Improving mobile learning with enhanced Shih's model of mobile learning

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Abstract: More recent motivational research focuses on the identification of effective techniques for enhancing instructional design and meeting the needs of diverse student populations (Wlodkowski R. J., 1981). Learning-motivation researchers are applying some of the same theories and concepts found to be effective in industry to the development of motivational models that enhance the teaching-learning environment. One of such models is the Attention Relevance Confidence Satisfaction (ARCS) model of motivational design developed by John M. Keller (Small Ruth V., 2007).

The continuous improvement in handheld devices technologies has led to a new learning paradigm called mobile learning which involves the delivery of learning contents to learners utilizing mobile computing devices. Handheld devices, however, have constraints which limit their use for effective learning. Towards improving the effectiveness of mobile learning is a new mobile learning model proposed by Shih on which instructional designs for mobile learning can be based to facilitate mobile learning design and to achieve better mobile learning outcomes (Yushin E. Shih & Dennis Mills, 2007). Shih's model is based on Graphical User Interface (GUI).

This paper presents an enhanced Shih's model for effective mobile learning outcome in a university environment by making provision for instructional design to include online library search for both e-books and audio books using collaborative filtering algorithm to aid the search and posting and reading of testimonials about positive mobile learning outcomes so as to encourage other mobile learners. It also incorporates the use of Voice User Interface (VUI) to access the learning portal in order to overcome mobile devices interface limitations in addition to Graphical User Interface (GUI) proposed by Shih, so as to cater for the learning needs of the blind and the visually impaired.

Key words: mobile-learning; motivational design; learning model; Shih's model; enhanced Shih's model; collaborative filtering; Voice User Interface (VUI); Graphical User Interface (GUI)

1. Introduction

The continuous improvement in the capabilities and processing powers of mobile devices continues to shape the way we do things. One of the areas that this improvement has affected is teaching and learning.

Mobile learning represents exciting new frontiers in education and pedagogy. With the features of "wearable" computing and multimedia content delivery via mobile technologies, mobile learning becomes feasible and offers new benefits to instructors and learners (Rashmi Sinha, 2005).

Wireless network technologies like Wireless Fidelity (Wi-Fi), Worldwide Interoperability for Microwave Access (WiMAX) and Third Generation (3G) provide the enablement for ubiquitous learning (u-learning) and the availability of handheld devices and Personal Data Assistants (PDAs) pave the way for mobile learners.

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Mobile communications are no longer restricted to companies that can afford large investment in hardware or specialized software. Individuals now have easy and inexpensive access to mobile telephony and the cost of mobile access to the Internet is steadily reducing (Kristine Peters, 2007).

The ways individuals learn, however, differ and there are several learning theories. The questions now arise as to how instructional design for mobile learning environments can best be done to improve learning and teaching experience, and how a mobile learner can be motivated for learning and sustained for a long time.

Collaborative filtering algorithms are algorithms that are used to suggest new items or to predict the utility of a certain item for a particular user based on the user's previous likings and the opinions of other like-minded users (Badrul Sarwar, 2001).

Shih's mobile learning model is based on Keller's Attention Relevance Confidence Satisfaction (ARCS) motivational design to cater for the needs of different learners and facilitate mobile learning design. This paper presents an enhanced Shih's model for effective mobile learning outcome in a university environment by making provision for instructional design to include online library search for both e-books and audio books using collaborative filtering algorithm to aid the search and posting and reading of testimonials about positive mobile learning outcomes so as to encourage other mobile learners. It also incorporates the use of Voice User Interface (VUI) in addition to Graphical User Interface (GUI) proposed by Shih so as to cater for the learning needs of the blind and the visually impaired.

2. Materials and methods

2.1 Objectives of the research

Shih's mobile learning model is based on the ARCS model of motivational design to cater for the needs of different learners and facilitate mobile learning design. The main aim of this work is to find ways of improving on Shih's mobile learning model for a more fruitful mobile learner's experience and mobile learning design.

