few, almost suggesting a 'mirroring of learning'. The Pilot Study was carried over five days at an average of 90 minutes per group each day.

12.5 Procedure Followed

Day 1 was taken up with the learners becoming accustomed to using the computer and randomly assigning them to Group A and Group B. Apart from some males having used computers for gaming the rest were working at a computer for the first time but quickly grasped how to navigate between slides.

Day 2 and 3, were taken up with the Groups alternating between learning algebra F2F or ON. This involved the basics of addition, subtraction, multiplication and division in Algebra.

Day 4 and 5, were taken up with the Groups alternating between learning geometry F2F or ON. This involved dealing with angles related to straight lines and angles related to parallel lines.

For each lesson, there was a Pre-Test and Post-Test done to gauge the effectiveness of F2F and ON and the scores were taken into consideration. While the timing for the Pre-Test and Post-Test was also recorded, it was not found to be accurate, because of the weakness in the software for recording. If this had to work effectively, it would have added to the quality of the Pilot Study.

12.6 The Findings

12.6.1 Mean and Standard Deviation

A summary of the Mean and Standard Deviation is as given in Table 1. We see that in both algebra (ALG) and geometry (GO) there is an improvement in the mean post test results in both the Face-to-Face (F2F) as well as the Online (ON).

Table 1: Mean and Standard Deviation

	MEAN		STD DEV	
	Pre Test	Post Test	Pre Test	Post Test
ALG(F2F)	7.06	10.53	5.13	6.14
GO(F2F)	3.56	8.11	3.81	3.77
ALG(ON)	7.65	13.06	4.76	5.10
GO(ON)	2.39	8.50	2.59	5.66

The difference in the pre-test mean and the post-test mean in Algebra for F2F is 3.47 while for ON is 5.41, which shows that ON has been 55.91% more effective than F2F for Algebra.

In the same way, the difference in the pre-test mean and the post-test mean in Geometry for F2F is 4.55 while for ON is 6.11, which shows that ON has been 34.28% more effective than F2F for Geometry.

From the results we also see that the mean for algebra is much higher than the mean for geometry, be it in the Face-to-Face or the Online learning. This could possibly be because of spatial concepts that are needed in the learning of geometry, which may not be well grounded.

However, in the standard deviation, there seems to be a much greater variance in the post tests results, may be due to a small segment making substantial improvement.

12.6.2 t Test Distribution

Given the limitations of the Pilot Study undertaken, especially that there were only twenty subjects in all, statistical analysis using the t Test for independent samples offered a way forward for analyzing the recorded data.

Ferguson (1971), cited in [7] has suggested a "difference method", in case of a small sample size ($N < 30$). Here, the value of t can be directly computed using Formula (1):

$$t = \Sigma D^2 / \sqrt{[N \Sigma D^2 - (\Sigma D^2)]} / (N-1)\ldots\ldots\ldots \quad (1)$$

where:
D = Difference in score between initial and final testing (in the case of single group) or between pairs of matched subjects (for equivalent groups).

Table 2: F2F better than ON learning

	Algebra 1	Geometry 1
Computed Value of t	*1.96*	*3.21*
Critical value of t with 16/17 degrees of freedom with 10% level of Confidence	1.75	2.11

A summary of the t-distribution results where F2F is better than ON is given in Table 2. We see that the computed value of t for both Algebra 1 and Geometry 1 is higher than the corresponding critical value of t with 16/17 degrees of freedom with 10% level of Confidence. This shows that for Algebra 1 (addition), and Geometry 1(straight angles), F2F was more effective than ON learning. This also goes to show that for the basic lessons, F2F is more effective, but as the level of difficulty increases, ON can fetch better outcomes.

Table 3: ON better than F2F learning

	Algebra 2	Algebra 4	Geometry 3
Computed Value of t	*2.59*	*2.89*	*1.92*
Critical value of t with 16/17 degrees of freedom with 10% level of Confidence	1.75	1.74	1.74

A summary of the t-distribution results where ON is better than F2F is given in Table 3. We see that the computed value of t for Algebra 2, Algebra 4 and Geometry 3 for Online learning is higher than the corresponding critical value of t with 16/17 degrees of freedom with 10% level of a Confidence. This shows that for Algebra 2 (subtraction), Algebra 4 (division), and Geometry 3 (Alternate and Corresponding angles), ON was more effective than F2F learning.

For the rest of the lessons: Algebra 3, Geometry 2, and Geometry 4, the computed value of t was lower than the critical value of t with 16/17 degrees of freedom with 10% level of confidence.

We can see from the t distribution analysis, that while F2F is effective for the learning of one type of concept, ON is effective for the learning of another type of concept.

12.7 What Worked Well

The Pilot Study worked well for a number of reasons: (a) breaking up of concepts into smaller steps, (b) having a technical assistant in the computer laboratory, (c) learners enjoyed doing mathematics on the computer, (d) having the 'Paint' program as a time-filler helped, (e) having a small batch size helped with monitoring.

12.8 Lessons Learnt

Some of the critical lessons learnt are: (a) having a larger sample size, especially in the light of learners being absent. (b) having a more interactive software for learning, (c) having a system to time the pre-tests and post-tests, (d) providing an outline at the beginning and a summary at the end of each lesson, (e) need for greater statistical analysis, (f) having a cognitive test administered to see the correlation between the test scores and the learning outcomes, (g) care would need to be taken for effective application of ANOVA, that the dependent and independent variables are distinct without interference, (h) the sample size would have to be composed of equal number of males and females for comparative purposes, (i) would have to carefully monitor the duration of each lesson, (j) would have to put additional hyperlinks to cater to the gaps in learning.

13 Conclusion

The Pilot Study was a very enriching experience both for the learners as well as for the experimenters. E-Learning has a fantastic potential to deliver, especially in rural India, where the teachers are scarce and the learners are far flung. This format can also provide standardized software, that takes into account the cognitive abilities of the learner and tries to design the multimedia package accordingly.

Going by just the mean scores of F2F and ON learning, it appears that ON or e-learning is far superior. But the findings of the t-distribution series shows that in two instances, F2F is more effective, while in three instances ON is more effective. This is in keeping with the current literature where the house is divided in its opinion as to which is better. Perhaps the way forward could possibly be WBI-S or Web Based Instruction – Supplement which is sometimes referred to as a Blend of F2F and ON learning. This will also cater to individual styles of learning.

The secret of acquiring knowledge and skills is to have the learner 'engaged', which e-learning is better equipped to deliver at the middle school level. Finally as technology is improved, it will be able to mimic the F2F learning with greater accuracy, and at the same time reduce the cognitive load on the learners.

World Bank consultations at the turn of the century have proposed, "education for all"—possibly though e-learning and this may be humanity's best chance to end poverty. Fortunately, India has a National Resource Centre for Online Learning (NCST) in Mumbai to see to the growth of e-learning, and point the way forward, especially for rural regions where approximately two-thirds of India dwells.

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Specifying Requirements for Multimedia Educational Tutorials

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ABSTRACT
The Multimedia Requirements Method for Easy Risk Mitigation (MURMER) was proposed at SIGDOC '06 [1]. This method represents requirements for multimedia document types containing audio, video, image or textual data. Now MURMER and its resulting online tutorials have been augmented to encompass content to be taught and tested online, via an interactive quiz. In general MURMER aims to provide a straightforward and clear understanding of the whole requirement pane of the final product, which happens to be an online tutorial. It also aims to decrease risk levels associated to the requirements phase and improves overall completeness. The feasibility of the proposed method is shown in a tutorial example created in Adobe Flash and with corresponding MS Powerpoint documents. This tutorial is being used to teach face-to-face and online versions of our Operating Systems course. MURMER investigation is compared to other UML-driven schemes. Its efficiency is based on simplicity and completeness. It is also effective as a risk mitigator.

Categories and Subject Descriptors
D.2.7 [**Software Engineering**]: Requirements Analysis, Risk Mitigation– *documentation*.

General Terms
Multimedia, Requirements, Documentation

Keywords
Risk Mitigation, Multimedia Requirements

1. INTRODUCTION

The term 'multimedia' as is used in this paper refers to the encapsulation of text, images, audio, and video in a single document [1]. In particular, these methods are for specifying requirements for a step by step online tutorial on a particular topic, followed by an interactive quiz which stores student answers in a file stored locally on the student's computer.

Many experts in the field admit the explosion of capabilities in recent years towards the goal of creating worthwhile and creative multimedia documents [2]. As a result there is an abundant supply of products for creating tutorials. At Florida Insitute of Technology Adobe Flash is being used to create these tutorials which incorporate audio, video and animation and allow for the interaction (i.e. button pushing) by students. These tutorials are easily playable using browsers with few add-ons (usually only QuickTime or Windows Media Player). As it has often been the case in the past, the creators of these documents often ignore sound design principles that are used with other traditional software processes, and systems are often hacked or thrown together without any design documentation at all. When it comes to methodologies like UML the jury is out when it comes to full adoption for specifying requirements of multimedia tutorials that we have described here.

This research continues the evolution of a simple method for representing requirements for multimedia documents which contain audio, video, images, and/or text. The primary goals for implementing and using this method include risk mitigation, simplicity, completeness, and a straightforward representation of the final product. The requirements document methodology proposed would also work well in a customer-driven enterprise environment, where customers insist upon the early risk mitigation of costly media components such as video.

As a proof of concept, the researchers produced a PowerPoint Document for the requirements method and the final product is a simple tutorial created using Macromedia's Flash software.

2. MULTIMEDIA REQUIREMENTS RESEARCH BACKGROUND

Multimedia research through the middle 1990's focused on the development of infrastructure to support the capture, storage, transmission, and presentation of multimedia data [1]. Now that products have matured and developers are getting more formal about the design and documentation of such systems, it is natural to employ some worthwhile methods for documenting sound engineering principles.

For example, as B. Adams, et al. point out in [2], a typical viewer of a video is expecting to watch a movie, i.e. to be entertained or educated somehow. However, without planning, a requirements document or any other design documents, a lot of video that is produced is not thought out, and therefore lacks the necessary elements to make the content interesting, informative, pre-approved, verified, validated, etc.

If a multimedia document designer uses the traditional three-part creation process used by professional filmmakers: namely,

preproduction (storyboarding and scripting), production (principle photography), and postproduction (editing) [2] then a typical requirements document could be represented as a storyboard plus some other elements representing flow, behavior, placement, and content.

R. M. Newman has also proposed a hypermedia product using storyboarding as a means of representing linear sequences that are "industrial strength", or best suited for formal verification and validation of processes and procedures in industry. The method Newman proposed is somewhat heavyweight, whereas the MURMER method is meant to be used for basic tutorials and is simpler and less formal and represents a more lightweight process. If risk mitigation is taken as a primary goal, the MURMER method is simple yet also capable of showing a potential customer the general proposed layout of the multimedia presentation without producing the more expensive elements such as video, audio, animation, or the interaction with the user that is part of the final product. This capability is key since many customers might be reluctant to authorize contracting of a multimedia project if the video will be costly or somehow otherwise *high risk*. In general, in any software production environment, customers first want to get an idea of what to expect of the final product. The proposed method acts as a risk mitigator (cost) and a means by which a developer can easily and quickly present ideas at the requirements stage.

3. MULTIMEDIA REQUIREMENTS METHOD FOR EASY RISK MITIGATION (MURMER)

The design principles of MURMER include simplicity, completeness, and risk mitigation. Risk mitigation means that the costliest components, although represented and determined at the requirements stage, are not implemented or even prototyped at this early stage.

The requirements document is an official statement or specification of the system requirements for customers, end-users and software developers. Stakeholders of the system are people who have a direct or indirect influence on the system requirements and may include end-users, outside customers, managers, as well as the software engineers themselves [4]. It is desirable to have a requirements document which is readable and easily understood by all stakeholders.

MURMER represents content and sequence timelines with three Formal Sets: 1) a Storyboard (PPT) of the proposed presentation, 2) a Content Filelist of audio files, video files, image files, and text files, and 3) one or more Finite State Machines showing the timeline of frames. In addition, it is useful to create scripts for frames that can be checked for correctness and can be used to build content text files for each frame. Since many F.I.T. students are not native English speakers we see an advantage for audio to accompany all text. This also makes it easy to produce podcasts for students which gives an alternative delivery method. Together, these elements adequately represent an abstract representation of the necessary elements for a multimedia presentation such as a simple tutorial. It is argued that at this early stage (requirements) a designer is only required to represent the essential components abstractly. Each of the three MURMER components are described below.

The slides of the *PowerPoint Storyboard* have a one-to-one correspondence to the frames of the final Flash presentation proposed. While developing MURMER, it became apparent that it would be productive to create a set of reusable Frame Templates to use at the storyboarding phase. The Frame Templates each represent a specific positioning of all types of content, including audio, images, video, and text. Then the developer chooses from the Frame Template set when designing the Powerpoint storyboard. This helps provide consistency, continuity, and reusability early on in the design process. A sample frame of the storyboard is shown in Figure 1.

Figure 1: A Sample Frame Displaying the Layout of Multimedia in the Flash Document

Note the correspondence of each content item mentioned in the Frame and its corresponding content file in the Content File List. This is especially convenient if the customer initially provides content to be used such as images and video. For instance, if one is contracted to create a promotional Flash document for a company, it might be the case that the company will initially make available and provide images and video that can be placed and included at the requirements stage.

The *Content Filelist* represents all content and each file should follow a naming convention and directly correspond to those files used in the PowerPoint Storyboard described above. Each file may represent an existing piece of content or a proposed piece of content. There are four types of file lists in the Content Filelist: 1) text, 2) audio, 3) video, and 4) images. The naming conventions for the files should be used throughout the project.

See Figure 2. for a mapping of the Content Filelist from the Powerpoint slides to the actual files. This mapping provides completeness since it represents all content proposed for the presentation.

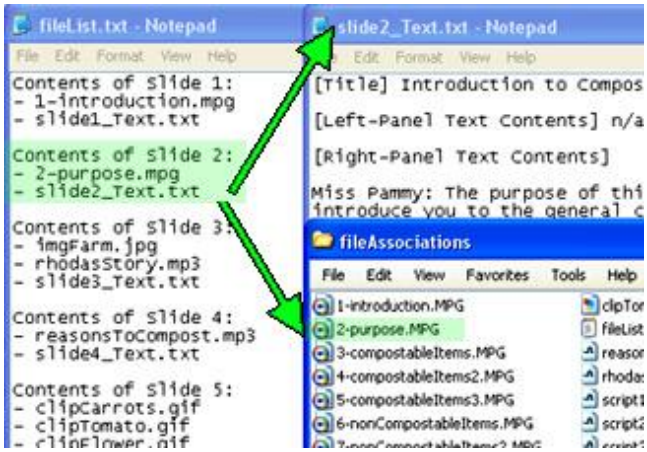

Figure 2: The Content File List on the Left-Hand Side Maps from Slide Number to Actual File Contents

A recent addition to MURMER is the allowance of the specification of an output file deliverable of the quiz answers that is produced by the Flash tutorial itself. This is readily accomplished by presenting the quiz questions, giving multiple choices, and retrieving and storing the user's answers in a text file which then gets stored locally. This file can be easily included in the filelist.txt file. Instructions are given to the student to email this answer file to the instructor to show proof of completion of the quiz and to give a grade for the quiz.

The *Flash State Machine* is a finite state machine representing the flow of all of the frames of the PowerPoint Storyboard. It also serves to show the navigational components of each frame and should answer questions such as 'Can we access the previous frame from the current frame?'. The FSMs could be expanded to also answer such questions as 'What media can be initiated from this frame?' See Figure 3. for the FSM for a tutorial which incorporates an interactive quiz at the end.

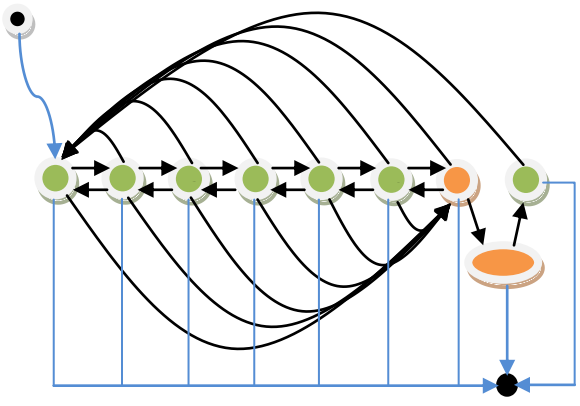

Figure 3: The Finite State Machine Model Displays Navigation Properties of Each Frame Within the Presentation.

4. FRAME TEMPLATES

The concept of Frame Templates is proposed to provide consistency, structure, and a general set of graphics, buttons, windows, or other graphical components for groups of frames in the final product. The actual Powerpoint Storyboard slides created as part of the requirements analysis may have a many-to-one correspondence to the Frame Templates. Template groups may be unique to a presentation or they may be unique to a group, company, or even just a single frame. There is no limit to the number of templates one can design. Note that the use of frame templates also provides reusable components for design.

Figure 4: The Final Version of a Frame from *Composting 101* Created From a Powerpoint Frame Template and Components From the File List.

5. WHY USE MURMER?

The Unified Modeling Language (UML) is the de facto standard for graphically documenting modern software systems [5]. However, there is often a collective sigh of relief from the software developers when they hear that they will not be required to completely utilize UML, as it is complex and difficult to master. With a 10-20 minute tutorial to be designed and implemented, one might argue that the creation of the corresponding UML diagrams (there are thirteen of them) is time/cost prohibitive. Even the Object Management Group itself warns of the complexity associated with UML [5].

When teaching or managing teachers who teach classes in an online format, it is cost-effective and beneficial to create and can as much extra material as is possible to augment routine weekly synchronous classroom discussions or "live chats". The use of MURMER can be used as follows:

- Specification of all textual content to risk mitigate coverage and correctness of the material to be presented.
- Specification of the length of the tutorial in frames.
- Placement of quizzes and interaction.

- Placement of images and video.
- Specification of all filenames of all content including all audio and video.

With the advent of handheld devices, tablets, iPods, iPads, and phones as delivery methods, students are able to take advantage of browser based tutorials almost anywhere. MURMER does not address usebility issues since many of these issues are reconciled by the use of the internet browser as a delivery interface. It is felt that specifying requirements for the student is outside the realm of this methodology.

6. FUTURE ADDITIONS AND RESEARCH TO MURMER

In their discussion of requirements for multimedia, Cutts, et. Al. [11] mention separate requirements for the tutor and the student. MURMER primarily addresses tutor and implementor requirements. The student view is not really addressed. They also specify timing controls which is not addressed by MURMER, i.e. it's pace is self-directed by the user of the tutorial. Although this is intentional with MURMER, it does limit the tutorial type that one can produce. For instance, timed quizzes are not represented since the student gets as much time as they want to complete the quiz. Cutts, et. Al. also include a table of contents which is not currently an artifact within MURMER.

7. CONCLUSIONS

The MURMER method represents a starting point for representing simple multi-media tutorials that merge audio, video, text, animation, interaction, and images. Its primary function is that of a risk mitigator, so that risky or costly components such as video (or animation) are documented early on. Other goals with the method include simplicity, correctness, and completeness when designing tutorial or presentation type media which incorporate text, images, audio, and video. The method is simple as it relies on well-known tools such as PowerPoint, notepad or text files, and state machines to represent the entire specification. The method is complete as it covers all content and has a representation of the high risk components and where they would be placed in the overall design. MURMER also strives to be customer-oriented, since it is simple and accessible to customers, can be done at the early (requirements) phase, and can provide excellent risk mitigation at such early stages of development. In a nutshell, education administrators are in a position to want to build tutorials that can be canned and available via learning management systems, websites, iTunesU, YouTube, etc. But production of such tutorials is jeopardized by incomplete or nonsensical content or worse yet, in the case where the content is just plain incorrect. One could argue that a complete online tutorial is 100% unusable if even one topic area is incorrectly stated or contains errors of fact.

In a working environment where resources are slim, students often assist in the production of these online tutorials. It is not fair to rely upon the student to fact check the content of the tutorials when their primary function is to create the tutorial itself. This separation of management of content versus delivery of content, and the quizzing of content must be separated just as in the engineering of other software artifacts

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Technology Instigated Learning Outcomes (TILO):

A Management of Technology (MOT) based framework for enabling student needs inside and outside the classroom environment

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Abstract— *The research focuses on various factors influencing student needs inside and outside the classroom environment. The importance of Learning Management Systems (LMS) are being highlighted in the literature followed by proposing a conceptual LMS framework which is debated over the use of Internet rich application usage. An empirical evaluation was undertaken to validate the research questions formulated in the study. The research has been carried out at an International University in Vietnam at the Center for Commerce and Management, during the winter semester of 2009. As employees of the institution, it had become instrumental in gaining entry towards conducting the research on the students in Vietnam in a global context. Participants in the study consisted of 91 students spanning two classes (taught by the authors) using the interaction survey method by building a customized minimalist questionnaire consisting of 12 questions. The demographic backgrounds of these students were taken from an International institution located in Vietnam. Hence, policy recommendations and decision making with respect to LMS deployment and usage should be dealt with prudence and pragmatism. SPSS 20.0 was employed to analyze and interpret the collected data. Chi-square test, Frequency distribution, independent samples t-test and percentage methodologies were adopted during the analysis phase of the project. The results of the study indicates that the students' perception of Technology Instigated Learning Outcomes (TILO) seems to be positively motivated towards adopting TILO as the default choice for deployment as a LMS in future.*

Keywords: Assessments, LMS, Student needs, SPSS, TILO, Vietnam

1. Introduction

Technology Management is a set of management disciplines allowing organizations to manage their technological fundamentals to create competitive advantage. International students are the consequence of the whirlwind of changes that characterizes contemporary universities. The trend of globalization and digital revolution is increasingly forcing students and universities to become internationally competitive in an 'increasingly globalized higher education marketplace' (Amaldas et al., 2010).Typical concepts used in technology management are technology strategy (a logic or role of technology within an organization), technology forecasting (identification of possible relevant technologies for the organization, possibly through technology scouting), technology road mapping (mapping technologies to business and market needs), technology project portfolio (a set of projects under development) and technology portfolio (Technology Management, 2012). Since technology is such a vital force, the field of technology management has emerged to address the particular ways in which companies should approach the use of technology in business strategies and operations. Technology is inherently difficult to manage because it is constantly changing, often in ways that cannot be predicted. Technology management is the set of policies and practices that leverage technologies to build, maintain, and enhance the competitive advantage of the firm on the basis of proprietary knowledge and know-how (U.S. Office of Technology Assessment, 1995).

The U.S. National Research Council in Washington, D.C., defined Management of Technology (MOT) as linking "engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization" (National Research Council, 1987). While technology management techniques are themselves important to firm competitiveness, they are most effective when they complement the overall strategic posture adopted by the firm. The strategic management of technology tries to create competitiveness by incorporating technological opportunities into the corporate strategy (U.S. National Research Council, 1987).

As academics in tertiary institutions across the world experiment with technologies towards improving their overall course experiences, it is important to recognize that their role as teachers, has remained essentially the same over the years: to educate and inspire students, and to offer them the means to build stable foundations for a successful future. While teachers can continue to be highly effective with the traditional lecture-style instructional method, a new technological resource, that of web-based LMS, is spreading out (Georgouli et al., 2008). Research results demonstrate that, although innovation may build upon the technical prospects, concrete difficulties arise, caused by problems of incongruity at the level of the educational model (Griffiths, 2005; Laurillard, 2002; Jonassen et al., 1998) learners per-

ceive a shift in the educational culture causing stress and creating reluctance to participate. Moreover, traditionally-minded educators often disapprove or feel uncomfortable with this implied change in educational policy. After a long period of using LMSs in tertiary education, it became obvious that these tools cannot reach their full potential if teachers are unwilling to adapt to a different teaching style, based on technology. In order to adapt successfully, teachers must be trained to develop their pedagogical autonomy and to become proficient in the use of technical tools, in order to be able to make experimentation's, to discover the need for a sound new pedagogy and to foster it in university teaching. LMSs are the most representative e-learning applications. Some are open source software; others are commercially provided (Georgouli et al., 2008). In a constructivist environment, Information and Communication Technologies (ICT) are currently used in a web centric instructional delivery mechanism. In relation to this, higher education can be investigated as a mixed mode method of instruction that could involve web based and face to face teaching mechanisms which emulates constructivist models by learning the effects of student epistemological believes (Amaldas et al., 2010). Five epistemological models of persuasion were previously researched upon which included four factors: (1) Simple Knowledge (knowledge characterized as independent pieces of information contributing to inter-related concepts); (2) Certain Knowledge (tentative and evolving knowledge); (3) Fixed Ability (innate abilities improve learning); (4) Quick Learning (micro-learning perspectives).

Quick Learning is the focal point of the Authors' teaching method to optimize TILO as an LMS framework for students. Lectures are taught to students for 45 to 60 minutes. Next, the students are grouped into 5 and given a task which has to be solved in 10 minutes. Each of the individual students are instigated to speak in front of the class. The rest of the students enables the presenter to self assess and correct oneself during and after the presentation as observed in the classes of the Authors. In this manner, each student is forced to listen attentively to the lectures and is required to read the lecture notes in advance using the LMS before walking into the classrooms. This paves the pathway for the students to do well in each classroom leading to perfection of ideas and motivation to do give their best performance in the examinations.

The above mentioned concepts can be utilized for distance-learning and as a supplement to in-class lectures, on which course announcements, homework assignments, lecture notes and slides can be posted, for Internet access (OECD, 2005). These days, we observe a movement in higher education leading from proprietary software to open source, for e-learning applications (Coppola and Neelley, 2004). In fact, open source software development can provide the necessary flexibility to combine languages, scripts, learning objects and lesson plans, effectively, without the cost and rigidity of proprietary packages (Williams, 2003). An LMS is not limited to a strictly determined educational role: it may also function as a new means for communication. Therefore, we have to examine closely the use of these platforms at all educational levels (Pirani, 2004). Hence, LMS become a crucial part of becoming an enabler of MOT based technologies and supports numerous technologies. This paper discusses the need for MOT methodology inside and outside of a classroom environment enabling an LMS based framework: the Technology Instigated Learning Outcomes (TILO) towards improving the learning outcomes of students and assessing their needs in the context of current usage of Internet Rich Application (IRA) interfaces.

