VocaTest: An Intelligent Tutoring System for Vocabulary Learning using the "mLearning" Approach

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Abstract

Measuring student’s knowledge about the subject matter is a key challenge for any computer aided learning (CAL) system, and eLearning is no exception. A good pedagogical framework is essential in order to create an effective teaching and learning environment over the Internet where lessons can be delivered according to student’s performance. The Web-based Intelligent Learning Environment (WILE) is such a framework, which has all four essential components of a typical Intelligent Tutoring System, namely, 1) the communication module, 2) the pedagogical module, 3) the student model and 4) an expert module, but deployed over a client-server architecture. Web-based learning or eLearning has generated a great deal of interest among the educators around the world and made teaching and learning possible “anytime”, “anywhere” as long as an Internet connection is available through a computer. Over the time, eLearning has matured from a place for publishing plain content to an adaptive learning environment.

Recently, with the extended features of mobile phones and other handheld devices, a newer way of teaching and learning emerged – mobile learning or mLearning. mLearning offers greater flexibility over eLearning’s original “anytime” and “anywhere” capability, but has serious constrains in displaying large content.

This paper reviews the state-of-the-art in mLearning technology, argues about the appropriate usage of mLearning and finally, introduces an intelligent tutoring system for vocabulary learning implemented in a mLearning environment.

Keywords: mLearning, Intelligent Tutoring System, JAVA.

1. Introduction

A web-based educational system is an Internet based environment in which students and educators can perform learning related tasks. Khan [1] identified the following key features of web-based learning environments: interactive, device-distant-time independent, globally accessible, distributed, learner-controlled, convenient, environmentally friendly, non-discriminatory, cost effective and etc.

Although the benefits of a web-based education system are many [2], Kinshuk et al [3] has warned that “the freedom and flexibility offered by the Internet can, however, turn into an extensive waste of time, effort and resources”, if there is no sound pedagogical model behind this system.

Bloom [4] has demonstrated that one-on-one tutoring is the most effective mode of teaching. However, individual tutoring incurs financial and logistical problems. Computer and Internet technology have come forward to help this situation by providing highly interactive and intelligent learning environment that are independent of time and space constraints.

As mobile phones and handheld devices become more popular and affordable nowadays, the concept and demand of mobile learning or mLearning emerged. mLearning offers new possibilities in education where students can learn even in their fragmented leisure time and shows huge potentials to leverage the existing web-based intelligent learning environment.

The aim of this paper is to underline the potential of mLearning, and how the handheld computing can be combined with Internet technology to introduce a new way of teaching and learning. Section 2 focused on the state-of-the-art in web-based intelligent learning environment (WILE) and mLearning technology. Section 3 discussed the functional architecture of the intelligent tutoring systems for vocabulary called
VocaTest. Finally we present some related works done in mLearning area and concluding remarks.

2. Web-based Intelligent Learning Environment and mLearning

2.1. Web-based Intelligent Learning Environment

Computer Aided Learning (CAL), which has been used in learning and teaching since 1950s, is basically an information technology based system that is used for educational purposes [5]. Traditional CAL resources primarily consisted of tutorials, which are essentially computer-based forms of “programmed instructions”. During the late 1950s and early 1960s, with the advent of Artificial Intelligence (AI), a new type of CAL system, called “Intelligent Tutoring Systems”, emerged.

The Intelligent Tutoring Systems (ITS) typically consist of an internal model of the expert knowledge, the learner's current knowledge and the pedagogical principles. As the learner proceeds, the model of the learner's knowledge and the model of the expert's knowledge are compared, and using AI, the sequence of instructions is dynamically generated to suit the needs of the learner [6]. Figure-1 shows the functional model [Kassim, Kazi – IJEE Paper] of an ideal ITS.

Web-based Intelligent Learning Environment (WILE) [7] is not a new kind of educational approach. It has been evolved from the traditional Intelligent Tutoring Systems (ITS). A good number of web-based learning systems have been developed so far. Early versions were hypertext based information retrieval systems and while later versions were adaptive and intelligent thereby making the web a more important educational medium [8]. Examples of Web-based intelligent learning environments are as follows:

- CALAT [9]: Using a conventional WWW browser on the client, students access CALAT server which provides an individual adaptation capability. The ITS kernel on the CALAT server, employing overlay model, presents the courseware pages so that the student can achieve a learning goal consisting of hierarchical sub-goals. Three types of pages are available in the CALAT courseware: explanation, exercise and simulation. Explanation page, presenting a material corresponding to the conceptual learning sub-goals, can be any type of HTML data including plain text, image, audio, JAVA applet, and/or plug-in application.

Figure 1. Functional Model of an Ideal ITS

- ELM-ART [10]: The WWW-based introductory LISP course ELM-ART (ELM Adaptive Remote Tutor) is based on ELM-PE [11], an on-site intelligent learning environment that supports example-based programming, intelligent analysis of problem solutions, and advanced testing and debugging facilities.

- PAT-OnLine [12]: PAT Online, a variant of the PAT Algebra Tutor, is a model-tracing tutor being used in several middle, high school and college classes.

- AlgeBrain [13]: a web-based intelligent tutoring system for Algebra which was converted from a stand-alone application.

- ADIS [14]: is an intelligent tutoring system developed as a teaching aid for a course on Data Structures to enhance students' understanding of data structures such as linked-lists, stacks, queues, trees and graphs. ADIS has the capability to display data
structures graphically on the computer screen as well as allowing graphical manipulation of the data structure created. There is a tutorial mode incorporating exercises, where students can learn basic algorithms (insertion, deletion etc.) of data structures visually.