2.2 Methodology

An attempt was made to study Shih's model of mobile learning and enhanced it with collaborative filtering algorithm, provision of e-books, audio books, voice applications and provision for posting testimonials about positive learning outcomes so as to encourage other mobile learners.

2.3 Mobile learning

According to Niall Winters (Mike Sharples, 2006), current perspectives on mobile learning generally fall into the following four broad categories:

(1) Technocentric: Here, mobile learning is viewed as learning using a mobile device such as PDA, mobile phone, iPod, playstation portable, etc.

(2) Relationship to e-learning: This perspective characterizes mobile learning as an extension of e-learning.

(3) Augmenting formal education: A means of augmenting formal education.

(4) Learner-centered: Any sort of learning that happens when the learner is not at a fixed, predetermined location or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies.

According to Parsons D. and Ryu H. (2006), m-learning is broadly defined as the delivery of learning content to learners utilizing mobile computing devices, and according to Kambourakis G., Kontoni D. P. N. and Sapounas, I. (2004), m-learning is the point at which mobile computing and e-learning intersect to produce an anytime,

anywhere learning experience.

From the various definitions of m-learning, we can conclude that m-learning is a form of e-learning that involves any learning with the use of mobile device to produce an anywhere and anytime learning experience to cater for the needs of different learners and augmenting their formal learning experience.

2.4 Learning theories

Learning theories deal with the various ways people learn, some of which are:

(1) Behaviourism: Learning through frequent examples, interactions and practices;

(2) Cognitivism: Exploiting the working process of the mind to enhance learning process;

(3) Constructivism: Learning through experiments and problem solving skills;

(4) Vygotsky's Learning Theory: This emphasizes that learning is social and includes arguing, reflecting and articulating to others.

2.5 Motivation in instruction design

Developing life-long learners, who are intrinsically motivated, display intellectual curiosity, find learning enjoyable and continue seeking knowledge after their formal instruction has ended has always been a major goal of education. Early motivational research was conducted primarily in the workplace and centered on ways to motivate industrial workers to work harder, faster and better. More recent motivational research focuses on the identification of effective techniques for enhancing industrial design, improving classroom management and meeting the needs of diverse student populations. Learning-motivation researchers are applying some of the same theories and concepts found to be effective in industry to the development of motivational models that enhance the teaching-learning environment. One such model is the ARCS (Attention Relevance Confidence Satisfaction) model of motivational design developed by John M. Keller of Florida State University (Ruth Small, 2007).

Motivational research has been hindered because of an unrealistic expectation that a cookbook can be provided telling educators how to motivate their students. There is no cookbook, but there are general principles of motivational design that can be considered when designing instructions according to Alkin (1992) and cited by Charles B. Hodges (2004).

2.5.1 ARCS model of motivational design

Keller's ARCS model divides learning cycle into the following aspects:

(1) Attention: This involves attracting learners by stimulating their interest and curiosity.

(2) Relevance: This involves showing learners the relevance of their learning, so that their motivation to learn increases.

(3) Confidence: This involves making the learners develop confidence in themselves.

(4) Satisfaction: This provides opportunities for learners to use their newly acquired skills and knowledge in a real-life situation or a simulated setting.

2.5.2 Shih's mobile learning model

Shih's mobile learning model was created to support instructional design for mobile learning and the learning cycle includes:

(1) Sending a multimedia message to mobile phones to trigger and motivate learners.

(2) Searching the Web for relating information by using embedded hyperlinks (URLs) in the message received in the phone.

(3) Discussing with learning peers by text, voice, picture or video messaging.

(4) Producing a digital story telling of what they learn by audio or video diary (moblogging journal).

(5) Applying what they learn in the simulated environment, such as online educational gaming.

The model is depicted below (Figure 1).

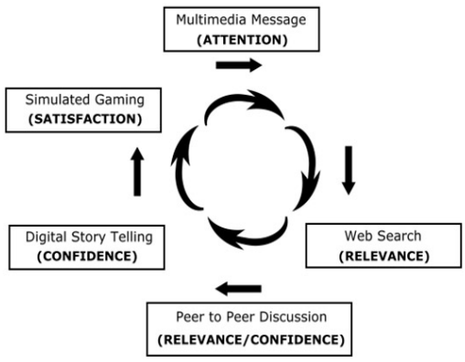

Figure 1 Shih's mobile learning model

The learning model according to Shih would be most suitable for applications in blended and/or pure mobile learning environments.