1.1 Thematic Focus

It is every academic administrator's responsibility towards improving the quality of teaching and learning in tertiary institutions across the society. In this context, the tertiary institutions dealing with educating students in Management and Technology Infrastructure (MTI) development is responsible for implementing various educational support programs especially to inculcate the use and integration of educational technologies amongst academics and students to improve the effectiveness of the teaching and learning processes incorporated. The definition formulated for MOT framework used in this paper is based on the definitions of the European Institute of Technology Management (EITM, 2007), Khalil (2000), Tabbada (2000) and Kanz and Lam (1996). Khalil (2000) defines MOT as an interdisciplinary field that integrates science, engineering, and management knowledge and practice. Khalil (2000) views MOT as an interconnection amongst disciplines focusing on technology creation enabling service oriented economic incentives. EITM (2007) defines MOT as involving the effective identification, selection, acquisition, development, exploitation and protection of technologies needed to maintain a market position and business performance consistent with individual company goals.

Kanz and Lam (1996) take the role of defining MOT using a more practical viewpoint. Kanz and Lam (1996) define MOT at a more simplistic societal leveling linking the underlying use of technologies working together with people to achieve systematic methods towards applying knowledge in order to produce goods and services. Tabbada (2000) takes on higher tier of academic perspective defining MOT as an educational research tool fabricated to manage the technology components of individual product life cycles, capitalize on process technology to gain competitive advantage, and integrate product and process technologies. In this paper, MOT is defined as an educational framework that is utilized in engineering, science and management departments towards knowledge acquisition for the effective standardization and delivery of industry recognized courses as the core components in tertiary institutions. Utilizing this

framework the researcher intends to provide the necessary framework for the educational institutions and multinational organizations to gain competitive training advantages towards attaining desired levels of growth and performance on its students and future employees.

The role of the technology management function in an organization understands the value of certain technologies for the organization. Continuous development of technology is valuable as long as there is a value for the customer and therefore, the technology management function in an organization should be able to argue when to invest on technology development and when to withdraw. Technology Management can also be defined as the integrated planning, design, optimization, operation and control of technological products, processes and services, a better definition would be the management of the use of technology for human advantage (Technology Management, 2012).

A fundamental point when understanding how technology is acquired is that technology is not just a physical thing but also comprises of knowledge embedded at the hardware and software level. The acquisition of technological capability is therefore not a one-off process but a cumulative one in which learning is derived from the development and use of technology (Bennett, D. & Kirit Vaidya, 2001).

Technology Based Learning (TBL) constitutes learning via electronic technology, including the Internet, intranets, satellite broadcasts, audio and video conferencing, bulletin boards, chat rooms, webcasts. TBL fosters greater accessibility to learning by offering anytime and anywhere delivery. Furthermore, learning can be synchronous, when delivery occurs when instructors and learners meet at a specific time in a physical or virtual classroom, or it can be asynchronous, when the learning does not occur at a pre-specified time and thus, can be self-paced. Web conferences, online forums, electronic mailing lists, wikis and virtual collaborative workspaces, blogs (weblog), simulations, LMSs are the most common delivery methods and tools used in a TBL environment (Cavus, N. & Kanbul, S., 2010). There are numerous advantages to TBL in comparison to face-to-face learning. Five of the primary benefits are (Koller, Harvey & Magnotta, 2008): (a) Accessibility, offering anytime and anywhere delivery; (b) Training that is self-paced and matched to the learners‘ needs; (c) Full scalability; (d) Timely dissemination of up-to-date information; and (e) Streamlined and effective learning delivery.

1.2 Purpose of the Study

The purpose of the study is to examine which IRAs are expected to be available for use by students. A TILO framework was developed by the authors during interactions in a Classroom Based Virtual Learning Environment (CBVLE). The framework was introduced by the authors during their academic teaching at an international campus in Vietnam during the winter semester of the academic year of 2009 to improve the learning outcomes of the students being taught. The study focuses on answering the following research questions:

1) What are the opinions of students inside and outside CBVLE?
2) What are the significant differences between the gender based perceptions on TILO?
3) Are there significant differences in the students' perceptions between the two classes in using TILO as a framework?

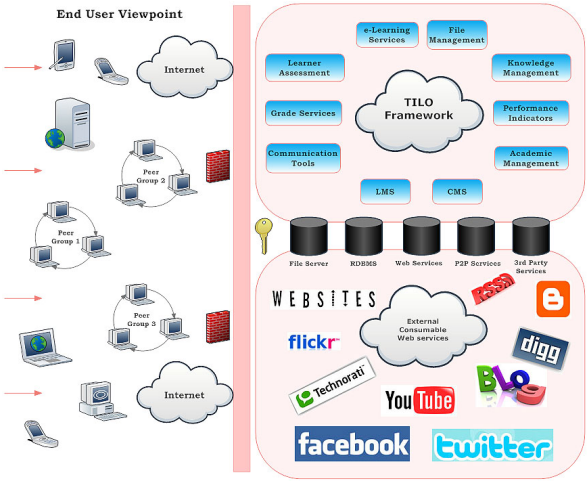
The rest of the paper investigates the proposed research questions using empirical instrument for evaluation and validation.

2. Theoretical Framework

As shown in Figure 1, we present the design of an instructional model, using the aforementioned framework, namely, TILO by exploring the available physical and learning technology infrastructures, and the pedagogical setup resulting from it. The main purpose of the current design effort is to determine those e-course modules that would reflect our instructional approach for enhancing the classroom environment by adopting a blended learning instructional methodology involving the (1) Rich Pictures (RP): used as a tool to easily communicate the ideas across to students for visualization; (2) Guest Lectures were introduced as a Pilot study for students to meet Professionals from the industries for career advancement; (3) Classroom based interactions enabled students to become more confident and to upheaval their stature as individuals; (4) Interactive White Board application was used as a Pilot study to kindle interest and motivation to use TILO; and finally (5) Virtual Classroom based interactions enabled students to write freely about their ideas as they are in their own den which is their homes (LMS based as practised by Christine).

Our pedagogical setup federates a "student-teacher-centered" learning mechanism derived from the American Psychology Association (APA, 1997). Design factors also involve the use of Merrill's first five principles of instructions: (1) Learning is promoted when learners observe a demonstration, the demonstration principle; (2) Learning is promoted when learners apply the new knowledge, the application principle; (3) Learning is promoted when learners engage in a task-centered instructional strategy, the task-centered principle; (4) Learning is promoted when learners activate prior knowledge or experience, the activation principle; (5) Learning is promoted when learners integrate their new knowledge into their everyday world, the integration principle (Merrill, 2002) and also from motivational factors involving Viau's theory as follows: Understanding the future competences to be acquired; Appreciating the interest and value of the task at hand, and feeling in control of the activities that are being carried out (Viau, 1994).

Fig. 1: TILO LMS Framework



Source: Designed by the Authors

A LMS is a system that plans, communicates and manages educational materials in on-line and virtual classrooms both. Learning Content Management System (LCMS), however, is a multi-user system that can produce, store, recycle, and manage digital learning materials, and transfer them to users (Han, 2010). In defining an LMS framework, users learn educational materials provided by the LMS in their preferred devices, such as a computer, PDA, laptops, smart phones and other devices that can access the internet using an IRA or web interface. In this case, learners only initiate the interaction which is recorded and appropriate services are initialized and consumed for exchange of information.

Figure 1 demonstrates a hypothetical framework for utilizing a learning management cloud service involving the consumption of e-Learning services and communication tools. Consumable services (Web or Grid services) using intercommunication mechanisms enable true IRA experiences when it comes to utilizing a high performance LMS platform. The proposed framework tries to provide for a variety of consumable services and tools such as Sharable Content Object Reference Model (SCORM) standards, which are a collection of standards and specifications for web-based e-Learning by the end users (students in our case) by interconnecting devices and applications through a variety of networks (P2P, LAN, WAN, etc). The framework defines all the respective communication links between the client side and the host system usually referred to as a run-time environment.

3. Methodology

3.1 Research Instruments

A questionnaire was developed based on the research questions formulated as "Students' prospects on Technology Instigated Learning Outcomes (TILO)" which was prepared by the authors in relation to IRA tools aimed at finding out students' prospects on TILO. The internal consistency of the questionnaire was observed to be 96.5% using the Cronbach alpha method wherein the content verification and validation of the questionnaire were validated by the respective Academic Managers of the department (experts of Management and Information Technology) in the area which were found to be satisfactory. The questionnaire consisted of two sections: Section one consisted of 5 items (Age, Gender, Nationality, Class Name, Class Type) which were developed as a specific section towards observing the demographic backgrounds of the respondents. Section two of the questionnaire consisted of 12 questions, prepared to understand the learning traits and requirements of the students' prospects of utilizing IRA tools using TILO. All questions represented a positive reaction to TILO framework indicating that the respondents rated each of the questions utilizing a Likert scale (ranging from 1 - 5) starting from "Strongly agree (5)","Agree (4)", "Neutral (3)" "Disagree (2)" and "Strongly disagree (1)".

3.2 Respondents

This study has been carried out at an International University in Vietnam at the Center for Commerce and Management, during the winter semester of 2009. As employees of the institution, it had become instrumental in gaining entry towards conducting the research on the students in Vietnam in a global context. Participants in the study consisted of 91 students spanning two classes (taught by the authors) wherein the female participants comprised of 58.4% (n = 54), while the male participants were 41.6% (n = 37).

4. Findings and Discussions

An online questionnaire was used to collect the data wherein 100% of the respondents (all 91 students) enabled the data acquisition process by making the questionnaire a part of the students' assessment criteria. All the data collected was made possible using an online web-based questionnaire designed and developed in-house by the authors. The collected data was coded using the Likert scale and the total counts of the individual scores were tabulated individually using SPSS 20.0 64-bit software. The obtained dataset was independently prepared using a spreadsheet and the data was exported as a "Comma-Separated Value" (CSV) file named data.csv. This is a typical spreadsheet product with several inadequacies for processing in SPSS which was fixed during data processing. Data processing using a spreadsheet application such as Microsoft Excel or Open Office Calc is a tedious but necessary first step for almost every data set being prepared. After data importing, the SPSS statistical software was utilized to analyse and interpret the collected data. Frequency, Chi-square, independent samples t-test, and percentage methods were used during the analysis phase of the data processing stage.

The interesting aspect of the questionnaire design was to have a minimalistic set of questions in order to reduce user fatigue during the data collection process. Most of the time questionnaires are quite elaborate in the sense of collecting large series of datasets of questions being answered by most users (in our case students) which includes repeated evaluations of assessment types. Table 1 presents the mean and standard deviation for individual questions coded for the respondents from the given questionnaire. The results indicate that students have great expectations from TILO system wherein the inevitable truth is that educational technologies are very important to educational institutions.

Table 1: Questionaire used for Assessment.

Questionnaire	Mean	SD.
Question 8: TILO should provide options for group or peer study.	2.08	1.470
Question 2: TILO should provide opportunity to send our homework to our Lecturers via the Internet.	1.52	1.015
Question 1: Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support.	1.51	1.089
Question 3: TILO must provide lessons for self assessment (tests) of the user with instant support for appropriate content.	1.48	0.982
Question 5: TILO users need access to communication tools (email, instant Messaging, blogs, etc) to communicate with lecturer and peers.	1.42	1.055
Question 6: TILO should provide a to-do list of learning activities automatically (announcements, homework, exam, mails, etc).	1.29	0.807
Question 4: TILO must provide each lesson with context sensitive self help system.	1.29	0.735
Question 10: TILO should provide self-test evaluation for final examinations preparation and provide a way to exchange user files with peers.	1.29	0.834
Question 12: TILO should be interactive with prompt feedback of user's online assessments.	1.16	0.500
Question 7: TILO should provide options for displaying my performance.	1.08	0.307
Question 11: TILO must provide secure access to personal information and content using a collaborative learning environment.	1.04	0.206
Question 9: TILO should provide profile information of the Lecturers.	1.00	0.000

Source: As designed by the authors

As shown in Table 1, the highest mean recorded from the respondents (students) prospects was from Question number 8 "TILO should provide options for group or peer study (M = 2.08)". The importance of information exchange is increasing day by day at an exponential rate especially when the rate of users are quite high like in that of a classroom. Hence, applying and managing continuously updated information between peer groups with networking technologies (ICT resources) and infrastructures (MOT enablers) in the management based educational sector is quite important as rightly identified by the group in Vietnam. Zhang, Perris and Young (2005) found that flexibility of time and place is a major advantage in all online courses.

The second highest mean of the students' perception was found to be Question 2 "TILO should provide opportunity to send our homework to our Lecturers via the Internet (M = 1.52)". Students require an optimal mechanism for downloading and uploading information especially homework. There are a number of host technological solutions such as AJAX or JQuery based homework drop boxes which could be custom built for uploading homework or assignments to the respective lecturers. Technology and infrastructure (access and connectivity) play a crucial role in the delivery of information at the right time. An example of this would be the a student sending an assignment file for evaluation. The system should be able to record the date and time at which this information was uploaded to enable assessment as soon as possible. Infrastructure plays an important role in connecting the staff with the respective students both within and outside of the classroom environment using proper technologies and infrastructure made available to the end users. Hence, it is observed that technology usage and its associated infrastructure could be put to good use showing in our case a positive outcome among the students indicating that these students give extra importance to technologies' usage during assessments inside and outside the classroom environment physically and virtually (online).

Another observation that is closely useful for discussion here is "Question 1: Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support. (M = 1.51)" wherein students give importance to appropriate multimedia content having a creative angle. Including print support to lecture materials is crucial for students to save not only on paper but also print only those slides or information that is important to them. Multimedia enabled content helps students to interact with the virtual environment which should also include assessments (quizzes) at every level being taught virtually. The element of self paced learning is always misjudged where lecturers regularly feel lazy (sometimes fatigued due to commitments) to update the contents online or they tend to overdo it and not teach well inside the classroom environment. This scenario is closely perceived in institutions where lecturers are expected to develop both the online content (multimedia included) and the contents of the course which is generally time consuming.

This leads to improper design and constraints both the energy and creativity of the staff in charge leading to failures in the learning outcomes of the students. In case of Question 3, students indicate that they strongly agree with "Question 3: TILO must provide lessons for self assessment (tests) of the user with instant support for appropriate content. (M = 1.48)".

Thus assessments and assessment tools are important to provide self assessment mechanisms for students to significantly improve themselves during their virtual classroom experience. This is most useful especially when looking at

"Question 5: TILO users need access to communication tools (email, instant Messaging, blogs, etc) to communicate with lecturers and peers. (M = 1.42)" wherein communication tools such as online chat tools and personal blogs etc., enable to improve the interactions between student group and their moderator (usually a leader or the lecturer). These tools need to be available all the time using appropriate menus to enable the users to constantly stay in touch making the online experience a unique one for each of the users. The rest of the questions are related to students agreeing with having a collaborative environment which includes profile information of the Lecturers, interactive learning activities, automatic announcements, homework, examination, mails that include context sensitive self help system. The students also perceive the need for having administered a self-test evaluation before final examination preparations and mechanisms to provide for a way to exchange user files with their respective peer groups. Prompt feedback of user's online assessments (displaying my performance) needs to be securely displayed based on the user's point of access using a user name and password within the collaborative learning environment.

4.1 Gender Analysis

For a given class (two in this case) of Management students in an international university, we were interested in observing if there was really a statistically significant difference between the gender's and the results obtained for TILO. The results obtained are based on gender's opinions obtained from the questionnaire shown Table 1 wherein independent samples of t-test were carried out and the results are shown in Table 2.

Table 2: Gender t-test

Gender	N	Mean	F	P
Male	71	2.01	1.232649	0.001
Female	20	2.30		

Source: As calculated by the authors

Based on the results obtained as disclosed in Table 2, a statistically significant difference between genders' opinions were observed on the TILO framework introduced to the students. The mean of female students' opinions on TBL environment was 2.30 when compared to 2.01 for male, a statistically difference that was found to be significant was ($p = .001$). Many studies include that the women are as successful as the men in most cases, which is clearly not the case in our study as the results indicate that women are more technology oriented than men in the case of Vietnam.

4.2 Evaluating Classes Independently

Based on the results obtained in Table 3, there is a statistically significant differences between the two classes assessed on TILO which indicates $p < 0.05$. Business computing students have more prospects from TILO in terms of IRA usage than Business Frameworks students.

Table 3: Independent Classes t-test

Gender	N	Mean	F	P
Male	71	1.44	0.39	0.005
Female	20	1.55		

Source: As calculated by the authors

The results indicate a mix of technology savvy students who are inclined towards technology-enabled as opposed to entrepreneurial outlooks. But the findings should not be judged simply as statistically significant as sources in Vietnam indicate that one in ten people are interested in having their own business as opposed to working for corporate after education. Hence, it cannot be really concluded that Business Computing students are really more technology savvy than the Business Frameworks students as per the results obtained.

5. Conclusion

LMSs are just collections of IRA tools, even if they embody some kind of a pedagogical "vision" (Georgouli et al., 2008). LMSs are likely to become a common place technology that would be adopted as fluidly as that of the Internet or E-mail. Majority of the institutions of higher education will need to adopt one form of LMS or the other being either an open source or a commercial version of the software platform. LMS will occupy an ever increasing and prominent role in the teaching and learning processes, paving new pathways towards changing the existing techniques of teaching and learning, from a traditional methodology to totally synchronous or asynchronous distant mechanisms. In the case of business and management courses, the transition from the traditional instructional methods to one being enhanced by Technology Instigated Learning Outcomes or TILO has proven to be a useful model towards supporting collaborative learning which has been proposed here as a theoretical framework. The framework of the model could be easily extended as a LMS instructional system geared towards delivering educational materials; activate current knowledge bases; to produce and apply new knowledge, to support the teaching community and to motivate the students in our case in Vietnam. It is believed that this framework could be easily extensible to other management based educational courses in the field of management and technology domains. The survey results showed that students in general are in need of a very techno savvy platform such as a LMS in future towards utilizing IRAs in general. The analysis suggests that students have limited access to such resources in the current institution and if the TILO framework and its methods are incorporated or adopted into the current LMSs or existing platforms such as blackboard or WebEMS, it could improve the adopting of IRAs in future.

Further studies should enable the correlation of the results with further demographic data of the students, their grade levels and the times they took such courses in the near future.

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Supply Chain Financing: A Transformational Tool for Organizations as a Buyer and Supplier

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Abstract – *Supply chain financing (SCF) has emerged as a transformational tool to automate and streamline the financial flow in organizations as a buyer and a supplier. In this research work, an in-depth study has been carried out on different facets of SCF. Organizational study has been carried out in 60 Indian organizations to identify organizational challenges and desirable responses. The problems of organizations in SCF are ascertained. At the same time, the reasons of organizations to focus on SCF are determined. Perceptual study has been carried out with 300 SCF experts to discover the facets of SCF for effective organizational management. It comes out that SCF streamlines business processes, enhances physical as well as financial supply chain visibility and mitigates financial risk. Furthermore, SCF interlocks financial processes of organizations as a buyer as well as a supplier that results in formation of a cost-advantaged supply chain.*

Keywords: Days payable outstanding (DPO), days sales outstanding (DSO), information technology (IT), supply chain finance (SCF), supply chain management (SCM)

1 Introduction

Supply chain management (SCM) involves procuring the right inputs (raw materials, components and capital equipment); converting them efficiently into finished products; and despatching them to final destinations. It involves the oversight of the flow of materials, information and finances. The product flow consists of the movement of goods from suppliers to customers, as well as any service needs. The information flow involves transmitting orders and updating the status of delivery. The financial flow includes the credit terms, payment schedules, and consignment and title ownership arrangements. With the advent of Information Technology (IT) based supply chain solutions, the flow of materials and information have been automated and streamlined but flow of finances has lagged behind. Supply chain financing (SCF) has emerged as a transformational paradigm to address this need. It is worth noting that various authors have used the term financial supply chain interchangeably with channel finance, financial value chain and supply chain finance. For the purpose of this research, the use of any of these terms has been used to imply Supply chain financing (SCF).

2 Review of Literature

A supply chain financing (SCF) solution combines trade financing provided by a financial institution, a third party, or internal funds; and a technology solution that unites the buyer, supplier, and the trade financing source electronically, and provides financing triggers based on one or several supply chain events [1]. It is an important dimension for organizational management [2].

SCF assists in organizational management by enabling improved network technology, decreasing cost and streamlining business practices with supply chain partners. SCF helps in coordinating different facets of risk management in organizations. SCF enables real business priorities within an organization by supporting cross-functional processes [3].

SCF incorporates cost management and business processes to provide a comprehensive view of financial needs to facilitate organizational management. SCF focuses on bottom line impact of decisions made regarding the physical supply chain. A tight integration between the physical and the financial supply chains allows organizations to make informed decisions based on the relationships between cost and logistics, design and partners rather than on an independent view of any one factor [4].

SCF facilitates organizational management by enabling supply chain integration. There is some evidence that supply chain integration impacts performance of the firm. For instance, it has been suggested that integration of supply chains can enhance a firm's time-based competitiveness by compressing cycle times [5]. Integrated supply chains provide operational visibility, coordination of plans and streamlined flow of goods that compress the time interval between a customer's request for a product or service and its delivery [6]. This capability is also suggested to positively impact top and bottom line financial performance [7], improve customer relationships and promote market growth [8].

SCF is extremely beneficial from the perspective of organization as a buyer. In the emerging business environment, the pressure on the buyers to improve end-to-end purchase-to-pay processes and reduce cost and cycle time continues to grow. The focus of many SCM initiatives to date has been the physical processes and logistics costs that tend to be visible and as a result, easier to track. SCF focuses on less visible costs hidden in payments and reduces risk in the end-to-end processes. SCF also recognizes the dynamic transformation in the marketplace where the traditional

mantra for reducing the costs for the buyer at the expense of the supplier is increasingly being replaced by cost reduction, including finance, for both parties [9]. SCF enables buyer organizations to outsource management of all payables to a financial institution or an IT platform supplier. This can result in significant savings on administration of their AP departments [10].

Organization as a supplier face challenges in the order-to-cycle processes. SCF enables suppliers to improve their order-to-cash processes in order to reduce cost and improve efficiency. Banks have traditionally supported the order-to-cash processes but many of these services were stand-alone. SCF enables automation of order-to-cycle processes and forces the banks to re-think and reinvigorate the suite of services they can provide [11]. SCF ensures visibility to supplier organizations to notice approved invoices posted on a web platform. This allows them to approach a third-party lender and borrow at a discount against the approved invoice amount [10].

3 Objectives of research

This research aims to conduct an in-depth study on SCF. Following objectives have been set for this research work:

i. To identify organizational challenges and desirable responses for organizations in SCF
ii. To understand the problems of organizations as a buyer and supplier
iii. To determine the reasons for organizations to focus on SCF as a buyer and a supplier
iv. To discover the facets of SCF for effective organizational management

4 Organizational study

Organizational study was carried out to discover the way in which organizations manage themselves and how they can be in a better position by implementing SCF processes. At first, the current hurdles faced by organizations from achieving top-class performance in SCF are identified along with desirable responses to overcome them. After that, the problems which organizations face as a buyer and a supplier are ascertained. Then, the reasons due to which organizations focus on SCF in their role of a buyer as well as a supplier are found out.

4.1 Sampling methodology

The selection of organizations is based on the following criteria:

i. The sample organization should have either fully adopted or partially adopted or planned to adopt the ERP or such other application package.
ii. The sample organization should have demonstrated potential with regard to business needs and resources to adopt modern financial supply chain practices.
iii. The organization should be seriously planning to adopt or already adopted SCF initiation a systems basis.
iv. The sample organization should have a turnover of at least USD $20 million.

4.2 Sampling design

For the purpose of designing a sample, an individual organization is chosen as sample unit. The organizations that fulfilled the criteria of sampling methodology and indicated willingness to participate in the study were sent the organizational questionnaire. In all, 153 organizations were sent the questionnaire. Finally, the responses were obtained from 60 organizations representing a response rate of 39.2%.

4.3 Present organizational challenges and desirable responses

Table 1 shows challenges faced by organizations in SCF and desirable solutions suggested by them for overcoming the challenges.

Table 1
Main Organizational challenges and desirable solutions

Main challenges	Selected	Desirable solutions	Selected
Difficult to obtain clear picture of cash flows, inventory and financial commitments	66.7%	Improve visibility in ordering activity, inventory and financial commitments	60.0%
Lack of collaborative technology to manage end-to-end processes	50.0%	Implement collaborative processes for cross-departmental coordination	50.0%
Inadequate financial risk management systems	40.0%	Leverage external expertise for financial risk sharing	35.0%
Decentralized organizational approach to financial processes	25.0%	Link financial metrics to supply chain processes and strategies	23.3%
Complexity of transactions place stress on internal skill sets	6.7%	Simplify transactions to reduce stress on internal skill sets	6.7%

As per Table 1, two-third majority of the organizations identified lack of visibility into projected cash flows, inventory movement and financial commitments as the topmost challenge faced by them. Three-fifth majority of the organizations agreed that improving visibility in ordering activity, inventory and financial commitments is a desirable response to the above challenge. This shows the importance of visibility of information about cash flows, inventories and

fulfillment capabilities found not just between immediate buyer and supplier, but also among trading partners constituting the entire supply chains.

The increasing realization in the minds of organizations is that they alone cannot face up the emerging competitive pressures. Most organizations are experiencing that it becomes critical to work closely with their business partners so as to succeed in the competitive world. It becomes apparent from the organizational survey in which one-half of the organizations recognized lack of collaborative technology to manage end-to-end processes as the second topmost challenge. Implementation of collaborative processes for cross-departmental coordination as desirable solution to this challenge is suggested by one-half of the organizations. It is quite evident that organizations are fast recognizing the need of channel collaborations. They are realizing that the ultimate core competency they hold today comes from collaborative alliances with their supply chain partners.

Improvements in transportation, growth in trade and advancements in IT have resulted in the widening of trade networks. Presently, organizations do take a higher amount of risk when dealing with new buyers and suppliers. In the organizational survey, two-fifth of the organizations opinioned third key challenge as inadequate financial risk management systems. Risk may take the form of credit risk, interest rate risk, loans and security investment, compliance risk from disclosures to channel members and process/transaction risk from service failures resulting from operational or technical problems. Leveraging external expertise for financial risk sharing is recommended by 35.0% of the organizations as the corresponding solution.

