MOBILE COMPUTER BASED CLASSROOM ASSESSMENT

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ABSTRACT : Formative assessment of student progress and attitudes is important to our continuous improvement process, but collecting and compiling the data is burdensome without access to computer tools. This research is to set up a mobile computer based lab that will enable faculty who teach in rooms without computers to use testing and survey tools. The technologies necessary to develop such system including wireless communication, World Wide Web (WWW), database, and mobile computing are investigated in this research. The real-time based formative assessment of student is proposed. A hardware configuration for real-time assessment is also presented in the research.

Key words : *Construction, Education, Mobile-Computer, Assessment*

1. INTRODUCTION

Construction courses at Indiana University-Purdue University Indianapolis (IUPUI) are taught in many settings: traditional classrooms, laboratories, computer labs, and combinations of the above. During the lectures in traditional classrooms it is difficult to properly monitor student understanding because there are not enough means of student assessment.

Adding computing capabilities in the traditional classrooms would provide great advantage for various classroom activities. The immediate possibility is to use computers to collect students' input and adjust the lecture content based on the input while class is in session. However, it is not feasible to equip the traditional classrooms with computers because of many limitations.

The solution for this would be to introduce mobile computing devices in the classrooms. Mobile computing devices such as Pocket PCs, Palms, and laptop computers became as powerful as desktop computers yet very affordable. Wireless network services are readily available on many campuses including IUPUI which allow students to use mobile devices for academic purposes. The technology for mobile computing now has reached the level of common availability so that it can be easily implemented in classrooms [1].

This research explores applicability of mobile computing in classrooms to help improve student learning. A database framework for student assessment using wireless computers is presented. Also, a framework for real-time based student assessment is also proposed in this research.

2. RESEARCH GOALS AND OBJECTIVES

2.1 Goals

The primary goal of this research is to expand the use of information technology (IT) into more of the classrooms to provide better feedback of student progress to both the student and the teacher. Construction classes can take a great advantage of IT to enhance teaching and learning. The secondary goal is to build a wireless classroom paradigm for student-teacher interactions.

2.2 Objective

The primary objective of this research is to develop a database framework of a system that can provide continuous and immediate feedback by adapting wireless classroom technology and implement it into more of the construction classrooms. By utilizing wireless classroom technologies, more interaction among the students and the instructor will be based on real-time assessment of the students in an otherwise traditional classroom.

3. COMPUTING IN CLASSROOMS

3.1 Mobile Computing in Classroom

Most U.S. universities provide wireless network services throughout their campuses. The classrooms in Indiana University-Purdue University Indianapolis (IUPUI) are equipped with wireless network like many other schools making the students be able to access the Internet any time. Many students carry their own notebook computers to classrooms to find online resources in the school libraries and the Internet.

3.2 Online Courseware

Online courseware is Web-based services with which faculty can deliver course materials and administer exams. It allows for the distribution of static content (e.g., syllabi, schedules, announcements, and lecture notes), and also provides access to interactive tools (e.g., discussions, whiteboard, live chat, and online assessments) [2]. There are several online coursewares currently in service such as WebCT, Blackboard, Prometheus, and Oncourse. These serve several thousand institutions currently and more institutions are choosing to adapt the services.

They all provide tools for students to participate in discussions and small group activities; share files; communicate asynchronously; and read, review and reflect upon interactive text materials with audio and visual enhancements repeatedly. WebCT and Blackboard also offer the value added components of synchronous communication through chat and whiteboard sessions [3].

3.3 Wireless Quizzing

The most popular form of wireless computing used in classrooms is *wireless quizzing*. A wireless computing unit replaces OMR (Optical Mark Read) or OCR (Optical Character Read) answer sheet with an electronic version which reads a student's answer and sends it to the server. The student would select an oval for the right answer which otherwise would be done on an OMR sheet in conventional cases with a pencil or a black marker [4].