ILESA [15]: a web-based tutoring tool for Linear Programming problems. ILESA (Intelligent Learning Environment for the Simplex Algorithm) does not try to replace human teachers in the task of teaching the simplex algorithm (the process of teaching the theoretical concepts must be accomplished by them), but to tutor students in developing problem solving abilities from the theoretical concepts acquired.

ELM-ART-II [16]: an intelligent and interactive web based textbook that supports the learning of programming in LISP. ELM-ART-II demonstrates how interactivity and adaptivity can be implemented in WWW-based tutoring systems. It supports adaptive navigation as individualized diagnosis and help on problem solving tasks. Adaptive navigation support is achieved by annotating links. Additionally, the system selects the next best step in the curriculum on demand.

WILEDS [17]: provides a web-based intelligent learning environment where students are able to try out problems related to the various topics in digital systems. It is developed on the robust framework of intelligent tutoring system in order to assess students, starting from automatically generating problems to checking the students’ solutions. Details about student progress are kept in a database for easy reference and monitoring by the course instructors. Students who need additional help can thus be easily identified.

The adaptive nature in the more recent systems is achieved by incorporating a student model which maintains up-to-date information about the learner’s background, current stage of knowledge, goal and, etc.

2.2. mLearning

Quinn [18] defined mLearning as “learning through mobile computational devices”. Chabra et al [19] perceived mLearning as “the ability to receive learning anytime, anywhere and on any device”. mLearning offers both students and teachers the opportunity to interact and gain educational material through mobile devices independent of time and space. Actually, mLearning is not a new concept; it evolves from eLearning technology offering a greater flexibility in mobility.

In an ideal mLearning environment, we need a mobile device with Internet connection, web server hosting learning materials and database to record learner’s profile and other relevant information. Currently few technologies are available including GSM, GPRS (2.5G) and 3G (UMTS, W-CDMA, EDGE, etc.) that provide Internet connectivity for a mobile device. The most widely used protocol is currently Global System for Mobile communications or GSM. With three variations in protocol (GSM 900, GSM 1800 and GSM 1900) and two combinations of protocols (dual-band and tri-band), it enables users to travel extensively and use the same mobile phone for calls, Internet access and mobile telephony services. But the slow data transfer rates offered by GSM (9.6 Kbps) may not suitable for mLearning. General Packet Radio Service (GPRS) enabled networks offer ‘always-on’, higher capacity (30 to 100 Kbps), Internet-based content and packet-based data services. This enables services such as color Internet browsing, e-mail on the move, powerful visual communications, multimedia messages and location-based services. The newer technologies such as Universal Mobile Telecommunications System or UMTS, W-CDMA and EDGE are the third generation (3G) mobile communication systems. 3G offers support for a wide range of voice, data and multimedia services. This technology is capable of data transfer speeds of up to 2 Mbps. Most, if not all, of the mobile network operators provide Short Messaging System and Multimedia Messaging System that also play a big role in mLearning.

The most crucial part of a mLearning environment is the usability of the mobile devices through which learners access the content. Even the new generation mobile phones and handheld devices have more memory, bigger display area, still not suitable for accessing existing eLearning content. In a generic mLearning situation, learners with mobile devices usually have some fragmented leisure time period for learning activities. Therefore, mLearning content should be short in sessions and entertaining in order to keep the learners engaged.

mLearning content can be standalone or coming from web server or mixture of both. Content should be developed in such a way that most of the mobile devices, if not all, can support. To achieve the maximum compatibility for content, Java is a good tool of choice for developing mLearning applications as
most of the mobile phones and devices are Java enable today.

3. VocaTest: An Intelligent Tutoring System for Vocabulary

VocaTest is a Java based client-server application where the client program is a Java MIDlet running on Java-enabled mobile devices and the server program is a set of Java Servlets running on Tomcat server. One of the big advantages of developing mLearning client application using MIDlets is its capability of running offline and making connections to the Internet whenever necessary. Thus the learner can save the connection cost and experience a faster learning session.

When learners start the VocaTest application in a spontaneous learning situation, he or she has to log in with the user id and password (figure 2). VocaTest MIDlet will open a URL connection to the login servlet for authentication process. Upon successful authentication, the server program will randomly fetch 5 English words from the database and compose a multiple choice type vocabulary quiz (figure 3). Every word stored in the database with four options and the correct answer has an associated level of difficulty. The system also stores the learner’s current level of knowledge about the subject matter. Therefore, quizzes are composed at the right level of difficulty for a particular learner. Figure 4 shows a typical quiz session in VocaTest. After finishing the session, the MIDlet will send the performance data to the server side so the learner’s current level of knowledge can be updated. After each session, the system prompts for next session which would be handled in same way without the authentication process.

In VocaTest, teachers can add question into the question database with multiple options and the correct answer using a mobile device too. Currently, we are working on to implement Chinese and Japanese characters into VocaTest environment.

4. Related works and Conclusion

mLearning has been studied for last couple of years and therefore some progresses have been made by many research units [20-21]. It is also observed that some efforts have been made to develop foreign language learning systems [22]. The advantage of the VocaTest system is that it has an intelligent tutoring
system approach while others are standalone applications.

We believe that mLearning will find an appropriate niche to meet certain learning situations like spontaneous learning in fragmented time-slots. Due to the nature of mLearning situations, contents should be developed appropriately.

5. References