Decentralized organizational approach to SCF processes is seen as the fourth most important challenge by one-fourth of the organizations. This silo approach leads to lack of coherence in the organizational processes. In order to overcome this challenge, linking financial metrics to supply chain processes and strategies is advocated by 23.3% of the organizations. This provides organization with the ability to seamlessly communicate within as well as outside organization thereby enhancing visibility.

6.7% of the organizations viewed complexity of transactions that place stress on internal skill sets as the last challenge. Similar number of organizations supported simplifying transactions to reduce stress on internal skill sets.

4.4 Problems of organizations as a buyer and supplier

The organizations are encountering certain problems as a buyer as well as a supplier. They are shown in Table 2.

Table 2
Problems of organizations as a buyer and supplier

Main challenges	Selected	Desirable solutions	Selected
Suppliers' unwillingness to extend requisite payment terms	55.0%	Cash flow uncertainty	60.0%
Lack of automation for managing financial processes	50.0%	Lack of automation for managing financial processes	56.7%
Long and costly financial transaction processes	41.7%	Complexity of supporting multiple buyers and their different payment and financing terms	41.7%
Difficulty in estimating the true cost of capital in relationship with suppliers	31.7%	High cost of capital makes it difficult to obtain working capital	33.3%
Constrained IT resources to support automation efforts	21.7%	Constrained IT resources to support automation efforts	25.0%

From Table 2, suppliers' unwillingness to extend requisite payment terms is rated as the foremost problem by 55.0% of the organizations as a buyer. This suggests that financial processes of organizations lack requisite integration. As a supplier, cash flow uncertainty tops the problems encountered by three-fifth of the organizations. Uncertain cash flows makes it difficult for organization to effectively use their AP/AR balances. It can be inferred that financial processes of organizations lacks visibility.

Lack of automation for managing financial processes is identified as the second major problem by majority of organizations as a buyer as well as a suppler (50.0% and 56.7% respectively). It implies that the financial processes of organizations lack required automation. Also, the problem is moderately more acute when organization acts as a supplier. The probable reason can be the relatively vast geographical spread of dealers/customers.

As a buyer, 41.7% of the organizations selected long and costly financial transaction processes as the third main problem. This suggests that the financial processes should be shortened and simplified. As a supplier, 41.7% of the organizations identified complexity of supporting multiple buyers and their different payment and financing terms as the third key problem. This implies that the organizations financial processes lack standardization.

Difficulty in estimating the true cost of capital in relationship with suppliers is chosen as the fourth main problem by 31.7% of organizations as a buyer. This indicates lack of integration with the suppliers. As a supplier, one-third of the organizations recognized high cost of capital as the fourth main issue. This suggests that inefficient financial processes have increased organizations dependence on working capital.

The last problem selected by organizations as a buyer as well as suppliers is constrained IT resources to support automation efforts (21.7% and 25.0% respectively). This shows dilemma of some of the organizations as inefficiency of their processes forces them to automate but possess limited IT resources.

4.5 Reasons of organizations as a buyer and supplier to focus on supply chain financing

Table 3 displays the major reasons due to which organizations focus on SCF.

Table 3
Reasons of organizations as a buyer and supplier to focus on supply chain financing

Main challenges	Selected	Desirable solutions	Selected
Pressure to lower the cost of goods sold	55.0%	Pressure to lower the cost of goods sold	75.0%
Pressure to increase DPO	50.0%	Pressure to shorten DSO	56.7%
Manual-intensive paper-based financial processes are becoming too cumbersome	50.0%	Manual-intensive paper-based financial processes are becoming too cumbersome	63.3%
Opportunity to lower overall weighted cost of capital in end-to-end supply chain	40.0%	Opportunity to lower overall weighted cost of capital in end-to-end supply chain	45.0%

As per Table 3, pressure to lower the cost of goods sold is identified as the topmost reason to focus on SCF by organizations both as a buyer as well as a supplier (55.0% and 75.0% respectively), though overall, organizations as a supplier feel this pressure more intensely.

As a buyer, pressure to increase days payable outstanding (DPO) is picked by one-half of the organizations thereby making it the second most important reason. As a supplier, pressure to shorten days sales outstanding (DSO) is selected by 56.7% of the organizations as their second main reason for focusing on SCF. This indicates that organizations are little more inclined towards shortening DSO than lengthening DPO.

Cumbersomeness of manual-intensive paper-based financial processes is elected as the third key reason by organizations both as a buyer as well as a supplier (50.0% and 63.3% respectively). At the same time, organizations feel this awkwardness more as a supplier.

Opportunity to lower the overall weighted cost of capital in end-to-end supply chain is chosen as the last reason by organizations both as a buyer as well as a supplier (40.0% and 45.0% respectively). Again organizations view slightly more opportunity as a supplier.

The overall picture suggests that organizations are more prone to pressures from their dealers/customers and they tend to view little more opportunities from that side. This shows increasing buyers strength in the marketplace that demands organizations to be more proactive.

5 Perceptual study

Perceptual study has been done to discover the facets of SCF for effective organizational management. For this study, perceptual questionnaire has been employed to determine the views of 300 SCF experts working in Indian organizations. Individual depth interviews have been carried out of some SCF experts to gain insights on certain issues related to perceptual questionnaire. SCF experts of various organizations have filled this questionnaire. The responses received have been analyzed on a five-point Likert scale from the perspective of strong disagreement (S-D), disagreement (D), indifferent (I), agreement (A) and strong agreement (S-A).

Factor analysis has been carried out using Statistical Package for Social Sciences (SPSS) 16.0 for Windows to extract critical variables. The goal was to identify a smaller set of variables, which is similar to the approach adopted by Choi and Hartley [12] and Kannan and Tan [13]. For the analysis of perceptual questionnaire, principal component analysis with eigenvalues greater than 1 has been used to extract variables and Varimax rotation with Kaiser Normalization has been used to facilitate interpretation of the factor matrix.

Correlation analysis has been carried out to determine the type of correlation between the variables. Correlation measures the extent to which the variables are related. Pearson's correlation coefficient (r) is a measure of linear correlation. The correlation coefficient is a numerical number between –1 and 1 that summarizes the magnitude as well as the direction (positive or negative) of association between two variables. Guilford [14] classified the nature of relationship between two variables on the basis of levels attached to correlation coefficient. It is shown in Table 4.

Table 4
Value of correlation coefficient, type of correlation and nature of relationship

Value of correlation coefficient	Type of correlation	Nature of relationship
0.00 to 0.19	Negligible correlation	Almost negligible relationship
0.20 to 0.39	Low correlation	Small but definite relationship
0.40 to 0.69	Moderate correlation	Substantial relationship
0.70 to 0.89	High correlation	Marked relationship
0.90 to 0.99	Very high correlation	Very dependable relationship
1.00	Perfect correlation	Perfect relationship

5.1 Sampling methodology

Following criteria was employed to select the SCF experts:

i. The expert should be working in a reputed Indian organization that has implemented SCF.
ii. The expert should have at least 3 years work experience in SCF.

5.2 Sampling design

For sampling design, an individual SCF expert is selected as a sample unit. The SCF experts that fulfilled the sampling methodology criteria and showed willingness to participate in the study were sent the perceptual questionnaire. Out of 721 questionnaires sent, responses were obtained from 300 of them, representing a response rate of 41.6%.

5.3 Experts responses

Different facets of SCF have been discovered after considering experts' responses to five statements on SCF for organizational management. The statements are:

I SCF coordinates financial risk management in organizations.
II SCF focuses on top as well as bottom line impact of decisions made regarding the physical supply chain.
III SCF has strong appeal for creating a cost-advantaged supply chain.
IV SCF enhances organizational visibility leading to greater movement of inventory and cash.
V SCF enables interlocking of organization's financial processes as a buyer as well as a supplier.

The experts' responses are summarized in Table 5.

Table 5
Experts' responses

Question / Opinion	I	II	III	IV	V
(S-D)	23	38	21	11	12
(D)	50	129	51	40	35
(I)	122	95	99	71	72
(A)	75	26	100	137	144
(S-A)	30	12	29	41	37
Total	300	300	300	300	300

5.4 Factor analysis

Table 5(I), 5(II) and 5(III) shows the total variance explained, Table 6 presents the rotated component matrix and Table 7 displays the correlation matrix.

Table 5(I)
Total variance explained (Initial eigenvalues)

Component	Initial eigenvalues		
	Total	% of variance	Cumulative %
1	3.379	67.943	67.943
2	1.349	26.990	94.933
3	0.250	5.002	99.935
4	0.003	0.065	100.000
5	1.02E-016	2.03E-015	100.000

Table 5(II)
Total variance explained
(Extraction sums of squared loadings)

Component	Extraction sums of squared loadings		
	Total	% of variance	Cumulative %
1	3.397	67.943	67.943
2	1.349	26.990	94.933

Table 5(III)
Total variance explained
(Rotation sums of squared loadings)

Component	Rotation sums of squared loadings		
	Total	% of variance	Cumulative %
1	3.323	66.467	66.467
2	1.423	28.466	94.933

Table 6
Rotated component matrix

	Component	
	1	2
I	0.733	0.589
II	-0.090	0.956
III	0.937	0.344
IV	0.974	-0.137
V	0.975	-0.157

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser Normalization.

Table 7
Correlation matrix

	I	II	III	IV	V
I	1.000	0.403	0.906	0.574	0.570
II	0.403	1.000	0.230	-0.170	-0.195
III	0.906	0.230	1.000	0.855	0.853
IV	0.574	-0.170	0.855	1.000	0.998
V	0.570	-0.195	0.853	0.998	1.000

5.5 Inference

From Table 5(I), component 1 and component 2 have the initial eigenvalues of 3.397 and 1.349 respectively, both of which are greater than 1. The rotation sums of squared loadings show 66.467% variance for component 1 and 28.466% variance for component 2 (Table 5(II)). Cumulatively, 94.933% of data is represented by component 1 and component 2 (Table 5(III)). So, they can be extracted for analysis.

As per Table 6, variable II has the highest value of 0.956 in column of component 2. In column of component 1, variable V possesses the highest value of 0.975 that is closely followed by variable IV with a value of 0.974. However, variable V is better representative because it is it is less correlated with

component 1 with value of –0.157 as compared to value of –0.137 for variable IV.

Therefore, it is clear that two main variables can be extracted for inference of the factor analysis. They correspond to the statements II and V viz:

- II: SCF focuses on top as well as bottom line impact of decisions made regarding the physical supply chain.
- V: SCF enables interlocking of organization's financial processes as a buyer as well as a supplier.

From Table 7, correlation between I and II is 0.403 and correlation between I and V is 0.570. This shows substantial relationship between I and II as well as between I and V. However, correlation between I and V is more substantial (Table 4). So, it can be inferred that SCF coordinates financial risk by interlocking organization's financial processes as a buyer as well as a supplier. However, this relationship is not very dependable because of the lacunae of organizations to interlock their financial processes. In the researchers' view, there maybe imbalance in interlocking financial processes of organizations either as a buyer or as a supplier.

The correlation between II and III is 0.230 and between III and V is 0.853. It shows a marked relationship between III and V. It may be inferred that SCF creates a cost-advantaged supply chain by interlocking organizations' financial processes as a buyer as well as a supplier.

The correlation between II and IV is –0.170 that is almost negligible negative relationship. The correlation between IV and V is 0.998 that is very dependable relationship. So, it can be stated that SCF enhances visibility by interlocking organizations' financial processes as a buyer as well as a supplier thereby leading to greater movement of inventory and cash.

6 Findings

The findings of the research are as follows:

- SCF plays a critical role for organizational management. It streamlines business processes, coordinates different facets of risk management, supports cross-functional processes etc.
- Organizations are looking to improve physical as well as financial supply chain visibility, form collaborative alliances, hedge financial risk etc.
- Financial processes of organizations lack requisite integration and standardization, are manual-intensive and paper-based, and need to be shortened and simplified.
- The inefficiencies of the financial processes of organizations tend to increase the cost of goods, reduce DPO for organizations as a buyer and amplify DSO for organizations as a supplier.
- SCF interlocks financial processes of organizations as a buyer as well as a supplier that leads to formation of a cost-advantaged supply chain and enhances organizational visibility thereby resulting in greater movement of inventory and cash.
- SCF has the potential to coordinate financial risk by interlocking financial processes of organizations as a buyer as well as a supplier subject to management of the imbalances in the supply chain.

7 Conclusion

Organizations are struggling with inefficiencies of their financial processes. These inefficiencies tend to increase the cost of goods, reduce DPO for organizations as a buyer and amplify DSO for organizations as a supplier. SCF facilitates organizational management by streamlining business processes, improving coordination of processes, reducing cycle time, enhancing physical as well as financial supply chain visibility, facilitating formation of collaborative alliances, enabling supply chain integration and managing financial risk. SCF interlocks financial processes of organizations as a buyer as well as a supplier that results in formation of a cost-advantaged supply chain and enhances organizational visibility thereby leading to greater movement of inventory and cash.

8 Recommendations

Based on the extensive research work, the recommendations are given below:

- SCF should be deployed to integrate physical and financial supply chains in order to bridge the information divide and mitigate financial risk. Therefore, effective financial risk sharing arrangements should be implemented by building long-term relationships with trading partners, collaborating with banks/financial institutions and partnering with other channel organizations.
- SCF should be deployed to integrate organizations' network design processes with upstream as well as downstream supply chain processes for realizing business growth opportunities. Therefore, organizations should integrate channel planning and execution with SCF system to generate end-to-end visibility of processes and coordinate global execution. This will enable interlocking of organizational processes as a buyer as well as a supplier and ensure real-time exchange of information across the supply chain.
- Organizations should manage imbalances in the supply chain in order to interlock their financial processes as a buyer as well as a supplier.

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Collaborative Office System Based on Homemade Software and Hardware

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Abstract - *This paper mainly studies the integration of homemade hardware and software environment, to construct a provincial government office information system. From all the designs of system's hardware support foundation, application integration technology, network security technology, security of data conversion technology to provide optimal technology, comprehensive implementation. And at last, make the system become a reliability, dependability, stability, safety and efficient working environment. Several characteristics of such an environment are motioned also.*

Keywords: Collaborative Office System, Cross-Platform, Workflow, OA

1. Introduction

Based on modern information technology and network technology, an office automation system collects, processes, stores and transmits data and information in the form of electronic office communication. As a computer-based information processing system, by means of word processing, electronic mail, desktop publishing, telecommunication and document image processing, etc, an OA system could collect, process, store and transmit electronic message, documents and forms. It also has many powerful functional extensions, such as information sharing, real-time information release, remote video conferencing, online inquiries, polls and social economic statistics, real-time remote video conferencing, online inquiries, polls and social economic statistics, etc. The main goal of such a system is to realize a reliability, dependability, stability, safety and efficient working environment for the individual, work group and organizations it focused[1,2].

2. System Task

Different with most the other OA system, the goal of his project is developing a government office information system, which is based on the all homemade CPU server, OS operating system and middleware. It should complete many researches on workflow technology, office information services technology, information security technology and adaptive application integration technology. It should breakthrough many bottlenecks on integration, application migration and optimized. In other word, we are going to provide a best homemade integration information platform which is suitable for the most government office working service [3,4,6].

2.1 Research on Application solution

1. Overall solution for collaborative office system

2. Integrated case library and document ation

3. The data migration tool

4. System optimization and evaluation

2.2 Transform for Application Support Platform

1. Workflow Platform based on homemade software and hardware

2. Seamless integration of homemade office software

3. Data exchange platform based on

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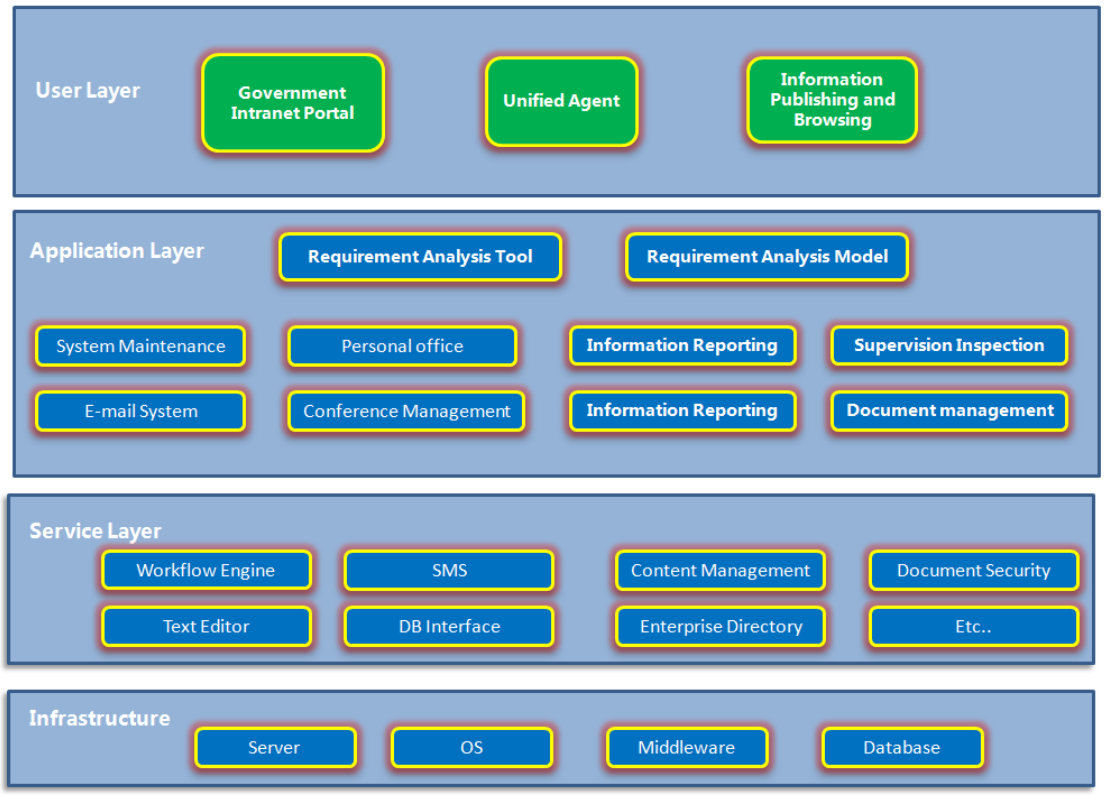

Fig1 System structure

homemade software and hardware.

4. Document security technology based on homemade basic software

2.3 Transplantation for office information system

1. Transplantation for office information system based on homemade CPU/OS

2. Smooth migration for existing data

3. Data migration tool and related Documents

Based on the task mentioned ahead, we designed a system structure as Fig1.

3. System structure

As shown in Fig 1, the system is divided into User Layer, Application layer, Service layer and Infrastructure.

3.1 User Layer

Through the client software, user layer provide users with various services. At present popular browsers such as IE, Netscape Navigator/Communicator, are ideal client tools because their operations are easy and convenient for accessing various applications. Using the unified browser interface, users can carry out office and business management, and obtain the required information via query and search functions provided by system.

3.2 Application layer

Application layer are mainly responsible for performing various business processing and calculation, and return the results in HTML text format back WWW server to complete various applications. Application layer entities can be a set of commercial software products or user self-developed application software. Application Layer performs internal office, Foreign Service, information collection and public administration.

3.3 Service layer

Service layer mainly solves the problem for the data storage, management and sharing. Data information from different department is stored in database for consolidation and maintenance, which can be convenient for users to use and reduce user data management

burden, and helps improve the safety. For different kinds of database in original departments, heterogeneous database can be Interconnect via special gateway or ODBC offered by database vendors to implement transparent and interleaved access.

3.4 Infrastructure

The infrastructure is responsible for management and maintenance for computer room's hardware to provide normal operation for network and basic equipment.

4. Characteristics of the system

We are going to provide a powerful, easy to use, different communicating tools compatible (wire or wireless), and instant office platform. The most important characteristics of such a system are listed as bellow:

4.1. Sharing common resources

All individual, work group and organizations in this platform may send, receive, and communicate their work with others. Share and manage common resources with others, such as various types of documents, forms, images and software and hardware resources, for example:

1. Use mobile phone to receive real-time working information from/to the platform [1]. Realize the full mobile commutation normalization, easy, quick and security.

2. Can formulate task and assessment, task assessment and calculation; also take scores after the task finished.

3. All the communication data and the task are progressing will be recorded clearly and correctly in the platform, to ensure that all task is rule-based, all results are checkable, reuse-able, and evaluate-able.

4.2. Task arrangement

Collaborative office includes not only all contents of the traditional OA, more laterally and longitudinally is expanded. It involves the management of almost all aspects of the applications are fully integrated.

1. Through a “new task” setting, any user can easily achieve layout, distribution and arrangement.

2. According to the task order, any user can easily set the task classes, important degree, task style.

3. According to the task needs, any user may set task’s duration and schedule and communicate with others.

4. Set the send mode, reminding method, and if it is need to set the top level.

4.3. Real-time tracking to the task’s status

The coordination office system helps every user to manage a new task’s schedule, understand how the task is in progress, tracking the status in a real-time [5]. Also they can communication with others just on-time to push forward.

1. Working list. When a new task is set, the worksheet should be stored in a working list automatically or manually. After the task is finished, it should be passed to next person immediately according its schedule. Such a passed message is stored in the working list too.

2. Task receiving. User here can manage the accepted task from their leader, setup a relevant schedule. And they can understand the progress of the task and tracking the status just on time.

3. Task passing. User can send the result of his task to other colleague immediately.

4. Task tracking. User can view the result from other employees transferred to him, according the task layout.

5. Attachment view. There are several convenient ways for users to query the attachment information from others.

6. Task folder. Users can store a finished worksheet into one of the task folders, according the classification of them. They can manage his task folders conveniently.

4.4. Quantitative assessment

By establishing a working list, our platform takes a fully support to the worksheet management. It includes establish a new task schedule, statistics full score monthly or weekly, rewards or punishments according to the task's assessment. The platform provides a task expected time setting and checking inside the working list.

4.5. Handwritten signature

1. Handwritten endorsement function. It is a special function of our office system. Users can take a signature and/or endorsement inside a document attached.

2. The effect of handwritten signature may not be re-setting, modify, or delete, to preservation reader's decision.

3. Only authorized person can do so.

4.6. Pages landscaping

With cartoon feature pages landscaping designed.

For example, a user may attach his relief into the manager column of the working list. It is a true sign from such a manager, and his colleague can know clearly which one should take responsibility for this step. As your wonder, it is recreated rapidly with the digital image processing technology from a common picture himself. Such a function is provided in order to make an interesting work instead a common serious work.

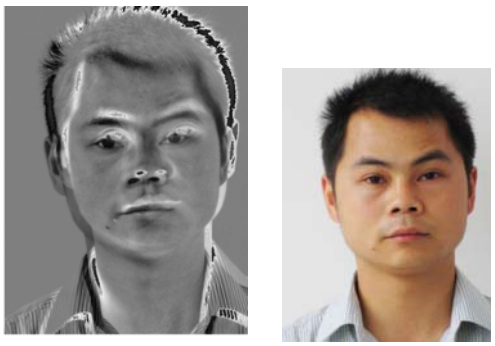

Fig 2 A relief recreated from his own photo

5. Conclusion

This paper presents a solution of a cross-platform based on homemade CPU/OS for office information management. The key issues to be resolved in the process of building the system are discussed based on the introduction of the architecture of the system in the first paragraph. The characteristics of the system are discussed also in later. Especially, a cartoon feature pages landscaping design is provided, it may be a new function in a common OA system.

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Mean Failure Cost as a Measure of Critical Security Requirements: E-learning Case Study

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Abstract – *As for the relevance of using E-leaning as a kind of modern education for schools and business throughout the world, the support of the newest technological components is important. In contrast, the integrity of this cyber system has become more critical. Security of E-learning systems is a current issue that needs to be highlighted to guarantee educational process with higher quality and to maintain its well running. Nevertheless, considering a total secure system is really a challenge. Security assessment policy and metrics are recommended, they serve as a guideline to the issues related to the availability, reliability, integrity, and confidentiality of the online teaching/learning system. In this paper, we illustrate a rigorous cyber security measure to quantify security threats which is the Mean Failure Cost for E-learning systems and then we propose an extension of its formula to measure the critical security requirements. Our focus is to enrich the MFC measure in order to develop a comprehensive science of cyber security and to get more safe and effective systems.*

Keywords: Critical security requirements, cyber security metrics, risk management, E-learning, Mean Failure Cost.

1 Introduction

In today's Internet age, education requires the share and the distribution of information. E-learning has become a popular way of learning for schools and business and has increased exponentially in recent years [1]. According to Derek Stockley [2], it is the delivery of a learning, training or education program by electronic means like computers or electronic devices (e.g. mobile phones).

Nickolova and Nickolov [3] suggest that there was a great progress in the use of E-learning as a new way of distributing knowledge, this is justified from the perspective of developing E-learning software applications and portals with no constraint of time and space resulting expansion of mobile learning this day. Among the advantages of E-learning systems we note the rapid and efficient distribution of learning resources, the flexibility in communication and collaboration without time force.

E-learning systems are vulnerable; the serious security threats include software attacks (virus, worms, macros, denial of service), data espionage, acts of theft (illegal equipment or information) and intellectual property (piracy, copyright, infringement) [4]. Cyber security is emerging as a major concern for researchers and practitioners, dealing as it does with privacy, confidentiality, user authentication, etc.

Given the exponential increase of security threats, to guarantee educational process with higher quality [5, 6], to maintain the perfect running of the system and to learn in safe, we need strong security risk management approaches. Actually, these approaches are fundamental in assessing security risk and provide us with good plan for risk mitigation.

Quantitative models are provided to measure reliability and safety of a given system [7, 8 and 9] like the mean failure cost (MFC), the Mean Time to Failure (MTTF), the mean time to detection of vulnerability (MTTD), and the mean time to exploitation of vulnerability (MTTE). These models are adopted to measure security dependability.

To the best of our knowledge, the MFC measure presented in [7, 10 and 11] is a rigorous suitable cyber security measure which presents several benefits. In fact the MFC is advantageous in comparison with other known approaches of security threat metrics, it reflects variance between system stakeholders, one user can attach different stakes regarding the same security requirement [13]. It considers the variance in failure cost from one sub-specification to another, the variance in failure probability from one sub-specification to another and the variance in failure cost from one stakeholder to another [9]. The MFC takes into account complex system specifications, and considers variations by stakeholder, requirements, components, and threats in order to adopt a good quantified security threat measure.