3.4 Just-in-time Teaching

Just-in-time Teaching (JiTT) is to survey students' understanding on a regular basis and provide appropriate feedback during classes. Between classes, students complete constructed exercises and submit them electronically using course management software such as Blackboard or WebCT, or simple email, by a preassigned time a few hours before class. These JiTT exercises, or "JiTTs", are short assignments typically focusing on material that will be covered in the next class. Students are required to read ahead on their own to answer the questions. Once submitted, instructors review students' JiTT responses an hour or two prior to class and use the responses to organize and modify the upcoming classroom session. Excerpts from students' submissions are presented during the class as the basis for discussion, replacing the traditional lecture, and are used to develop follow-up exercises that groups of students work on in class [5].

4. FRAMEWORK FOR MOBILE COMPUTER BASED CLASSROOM ASSESSMENT

4.1 Classroom Assessment

Assessment is defined to include all activities teachers and students undertake to get information that can be used diagnostically to alter teaching and learning [6]. Depending on the purpose and time conducted, assessment can be categorized in two types: *summative* and *formative.*

Summative assessment is the attempt to summarize student learning at some point in time, usually the end of a course. They are not designed to provide the immediate, contextualized feedback useful for helping teacher and student during the learning process. By contrast, formative assessment occurs when teachers feed information back to students in ways that enable the student to learn better, or when students can engage in a similar, self- reflective process [7].

4.2 Necessary Mobile Computing Environment

Wireless network capability of mobile computer is essential for mobile computing proposed in this research. Every notebook computers currently in the market is equipped with such capability. As for PDAs, many of them come with a wireless network card and setting up PDAs to connect the Internet is very user-friendly.

A server computer is necessary to administer assessment and store data. For a small application, a personal computer running off-the-shelf software products will be sufficient to cover a few classes. A dedicated server is necessary for larger application which may cover a department or a larger institutional unit. The server must be equipped with a server operating system, larger hard disks and memory, and backup devices.

4.3 Framework for Classroom Assessment

The platform of classroom assessment consists of a web server and PocketPCs with ASP (Active Server Pages) access through wireless Internet connections. The web server contains Microsoft Access database and functions as a database server of the entire system. The World Wide Web (WWW) related programming languages such as Visual Basic Script combined with interactive software are used to develop the authoring module.

The student module utilizes the existing instructional technologies such as Oncourse [8] and Wireless Quizzing [4]. The format of Oncourse exams fits well the current desktop computer settings but was not suitable for PocketPCs. PocketPCs operates on a smaller screen which limits the size of the page that can be viewed at once. Instead of listing all the questions for the exam on a single web page, this system lists one question per screen. This way, a user can view a question in its entirety most of the cases. The database framework was developed based on this "single question per page" format. On the other hand, additional navigation tools became necessary to accommodate this format.
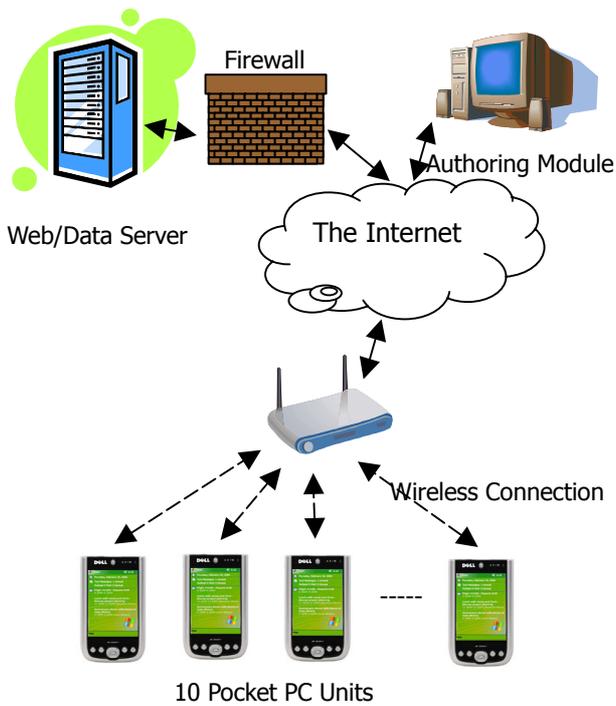
Figure 1. Hardware Configuration

Oncourse's exam authoring tools were very useful for preparing an exam. To incorporate a new exam format for PocketPC while utilizing Oncourse's tools, the export functionalities of Oncourse can be used to create intermediate exam source data. The exported exam source data is in a proprietary ASP (Active Server Page) file format.