2.6 Collaborative filtering

2.6.1 Overview of collaborative filtering process

According to Charles B. Hodges (2004), the goal of a Collaborative Filtering (CF) algorithm is to suggest new items or to predict the utility of a certain item for a particular user based on the user's previous likings and the opinions of other like-minded users. In a typical CF scenario, there is a list of *m* users U= $\{u_1, u_2 \ldots u_m\}$ and a list of *n* items I= $\{i_1 , i_2 \ldots i_n\}$. Each user u_i has a list of items I_{ui}, which the user has expressed his/her opinions about. Opinions can be explicitly given by the user as a *rating score*, generally within a certain numerical scale, or can be implicitly derived from previous records, by analyzing timing logs, by mining web hyperlinks and so on. Note that $I_{ui} \subseteq I$ and it is possible for I_{ui} to be a *null-set*. There exists a distinguished user $u_a \in U$ called the *active user* for whom the task of a collaborative filtering algorithm is to find an item likeliness that can be of two forms:

(1) Prediction is a numerical value, $P_{a,j}$, expressing the predicted likeliness of item $i_j \notin I_{ua}$ for the active user u_a. This predicted value is within the same scale (e.g., from 1 to 5) as the opinion values provided by u_a.

(2) Recommendation is a list of *N* items, $I_r \subset I$, that the active user will like the most. Note that the recommended list must be on items not already utilized by the active user, i.e., $I_r \cap I_{ua} = \Phi$. This interface of CF algorithms is also known as *Top-N recommendation*.

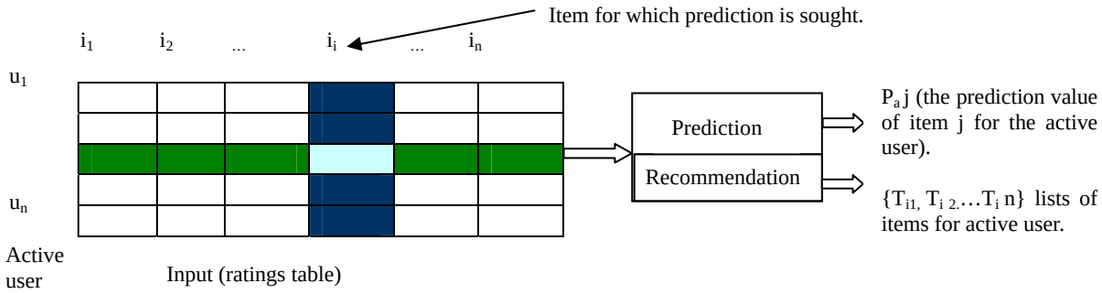

Figure 2 The collaborative filtering process

Figure 2 shows the schematic diagram of the collaborative filtering process. CF algorithms represent the entire ***m X n*** user-item data as a ratings matrix, $\mathcal{A}$. Each entry $a_{i,j}$ in $\mathcal{A}$ represent the preference score (ratings) of the *i*th user on the *j*th item. Each individual rating is within a numerical scale and it can as well be 0 indicating that the user has not yet rated that item.

2.6.2 Classification of collaborative filtering approaches

According to Similarity Fusion (2007), collaborative filtering approaches are often classified as memory-based or model-based. In the memory-based approach, all rating examples are stored as-is into memory (in contrast to learning an abstraction). In the prediction phase, similar users or items are sorted based on the memorized ratings. Based on the ratings of these similar users or items, a recommendation for the test user can be generated. Examples of memory-based collaborative filtering include user-based methods and item-based methods.

In the model-based approach, training examples are used to generate a model that is able to predict the ratings for items that a test user has not rated before. Examples include decision trees, aspect models and latent factors models.