The MFC model provides excellent knowledge about the loss that each stakeholder stands as a result of security breakdowns [8, 12 and 14].

The MTTF has some inconveniences comparing to the MFC system reliability measure [7]:

- Independence of failure cost with respect to sub specificities: The MTTF makes no distinction between requirements
- Independence with respect to stakeholders: It is not dependent on the stakeholder but depends exclusively on the system under observation.

- Independence of failure probability with respect to sub specificities: any failure with respect to any sub specificity is a failure with respect to the whole specificity

The MTTD and the MTTE present the same shortcomings, they form an abstract measure of the failure rate of the considered system. In front of the proposed limits of the MTTF measure, the MFC is the best solution to measure system security reliability; It can be applied to manage and quantify security threats of all E-systems like E-Commerce, E-learning, and E-Government. It is independent from the system but varies from a stakeholder to another [13]. We illustrate in this paper a simple E-learning application to compute it in a practical case study.

Results of security threats analysis may also be useful in a practical plan to provide us with pertinent information in order to implement a secure environment. In the science of cyber security except the assessment of the risk, other challenges are required, especially in a complex system we need the knowledge of the critical security requirements in quantitative way. Hence, we propose in this paper an expansion of the MFC formula to underline the estimation of critical security requirements.

Nowadays, security requirements become an important issue in information systems, it improves the quality of software process and products. Security requirements are considered as the level of protection necessary for equipment, data, information and applications to meet security policy.

Measuring in a structured way the critical security requirements regarding the complexity of a given architecture system is beneficial to make more effective system in the development phase and in earlier phases. A well defined security process is advantageous and a well defined security requirements plan is recommended.

This paper is organized as follows. In section 2, we present the MFC cyber security metric, in section 3, we illustrate the threats quantification of the MFC for E-learning systems. In section 4, we discuss and compute the critical security requirements using an extension of MFC formula. Finally, in section 5, we conclude by summarizing our results, and sketching directions of further research.

2 The mean failure cost as a measure of cyber security

The Mean failure Cost is a recent value based measure of cyber-security, presented in [9, 11 and 9], it computes for each stakeholder of the given system his loss of operation ($/H). This quantitative model is a cascade of linear models to quantify security threats in term of loss that results from system vulnerabilities. In addition, Anis et al [15] implemented a tool that automatically computes the MFC for a given system, it calculates MFC metrics. They define the MFC as:

$$MFC = ST \circ DP \circ IM \circ PT \quad (1)$$

Where ST, DP and IM are three matrixes, PT is a vector:

- The stake matrix (ST) is filled by stakeholders according to the stakes they have in satisfying individual requirements;
- The dependency matrix (DP) is filled in by the system architect (i.e., cyber security operations and system administrators) according to how each component contributes to meet each requirement;
- The impact matrix (IM) is filled by analysts according to how each component is affected by each threat;
- The vector of threat emergences probabilities (PT) that represents the probability of emergence of the various threats is done empirically, by simulating and/or operating the system for some length of time and estimating the number of threats that have emerged during that time.

The whole details of the MFC features are presented in the summarized table 1.

3 Computing mean failure cost for E-learning system

3.1 The stakes matrix (ST)

The stakes matrix composed with the list of four stakeholders and the list of security requirements [15]. The four needed actors that interact with each other are presented as follows:

- The system administrator: provides the file-level access for each teacher, the one course should have a single directory on the server. It is the person who maintains and operates the system. In consequence, he forms a technical director of the platform and the network administrator [16].
- The teacher: guides and tutors learners to meet educational goals. He varies the knowledge using different formats. He also needs to communicate with the learner using synchronous or asynchrony communication tools [5, 17].
- The student: is the engine of the learning process. He searches to learn, communicate, discover and analyze knowledge [5, 16].
- The technician: is the responsible for the minor change of the site like the update of themes, the installs of modules, and the upgrade of system software [18].

TABLE 1: THE MEAN FAILURE COST MEASURE (MFC)

MFC	• Is a vector • Entries = system stakeholders	MFC(H)	Is the mean failure cost of stakeholders= cost ($/H)
ST: Stake matrix	• Is a matrix • Rows= stakeholders • Columns= security requirements	ST(H,R)	• Is the stake that stakeholders H satisfy a requirement R • Is quantified in terms of cost per unit of operation time:$/Hour
DP: Dependability matrix	• Is a matrix • Rows= security requirements • Columns= system components	DP(R,C)	The probability that the system fails to meet requirement R if component C is compromise
IM : Impact matrix	• Is a matrix • Rows= system components Columns= security threat	IM(C,T)	The probability that Component C is compromised if Threat T has materialized
PT : Vector of probability	• Is a vector • Entries: Threat	PT(T)	The probability that threat T materialized for a unit of operation time (one hour of operation)

E-learning systems share similar security requirements with other e-services related to the accessibility of service via internet, the consumption of service by a person via internet and the payment of a service by the consumer [3, 4]. According to [19], we can classify the following basic security requirements of the E-learning system into six aspects; Confidentiality, Integrity, Availability, Non-repudiation, Authentication and Privacy:

- Authentication: The authentication mechanism is required to identify the application user of the platform and to give him the right to access to the application with his own account [17].
- Confidentiality: is required to ensure that data and resources available on the platform are accessible only by those with rights of access. Confidentiality of Platform is guaranteed by ensuring a secure data environment [20].
- Integrity: Integrity of data and resources in the open source software E-learning platform is required to ensure that the information available on the platform can be modified only by authorized entities [21].
- Availability: Availability of the application is a very important subject, so it is required to ensure that the web application is always available and operational when the user needs it [20, 21].
- Non-repudiation: Needs to ensure that no party in an operation can deny participating in the operation. We can also define the mechanism of Non-repudiation as the mechanism that ensures that the sender of the message can't deny having sent the message in the future [19].
- Privacy: Is necessary to ensure non-disclosure of information given and for each user. [19]

Each row for the matrix presented in table 2 is filled by relevant stakeholders who have internal or external usage for the platform, each cell expressed in dollars monetary terms and it represents loss incurred and/or premium placed on requirement. To fill ST Matrix we did a survey for EVT1. ST (Hi, Rj): Is the stake that stakeholders Hi has in meeting requirement Rj.

3.2 The dependability matrix (DP)

The online environment involves several dimensions in their architecture in order to support the various needs of stakeholders. The architecture is the integration of several technological components. According to [16] they are not a unique architecture for E-learning system, so, there is no independent architecture, but we recognize for Moodle and WebCt the two popular and well known E-learning systems that actors are common like teacher, student, knowledge manager and administrator. Also, architectural components are common like browser, database server and web server. Based on the architecture diagram presented by Selvi et al. [22] we recognize six architectural components as follow:

[1] http://www.evt.edunet.tn/

- The browser: is the interface used by the client [22].
- The Web server: hosts the Content Management System (CMS) Applications for managing students and their academic and financial situations, it covers the module of the related E-learning system, it includes themes, activities, interface languages, database schemas and course formats. It also includes the management and labeling of objects. Other modules can incorporate the learner registration component which forms the administration components, then, it covers the tools that assist the creation of objects (content) [17, 22].
- Application server: incorporates the E-learning system platform; the request sent by the web server is forwarded to the application server; therefore the database concentrates on the storage, retrieval and analysis of data. It hosts online courses and is considered as the web server application programming interface which forms a standard web browser related to the organization. It covers the Learning Activity Management System (LAMS), it is used for designing, managing and delivering online collaborative learning activities. Therefore this is the useful environment for creating sequences of learning activities [17, 22].
- Database server: is the core (default) database and some extension tables of the E-learning system as the user administration data base [22].
- Firewall server: is the component that secures Internet input and output traffic, it also filters high-risk codes, such as viruses or worms [17].
- Mail server: considering the increase number of users and stored message, the mail server covers the email application, user's mail boxes [17].

Each row for the matrix presented in table 3 is filled by System Architects; each cell represents probability of failure with respect to a requirement given that a component has failed. DP (Rj, Ck): The probability that the system fails to meet requirement Rj if component Ck is compromise. To fill this matrix we have used the values from [23].

3.3 The impact matrix (IM)

E-learning systems allow multiple users or applications to download, upload and exchange distributed information. Communication issues between end-users' computers and E-learning site (portal) in these systems are very important, as the systems are defined by widely dispersed elements in terms of network topology and physical geography. Additionally, the systems often allow many-to-many communication which provides powerful capabilities and allows many system nodes to have the same communication at any given time. As noted in [4] a system can be attacked by a lot of threats that we can summarize the most important as follow:

- Viruses (VS),
- Denial of service (DoS),
- Acts of human error or failure (accidents, employee mistakes) (AH),
- Unauthorized access and/or data collection (DST),
- Deliberate acts of sabotage or vandalism (destruction of information or system) (DSV),
- Deliberate acts of theft (illegal confiscation of equipment or information) (TH),
- Compromises to intellectual property (piracy, copyright, infringement) (CIP),
- Quality of Service deviations from service providers (QoS),
- Blackmail for information disclosure (BID).

Each row for the matrix presented in table 4 is filled by V&V Team; each cell represents probability of compromising a component given that a threat has materialized, it dependent on the target of each threat, likelihood of success of the threat. To fill this matrix we have used the values from [23].
IM (Ck, Th): The probability that Component Ck is compromised if Threat Th has materialized.

3.4 The threat vector (PT)

Each row for this vector presented in table 5 is filled by Security Team; each cell represents the probability of realization of each threat, it depends on perpetrator models, empirical data, known vulnerabilities, known counter-measures, etc.
PT (Ti): The probability that threat Ti materialized for a unit of operation time (one hour of operation).

TABLE 2: STAKES MATRIX (ST)

	Requirements security					
	Confidentiality	***Integrity***	***Availability***	***Non-repudiation***	***Authentication***	***Privacy***
Stakeholders						
System administrator	*40*	*30*	*60*	*10*	*10*	*50*
Teacher	*20*	*20*	*60*	*20*	*30*	*40*
Student	0	5	5	0	5	0
Technician	10	7	15	5	5	15

TABLE 3: THE DEPENDENCY MATRIX (DP)

	Components						
	Browser	***Web server***	***Application server***	***Database server***	***Router/Firewall server***	***Mail server***	***No failure***
Security Requirements							
Confidentiality	0.2	0.333	0.333	0.5	1.0	0.333	0.0
Integrity	0.2	0.333	0.333	0.0	1.0	0.333	0.0
Availability	1	0.333	0.333	0.0	1.0	0.333	0.0
Non-repudiation	0.2	0.333	0.333	0.0	1.0	0.333	0.0
Authentication	0.2	0.333	0.333	0.5	1.0	0.333	0.0
Privacy	0.2	0.333	0.333	0.5	1.0	0.333	0.0

TABLE 4: THE IMPACT MATRIX (IM)

	Security Threats									
	VS	***DoS***	***AH***	***DST***	***DSV***	***TH***	***CIP***	***QOS***	***DIE***	***No Threats***
Components										
Browser	*0.004*	*0.005*	*0.100*	*0*	*0*	*0.300*	*0*	*0.200*	*0.200*	*0*
Web Server	*0.004*	*0.001*	*0*	*0*	*0*	*0*	*0.001*	*0.500*	*0*	*0*
Application server	*0.054*	*0.010*	*0.030*	*0.200*	*0.200*	*0.300*	*0.001*	*0.400*	*0*	*0*
Database server	*0.054*	*0.010*	*0.030*	*0.200*	*0.200*	*0.300*	*0.030*	*0.400*	*0*	*0*
Router/Firewall server	*0.010*	*0.050*	*0.010*	*0*	*0*	*0.01*	*0*	*0.010*	*0*	*0*
Mail server	*0.054*	*0.010*	*0.030*	*0.200*	*0.200*	*0.300*	*0*	*0.400*	*0.400*	*0*
No Failure	*0.600*	*0.700*	*0.500*	*0.600*	*0.500*	*0.300*	*0.300*	*0.300*	*0.700*	*1*

TABLE 5: THE VECTOR OF PROBABILITY (PT)

Threats	**Probability/hour**
VS	$5.04\ 10^{-3}$
DoS	$3.08\ 10^{-3}$
AH	$0.1\ 10^{-3}$
DST	$0.42\ 10^{-3}$
DSV	$2.31\ 10^{-3}$
TH	$2.5\ 10^{-3}$
CIP	$0.7\ 10^{-3}$
QOS	$2.5\ 10^{-3}$
BID	$1.4\ 10^{-3}$
No Threats	0,9819

Using this data, we compute the vector of MFC presented in table 6 using the formula: MFC = ST ◦ DP ◦ IM ◦ PT

The MFC for stakeholders can appear insignificant but for a failure to long-term they are significant. While our focus so far has been on measuring mean failure cost, we discuss in the next section how to found and compute the critical security requirement using an extension of MFC formula.

Table 6: The Mean Failure Cost for E-learning system

Stakeholders	**Mean Failure Cost $ /hour**
System administrator	0.785
Teacher	***0.743***
Student	0.056
Technician	0.223

4 MFC Extension: computing critical security requirements

In the stake matrix ST, we have introduced the costs that can be lost by the stakeholders. The stakes depend on the stakeholders and the security requirements. The MFC vector is the mean failure cost of system / stakeholder during a unit of operating time. The values of MFC don't distinguish between the low and the high cost of security requirement for the global system. In this section we introduce a new extension of the MFC formula to define which requirement is more critical than the others.

We consider a system S, we let H1, H2,…, HK be stakeholders of system and R one of the security requirements of system. Let MFCR be the random variable that represents the mean failure cost of the requirement R. We let PR the probability that the system fail to meet the requirement R.

We quantify this random variable in term of financial loss per unit of operation time. If we suppose that we have k stakeholders the stake matrix can be presented as a vector.

ST'		***R***
Stakeholders	***H_1***	
	…H_i…	***Stake that stakeholders H_i has in meeting requirement R***
	Hm	

We consider the architecture of system S and let C1, C2 ,…Ch be the components. Using the same principle of dependency matrix and under the constraint that we have one requirement R, the stake matrix can be presented as a linear vector.

DP'		***Components***		
		C_1	***…C_k…***	***C_{h+1}***
	R		***Prob of failing requirement R. once component C_k has failed***	

Taking the same impact matrix IM and the threat vector PT, the mean failure cost of the requirement R can be written as:

$$MFCR = (\sum_{i=1}^{k} MFC_i) \qquad (2)$$

Applying the above formula, we can define the MFC for each security requirement and witch requirement is more critical than the others.

TABLE 7: MFC FOR SECURITY REQUIREMENTS

Security Requirements	Mean Failure Cost $/hour
Confidentiality	0.294
Integrity	0.359
Availability	0.580
Non-repudiation	0.099
Authentication	0.210
Privacy	0.441

As it's appearing in table 7, the availability and the privacy are the most important security requirements in the proposed E-learning system.

When we talk about availability, the most known concerned attack is the denial-of-service (DoS) attack, an attacker attempts to prevent legitimate users from accessing information or services in the platform. There are two types of DoS attack: logic and flooding attacks. Logic attacks (e.g. ping) exploit existing LMS flaws to crash remote server or significantly decrease its performance. Flooding attacks overloads LMS with a high number of requests to disable legitimate users from accessing E-learning resources [21]. According to the MFC metric and especially the IM matrix the application server, the firewall server and the database server need more precious practical instruments of security.

About privacy, it is the non-disclosure of information for each user [19]. Security guidelines in the development phase are required to protect the privacy of student and teacher personal records, the protection of their personal information when using E-learning services is primordial.

5 Conclusion

E-learning becomes a popular way of learning for schools and business and has increased exponentially in recent years. To guarantee educational process with higher quality, to maintain the perfect running of the system and to learn in safe, we require the illustration of the MFC as a strong cyber security risk measure.

The MFC is advantageous in comparison with other know metrics of security, reliability and safety:

- It reflects variance between system stakeholders, one user can attach different stakes regarding the same security requirement
- It considers the variance in failure cost from one sub-specification to another, the variance in failure probability from one sub-specification to another and the variance in failure cost from one stakeholder to another.
- It takes into account complex system specifications, and considers variations by stakeholder, requirements, components, and threats in order to adopt a good quantified security threat measure.

In addition, our extension of the MFC formula to measure the critical security requirements is beneficial to a better management, assessment and control of the non secure system. These theoretical and practical improvements lead to the enrichment of the MFC application, to provide more comprehensive science of cyber security and their related metrics, especially to interpret in the deep and to get more safe and effective systems. Besides, the quantification of security threats and their impact throughout a financial measure open a wide range of further interpretation.

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User modifications as usability evaluation cues for a Personal Information Space

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Abstract **-** This paper describes an experiment conducted on a mockup of a Personal Information Space. Users were asked to perform data entry and retrieval tasks, then to modify the mockup according to their wishes and needs. The results allowed to validate the item structure for the future personal space, as well as to assess the role of user modifications as evaluation cues, and for the development of further ergonomic recommendations.

Keywords: Usability evaluation; user modifications; e-gov.

1 Introduction

Internet increasingly offers new services and applications for managing personal information, and plays now an important role in our daily lives. We consult various sites to access information that can be important and confidential. Personal Information Management (PIM) refers to the domain that studies how users manage their data and personal documents. Numerous studies have addressed user behavior: how they obtain, organize, maintain, retrieve, use and distribute their personal information items, according to various roles: citizen, parent, friend, employee, etc. [1]. This study was carried out within the ANR-PIMI project (context: government initiatives for paperless administrative procedures), which aims to develop a Personal Information Space on Internet for supporting remote e-procedures (getting a passport, paying taxes, etc.). It focuses on the intuitive behavior of users interacting with a future system mock-up, that has one particular characteristic: to be modifiable.

Recent work [2] proposed a structure of information items, organized into categories, topics and items. This resulted from several studies: a) an administrative forms analysis, b) three "focus groups" on how people use in order to store their information, and their issues about sharing, c) an online questionnaire on the same topics for a wider range of audience, d) a "card-sorting" study to validate categories created by users and to organize their information. The results show little variation in the structure and in the naming, and allowed the design of a structure with 114 items, 26 sub-categories and 9 categories.

This study complements that approach through an experiment with users to validate the structure, and to investigate shareability. Besides, the focus is on the modifiable nature of the interface to better identify user requirements in structuring/naming personal data, and thus go beyond simple (but useful) questionnaires and interviews, i.e., incorporating users modifications as usability evaluation cues. After a few points on PIMS and tools, this paper offers a literature review on modifiable interfaces. Then, it describes the experimental method and procedure, the mock-up and participants, then the results and their use for PIMI design. Finally the lessons learned and prospects are discussed.

2 Literature Review

2.1 Personal Information Management (PIM)

Organization and information retrieval aspects are the most noted ones. Hierarchical structures are still the most widespread and users favorite [3] [4] [5] [6]. These studies also show users difficulties in creating consistent and meaningful hierarchical structures, and in naming categories/items. Indeed, categorization of new items is considered difficult, with a high cognitive load due to the difficulty in maintaining clarity and intuitiveness of the initial structure. Placing a new item within a predefined structure raises issues of relevance, naming, and redundancy. In our experiment, the structure is already set, but can be modified to fit context of use, vocabulary and user needs. In [1, op. cit.] two types of personal information are identified: information own by the user (files, videos, etc.), and information about the user (identity, health). However, the presence of such information (about the user) in a PIM, its use in e-government procedures and its shareable nature are not much investigated.

2.2 PIMs Tools

We reviewed 15 tools: (#1 www.efficientpim.com, #2 www.thebrain.com, #3 www.essentialpim.com, #4 www.winpim.com, #5 www.lifemanagerpro.com, #6 www.azzcardfile.com, #7 www.pimonline.com, #8 www.pimone.com/pimone.htm, #9 www.myarchivebox.com, #10 www.evernote.com, #11 http://code.google.com/p/keynote-nf, #12 http://www.treepad.com, #13 www.milenix.com, #14 www.android-software.fr/pocket-docs, #15 www.gmail.com). Most tools (#1, #2, #3, #4, #5, #7, #8, #11, #12, #13, #15) offer an agenda, a calendar, a contact list, a keyword based search tool, a centralized password management function and notes editing. The naming of concepts / items is a problem for some tools (#1, #4, #7), an information structure already established is rarely offered, except for (#9) where a data categorization proposes a multi level structure of

categories/information, for (#1) and (#14) where simple structures are available for storing documents. Actually, in (#9) and (#14) data entry is not permitted, only files loading; also most allow to construct categories of notes/sub-notes, and tasks. On the content side, except for (#9), there is no structure/format for useful information such as: identity, family, health, income, ID papers, career, etc. Most interfaces are quite similar. (#1) further allows the user to view the schedule for the day, week or more. An interface customization is also possible in (#1, #3, #6, #8, #10, #15), whose main modifiable parameters are: color, window size, language, position and display menus/buttons.

2.3 Modifiable Interfaces

A challenge in the near future is the design of systems that the users can "develop" and change themselves. However, not everyone has programming expertise. The ability to modify, adapt, configure and increase the flexibility of use should allow users to continuously adapt their systems to their needs, their contexts of use and include their personal preferences [7] [8]. It may be adaptive or adaptable, or mixed initiative. It is adaptive if its mechanisms do not require user initiative and adaptable when changes are made upon direct user requests during use. In [7, op. cit.] two types of user activities are distinguished: setting among available alternatives (presentation, interaction mechanisms, or behavior), and software or a new artifact creation/modification, for instance macros. Four important interface customization factors [9] are to be considered during design for understanding the potential impact of custom interfaces on the performance of key tasks and user awareness: (a) customization control, (b) modification granularity: all the interface changes, several changes per session, one change at a time, etc., (c) the visibility of the modification, i.e., the different ways to show that a modification can be achieved (spatially: hide, move, copy and resize; labeling techniques: highlighting, and (d) the rate of change (in the case of an adaptive interface, it concerns every interaction; if it is adaptable, it will depend on user needs and availability: the frequency will then be lower).

In the literature, there are few contributions on user modifications in systems design/development. Users - Developers communication during the design process is not obvious. The various resources provided by developers are not always understood by users. Means of exchange about product development should be included in the artifact itself, i.e., during system use, and from the changes proposed by the user [10]. In this context, [11] describe MikiWiki, a shared environment where the design teams, including end users (as the domain experts) can communicate/write in a wiki style, with HTML and JavaScript to tailor communication and collaboration tools. This allows a collaborative design process by providing basic prototypes allowing users to remix, edit and create their own objects. Usability tests with users are planned on different scenarios. On the same topic, [10, op. cit.] experiments were conducted with two different systems to evaluate editing techniques/tools. Scenarios with modification tasks were submitted to users. The authors particularly wanted to show that multiple representations (different levels, different categories of users) can facilitate developers - users communication, and stimulate modifications. [12] conducted experiments with two systems to test the ease of user interface redesign in the context of plasticity, as well as to verify tasks remodeling acceptance by users. They use each system on a mobile platform, then a PC. Users are invited to adapt their interfaces according to the device used (screen size, font, etc.). The results show that, in the laboratory, with a short operating time (2h), discovery is difficult, meaning users did not realize what they could really modify (visibility issue); few changes were made by users. In [13] a novel environment for modeling business processes is proposed, allowing users (business process experts) to model and adapt the processes themselves. User tests were conducted to evaluate the interfaces, and their acceptance, but the prototype used did not allow modifications for users to adapt and adjust their processes. A new prototype should be implemented.

In short, very few experimental results were found about user modifications as a means of usability evaluation, during design or not. This study on a mock-up intends to complement the few above studies by providing new empirical results. It deals with the adaptable and customizable interfaces aspects. Users were invited to participate in an experiment with a mock-up of a PIM system (during design stage), and allowed to modify the structure and naming of information items. The results were used for an ergonomic interface specification. All adaptations were made from direct requests from users during use (customizable interface), not through adaptivity where the system, not the user, has the initiative. It can be said, as [14], that it is "light" EUD (End-User Development), i.e., "tailorability". This form of "adaptability" is justified by the different situations of system usage (at work, home, leisure), and by the difficulty of predicting new situations, on different technological platforms available (pc, mobile, tablet) and the wide variety of user profiles (expertise, functions) for which the products are intended.

3 The Experiment

The experiment concerned the study of the intuitive behavior of PIMI users. Users have been put in position of using a Personal Information Space in order to validate the predefined structure [2, op. cit.], and to observe their behavior facing an editable interface.

3.1 Material

The mock-up (Fig. 1) was developed with AZZ Cardfile, an information management software for configurable card files. AZZ Cardfile file organizes categories, topics and items. Each category is represented by a "group", and within groups, each section is in the form of a card that contains the items represented in a table form. The mock-up allows users, in a predefined structure, to: Enter information items; Browse

categories and headings for information retrieval; Change names of categories, topics and items; Modify the structure (moving headings and items, creating redundancies, adding new items and delete items).

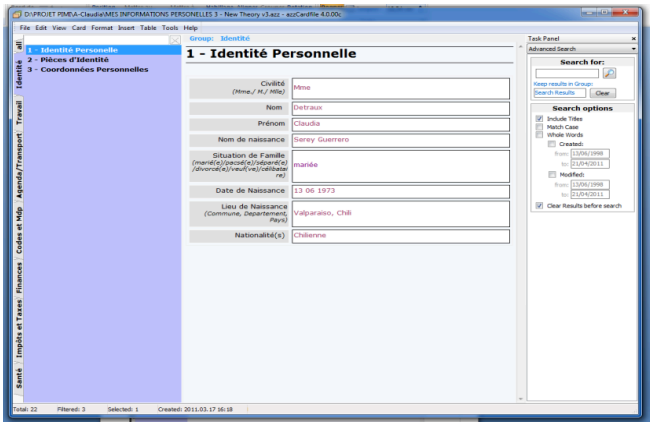

Figure 1. Screenshot of the PIM Mock-up

After an initial design, the structure was redesigned following additional qualitative analyses. The structure has 91 items organized into 30 topics and 8 categories: Identity & Contacts (personal identity, ID papers, personal details); Work (current work, affiliation details, career); Contacts & Agenda (personal & professional agenda and contacts); Transportation (private, public); Codes and Passwords (entry codes, locks, phones, passwords, websites, credit cards); Finance (income and benefits, investments, loans, bank accounts); Taxes (income tax reference, tax reductions, tax bracket, property tax, housing tax); Health (social security, health insurance, medical records).

3.2 Method

The sessions were conducted individually and supervised by the experimenter. They were all recorded (Dictaphone). Users were asked to think aloud, the experimenter being thus able to identify specific issues using also observation records.

3.3 Participants

The user population for our PIMI tool being very large (the citizen in general), we focused on profiles easily accessible, i.e., participants from the project partners institutions: 6 researchers, 6 administrative staff (INRIA Rocquencourt) and 11 university students (IUT Tarbes). The participants' characteristics are: 14 male (60.87%) and 9 female (39.13%); age average 36.8 years (sd: 12.51). Among the "researchers", all participants are male, the age average being 42.8 years (sd: 17.84). For "administrative", all participants are female, the age average being 44.8 years (sd: 9.68). In the category "students" 8 participants are male (72.72%) and 3 female (27.28%), the age average being 22.9 years (sd: 6.53).

3.4 Procedure

To be ecological, the sessions took place in the participants' own working environment (actual offices of researchers and administrative; university computer room for students. This way, they could easily access their belongings (bags, wallets, diaries, personal and work computers) to achieve the required experimental tasks. The mock-up was presented on a laptop. A pilot test was conducted to validate the experimenter discourse and to calibrate the experiment duration (about 1h). The sessions were conducted in two main phases: one phase of work on scenarios/tasks and a customization phase. The latter consisted in making changes in the Personal Information Space and to answer a questionnaire on information shareability.

3.4.1 Scenarios Sessions

The objective in this phase was to assess the difficulties in finding the relevant topics in the proposed structure and in understanding the terms, but also to observe the users confidence levels in their data entry. Each scenario deals with data that was previously detected as sensitive.

- *Scenario 1* - Discovery and Identification: data entry tasks (name, ID card, etc.). The goal was to familiarize users with the tool, its contents, to start customizing and to develop a sense of ownership.
- *Scenario 2* - Contact (professional) and Work: data entry tasks. The aim is mainly to check if the users can find these items (previously conflicting) in the structure.
- *Scenario 3* - Health: data entry tasks of "sensitive" information to verify users adherence to this topic, and to validate naming.
- *Scenario 4* - Data Retrieval: the tasks allowed to verify if the classification is appropriate to user expectations, focusing on items that presented conflicts in previous work. In this scenario, the task is to complete a registration form (fictional) and to seek information (also fictional) about another person.

3.4.2 PIMI Personalization

The goal in this phase was to cover the whole PIMI structure and allow users to modify it (as well as the naming). With the experimenter's help, the users were able to change categories topics and items location, add redundancy, change names and delete or add items. The mock-up allowed "drag and drop" to move items, and simple editing to change names. At the same time, the participants answered a questionnaire on the shareable nature of each information item.

4 Results

On a total of 23 sessions, only one participant (student) did not allow session recording and one participant (administrative) did not respond to the shareability questionnaire. All others have followed all steps and allowed the use of a Dictaphone. The average session duration was 68.4 mn. (sd: 16.57 mn.) which was, overal, a bit higher than initially estimated (60 mn.). For researchers, the average was 72.8 mn. (sd: 17.15 mn.). For administrative, average

duration was 66.67 mn. (sd: 17.73 mn.). In the student category, average length of sessions was 66 mn. (sd: 16.53 mn.).

4.1 Shareability

Before discussing structure and naming aspects, a few results on information shareability are worth mentioning. From the scenarios, the most sensitive items are: "identity documents" particularly "ID Card", and information under "medical records". The other elements were easily shared: little hesitation, reassured by asking questions before entering the information. Only 1 administrative participant has not responded to the questionnaire and only 4 participants (a researcher, one administrative and two students) said they did not want to share anything, and restricted information sharing to the minimum, and only "on demand" knowing in advance the underlying rationale of the requests. There is also a strong suspicion towards the categories "Agenda," "Finance" and "Codes", also observed in the modification scenario where they were among the most deleted topics. However, the headings "Identification Documents" and "Medical records" were not considered critical in this analysis as opposed to the outcome of the data entry scenario.

4.2 Difficulties in finding information

From the scenarios, a few items were difficult to find in the structure:

- *Personal Details:* section easily localized in the data entry task, but 6/23 students in the data retrieval task of "Phone Number" searched first in the Personal Identity section and suggested two different sections displayed on the same page.
- *Professional Contacts:* if this item was placed in the "Work" category, it would be more easily found, as 86.95% of users went directly searching in that category.
- *Professional details:* item easily found in the "Work" category whether in the data entry scenario or the data retrieval. However a user asked to group "current work" and "business contacts" on the same page.
- *Annual net income:* the placement of this item is not always accepted. 26.08% of users have had the tendency to seek information in the "Work" category, saying that salary is information corresponding to work, to the job. Other users also searched in the "Tax" category and confused it with the item "income tax reference." These may need to be apart, with description attributes that identify them more specifically.

4.3 Naming difficulties

The terms that raised most questions and understanding difficulties are the following:

- *Authority:* 17/23 participants had difficulty understanding the term (4/6 researchers, 6/6 administrative and 1/11 students), who all have taken some time to understand it. 6/11 students did not understand the term at all and needed help. This is explained by the fact that on the ID card, the term used is "Issued by".
- *Medical Records:* 16/23 participants have made comments on the terms in this section. 10/23 made statements like: item "very vague", "very large", "lacks precision", "do not understand what we are asked".
- *Membership Number:* 14/23 people were confused by this term, of which 4 have failed to understand without help (2/6 researchers and 2/11 students). The 10 others (3/6 researchers, 4/6 administrative and 3/11 students) have thought a bit and wondered if it was the social security number.
- *Current work:* 14/23 people had difficulties understanding the terms of this section (4/6 researchers, 2/6 administrative, 1/6 students), but after some time, they managed to understand. 2/11 students and sixth administrative failed to understand and asked for help.
- *Extension Number:* 10/23 participants mentioned this term. 1/6 researchers and 3/11 students did not understand, even confusing it with postal code. 1/6 researchers, 3/6 administrative and 1/11 students have thought deeply, but despite doubts, have answered the question.
- *Birth Name:* 5/23 participants (21.73%) had difficulty understanding this term. 2/6 researchers have been slow to understand, 2/6 administrative and 1/11 students have not understood at all.

4.4 PIMI personalization

After the scenarios phase (entry of personal data and retrieval of information from another PIMI to complete a fictitious registration form), participants were invited to discover the entire PIMI and to make changes. After testing the system, understanding its use, they expressed their needs, desires and limits in proposing modifications. This phase of the experiment was very well accepted by participants, even after spending about 30 minutes in the first phase, they took their time in the second phase.

Looking at Table 1, one can identify a total of 129 modifications suggested by users, averaging 5.6 per user (sd: 4.01). Only 3 out of 23 (2 researchers and 1administrative) have not made any changes. The participant who made the most changes suggested 15, while two people have suggested only 2 changes. By analyzing user groups, we can see that the "Students" are those who have made the most changes with an average of 6.81 (sd: 2.7). The "Administrative" is in second place with an average of 5 changes (sd: 5.4). Finally the "Researchers" follow with an average of 4 changes (sd: 4.42). The standard deviations show that the "Students" are clearly the most homogeneous group in terms of changes.

Table 1 also shows the 2 main modifications types: a) PIMI structure, and b) PIMI naming. Most changes are structural (108): mainly additions (44) and removing elements (36). Even if the changes are structural, the addition and/or removal of items, overall do not challenge the proposed conceptual structure. Users simply want their Personal Information Space set in details according to their own needs and wishes.

Table 1. Modifications proposed by the participants

PARTICIPANTS	MODIFICATIONS (by participant)									Total Modifications (by participant)	Total, Average & Standard-Deviation (by participant)		
	STRUCTURE								NAMING				
	Items Moved	(sub) Catégories Split-up	Items Grouped	Redundancies	Items Added	Items Removed	Items Order Changes	Total Modifications Structure			T	A	S-D
C1	1	2	0	0	1	1	1	6	3	9	24	4	4,4271
C2	0	0	0	0	0	0	0	0	0	0			
C3	0	0	0	1	1	0	0	2	8	10			
C4	0	0	0	2	1	0	0	3	0	3			
C5	0	0	0	0	0	0	0	0	0	0			
C6	0	0	2	0	0	0	0	2	0	2			
A1	0	0	0	0	1	0	0	1	2	3	30	5	5,4037
A2	0	0	2	0	2	2	0	6	1	7			
A3	0	0	0	1	0	0	0	1	1	2			
A4	0	0	0	3	10	2	0	15	0	15			
A5	0	0	0	0	0	1	0	1	2	3			
A6	0	0	0	0	0	0	0	0	0	0			
E1	0	0	0	0	2	2	0	4	0	4	75	6,8181	2,7863
E2	0	0	1	2	3	3	0	9	1	10			
E3	1	0	0	2	6	0	0	9	0	9			
E4	0	0	0	2	1	0	0	3	0	3			
E5	1	0	0	0	1	3	0	5	0	5			
E6	0	1	0	1	1	1	0	4	0	4			
E7	0	0	0	0	1	3	0	4	1	5			
E8	0	0	0	0	1	4	0	5	1	6			
E9	0	0	0	0	3	6	0	9	1	10			
E10	0	0	0	1	6	2	0	9	0	9			
E11	0	0	0	1	3	6	0	10	0	10			
Total	3	3	5	16	44	36	1	108	21	129			
Average	0,1304	0,1304	0,2173	0,6956	1,9130	1,5652	0,0434	5,8695	1,7855	5,6086			
s.-d.	0,3443	0,4576	0,5997	0,9261	2,4478	1,8787	0,2085	4,67391	1,7558	4,0197			

Some statements from interviews recordings illustrate their desire about what they will really use and what they imagine to need according to their lifestyles: "... I have everything on my I Phone, I do not need another agenda ...": he removed the category Calendar / Contact; " ... residence permit, I remove, I'm French, I don't need it ... : he removed that item; "... For now I use my phone agenda, but if later I want to use it ..." : he removed the Agenda section.

The changes that could influence most significantly the PIMI structure are: moving Items (3), split-up of categories/sections (3) representing only 5.5% of changes to the structure and 4.6% on total changes. Regrouping modifications (5) and changes of display order (1) represent 5.5% of structure changes and 4.6% of the total changes. They are focused on information presentation.

Changes on naming represent 16.27% of the total proposed changes. Most are synonyms that users prefer, such as "Birth Name" which becomes "Family name", "Individual Transportation" becomes "Personal Vehicle". Other include either more specificity or more generality, such as, respectively, "Extension Number" which becomes "Telephone Extension Number", "Engine Belt" which becomes " Technical Control Date".

There are 3 *items and categories displacements*: one by one researcher and two by students. However, this result corroborates the scenarios session where the category "Finance" lacked of clarity and led to a misunderstanding of the terms. For those unfamiliar and little used terms, definitions and examples should be provided. The use of redundancy will also help users find their information.

Separation of categories/sections: The split-up of the category Events/Contact led to 3 changes and was also subject to question during scenarios sessions.

Grouping of elements: 5 users preferred to display on one page items all related to "coordinates". This may not be surprising as coordinates are always linked to an individual (personal identity) or a place (work).

Redundancies (placement of the same element in two different categories/topics): 16 redundancies have been proposed: 9 by students, 4 by administrative and 3 by researchers. The Professional Contacts section, initially in the category Agenda/Contact, was duplicated in the category Work by 8 participants. This reinforces the results of the previous step where Professionals Contacts were searched primarily in the category Work. The Social Security & Mutual section was cited by 2 participants, wanting to see it in ID Papers or in a new section including "any type of papers". Other elements were cited only once.

Adding Items: Additions are numerous, but mostly proposed by 1 person each time. There is, overall, a desire of users to customize the structure: even though 6 people did not add any item, all others have proposed at least one addition. One item is particularly requested: attached document as proof (suggested by 10 participants including the attached Résumé suggested twice). Other items were added: Car ID card (3 times) and organ donation (twice).

Removing Items: This type of change was the second highest type of modification (36) and involved 21 different elements. The category "Codes" has been removed completely by 6 participants, mostly (5/6) students. Then

comes the "Credit Card Codes", deleted by 4 students. Also in the category "Codes", the item "banking site " under "Internet Codes" was removed by 3 students. The category "Agenda/Contact" was removed by 2 users, while 2 users deleted the Agenda section, bringing to 4 those who removed the Agenda section. The category "Finance" had seven of items deleted, a user even removed completely that category. The "Students" group is the one that removed most elements (total 30, average per participant 2.72) followed by administrative (5, average 0.83) and finally the researchers, where only 1 researcher proposed a deletion.

Overall, deletions are focused on 3 main categories: "Codes" "Agenda/Contact" and "Finance." We can differentiate the 2 categories "Codes" and "Finance" from "Agenda/Contact". Indeed, the reasons for removal (recorded comments) tend to group "Codes" and "Finance". Deletions for these 2 categories were caused by strong distrust in confidentiality and security of sensitive data. For "Agenda/Contact", the removal arguments put forward by users link redundancy with current systems (iPhone, paper agenda, phone, etc.). Also the students are the ones who express more distrust for the categories "Codes" and "Finance."

Naming: 3 terms that were changed are the ones that caused problems in understanding the data entry from the previous step: Birth Name, Authority, Extension number (although by a single person). 16 terms were changed, 3 of them by more than one person. Other proposals are synonyms for easier retrieval.

5 Conclusion

This study dealt with the adaptable nature of a Personal Information Space and how this could influence its acceptance. The literature review revealed little results on user modifications, especially from a methodological point of view, as an additional means for evaluating usability. Experimenting with an editable PIMI mock-up aimed at complementing this state by providing some initial experimental results. Useful information was obtained on how users enter and retrieve data, by modifying the interface settings. The modifications proposed were captured, then classified and analyzed according to their type and their underlying rationale. Finally we discussed the impact of these results on the PIMI system design.

The proposed structure, classification and item relevance in different categories and topics have been well accepted by users. The most fundamental changes (of the structure) represent only 5.5% of total changes. On the other hand, the total number of changes (129) and the participation of most users (20/23) during this modification stage allowed to witness a real interest from the users to express their needs. The only 3 participants who did not make any changes indicated that the structure suited them, ... although some elements could be different, ... and that they would eventually get used to it !

We found some consistency regarding the structure, organization and naming between the results from the scenarios session and the modifications session, which led to some adjustments in the structure of items.

By cons, regarding data sharing, we found that some usually called "sensitive" information in the data entry scenario (ID, Medical Records) is no longer considered sensitive during the modification of the interface. We assume that being able to decide with whom the user wants to share each item gives the user confidence in relation to the system, where sharing is agreed or not by the user. Similarly, the "medical records" section was treated rather in detail by the user who has decided not to share sensitive items, but for the items considered important to share (e.g. "blood type"), he decided to share them without hesitation.

Overall, it seems preferable to provide flexibility and means to adapt the interface rather than risk the rejection of a system [15]. Interfaces changed during the design process seem to stimulate the future user. Indeed when the user moves to the customization step, he/she changes attitude and becomes an "actor". In addition, he/she has a greater feeling of consideration. The possibility of customizing the interface promotes its acceptance, in addition to lifting the participatory barrier.

From the designer's point of view, the act of gathering customization ideas from users, in the early stages of design, from a modified mock-up, allows to check consistency of the basic structure, but also to make it flexible for different profiles identified and for the continuous change (age, work, etc.) of an individual. Moreover, it would seem sensible to consider several settings levels, depending on user profiles. Younger ones (students) seem more interested in the creation or deletion of "mini-structures." Other profiles opted instead for changes in details, naming and presentation.

The results led to some modifications to the structure of items and to propose a set of recommendations [16] intended to stimulate discussion and provide a basis for the specification of the new PIMI interface, for instance:

- Customize the structure naming. From a fixed number of synonyms, users should be able to choose the most significant one(s). Other synonyms can also used to "tag" this term, increasing the search tool power.
- Allow users to remove from their Personal Information Space elements they wish, providing the coherence of the structure is maintained.
- Allow users to reintroduce elements previously removed.
- Create some redundancy that should facilitate items search of by users, consistently with the structure.
- Allow users to specify the information they want to share and with whom they want to share it.

- Information should not be shared initially ("by default"), then the user should be able to express shareability by two methods: (a) "by Request" the user allows sharing from a request (institution, service, another person, etc.) specifying its permanent or temporary nature, (b) "item by item", as the user wishes.

In general, users are quite demanding about all that a new tool can offer them, including about the interface, about system features such as data synchronization, information security, and access by PDAs. They know the benefits and do not want to move backward technologically.

The end users will not replace software developers, but it is important to give them power of adaptation at a level of complexity suited to their abilities, especially for systems where information is very personal. This requires providing interfaces easy to modify and tailorable to a wide audience.

Further work will focus on a PIMI prototype (instead of a mock-up) and will focus particularly on the visibility of changes [7], this aspect not being addressed with the mock-up, the modifications being made with the experimenter's help. This prototype will be accessible via internet allowing also to expand the experiment to a larger population, with more variations in terms of user profiles.

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The Nigeria Electoral Laws and Automated Electoral Voting Process

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Abstract: *We are currently conducting a research work that will produce an automated electoral process which is expected to eliminate electoral irregularities in Nigeria. In this paper we present a facet of the research work in order to show that the automated system was developed in accordance with Nigeria electoral laws. Elections in Nigeria have been marred with violence and election irregularities. Most Nigeria politicians abuse their positions by sponsoring tugs who engaged in electoral violence. To boost credibility of the electoral process in Nigeria therefore, we proposed an automated electoral process that protect and provide true election results by using proposed automated electoral process flowchart. The restriction of 500 to 700 voters per polling unit by Independent National Electoral Commission (INEC) was eliminated in this system. Eligible voters can vote in any polling unit irrespective of where they registered. One unique characteristic of this developed automated system is that it provide for those in the Diaspora to vote outside Nigeria. The total file size per person is 80 Kilobyte and therefore we estimated a file size of 16 terabyte for 200 million people. Our preliminary test results showed that the proposed automated system can be physically and successfully implemented in Nigeria in line with the electoral laws.*

Keywords: Automated systems, electoral irregularities, electoral violence, electoral laws, polling units.

Introduction

Virtually all the National elections conducted in Nigeria were marred with electoral malpractice and violence that in some cases resulted to fatality [1]. Nigeria population is increasing and it is estimated to be one hundred and sixty-seven million by the end of 2011 [2]. Out of this number only a few, about 0.00018%, have access to the nations' wealth. Elections in Nigeria have been marred with violence due to corrupt politicians and lack of sincerity, patriotism and commitment from electoral officials. Most Nigeria politicians are ready to spend the nation's wealth to remain in power. The Nigerian constitution provides immunity for incumbent Governors, the President and the vice President. The Governors have under this immunity clause, misappropriated state funds. Together the Governors and the Presidency have by their actions frustrated the entire electoral processes. These politiciansHence, elections in Nigeria are marred with gross electoral irregularities. Most politicians get into public offices without the true mandate of the Nigeria people. Therefore this proposed automated electoral process helps to eliminate these and many more electoral irregularities and its' application is in line with the constitution of the Federal Republic of Nigeria.

However, this system was designed to accommodate all age groups including infants. But only those within the constitutional age of 18 years and above are eligible to vote. The data-capturing

or Registration proposed for this automated system is a continuous process

Nigeria Electoral laws

Section 77(2) of the 1999 constitution states that, "every citizen of Nigeria, who has attained the age of eighteen years residing in Nigeria at the time of the registration of voters for purposes of election to a legislative house, shall be entitled to be registered as a voter for that election".

Section 78 of the 1999 constitution states that, "the registration of voters and the conduct of elections shall be subject to the direction and supervision of Independent National Electoral Commission".

Third Schedule Part1 Federal Executive Bodies (Established by section 153) 15(a)(b) of the 1999 constitution of the Federal Republic of Nigeria states that: "The Commission shall have power to - Organize, undertake and supervise all elections to the offices of the President and Vice-President, the Governor and Deputy Governor of a State, and to the membership of the Senate, the House of Representatives and the House of Assembly of each State of the Federation; Register political parties in accordance with the provisions of this Constitution and an Act of the National Assembly" [3].

The electoral process begins with the registration of political parties and political parties must submit names of their candidates to the Independent National Electoral Commission (INEC) not later than 60 days to the date of elections as contain in Section 31(1) of the Electoral Act 2010 Amendment [4].

For the 2011 general election INEC registered 67,764,327 voters for a period of 24 days (15 January 2011 – 7 February 2011) throughout the country using biometrics [5]. INEC considered electoral constituencies based on population, equality of registered voters and local governments, contiguity of constituencies, historical, cultural and ethnic affinity, existing administrative and traditional boundaries, common interest, settlement pattern etc. During registration each polling unit has a maximum range of 500 voters to 700 voters [6]. The restriction of 500 to 700 voters per polling unit and voters required to vote at polling units where they registered by INEC were eliminated in this developed automated system. Eligible voters can vote in any polling unit irrespective of where they registered.

INEC Position on Electronic Voting.

After the election of April 16, 2011 there was violence in the northern part of the country due to alleged electoral irregularities. Despite the registration of voters using biometric data (face and 10 fingerprints), during voting normal ballot papers and boxes were used to conduct the election [7].

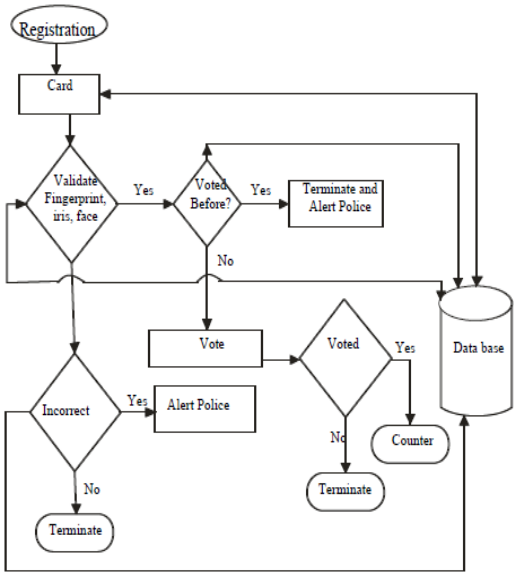

Figure 1 The proposed automated electoral process flowchart.

The chairman of INEC, Professor Attahiru Jega said that in 2015 election, electronic voting will be adopted to boost credibility of the electoral process. The INEC chairman insisted that election would be credible [8].

Figure 1, is a flowchart showing the summary of the proposed automated electoral process. The system can register 200 million Nigerians. After registration, all citizens who have attained the age of 18 years and above are allowed to vote by this automated system. Citizens who were below the required age for voting during registration become eligible to vote when they attain the age of 18 years without the need for another registration. Citizens are required to register their information at the different Registration centers in the country. Their personal data, such as 10 fingerprints, facial scan, and iris scan, are all captured and stored in the Database Server. A Voter's Card containing a unique Voter's Identity Number is given as confirmation of registration.

On Election Day eligible voters may visit any of the voting centers, not necessarily where they registered, to cast their vote. Authentication begins from the unique identification number through the stored fingerprints, iris to the face recognition. Failure of this authentication terminates the voting process, and the Database Server will take note of the failure. Taking note of authentication failures is necessary to stop the voting process at the initial stage when the same "failed voter" tries to vote from another Client Computer in another location. This will avoid the stress of making any further verification [9,10,11]. A successful authentication process of the fingerprints or iris or facial scan allows the voter to vote.

Conclusion

The system will continue to register all Nigerian's whether eligible to vote or not. The system is capable of registering over 200 million Nigerians in three days. However, during voting only those who have attained the age of 18 years and above are allowed to vote by this automated system. Citizens who were below the age of 18 years during registration become eligible to vote when they attain the age of 18 years without the need for another registration. The restriction of voters to the polling unit where they registered and 500 voters per polling unit by INEC were eliminated in this system. Eligible voters can vote in any polling unit irrespective of where they register. The system was developed to conform to relevant Nigeria electoral laws.

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Digital Forensic Acquisition and Analysis Tools and its Importance

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Abstract *- There are many digital evidence collection and analysis tools that are commercially available. The digital forensic field has created different opportunities for commercial enterprises and open source alternatives. In dealing with digital forensic investigation, in solving digital related crime evidence is gathered and analyzed and presented to a court of law to prove that illegal activity has occurred. It is important that when undertaking digital forensics investigation no alteration, damages or data corruption occurs. Choosing and using the right tools and techniques are very important in digital forensic investigation. The digital forensic techniques mentioned in this thesis are as follows. The aim of this research is to discuss the commonly used digital forensic acquisition and analysis tools and the need for such tools.*

Keywords - ***Acquisition, Analysis, Automated tools, Computer Forensic, Mobile Forensic***

1. Introduction

Casey (2004) defined digital evidence as any data stored or transmitted using a digital device that support or refute a theory of how an offense occurred or that address critical element of the offense such as intent or alibi. Nelson et al (2004) explains that digital forensic involves scientifically examining and analyzing data from digital device storage media so that the data can be used as evidence in court. Investigating digital devices typically includes securely collecting digital data, examining the suspect data to determine details such as origin and content, presenting digital based information to courts, and applying laws to digital practice. Digital forensics investigates stored or transmitted data from any digital devices.

According to Farrell (2009) tools that perform specific functions are constantly being developed and distributed in the academic and open source communities and these new functions are ultimatelly integrated into larger analysis suites. These suites can be large Graphical user interface based programs that allow an analyst to explore and search the data on a hard drive. GUI tools give an option for the investigator who wants to safely preview digital evidence prior to initiating the forensic process. An investigator can have a quick scan of digital media using read-only tools without altering any data in the media Few software developers have recently introduced digital investigation tools that work in windows, Graphical User Interface forensic tools do not require a strong understanding of MS-DOS and the various file system, they can simplify digital forensic investigation (Nelson et al, 2004). These GUI tools have simplified training for beginning examiners in digital forensic. GUI tools aid in logical examination of file structures, image scan, and keyword search.

2. Process of Digital Forensic

In digital forensic expertist as examiners are relied upon to interpret data and information retrieved by tools and provide findings by tools that can be trusted. According to Altheide and Carvey (2011) the process of digital forensic can be broken into acquisition, analysis and presentation. Acquisition refers to the collection of digital devices to be examined, these can be physical hard drive, optical media, storage cards from digital cameras, mobile phones, chips from embedded devices or single document files. The acqisition process should consist of creating a duplicate of the original data as well as maintaining good records of event carried out (Ademu et al, 2011). The goal of digital evidence duplication is to copy the original digital evidence that protects and preserves the evidence from destruction, damage, or alteration prior to analysis by the digital forensic practitioner.