2.7 Voice application and how it works

2.7.1 Voice application

A voice application is a collection of one or more VoiceXML documents. A VoiceXML document is composed of one or more dialogs. A single VoiceXML document serves as the application entry point (Building VoiceXML applications, 2008).

2.7.2 How a voice application works

Just as HTML is used to create visual application, VoiceXML is a markup language used to create voice application. With a traditional webpage, a Web browser will make a request to a Web server which in turn will send an HTML document to the browser to be displayed visually to the user. With a voice application, it is the VoiceXML Interpreter that sends the request to the Web server, which will return a VoiceXML document to be presented as a voice application via a telephone (Tutorials, Getting Started with VoiceXML, 2007).

2.8 Proposed enhanced Shih's model

The proposed enhanced Shih's mobile learning model cycle includes:

(1) Sending a multimedia message to mobile phones to trigger and motivate learners;

(2) Searching the Web for relating information by using embedded hyperlinks (URLs) in the message received or;

(3) Searching the online library for e-books and audio books on the subject of the message using collaborative filtering algorithm;

(4) Discussing with learning peers by text, voice, picture or video messaging;

(5) Producing a digital story telling of what they learn by audio or video diary;

(6) Applying what they learn in the simulated environment such as online educational gaming;

(7) Posting and reading of testimonials about positive learning outcomes.

All the seven steps (Figure 3) can also optionally carry out via Voice User Interface (VUI) .

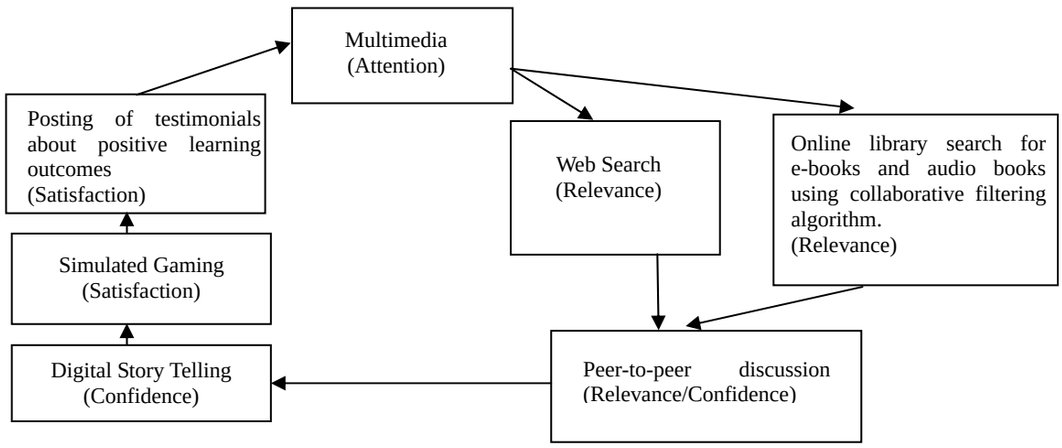

Figure 3 Enhanced Shih's mobile learning model

2.9 Contributions

With the enhanced Shih's mobile learning model, the students will be able to search the online library for useful books including e-books and audio books on what is being learnt and using collaborative filtering algorithms. The search by the student will be enhanced in that a list of useful learning materials previously accessed by other students on the same subject can be recommended thereby reducing the amount of time used for searching and ultimately conserving the mobile device's limited power. In addition, provision has been made for access to the learning portal through voice user interface and lastly, provision is also made for posting of testimonials about positive learning outcome in order to motivate other mobile learners.

3. Conclusion

Advancements in handheld devices technologies as well as networking technologies have continued to redefine the ways things are done. One of the areas affected is teaching and learning. These advancements have made mobile learning an option being employed by various institutions of learning to meet the needs of different categories of learners. The constraints of using mobile devices have to be overcome however, in order to improve the learning experiences of mobile learners and cater for the ways different people learn. Enhanced Shih's mobile learning model builds on Shih's model to cater for the different ways people learn and enrich their learning experiences. It also makes provision for access to the learning portal through the use of voice to cater for the learning needs of the blind and the visually impaired.

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