Duplication is an accurate digital reproduction that maintains all contents and attributes, and all slack space is transferred. When duplicating or copying evidence, ensure that the examiner's storage device is forensically sterile. Write protection should be initiated to preserve and protect original evidence. The MD5 or SHA-1 hashing algorithm should be used prior to duplication or copying. The write protection can be performed via either hardware or software. Please note that the formatted area is not the total storage of the drive, there can be some unallocated area of storage in hard drive. Hosted Protect Area (HPA) defined as a reserved area for data storage outside the normal operating file system Nelson et al (2004). The Protected Area of Run Time Interface Extension Services (P.A.R.T.I.E.S) is hidden from the operating system and file system, and that is normally used for specialized application. Duplicate or copy the electronic evidence to the examiner's storage device using the appropriate software and hardware tools.

According to the Digital Forensic Research Workshop (DFRWS) in 2001 Analysis refers to the actual media examination, the identification consist of locating items present in the device in question and then futher reducing this set of items that is needed (Palmer, 2001). This items are then subject to the approprate analysis. The types of analysis carried out can be file system analysis, file content examination, log analysis, statistical analysis etc.the examiner then interprets results of this analysis based on the examiners training, expertise, experimentation and experience. And presentation is when the examiner shares results of the analysis phase with the interested professionals. This involves generating report of actions taken by the examiner, uncovered evidence and the meaning of the evidence.

3. Computer Forensic Tools

Digital evidence is characterized by its fragile nature and it can easily be altered or destroyed, thus rendering it inadmissible in a court of law. Digital investigator should therefore take care to ensure that evidence is not destroyed as a result of a continuous investigation. One of the major time consuming tasks in a digital investigation is the search for digital evidence. Different toolkits have been developed that contain tools to support digital investigators in the process as much as possible in an attempt to increase the efficiency of a digital investigation.

- **Password Recovery Toolkit (PRTK)**

The Password Recovery Toolkit (PRTK) is an AccessData tools which is a Graphical User Interface appliaction for Windows. This tools helps to find and identify encrypted files on handheld, desktop and server computer systems, it can interpret the passwords or hashes of password in application such as Office 2000, WinZip etc. Recently an advance in the encryption function in Microsoft Offic XP, Internet Explorer and Netscape Navigator has posed concern. A new feature is added to PRTK known as the Distributed Network Attack (DNA) application (Aggarwal et al, 2008).

- **Distributed Network Attack (DNA)**

DNA is a password recovery tool with a twist. It uses multiple computers rather than a standalone system to attack a password encrypted file. DNA uses the concept of a network to allocate jobs to client machines to work on. DNA uses the power of multiple processors to make an exhaustive key space attack. The larger the network, the greater the number of machines and password attempts per second that can be tried. With the help of DNA investigators can crack the passwords of numbers of networked workstations, reducing the time needed to crack the most difficult passwords.

- **Forensic Toolkit (FTK)**

Forensic Toolkit is identified as the standard in computer forensic software. It is a court validated digital investigations platform that delivers computer forensic analysis, decryption and password cracking software all within an spontaneous and customizable interface. FTK supports PRTK, password list can be created, these are collection of words that appear to be character strings, a password list generator collects these character strings to create a list that PRTK uses to crack passwords. FTK is the only commercial forensic software product that supports both 32 bit and 64 bit Windows machines. FTK Toolkit is easy to use and understand, it has multiple data views that allow users to analyse files in a number of different ways and create detailed report and output them into native format. According to Jones et al (2005) recent versions of the FTK includes acquisition functionality, a forensic duplication can be acquired using FTK with the same hardware devices. FTK has unique features that index text to produce instant search result, data recovery from file system, e-mail recovery from the leading e-mail services and products along with the recovery of deleted messages, file filtering that eliminate known files and bad files.

- **EnCase**

EnCase is a commercial forensic investigation toolkit that is largely used within the law enforcement agencies. According to Nelson et al (2004) EnCase is able to acquire data in a forensically sound way in which such data can be reviewed by other popular commercial forensic analysis tools. The software can manage large volume of digital evidence, and transfer evidence files directly to law enforcement or legal

representatives as necessary. It enables attorneys to easily review evidence and also enables quick report preparation to be made. EnCase program has initiated Graphical User Interface tools for digital investigations.

A recent features of DOS disk acquisition amd preview tool called En.exe has been added to to EnCase. The GUI EnCase and the DOS En.exe programs create images of a suspect's disk drive. EnCase can also acquire a suspect'd disk drive on a network. Encase version 2.0 supports some Microsoft file system types such as FAT12, FAT16, FAT32, New Technology File System (NTFS), Universal Disk Format (UDF) etc. According to Casey (2002) EnCase provides an incredible amount of features and functionality but no one tool can do it all in forensic investigation. An important feature of the EnCase process is the integrated authentication and verification of evidence files. Throughout the examination process, EnCase verifies the integrity of the evidence by recalculating the Cyclical redundancy check (CRC) and the MD5 hash values and comparing them with the values recorded at the time of acquisition. This verification process is documented within the EnCase generated report. It is important to know that it is impossible for EnCase to write to the evidence file once it is created. Just like in other files, it is possible to alter EnCase evidence file with a disk-editing utilty. Though, if one bit of data on the collected evidentiary bit-stream image is altered after acquisition, EnCase will report a verification error in the report and identify the location of the registered error.

- **Deleted Data (DD)**

The most basic non commercial forensic duplication tools is definitely dd (Jones et al, 2005). One reason examiners use forensic imaging is for completeness. In foresnsic examination the idea of just examining an active file system as presented by the operating system is not sufficient enough. Most volumes contain potentailly required evivence outside of the viewable, allocated files on a mounted file system. Delected files are files that have been unlinked in which the file name entry is no longer presented when a user views a directory and the file name, metadata structure, and data units are marked as free. However the connections between these layers are still undamaged when forensic techniques are applied to the file system. Therefore in recovering the files it consist of recording the relevant file name and metadata structures and then extracting the data units.

- **Coroner Toolkit (TCT)**

TCT is designed by Dan Farmer and Wietse Venema, the Tct is aims primarily at investigating a hacked Unix host. It offers tools with useful investigative capabilities that are available nowhere else Kruse II and Heiser (2001). TCT is designed to help in reconstruction of event on a compromised network host. The most interesting feature of TCT is its ability to analyze activities on a live host and capture current state information that would be impractical to capture manually. TCT comprise a set of tools used to recover deleted auanix files. It contains a tool to attempt to reconstruct rational or logical data from a stream of bits, and it includes a tool for the Unix environment to create such a stream of bits from a file system. The unrm utility is a Unix tool that creates a single object containing everything that is within all the unallocated space on a file system which can be a huge amount of data.

- **Sleuth Kit**

Sleuth Kit is an open source forensic toolkit which is a suite of file system forensic tools designed by Brian Carrier to perform forensic analysis or investigation in Unix environment, the first version of Sleuth Kit was called the @stake Sleuth Kit (TASK) which was based on The Coroner's Toolkit (TCT) and was distributed with similar command line tools Kruse II and Heiser (2001). TCT ia a very powerful forensic analysis tools but its major challenge is the lack of portability between system and lack of support for non Unix-like file systems. Carrier developed the Sleuth Kit to provide a highly portable extensible and useful open source forensic toolkit. Since Sleuth Kit is an open source tool, support for any file system can be added. File system support may be added by users of the toolkit as required. The Sleuth Kit locally supports processing raw disk images but it can also import the ability to process additional image formats from the LibEWF (Expert Witness Format) and AFFLib (Advanced Forensic Format) packages.

Commercial tools such as Carnivore, NetIntercept, NFR Security, NetWitness and SilentRunner have been developed with integrated search, visualisation and analysis features to help digital investigators collect information from network traffic. There has been progression in the development of tools for collecting evidence on embedded computer systems. It is frequently used by digital investigator's to read information from pagers, mobile phones and personal digital assistants directly from the devices. But this approach does not provide access to deleted dtat and may not be possible if the device is password protected. Tools such as ZERT, TULP and Cards4Labs have been developed to access password protected and deleted data.

- **SafeBack**

SafeBack is used for bitstream backup. A bitstream backup is different from the regular copy operation. During the regular coping activities, files are simply

copied from one medium such as a hard drive to another e.g. a tape drive. When performing a bitstream backup of a hard drive, bit by bit copy of the hard drive is obtained and not just the files. Every bit that is on the hard drive is transferred to the backup medium.

- **GetTime**

GetTime is used to document the time and date settings of a victim computer system by reading the system date and time from Complementary Metal Oxide Semiconductor (CMOS). Digital forensic examiner should compare the data/time from CMOS to the current time before processing the computer of evidence.

- **GetSlack**

GetSlack is used to capture the data contained in the file slack of the hard drive. In the process of filling up clusters on the hard drive with files, the segment of a cluster that the file does not completely fill up is called slack space. Slack space is used by the operating system for different thing, but the ordinary computer user cannot view it. Special tools are required to view slack space. It is important to know that valuable information pertaining to an investigation can be found in the slack space.

4. Mobile Forensic Tools

- **Oxygen Forensic Suite**

Oxgen Forensic Suite is a mobile forensic software for analysis of cell phones, smartphones and tablets. Oxygen Forensic Software supports Symbian OS, Nokia S60, Sony Ericsson UIQ, Windows Mobile 5/6, Blackberry, Android and Apple Smartphones etc. Oxygent Software invented an advanced agent approach that allows Oxygen forensic suite to extract much more information from Smartphones than other logical tools.

- **Micro Systemation XRY Software**

XRY Software is a digital forensic tool designed by Micor Systemation used to analyze and recover information from mobile devices such as mobile phones, Smartphones, Gps navigation tools an tablet computers. XRY software is developed to recover the contents of a device in a forensic manner acceptable by many users. The XRY is a complete digital forensic system for mobile devices that can be used on any Windows Operating System.

5. The need for tools and techniques

Previously during digital crime investigation digital forensic investigators widely used the evidentiary computer itself to collect evidence. The main risk of this method was that operating the evidentiary computer could alter the evidence in a way that is untraceable. However UNIX programs like Deleted Data came into existence in the 1980s and was able to capture deleted data stored on a hard drive, but these tools was not widely used and then most digital evidence examinations were performed at the file system level neglecting deleted data. In 1990s tools like SafeBack was created to allow digital investigators collect all data on a computer disk without altering important data. As more people became aware of the value of computers, the need for more advanced tools increased. In order to address this need, integrated tools such as Encase and FTK were created to make the digital investigator's work easier. These tools allow the more efficient examination, by automating routine tasks and display data in a graphical user interface to help the user locate important information (Ademu et al, 2012). Recently Linux has been used as a digital evidence examination platform and tools like The Sleuth kit and SMART have been developed providing a user friendly interface. More advanced tools are available to recover overwritten data from hard drives, but these are expensive for most purposes. Regrettably, many people are still unaware of the need for these tools.

Conclusion

Digital evidence must be precise, authenticated and accurate in order to be accepted in the court. Digital evidence is fragile in nature and they must be handled properly and carefully. Detailed digital forensic investigative processes and good knowlede of digital forensic tools provide important assistance to forensic investigators in establishing digital evidence admissible in the court of law. Digital forensic tools and techniques are developed to achieve the goals of digital evidence searching, retrieval and recovery. The digital forensic investigator analyse a case and select techniques to be used in the process of investigation. Carrying out a digital forensic investigation using a method manually could consume a huge amount of time for example searching all the cluster in a hard disk could take unto few years of work. There is some specific task that could not be performed without the use of specific software tools. There are a large variety of software and hardware that have been developed to help digital forensic investigators in performing a digital forensic investigation.

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The Future of Nigeria E-Government

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Abstract

Nigeria is situated on the Gulf of Guinea in West Africa with a land mass of 923, 768 square kilometres. Nigeria is divided into 36 states and the capital is Abuja with a federal system of Government. The Nigeria population is 167,912,561 and is seen as a source of strategic economic strength and competitiveness, which in combination with the vast natural resources, should define a productive powerhouse with an assured market that makes it even more attractive to investors. Oil is the major income of Nigeria and is the 4th biggest exporter of oil, exporting 2.1 million barrels of oil each day. Nigeria's petroleum is classified as "light" and "sweet", as the oil is largely free of sulphur. Nigeria is blessed with abundant oil and gas to commercial quantities. Nigeria is ranked 8th in the world in natural gas reserve with 5.246 trillion cubic metres. With the vast cultural and ethnic diversities in Nigeria, together with its huge population, and distributed land mass, it presents a high logistics challenge for the central and state government to render services that will be accessed nationwide without the full implementation of e-Government facilities. Therefore, e-Government is inevitable for smooth interaction between the government, its agencies and its citizens. This paper recommends a Unified Nigeria e-Government Framework to enhance its e-Government development and to bridge the digital divide between Nigeria and developed countries.

Keywords: e-Government, Portal, Model, Galaxy, NIGCOMSAT-1R and ICT

1. Introduction

Nigeria is situated on the Gulf of Guinea in West Africa with a land mass of 923, 768 square kilometres. Nigeria is divided into 36 states and the capital is Abuja with a federal system of Government. Nigeria is the biggest market in Africa, with a reputation for huge returns on successful investments despite the high costs of doing business. Nigeria has more than 250 ethnic groups and achieved independence from the United Kingdom on October 1, 1960, and the formal name is Federal Republic of Nigeria. The colonial era in Nigeria was relatively brief, lasting only six decades or so depending on the part of the country, but it unleashed such rapid change that the full impact is still in the contemporary period (Library of Congress – Federal

Research Division, [7]. The Chairman National Population Commission Sumaila Danko Makama said that Nigeria population is 167,912,561 and has annual population growth rate of 3.2 percent or 5.6 million people per annum. The Nigerian population is seen as a source of strategic economic strength and competitiveness, which in combination with the vast natural resources, should define a productive powerhouse with an assured market that makes it even more attractive to investors. But presently, the infrastructural development is very poor [9].

2. Nigeria as Oil and Gas Producing Country

Oil is the major income of Nigeria. Nigeria is an oil producing country, and in 2011 the country produced 2.2 million barrels of oil per day placing them 12th among producers. Nigeria is the 4th biggest exporter of oil, exporting 2.1 million barrels of oil each day. Nigeria's petroleum is classified as "light" and "sweet", as the oil is largely free of sulphur. Nigeria is the largest producer of sweet oil in OPEC. This sweet oil is similar in composition to oil extracted from the North Sea. This crude oil is known as "Bonny light". Nigeria is blessed with abundant oil and gas to commercial quantities. Nigeria is ranked 8th in the world in natural gas reserve with 5.246 trillion cubic metres. There are 39 major natural resources in Nigeria such as gold, Iron ore, aluminium bauxites, uranium, and other solid minerals to commercial quantities.

3. The Development of ICT in Nigeria

The e-Government potential in Nigeria is high, but the actual implementation is yet to be realised. There are challenges particularly in respect to human capacity building - for both the users and administrators. Other challenges include change management, harmonization of government information, and citizen interaction. These are processes which have existed for many years, and can be difficult to change. It is difficult for users to buy into the new technology due to cultural change because they prefer manual systems that have been in place for many years. Nigeria is not among the UN 50 e-readiness nations, none of the African countries are among the e-readiness nations, United Nations e-Government Survey [11]. This could be due to our under-development in ICT. Nigeria is falling behind in digital divide compared to developed countries. According to Amalu [4], Nigeria did not make the list of 60 top countries with highest Internet penetration of over 50 percent. Nigeria did not also make the list of 57 intermediate Internet-penetrated countries with penetration between 23.8% and 49.9% percent, as of March 31, 2009 but, rather was among 120 low Internet penetration countries. Digital divide is a threat to

successful e-Government implementation in Nigeria.

The development of ICT enhances the adoption of e-Government in any country of the world. Nigeria is a virgin land and much is needed to attain full development. To be fully developed the country need be an electronic society (e-Society) and this can be enhanced with Information and Communication Technology (ICT). With the vast cultural and ethnic diversities in Nigeria, together with its huge population, and distributed land mass, it presents a high logistics challenge for the central and state government to render services that will be accessed nationwide without the full implementation of e-Government facilities. Therefore, e-Government is inevitable for smooth interaction between the government, its agencies and its citizens.

On December 19, 2011 Nigeria successfully launched a broadcast satellite into orbit NIGCOMSAT-1R from a Chinese launch pad. The satellite is expected to provide ICT infrastructures such as telephone, broadband Internet and broadcasting services in Nigeria and other African countries [8]. According to Akunyili [2], Nigeria growth in hardware market has been 30 to 40 percent in years. Nigeria had 72 million mobile cellular active subscribers by the end of 2009. Nigeria is home to one quarter of the continent's mobile cell phone subscribers. Nigeria telephone operators, Globacom and Main One landed submarine fibre cables from EUROPE to Africa. They are the first Nigerian companies to embark on such heavy investments apart from Sat-3 which is jointly owned by some African countries. Other Nigerian companies are active with strong bands in the ICT market, for examples Zinox, Omatek and Anabel.

The author further said that the government of Nigeria in 2006 established a public corporation known as Galaxy Backbone to provide the technological platform for e-Government, and is working on a comprehensive broadband policy vision document which will provide broadband definition, performance indicator, incentives for investment, macroeconomic targets, deployment guidelines and citizens charter. The use of Smart-phones now enables Nigerian to access Internet and also perform tasks that were hitherto the exclusive preserve of PC's, delivery efficiencies and opportunities for innovation. The introduction of five submarine cables (Sat-3, WACS, GLO1, and MAIN ONE and ACE) in 2011, with an approximately 10 terabytes of data, and national fibre backbone networks, brightens the potential of e-Government in Nigeria with more opportunities for investments.

The author concludes that she realises the challenges faced in the implementation of e-Government in Nigeria which are human capacity building for both the users and administrators. Other challenges envisaged include change management, harmonisation of government information, and citizen interaction. Regardless of the development of sophistication in the development of ICTs in Nigeria, human beings remain the most critical factor. They are the users and creators of data. They are the managers of the technology. Quoting Azenabor et al. [5] there cannot

be absolute trust and security in electronic communication as far there are human interaction, therefore "absolute trust and security is unattainable anywhere in the world including the developed countries". Attitudes and sincerity of the interrogators of the systems matter when dealing with people's details in their custody.

Nigeria being an emerging economy has done its best in the development of ICT technology which facilitates the implementation of e-Government and other technologies such as the Internet, mobile telephone, the different electronic application (e-banking, e-Commerce, etc), digital media and broadband technology. The digital divide between Nigeria and developed countries is wide and much is still needed to be done to close these gaps and push Nigeria to be among the first twenty e-Government country in the world. Nigeria started towards e-Government development in 2006 when it established Galaxy Backbone and yet much remains to be achieved. Nigeria needs to integrate government ministries in both federal and states departments and agencies in a manner that promote their online interaction. In developing e-Government framework for Nigeria, we will take the U.K and the U.S.A e-Government models as case studies.

4. The E-Government Models in U.K and the U.S.A

The U.K and the U.S.A are among the most developed e-Government countries in the world. The word 'e-Government' was first coined by United States National Performance Review in 1993 [6]. According to Alasem [3], by early 2000s the term 'e-Government' became popular across the world including many developed countries for describing the reinvention and improvement of processes within government and interface with citizens through (ICT) in general and the Internet in particular. There are many definitions of e-Government, Sharif and Irani [10] said that the e-Government implementation provides additional access to service and procedural application forms (such as planning permission, health and other benefits), the ability to perform simple searches, and the ability to contact council administrative members and representatives directly.

Affisco and Soliman [1] defined e-Government as the need for more efficiency in public sectors. Federal, state, and local governments worldwide are under pressure to deliver services more efficiently at lower cost and recognising e-Government as an attractive option both commercially and politically. The e-Government is a major project that can significantly reduce government expenses, increase cooperation among agencies, and enhance citizens' satisfaction if it is well designed and implemented with a coherent strategic focus in mind. Whatever definition given by different authors, the e-Government is the means by which government and its agencies run services to its citizens using Information and Communication Technologies (ICTs) such as Wide Area Network (WAN), The Internet, and mobile communication. The e-Government has the ability to transform

relationships between government and its citizens, businesses, and other arms of government.

These technologies can serve a variety of different purposes, better delivery of government services to its citizens, improved interactions with business industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits are: help to reduce corruption, increased transparency, greater convenience, revenue growth and reduce cost. The U.S.A and the U.K have developed and are enjoying the benefits of e-Government and these are some of the services they offered: applying for local government jobs, register for business with the government, transact business and other services with government online, paying tax to the government online, contact your elected officials online, apply for driver's license using online facility, finding schools online, find your doctors, dentists and get travel health information online etc.

The U.K and U.S.A e-Government have some similarity in the services they run online, but they also have some differences in their e-Government portals. Below are the differences between U.K and U.S.A e-Government portals and models.

Table 1: A Table of Comparison between U.K and U.S.A e-Government Portal

DIRECTGOV (U.K. PORTAL)	USA.GOV (U.S. PORTAL)
The website is crowded with too much information within and outside government cycle and the home page is overcrowded with much information vying for attention.	Information to the home page is direct and simple
The search engine works reasonably well but it routinely finds as many as 500 results, and, instead of working through the results, people tend to leave the site and go to Google where results are perceived to be better.	The search engine is very efficient and direct by searching for related information very quickly.
When looking for child care providers, the user is presented with search form for England only. There are links to websites for each of the devolved nations, but for Wales, this returns to the same England form.	It links to every federal agency and to state, local, and tribal governments, and is the most comprehensive site in – and – about U.S. Government. This portal allows visitors to find information on its site in several ways; through search engine; an index of links of organised audience, by topic, and organisation.
Directgov has no facilities such as interactive mail and web chat.	USA.gov has live chat available in English where service representative can answer website visitors' questions about federal agencies, programme, benefits, or services. USA.gov new blog will give consumers a fresh and interactive perspective on how they can use government resources to make their lives better, easier and more fun. There is interactive e-mail for visitors to e-mail their questions and receive responses. There is also facility for government podcasts.
In directgov there is no facility to contact elected officials, the Prime Minister, Member of Parliaments, the Mayors or Chancellors.	In USA.gov you can contact elected officials: send questions, comments, concerns, or well-wishes to the President or his staff. Also you can search for U.S. Senators, U.S. representatives, and select your state Governors, by e-mail, telephone and postal contact and state legislators by names and other elected officials by your zip code.

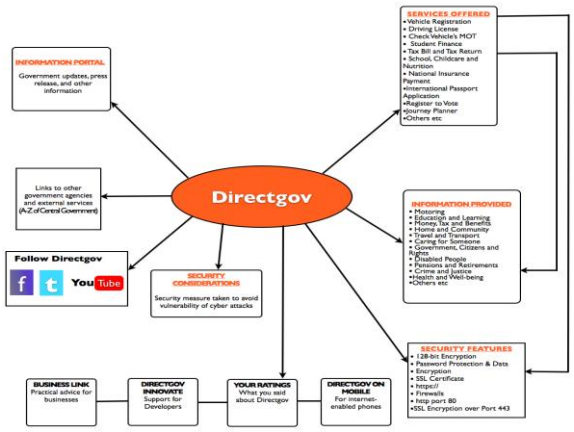

Figure 1: Diagrammatic representation of U.K. e-Government Model

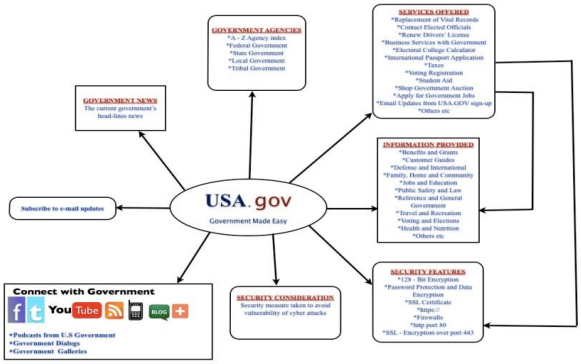

Figure 2: Diagrammatic representation of U.S.A e-Government Model

5. Nigeria E-Government Framework

The Proposed Unified Nigeria e-Government Framework is derived from the U.K and U.S.A e-Government models. The Information provided enables the public to have access to the government information online 24/7, starting with the federal ministries, federal departments and agencies, federal commissions, security agencies, education and learning and public safety. This also includes federal road safety commission (FRSC), motoring, grants and benefits, pensions and retirements as well as tourism. Others are home and community, disabled people, governments, citizens, and rights, crime and justice, national health insurance scheme (NHIS), travel and transport, defence and others. All the information you need to know about the government can be found online.

Government offers services to the public online and this will help to break the geographical barriers negating the need of travelling to government ministries, departments and government's agencies for information and services. Therefore the public can have access to government services online and they can make use of these facilities wherever they are and anywhere in the world. The services available are vehicle registration, renew driver's licence, check vehicle MOT, student aid and scholarship, tax bill and tax return, school, childcare and nutrition, and e-Health. There are services on how to contact your elected officials, apply for international passport, and apply for government jobs and others. The public make use of these facilities by online form submission, online payment by card, and other online payments including telephone transactions and payment.

e-Health: This enables a patient to have a consultation with a participating medical doctor in the national health insurance scheme (NHIS) who may not be necessarily based in Nigeria but anywhere in the world. This will help to improve access to reliable medical care.

The public cloud by the central government enables citizens all over the country to have access to e-Government services deployed through the cloud. The central government through the cloud allows all the local government areas to deploy and operate a unified set of applications for all citizens across all local government areas in Nigeria. This unified set of operation must have clear boundaries because each local government area operates on its own. That is to say that the unification comes in order to have a regulatory standard across all the local government areas by the central government. Each local government entity cloud in Nigeria should have their custom application too. Therefore, the unified Nigeria e-Government framework is embedded with cloud computing model which helps the government to achieve unified applications across all local government entities with multi-tenancy. Each of these local government areas in Nigeria is to be treated as a tenant. The unified set of applications can be deployed into an application store, where they can be easily deployed across tenants, that is the local government areas. Each of the tenants is to become an e-Local government and the whole set up consist of the overall e-Government solutions.

Government centralised and regulated database collects biometrics information and records of citizens and they are stored in the database system at a single location and could be accessible from numerous government agencies. The database could be up-graded so that it can handle more information, servers can be added to the database sites in the database system. There is a constraint and security to prevent unauthorised access on the database system so that no one can alter the data except the interrogators of the system (Database administrators and system analysts). Government agencies can only call and access the data when they want to find out certain information about citizens but they cannot alter the record in the database. The database is connected through a network and there should be backups in case of attacks. The government interrogation circle enables various government departments and agencies to access information from the centralised and regulated database system.

e-Local governments have access to government facilities with good Internet connectivity through the cloud and there are availability of e-Kiosks for access to government information and services. The e-Kiosks are available for those who have no access to computers and those who are not computer literate and there are trained members of staff to help out.

Nigerians in diaspora are very important and useful for the economic development of Nigeria. This is because Nigeria as a nation has experienced brain drain over the last three decades which has had an adverse effect on the economy. Nigerian professionals are scattered all over the world especially in Europe, North America and Asia. The present administration actively recruits Nigerian professionals in the diaspora into its government and also encourages others to come back home and contributes to the growth of the country. In cases where Nigerians in the diaspora cannot relocate home, this medium will still be able to tap into their experience and knowledge by encouraging suggestions

from such individuals. Therefore the system is open for them to register into the Nigerians in diaspora e-Government portal. They can also register to vote, register for census and register for record keeping.

The National Independent Electoral Commission (INEC) already has a database system but more is need to enhance its functions. Government spends billions of naira in updating electoral records every four years when the general election is about to take place. This should be discouraged rather every citizen should register to vote online by filling the application form and sending it to the commission. After the processing, the applicant should be invited by the commission to come for biometric voter's card and if it is multipurpose Biometric National Identity Card (BNIDC) the citizens should be referred to government centralised and regulated database system for issuance of the card. Government also spends huge sums of money on electoral ballot paper during elections. We advise that there should be soft paper ballot on the electoral database system with all the political logos on it, and it should be printed by the commission in each state few days to the election, therefore this will help to save wastage and cost.

The government should be able to make use of the social networking technologies and give feedback to the public from frequently asked questions; such as interactive online services to enhance the convenience of citizens-sending messages to mobile phones, emails and other interaction with governments and its representatives. Nigeria has about thirty-nine major minerals for export, international business interest should be able to contact the government online for this transaction. The Proposed Unified Nigeria e-Government Framework is secured against vulnerability of cyber-attack with security features and authentication and encryption. Other links to the government for government updates; press release, latest government information, about Nigeria; tourism and e-Government events and government authorities; A-Z agency index, central governments and state governments are easily accessible.

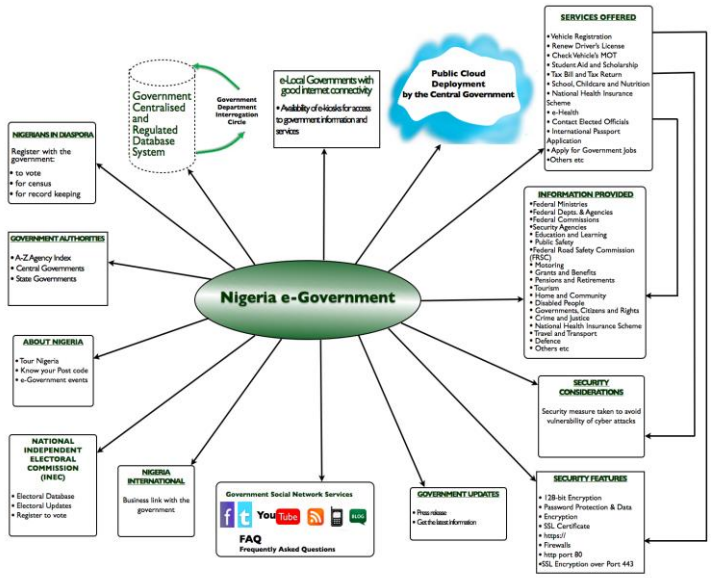

Figure 3: The Proposed Unified Nigeria e-Government Framework

6. Conclusion

We recommend that the Nigerian government should embrace electronic communication by investing more in e-Government in Nigeria at all levels of government; federal, states and local government areas. The federal government of Nigeria is eager on e-Government developments, lack of power supply, poverty, ICT infrastructures are major hindrances to its adoption. Government should commit more financial and infrastructural development as well as manpower if we are to meet our target of vision 2020 to be among the 20 most economically developed nations in the world. The security issues should not be treated with laxity, as far as we are embracing this technology much should be given to it with full protection so as to bring trust in the minds of the public. We will also recommend the Proposed Unified Nigeria e-Government Framework in (Figure 3) to the federal government, state government and local government in Nigeria so as to bridge the digital divide between Nigeria and developed countries.

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Assessing Corporate IT Governance with CMMI and MCDM

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Information Technology (IT) has been a focus of research and practice for many decades. Many organizations have implemented IT governance frameworks to improve their management and governance of IT. ITIL (Information Technology Infrastructure Library) is one of widely accepted approaches to IT service management. It is one of frameworks designed to assist firms by providing them with consistent and comprehensive documentation of best practice drawn from the public and private sectors internationally. However, practitioners are often puzzled about where they stand, how well they are doing, and what they should do next. Many researchers conduct Capability Maturity Model Integration (CMMI) as a process improvement approach to help organizations to improve their performance.

Managers usually make strategic decisions based on a single purpose or dimension, but strategic planning is influenced by many different factors and viewed from several perspectives, such as cultural, technological and structural standpoints. DANP (DEMATEL-based Analytic Network Process) is a new multiple criteria decision making approach used to gathers collective knowledge to capture the causal relationships between strategic criteria. Therefore, this paper proposes a hybrid assessment approach combined by CMMI and DANP as a means to help answer these and related questions.

Keywords: CMMI, DANP, ITIL, IT governance,QFD,MCDM

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1. Introduction

Information Technology (IT) has been a focus of research and practice for many decades. Many organizations have implemented IT governance frameworks to improve their management and governance of IT. ITIL (Information Technology Infrastructure Library) is one of widely accepted approaches to IT service management. It is one of frameworks designed to assist firms by providing them with consistent and comprehensive documentation of best practice drawn from the public and private sectors internationally. However, practitioners are often puzzled about where they stand, how well they are doing, and what they should do next. Many researchers conduct Capability Maturity Model Integration (CMMI) as a process improvement approach to help organizations to improve their performance.

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2. IT service management.

The Information Technology Infrastructure Library (ITIL) is a set of concepts and practices for Information Technology Services Management (ITSM), Information Technology (IT) development and IT operations. ITIL gives detailed descriptions of a number of important IT practices and provides comprehensive checklists, tasks and procedures that any IT organization can tailor to its needs. The IT Infrastructure Library originated as a collection of books, each covering a specific practice within IT Service Management. ITIL was built around a process-model based view of controlling and managing operations often credited to W. Edwards Deming and his plan-do-check-act (PDCA) cycle.

2.1 Overview of the ITIL v3 library

ITIL v3 is an extension of ITIL v2 and does not replace it. The two publications should therefore not be considered in isolation. ITIL v3 provides a more holistic perspective on the full life cycle of services, covering the entire IT organisation and all supporting components needed to deliver services to the customer, whereas v2 focused on specific activities directly related to service delivery and support. Most of

the v2 activities remained untouched in v3, but some significant changes in terminology were introduced in order to facilitate the expansion.
Five volumes comprise the ITIL v3, published in May 2007:
1. ITIL Service Strategy
2. ITIL Service Design
3. ITIL Service Transition
4. ITIL Service Operation
5. ITIL Continual Service Improvement

2.1.1 ITIL Service Strategy
As the center and origin point of the ITIL Service Lifecycle, the ITIL Service Strategy volume provides guidance on clarification and prioritization of service-provider investments in services. More generally, Service Strategy focuses on helping IT organizations improve and develop over the long term. In both cases, Service Strategy relies largely upon a market-driven approach. Key topics covered include service value definition, business-case development, service assets, market analysis, and service provider types. List of covered processes:
(1). Service Portfolio Management
(2). Demand Management
(3). IT Financial Management

2.2.2 ITIL Service Design
The ITIL Service Design volume provides good-practice guidance on the design of IT services, processes, and other aspects of the service management effort. Significantly, design within ITIL is understood to encompass all elements relevant to technology service delivery, rather than focusing solely on design of the technology itself. As such, Service Design addresses how a planned service solution interacts with the larger business and technical environments, service management systems required to support the service, processes which interact with the service, technology, and architecture required to support the service, and the supply chain required to support the planned service. Within ITIL v2, design work for an IT service is aggregated into a single Service Design Package (SDP). Service Design Packages, along with other information about services, are managed within the service catalogues. List of covered processes:
(1). Service Catalogue Management
(2). Service Level Management
(3). Risk Management
(4). Capacity Management

(5). Availability Management
(6). IT Service Continuity Management
(7). Information Security Management
(8). Compliance Management
(9). IT Architecture Management
(10). Supplier Management

2.2.3 ITIL Service Transition

Service transition, as described by the ITIL Service Transition volume, relates to the delivery of services required by a business into live/operational use, and often encompasses the "project" side of IT rather than "BAU" (Business as usual). This area also covers topics such as managing changes to the "BAU" environment.

List of processes:

(1). Service Asset and Configuration Management
(2). Service Validation and Testing
(3). Evaluation
(4). Release Management
(5). Change Management
(6). Knowledge Management

2.2.4 ITIL Service Operation

Best practice for achieving the delivery of agreed levels of services both to end-users and the customers (where "customers" refer to those individuals who pay for the service and negotiate the SLAs). Service operation, as described in the ITIL Service Operation volume, is the part of the lifecycle where the services and value is actually directly delivered. Also the monitoring of problems and balance between service reliability and cost etc. are considered. The functions include technical management, application management, operations management and Service Desk as well as, responsibilities for staff engaging in Service Operation.

List of processes:

(1). Event Management
(2). Incident Management
(3). Problem Management
(4). Request Fulfillment
(5). Access Management

2.2.5 ITIL Continual Service Improvement (CSI)

Aligning and realigning IT services to changing business needs (because standstill

implies decline). Continual Service Improvement, defined in the ITIL Continual Service Improvement volume, aims to align and realign IT Services to changing business needs by identifying and implementing improvements to the IT services that support the Business Processes. The perspective of CSI on improvement is the business perspective of service quality, even though CSI aims to improve process effectiveness, efficiency and cost effectiveness of the IT processes through the whole lifecycle. To manage improvement, CSI should clearly define what should be controlled and measured.

CSI needs to be treated just like any other service practice. There needs to be upfront planning, training and awareness, ongoing scheduling, roles created, ownership assigned, and activities identified to be successful. CSI must be planned and scheduled as process with defined activities, inputs, outputs, roles and reporting.

List of processes:

(1). Service Level Management
(2). Service Measurement and Reporting
(3). Continual Service Improvement

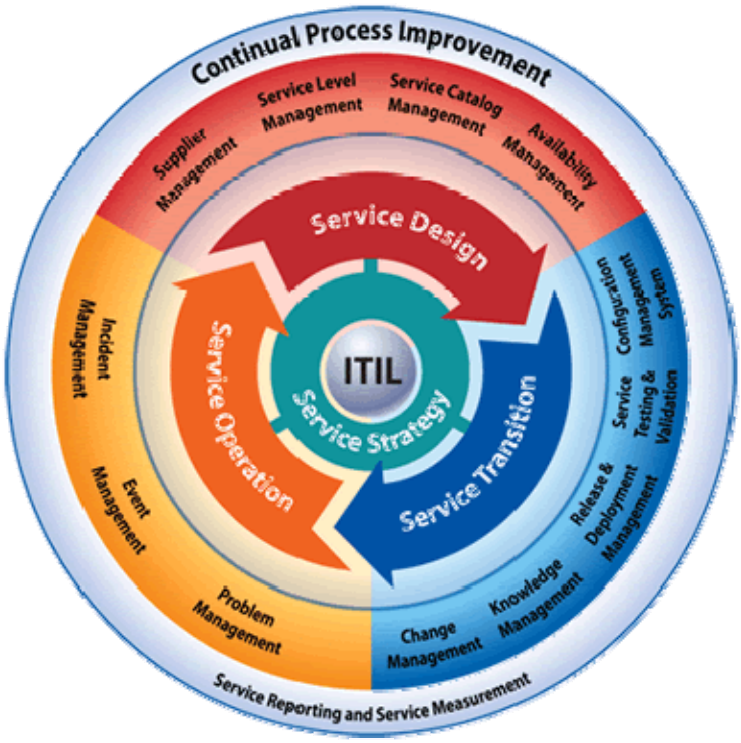


Figure 1. ITIL V.3 Framework

Source: ITIL V3 Foundation

2.2.6 Information Technology Services Assessment in Organizations

Recently many researchers evaluated the perception gaps of service quality between information technology service providers and their clients to assess these gaps by using the instrument SERVPERF of the SERVQUAL model.

E-Government services such as the online tax filing and payment system (OTFPS) were assessed by using a theoretical model based on the theory of planned behavior (TPB), technology adoption model (TAM), diffusion of innovation theory (DOI) to identify the determinants for acceptance, and the causal relationships among the variables of acceptance behavior. Furthermore, some researchers discovered e-Government adoption behavior differs based on service maturity levels, i.e., when functional characteristics of organizational, technological, economical, and social perspectives of e-Government differ from the perspectives of service maturity stages.

3. DEMATEL-based Analytic Network Process (DANP)

3.1 The DEMATEL Method

Because evaluation of knowledge management capabilities cannot accurately estimate each considered criterion in terms of numerical values for the alternatives, fuzziness is an appropriate approach. The DEMATEL method is an emerging method that gathers group knowledge to capture the causal relationships between criteria.

The original DEMATEL (DEcision-MAking Trial and Evaluation Laboratory) method studied the disjointed and antagonistic phenomena of world and investigated integrated solutions. In 1973, the Battelle Memorial Institute conducted the DEMATEL project through its Geneva Research Centre. In recent years, this method has become very popular in Japan.

It is especially practical and useful for visualizing the structure of complicated causal relationships with matrices or digraphs, which portray the contextual relations between the elements of a system, where a numeral represents the strength of influence. Therefore, the DEMATEL method can convert the relationship between the causes and effects of criteria into an intelligible structural model of the system.

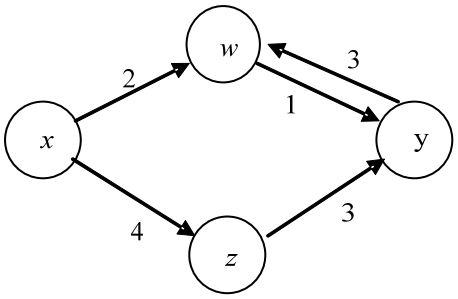
The DEMATEL method has been successfully applied in many fields. For example, Tamura et al. (2002) try to decrease anxiety of people by extracting and

analyzing various uneasy factors in order to create future safe, secure and reliable (SSR) society. More recently, Chiu et al. (2005) adopted the method to study marketing strategy based on customer behavior related to LCD-TVs. Also Hori and Shimizu (1999) employed it to design and evaluate the software of a display-screen structure for analyzing a supervisory control system.

3.2 The DEMATEL for Constructing a NRM

The DEMATEL method (Gabus and Fontela 1972; Ou Yang et al. 2008) was utilized to investigate the interrelations among criteria to build a NRM. The technique has been successfully applied in many situations, such as development strategies, management systems, e-learning evaluations, and knowledge management (Lin and Tzeng 2009; Tsai and Chou 2009; Tzeng et al. 2007; Wu 2008). The method can be arranged as follows:

Step 1: Obtain the direct-influence matrix by scores. Respondents are required to point out the degree of direct influence among each criterion. We suppose that the comparison scales, 0, 1, 2, 3 and 4, stand for the levels from “no influence” to “very high influence”. Then, the graph which can describe the interrelationships between the criteria of the system is shown in Fig. 1. For instance, an arrow from w to y symbolizes that w impacts on y, and the score of influence is 1. The direct-influence matrix, A, can be derived by indicated one criterion i impact on another criterion j as aij.



$$\boldsymbol{A}=\begin{bmatrix} a_{11} & \cdots & a_{1j} & \cdots & a_{1n} \\ \vdots & & \vdots & & \vdots \\ a_{i1} & \cdots & a_{ij} & \cdots & a_{in} \\ \vdots & & \vdots & & \vdots \\ a_{n1} & \cdots & a_{nj} & \cdots & a_{nn} \end{bmatrix}$$

Step 2: ***Calculate the normalized direct-influence matrix S***. ***S*** can be calculated by normalizing ***A*** through Equations (6-1) and (6-2).

$$\boldsymbol{S}=m\cdot\boldsymbol{A} \tag{6-1}$$

$$m=\min\left[\frac{1}{\max\limits_{i}\sum\limits_{j=1}^{n}|a_{ij}|},\frac{1}{\max\limits_{j}\sum\limits_{i=1}^{n}|a_{ij}|}\right] \tag{6-2}$$

Step 3: ***Derive the total direct-influence matrix T***. ***T*** of NRM can be derived by using

a formula (6-3), where $\boldsymbol{I}$ denotes the identity matrix; i.e., a continuous decrease of the indirect effects of problems along the powers of $\boldsymbol{S}$, e.g., $\boldsymbol{S}^2, \boldsymbol{S}^3, ..., \boldsymbol{S}^q$ and $\lim_{q\to\infty} \boldsymbol{S}^q = [0]_{n\times n}$, where $\boldsymbol{S} = [s_{ij}]_{n\times n}$, $0 \le s_{ij} < 1$ and $0 \le \sum_i s_{ij}$ or $\sum_j s_{ij} < 1$ only one column or one row sum equals 1, but not all. The total-influence matrix is listed as follows.

$$\begin{aligned}\boldsymbol{T} &= \boldsymbol{S} + \boldsymbol{S}^2 + \cdots + \boldsymbol{S}^q \\ &= \boldsymbol{S}(\boldsymbol{I} + \boldsymbol{S} + \boldsymbol{S}^2 + \cdots + \boldsymbol{S}^{q-1})(\boldsymbol{I} - \boldsymbol{S})(\boldsymbol{I} - \boldsymbol{S})^{-1} \\ &= \boldsymbol{S}(\boldsymbol{I} - \boldsymbol{S}^q)(\boldsymbol{I} - \boldsymbol{S})^{-1}\end{aligned}$$

when $q \to \infty$, $\boldsymbol{S}^q = [0]_{n\times n}$, then

$$\boldsymbol{T} = \boldsymbol{S}(I - \boldsymbol{S})^{-1} \tag{6-3}$$

where $\boldsymbol{T} = [t_{ij}]_{n\times n}$, $i, j = 1, 2, ..., n.$

Step 4: Construct the NRM based on the vectors r and c. The vectors r and c of matrix T represent the sums of rows and columns respectively, which are shown as Equations (6-4) and (6-5).

$$\boldsymbol{r} = [r_i]_{n\times 1} = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1} \tag{6-4}$$

$$\boldsymbol{d} = [d_j]_{n\times 1} = \left[\sum_{i=1}^{n} t_{ij}\right]'_{1\times n} \tag{6-5}$$

where r_i denotes the sum of the i th row of matrix $\boldsymbol{T}$ and displays the sum of direct and indirect effects of criterion i on another criteria. Also, d_j denotes the sum of the j th column of matrix $\boldsymbol{T}$ and represents the sum of direct and indirect effects that criterion j has received from another criteria. Moreover, when $i = j$ $(r_i + d_i)$, it presents the index of the degree of influences given and received; i.e., $(r_i + d_i)$ reveals the strength of the central role that factor i plays in the problem. If $(r_i - d_i)$ is positive representing that other factors are impacted by factor i. On the contrary, if $(r_i - d_i)$ is negative, other factors has influences on factor i and thus the NRM can be constructed (Liou et al. 2007; Tzeng et al. 2007).

4. Capability Maturity Model Integration (CMMI)

In 1991, the Software Engineering Institute (SEI) of Carnegie Mellon University introduced the capability maturity model for software (SW-CMM) to evaluate the

capability maturity of software development contractors of the US Defense Department and provide a roadmap for software process improvement. Since SEI released SW-CMM Version 1.1, it has been applied to different areas. Hence, many capability maturity models have been proposed, including the software acquisition CMM (SA-CMM), system engineering CMM (SE-CMM), integrated product development CMM (IPD-CMM) and people CMM (P-CMM)(Huang and Han 2006).

Table 1. CMMI : SW-CMM Version 1.1

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process standardization* (SS) *(IPPD)* *(IPPD)*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Integrated Supplier Management Risk Management Decision Analysis and Resolution Organizational Environment for Integration Integrated Teaming
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial		

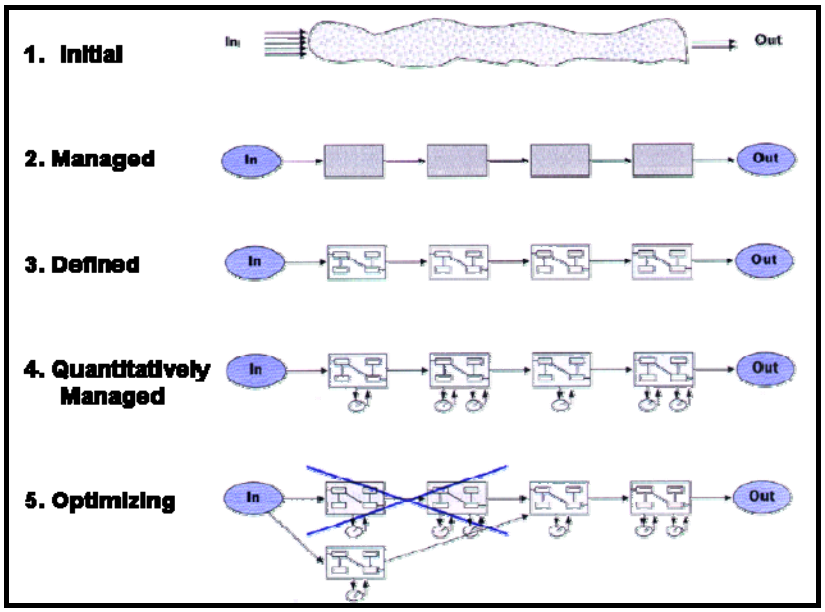
Source: SW-CMM Version 1.1

As these models were developed by different organizations, they had many overlapping applications and lacked consistency in architecture, terminology, and assessment methodology. These problems increased costs and the time required to implement multiple model-based process improvements. Therefore, SEI released the capability maturity model integration (CMMI) system in 2001 to integrate existing capability maturity models. Huang and Han (2006) observed that the advantages of CMMI are: (1) it eliminates inconsistencies and duplication, and thus streamlines enterprise-wide process improvements; and (2) it reduces the cost and time associated with model-based process improvement, and thereby increases the return on an organization's investments.

To accommodate different process-improvement needs for software organizations,

the CMMI product team provided them with two choices (staged or continuous representation) to increase the maturity of their processes. Under CMM, staged representation provides a framework for organizing the evolutionary steps into five levels of maturity (initial, managed, defined, quantitatively managed, and optimizing). (Huang and Han 2006)

These levels are ordinal scales for measuring the maturity of an organization's software process and can also be used for its internal process improvement. SEI then added the continuous representation framework to the CMMI. Because of its flexibility, the framework enables software organizations to choose their improvement paths. The continuous representation facilitates comparisons of a specific process area across software organizations, and thereby allows process improvement to be compared with that of the ISO/IEC 15504 standard. (Huang and Han 2006)



Source: SW-CMM Version 1.1

Figure 2. Rational of CMMI Staged Representation

5. Quality Function Deployment approach(QFD)

Quality function deployment (QFD) is a valuable method that provides a means of translating customer needs into the appropriate technical requirements for each stage of detailed operations in product development and production.

The purpose of this study is to develop an effective decision-making method based on QFD and DANP approach to help for making better decisions of planning or evaluation problems.

The QFD is an integrated planning method that can assure and improve the alignment of elements of design processes with the requirements of customers, as well as it is a managerial philosophy that can help enhance the organizational and managing effects [40]. Especially, QFD employs a cross-functional team to plan and design new or improved products or services through a structured and well-documented framework. In contrast with traditional requirements of engineering methodologies, benefits of using QFD are such as: carries the voice of the customer into the process; abolishes waste and creates flexibility; supports customer-oriented decisions of design; determines objectives and creates focus on the essential; takes interests of various groups into account; systematizes communication and provides for continuity and responsiveness; creates transparency and makes coordination processes easier; and speeds up development process.

5.1 What QFD can do

According to Wikipedia's definition, Quality function deployment (QFD) is a "method to transform user demands into design quality, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process." , as described by Dr. Yoji Akao, who originally developed QFD in Japan in 1966, when the author combined his work in quality assurance and quality control points with function deployment used in value engineering.

QFD is especially designed to help practitioners focus on characteristics of a new or existing product or service from the viewpoints of market segments, company, or technology-development needs. The technique yields graphs and matrices.

QFD helps transform customer needs (the voice of the customer [VOC]) into engineering characteristics (and appropriate test methods) for a product or service, prioritizing each product or service characteristic while simultaneously setting development targets for product or service.

5.2 House of Quality

House of Quality is a diagram, resembling a house, used for defining the relationship between customer desires and the firm/product capabilities. It is a part of the Quality Function Deployment (QFD) and it utilizes a planning matrix to relate what the customer wants to how a firm (that produces the products) is going to meet those wants. It looks like a House with a "correlation matrix" as its roof, customer

wants versus product features as the main part, competitor evaluation as the porch etc. It is based on "the belief that products should be designed to reflect customers' desires and tastes". It also is reported to increase cross functional integration within organizations using it, especially between marketing, engineering and manufacturing.

The basic structure is a table with "Whats" as the labels on the left and "Hows" across the top. The roof is a diagonal matrix of "Hows vs. Hows" and the body of the house is a matrix of "Whats vs. Hows". Both of these matrices are filled with indicators of whether the interaction of the specific item is a strong positive, a strong negative, or somewhere in between. Additional annexes on the right side and bottom hold the "Whys" (market research, etc.) and the "How Muches". Rankings based on the Whys and the correlations can be used to calculate priorities for the Hows.

House of Quality analysis can also be cascaded, with "Hows" from one level becoming the "Whats" of a lower level; as these progresses the decisions get closer to the engineering/manufacturing details.

Moreover, QFD has been applied in various industries such as transportation, communication, electronics, electrical utilities, software systems, manufacturing, services, education, and research. It has been successfully applied in many companies as a powerful tool that addresses strategic and operational decisions in businesses.

To advance continuous improvement for strengthening global competitiveness, most companies are striving to eliminate the IT services gaps and seize users’ needs and to seek for higher levels of quality for their products and services. To fulfill these IT service demands, we adopt Quality Function Deployment (QFD) with ITIL to provide profitable solutions with the emphasis on goal-oriented, fast, flexible and customer-focused approach.

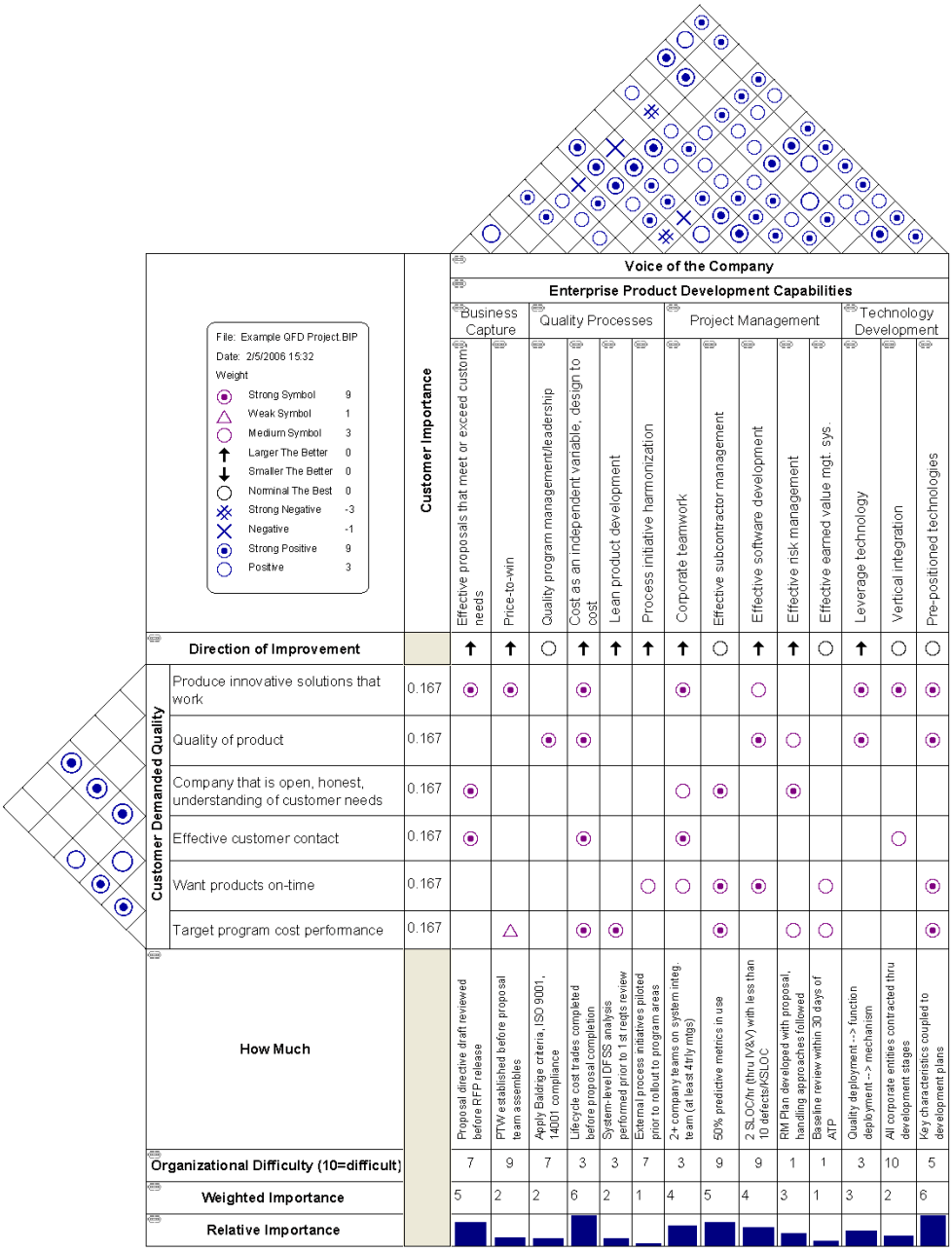


Figure 3. QFD House of Quality for Enterprise Product Development Processes

6. A novel hybrid ITIL service approach combined by DANP and QFD

The aim of this study is to build in the service user satisfactions at the IT system services phase, which is attracting a lot of attention in recent researches.

During the QFD implement process, the Analytic Network Process (ANP) has been used to determine the relative importance weights between criteria or the

intensity of the relationship between the row and column variables of each matrix.

To develop an effective decision-making method to help for making better decisions of planning or evaluation problems.

Since the key tool of QFD is the matrix, we focus on the series of interactive matrices and therefore apply the super-matrix of the ANP in order to perform our proposed method. In the proposed method, it incorporates several QFD matrices into a super-matrix based on the Series System model. The procedures of proposed method are mainly divided into two phases as follows.

Phase 1: Using QFD to develop decision structure.

In this phase, it begins with the way to confirm strategic needs obtained through business surveys and analyses. Next, it is necessary to define the decision goal and to collect relevant information, evaluation criteria, and the alternatives. Then, these decision elements are structured into a three dimension HOQ through the QFD methodology. Commonly, persons employ the way of traditional two-dimension HOQ, so that they need to use two HOQs with twice translations. Where the first HOQ translates the criteria into sub-criteria, and then the second HOQ converts the sub-criteria into the alternatives. Obviously, the way of using a three-dimension HOQ is more effective and beneficial than that way of using a two-dimension HOQ. Because the former provides more integrated information in a compact form, and it is also more convenient for the calculations with the super-matrix of the ANP. Of course, if necessary, a four dimension HOQ can also be extended to use.

Phase 2: Using ANP to prioritize alternative.

Once that decision structure is settled down, it is required to employ Saaty's five-point scale for making all paired comparisons of decision elements, and then to incorporate all sub-matrices into the super-matrix which is a hierarchy structure with four levels including inner dependences. Through performing calculations with the super-matrix of the ANP, finally the overall priorities of alternatives may be obtained. As for the calculations of the super-matrix, we can easily solve it with the ways using either the Microsoft Excel, Mathlab, or the professional software named "Super Decisions" provided by the Creative Decisions Foundation.

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E-GOVERNANCE ISSUES – SINGULURI FRAMEWORK

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ABSTRACT

e-Governance, became part of every citizens walk of life. Its benefit made citizens incline towards it and taking this as edge, the e-Governance stretched its services in all directions for simplifying the working style with happy living. The mammoth increase of its utility made it cross the beneficial boundaries and led to some issues. The issues depend on its area of applications like Business to Citizens (B2C), Business to Business (B2B) and Business to Government (B2G). These issues are not only irksome but also hampering the development of Nation. In order to minimize the limitations of e-Governance, a novel Singuluri framework is proposed which comprises eight elements intended to fine tune the online governmental activities.

The framework elements are planning, audit on services, social audit, infrastructure audit, professional audit, software audit, software downtime and project budget.

1. **Planning:** Determining the goals of the e-governance function and the means of achieving these goals is done in this phase. Every e-governance activity commences with planning phase and it is followed by organizing, leading and controlling. Organizing includes gathering, allocating and coordinating the resources needed by e-Governance applications to accomplish the goals. Leading includes motivating, guiding and communicating with personnel who participate in e-Governance activities. Controlling includes actual performance with planned performance as a basis for taking any corrective actions that are needed. Top management of concern departments is responsible for preparing a master plan for the e-Governance activities. The plan sets both the long-run and short-run directions. The three important phases of plan preparation are

- Recognizing opportunities and problems of organization by introducing e-Governance applications.
- Identifying the resources needed to for e-Governance activities
- Formulating strategies and tactics for acquiring the needed resources and process.

Auditors should evaluate whether top management has formulated a high-quality information systems plan appropriate to the needs of the e-Governance applications. Poor planning leads to insufficient hardware, software and personnel resources to handle the e-Governance applications. Top management must prepare two types of information systems plans - strategic plan and operational plan.

The strategic plan is the long-term plan for the next three to five years of operations. The contents of a strategic plan typically include the Evaluation of Current applications, Direction of planning, Development strategy. Short Term Operational Plan is the short-term plan for next one or two years of operations. The contents of an operational plan typically include the Report on progress. Both the strategic plan and the operational plan need to be reviewed regularly and updated as the need arises.

E-Governance planning needs changes from application to application, organization to organization, state to state and country to country. At most responsibility for e-Governance planning should be vested in e-Governance steering committee. The steering committee should assume overall responsibility for the activities of e-Governance applications. Their makeup should vary depending on how critical the e-Governance function is.

2. **Audit on Services:** An e-Government service is a series of activities performed on an application, or group of applications, on the Internet that provides a specific service to public, business or government. The goal of an e-Service is to provide a start-to-finish solution to the customer. Coverage of Critical citizen services is the prime criteria for selection of

an e-Governance project for audit. Evaluation of Quality of service with end user satisfaction is the scale for measuring performance of e-Governance projects.

The auditors should first sort out the involved services of e-Governance. The various services are designing, developing and implementation of the Internet application, Training on use of services, Marketing of service capabilities, Customer service support, Maintenance of existing services, Collecting and reporting summary statistics on e-Services performance and usage, Electronic payment acceptance related services, Annual surveys of customers/government partners.

A process of identifing new e-services has been established for the development and implementation of an e-Service.

- A business or customer base asks for specific services to be provided on the Internet.
- DoA solicits an agency to develop specific e-Services based on industry knowledge and technological capabilities.
- e-Service successful in another state.
- An agency internally identifies a government service that could be available on the Internet.

Auditors should look into the process of project prioritization. The demand for online access to government services is growing. As multiple e-Governance applications are to be developed, a development schedule is prepared for those services that have passed the above said three perspectives. Once an e-Service is approved and scheduled, it means everyone involved has agreed to work on the project and dedicate resources as needed. e-Services are listed on the schedule in priority order. Project rankings are determined by evaluating the value of the service and the project resources available. The level of importance in providing the service is defined.

Auditors should evaluate each and every step involved in development process. The development and implementation process of an e-Service involves the following steps

- Staff meetings are conducted to gain an understanding of internal processes related to the program service and to share design ideas.
- e-Services may be moved ahead of schedule or bumped down the development schedule depending on many factors.
- Development schedule progress and revision decisions are made periodically.
- A pilot project is provided to the agency for review and acceptance.
- Once a service is produced, it is tested for a specific time period and bugs are worked out.
- Training programs are conducted for agency personnel and customers, as needed, on how to use the e-Service.
- The e-Service is then made available to public to make use of it.

Auditors should concentrate much on the financial transactions, which is the fee charged by the government for e-Services. There are two types of fees associated with an e-Service. The first fee is a convenience fee charged by government to pay for the services it provides. For this audit report, a convenience fee is defined as an amount added to a transaction of an e-Service. In general, any e-Service that collects money of any amount has a convenience fee added to it. The second fee associated with e-Services is a fee charged for acceptance of electronic payment (e-payment). These fees are associated with the method used to pay for e-Service transactions and are termed "cost of sale" fees. There are two e-Payment methods available (credit/debit cards or electronic checks). Fees vary depending on the method used. These fees are charged by and paid to the credit card network and merchant banks.

Auditors should measure the success of e-Services as follows.

- The e-Service success is measured by its adoption rate. The adoption rate is the percentage of people using the e-Service versus the total number of people that use a particular traditional government service.
- Other e-Service success factors include revenue generated versus total production and maintenance costs
- Awards or national recognition and citizen or business compliments.

3. **Social audit:** E-Governance is developed for the benefit of public. Hence, while designing the e-governance applications, it the responsibility of government to make people participate in its design and implementation. In this regard, the social audit plays important role. A social audit is a process in which the people work with the government to monitor and evaluate the planning and implementation of a scheme or programme. The social audit process is critically dependent on the

integration and wide distribution of all relevant information. In order to discuss the question "How the social audit is related to other types of audits?", first we should consider different types of audits in connection to public. They are Government Audit, People's Audit, Combined Audit.

Government Audit: This is done usually by professional auditors without significant involvement of affected people. They concentrate on two aspects. Firstly they assesses primarily procedural integrity and outputs, Secondly they concentrate on ability to get public perceptions or verify outcome.

People's Audits: This is conducted by the people, sometimes with assistance from NGOs, with a standing invitation to the government. Points to observe are getting public perception, local knowledge and public verification. They can assess outcomes and priorities.

Combined Audit: Conducted in participation of both by the government and the people, especially by those people who are affected or by the intended beneficiaries of the scheme being audited. This can bring the views and facts of the people look at progress. This makes participate the people in the task of verification and the chances of acceptability by the government are high.

A social audit is conducted over the life span of a scheme or programme and not just in one stage. It audits planning, implementation, monitoring and evaluation that is it audits the process, the outputs and the outcome. The various elements involved in social audit are as follows.

- Raising awareness of rights, entitlements and obligations under a scheme.
- Specifically, about the right to participate in a social audit.
- Ensuring that all forms and documents are user friendly.
- Ensuring all relevant information is accessible, displayed and read out.
- Ensuring that the decision making process is transparent, participatory and, as far as possible, carried out in the presence of the affected persons.
- Ensuring that there are regular public hearings where the scheme and the process of social auditing is publicly analyzed.
- Ensuring that the findings of social audits are immediately acted upon.
- Also ensuring that these findings result in the required systemic changes
- Ensuring that all decisions and their rationale are made public as soon as they are made.
- Ensuring that measurements, certification and inspection involve the affected people on a random and rotational basis.

Social audit is done in three phases. They are Phase 1 - Planning And Data Collection, Phase 2 - Evidence-Based Study, Phase 3 - Public Answerability. The Seven Key Features of Social Audit are Collecting the Evidence, Community Participation, Fairness, Stakeholder Involvement, No Allegations, Repeat Audits, Results Sharing.

4. Infrastructure audit: The infrastructure includes all the physical and abstract elements which are involved in developing and implementing the e-governance applications. The telecommunication network, electricity, Kiosks, different source of access media like Mobiles telephony, Radios, Computers and Television, security devices like smartcards, biometrics, etc can be considered as infrastructure. As multiple elements are involved in the development of e-Government projects, the infrastructure is habitually the element most open to compromise and this is the one that frequently presents the greatest risk to e-Government projects.

Identifying the infrastructure which is associated with the e-Governance application is difficult because of two reasons. First, the e-Governance application possesses a substantial number of information systems assets and may be scattered at different locations. One way to identify infrastructure elements is to seek out Instances within various general categories as Human Resources, Hardware, Facilities, Documentation, Supplies Data / Information, Application Software, System Software.

The valuation might differ from place to place, person to person and depending on situation. The valuation also depends on the way in which the infrastructure could be lost, the period of time for which it is lost, and the age of the infrastructure.

5. Professional audit: The skills of various IT professional are audited to see whether they obey certain standards to fit into the work to produce quality e-Governance applications. Professional audit is one of the key points in Singuluri framework. As per this the skills of various IT professional are audited to see whether they obey certain standards to fit into the work to produce quality E-Governance applications. As most of the e-Governance applications are online, and many of the citizens, organizations and others interact with these applications, the professionals who develop these applications should possess certain qualities to receive

the appreciations. If not appreciations, the applications should not cause any damage or inconvenience to public or organizations.

The e-Governance applications are basically brain work and hence they are to be audited. Every organization needs staff that is competent and trustworthy. Extensive power is often given to the persons responsible for the computer based information systems development, implementation, operating, and maintaining within organizations. Unfortunately, ensuring that an organization has competent and trustworthy information systems personnel is a difficult task. Some information systems personnel seem to lack a well-developed sense of ethics and some lacks technical skills. In connection the IT professionals working for e-Governance applications should be audited regarding their trustworthiness and their skills.

The various factors to be considered in professional audit are Separation of duties, Change management – change in management, Encouragement, Qualities of professionals, Staff relations, Stream lining the duties, Study of standards, Staffing concepts, Code of conduct, Improving professional skills for e-governance, Training programs. Skills and knowledge requirement for e-governance projects to be considered are Systems Development Capacity, Project/Change Management Capacity, Intelligent Customer Capacity, Operational Capacity.

6. **Software audit:** The software should be audited for correctness, perfectness and availability. The software audit comprises of the Application software audit, Database audit, System software audit. The software audit comprises Application software audit, Database audit and System software audit. In Application software audit, programs which are developed for e-Governance applications, the purchased programs, network protocols, the related packages and utilities are to be audited by auditors. In Database audit, the data which is acquired through application programs are stored in database and audited. In System software audit, the operating system, firmware, hardware that permits sharing and resources within a computer system are audited.

   Application software audit: Application software audit in connections to e-Governance should mainly cover the business rules in the flow and accuracy in processing, Validations of various data inputs, Logical access control and authorization and Exception handling. The various auditing elements are Review of documents, Functions of software, Execute the program options, Validations, Access controls, Exceptions, Corrections, Review of related software.

   Database Audit: The database subsystem is responsible for defining, creating, modifying, deleting, and reading data of e-Governance applications. It maintains declarative data, relating to the static aspects of real-world objects and their associations and procedural data, relating to the dynamic aspects of real-world objects and their associations. The various factors considered in database audit are Access Controls, Integrity Constraints, Concurrency Controls, Cryptographic Controls, File Handling Controls, Audit Trails, Backup, Recovery.

   System Software Audit: During system software audit the auditors should consider the points like Protection From User Processes, Mutual User Protection, User Protection, Self Protection, Environmental Protection, Integrity Threats, Integrity Flaws, Design Considerations Of Os, Os Certification

7. **Software Downtime:** Performance audit concern the efficiency, effectiveness, economy of a particular government activity. The performance is directly related to downtime of e-Governance application. The measure of e-Governance performance is the citizen satisfaction in terms of convenience, increased transparency and protection of the confidentiality, integrity and the reliability of the information stored and processed by the e-Governance applications. In e-Governance applications, the software and networking plays important role in exhibiting the performance of e-Governance application. As networks have grown in speed and ubiquity, their complexity has grown quickly. e-Governance applications make use of desktop computers, servers, LANs, WANs and the Internet. Hence the probability of network downtime is more.

   There are two types of network service interruptions leading to breakdown of e-services. First is degradation, when a service is slower than usual and the low performance services perhaps may be useless which lead to outage. The second is a customer accessing a Web site may be unavailable. Auditors should probe enquiry into such problems. The components to be observed related to down time are Network Products, Security Products, Cables And Connectors, Servers, Applications, Service Providers. Downtime leads to loss to revenue and productivity loss. Hence there should

be some means of estimating the revenue loss and productivity loss incurred due to downtime.

Revenue Loss Estimation: As e-Governance applications generate revenue, downtime impacts treasury. We may not calculate the downtime effects exactly but by applying some reasonable assumptions, we can derive a good estimate that can be used to justify the expense and effort involved in avoiding downtime. The use of software products which can identify the problem or even better software products which will identify a potential problem can help to reduce or completely avoid downtime. The points to considered in revenue loss calculation is Total hours of service degradation per year. Total number of revenue Generating employees affected by outages or service degradations. Average percent of productivity lost by revenue Generating employees during degradations. Average annual revenue generated by each revenue-Generating employee. Total downtime for e-Commerce systems multiplied by average hourly ecommerce Revenue.

Productivity Loss Estimation: When users are unable to access network resources their productivity decreases, which has a distinct impact on a bottom line of e-Services. Large e-services invest tens and hundreds of millions of dollars in technologies that increase productivity. In productivity loss calculation, we use four key pieces of information

- Total outage hours per year and service degradations due to each of the sources of downtime
- Total number of employees affected by outage or service degradations
- Weighted average hourly wage per employee
- Average percent of productivity lost by employees during outages and service degradations

The productivity loss is calculated in terms of revenue generating employees and non revenue generating employees. Down time is a serious problem which causes great revenue loss and hence vigilance it throughout e-Governance applications.

8. Budgeting: This deals with the various e-Government funding strategies and funding issues. The different funding methods are Issuing bonds, public-private partnerships to fund e-government, make use of inventive financing methods, concentrate on return on investment. Most of the countries are opting for e-Governance but there is no pre defined existing budgeting methods. As this is recent concept, budgeting frameworks are not well developed. The definition of e-Governance differs from country to country. Some considers it as departmental implementation, some as the local area implementations and some as national implementation. Hence deciding the budget is complicated issue. The estimation of expenditure and comparison of the costs versus the benefits of e-Government is to be established. The estimation of expenditure differs from one application to another application because of the differing installed bases, capital replacement costs and spending requirements on infrastructures for e-Government readiness. As e-Governance is an online activity, the cost incurred for privacy and security should also be considered.

The various funding issues are cost overruns due to miss planning of projects, imbalanced cost and savings, transaction costs and corruption in government procurement, governmental funding structure consideration, e-governance funding strategies. Different funding methods are issuing bonds, inventive financing methods, low hardware cost, outsourcing, software leasing, rent to own, 3-zero financing (triple zero). The return on investment techniques includes Share-In-Revenue, User Charges, Advertising, Excise, Entertainment and Luxury Tax, Further Developments for Return on Investment

Singuluri model – Case study: Taking the framework elements into consideration, a case study is probed into e-Procurement of Andhra Pradesh and a mathematical model is developed which made realize that the fine tuning of the various quantified data elements as per Singuluri Model, is generating an additional revenue of Rupees 2000 crores per annum to the government which is a very big dividend to the treasure of Andhra Pradesh.

Analysis Of The Problem: The gathered data of manual system and e-Procurement system with differences in their efficiency graded on five point scale from the year 2004 to 2009 and presented in the table-1.

The analysis of Singuluri model clearly indicate that from the inception of e-Procurement policy, it gained the acceptance by the general public and thus discarding the manual system and this

scenario is observed from the year 2004, which details of the efficiencies of both manual and e-Procurement under investigation is presented in the following table.

Year	Manual	e-Proc
2004	0.66	4.52
2005	0.88	5.14
2006	1.28	6.42
2007	1.76	7.74
2008		10.18
2009		13.2

The above information is presented graphically to show the impact of e-Governance acceptance from the year 2004. It is noticed from the efficiency table that the e-Procurement of Andhra Pradesh is missing social audit right from its inception and is causing discontent with cluster of contractors. The social audit which features collecting the evidence, community participation, fairness, stakeholder involvement, no allegations, repeat audits, results sharing aids in improvement of e-Procurement. It is observed that infrastructure audit is not up to the mark with insufficient human resources, hardware, facilities, documentation, supplies and software.

The software audit of e-Procurement is to be concentrated with improvements in application software, system software and database audit. Compared with South Eastern countries, India is lagging behind in software down time where fine tuning of network products, security products, cables and connectors, servers, service providers is required.

Forecast Of The Model: The analysis of the Singuluri models on manual and e-Procurement during the years 2004 – 2009 clearly reveal the naked truth that one of the important e-Governance framework element "The Social Audit" has shown no effect on either manual or e-Procurement efficiency right from its inception which is a major cause of worry. Social audit being the core framework element which will have a definite impact on the performance of e-Governance and once this being absent, the performance of e-Governance on an average found to be equal or less when compared to its performance in the year 2004 and in real sense, though the manual system is discarded, but still e-Governance could not penetrate to its intended levels. Even in the absence of social audit which is missing in the e-Governance framework the mere application of e-Governance procurement has resulted in high earnings of revenue in 2008 and 2009 when compared to its preceding years.

As social audit place a predominant role in e-Governance framework performance and if the government exercises the much needed care to inform the consumer about its impact definitely the performance will raise to the desired level thus resulting gain of additional revenue. To examine on the particular aspect the social audit element contribution if considered as low as 0.5 units there is additional revenue of 1000 crores per annum for the government and this analysis is presented here under. Assuming the efficiency of social audit is 1.0, for the framework data of 2009, the total efficiency of e-Procurement reaches to 14.79 units.

From the analytical observation of the above model it is noticed that a revenue of Rs.16,000 crores was generated for the area of efficiency 13.20 in the year 2009. If the social audit of 0.5 units is incorporated, the area of efficiency increases to 13.99 units and the estimated revenue is Rs.16,957 crores which makes a considerable difference of Rs. 957 crores. If the social audit of 1.0 unit is considered, then the area of efficiency increases to 14.79 units and the estimated revenue generation is Rs.17,927 crores which boosts up the difference to Rs. 1,927 crores which will be a boon to the treasury of Government of Andhra Pradesh.

The government of Andhra Pradesh is implementing various e-Governance activities in which some of the proposed framework elements are missing and leading to great loss of revenue, comfort, service, good will and technical hikes. As per recent survey, India is standing in 24th position in its e-Governance implementations compared to rest of the world and hence a stipules implementation of framework is demanded for results with greater precession and smooth functioning of G2C, G2B, G2G activities.

Singuluri model efficiency table for e-Procurement and Manual system Framework elements on five point scale [table -1]

		2004			2005			2006			2007			2008	2009
		e-Pro	Manual	Diff	e-Pro	Manual	Diff	e-Pro	Manual	Diff	e-Pro	Manual	Diff	e-Pro	e-Pro
1	Planning	2.63	1.18	1.45	2.68	1.26	1.42	2.78	1.31	1.47	2.82	1.30	1.52	3.31	3.67
2	Work Audit	0.37	0.06	0.31	0.37	0.13	0.24	1.23	0.18	1.05	1.68	0.18	1.50	2.32	2.73
3	Professional Audit	1.72	0.38	1.34	1.86	0.42	1.44	1.99	1.02	0.97	2.03	1.06	0.97	2.12	2.39
4	Infrastructure Audit	1.60	0.92	0.68	1.83	0.98	0.85	1.87	1.03	0.84	1.82	1.05	0.77	1.85	1.91
5	Social Audit	0.00	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Software Audit	1.42	N.A		1.68	N.A		1.69	N.A		1.73	N.A		1.88	1.97
7	Down Time/ Performance	0.00	0.03	-0.03	0	0.06	-0.06	0.00	0.04	-0.04	0.62	0.05	0.57	0.87	1.63
8	Budget	1.83	0.63	1.20	1.87	0.89	0.98	1.93	0.92	1.01	1.88	1.63	0.25	2.07	2.09
	Average	1.20	0.46		1.28	0.53		1.43	0.64		1.57	0.75		1.80	2.05

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