In order to integrate the wireless technologies into the construction classroom, the infrastructure had to be developed. This system uses a generic database and the software which can be easily obtained as off-the-shelf products and run on a non-high-end personal computer. The web server software is also generic so that it can be accessed by any web browser.

As shown in Figure 1, student units access the exams directly through the Internet using PocketPC's web browser. Authoring is also done using a web browser through the Internet connection. The server running on Windows XP Professional™ operating system provides Internet Information Service (IIS) by publishing the data on the web pages.

As shown in the schema diagram (layout of database entities) in Figure 2, the database consists of seven tables: Users, Tests, StudentTest, Question, Match, Choices, and StudentAnswer.

- Users Table (tblUsers): tblUser stores user information such as names, user ID, and password. The user level is determined during the authentication process by screening the user ID and user level. The administrators can access exam authoring pages and students' answers and grades while the regular users are limited only to the exam taking pages.
- Tests Table (tblTests): tblTests stores test ID and title. A test ID is automatically generated and used to

identify a test throughout the system. The title of a test is a descriptive name of the test.
- Student Test Table (tblStudentTest): tblStudentTest joins tblUser and tblTests to store incidents of exams taken by students. This table also stores the timestamps of exams and grading as well as exam scores.
- Question Table (tblQuestion): tblQuestion contains questions, question types (i.e. multiple choice, matching), points, and links to the images.
- Choices Table (tblChoice): tblChoice joins tblQuestion by listing choices of the question. It also contains correct answer of the question.
- Match Table (tblMatch): tblMatch stores match choices when the question type is "match."
- tblStudentAnswer (tblStudentAnswer): tblStudentAnswer stores answers entered by students while taking exam.
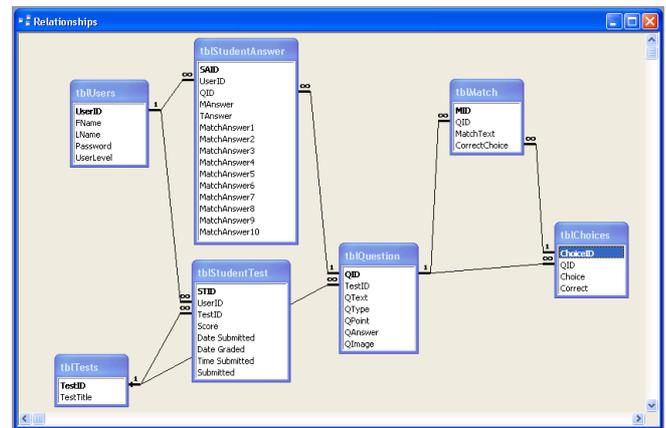

Figure 2. Database Schema

The user interface for the student unit was designed with the ease of use as the system's first priority. It uses standard web browser controls such as text input box, combo box, buttons and hypertext links to enter answers and navigate through the web pages. The total number of pages a student has to access during the assessment is six.

Figure 3. User Authentication and Test Selection

As shown in Figure 3, the first two pages are for authentication and exam selection. In the authentication

page, a user enters user ID and a password. Depending on the user level designation, a user will be directed to the administration page if he or she is an authoring instructor, or the exam list page if a student. The second picture in Figure 3 shows the list of exams that are currently open to the student. By clicking on the link, the student is directed to the question list page which is shown in Figure 4.

Figure 4. Question List Page

Figure 5 shows two types of questions-a multiple choice question and a match question. For multiple choice questions, the student selects a choice as an answer and submits it. Match questions are answered using pull-down combo boxes with which a student can make a selection as a matching answer to each item.

Figure 5. Multiple Choice and Match Question

4.4 Proposed Framework for Real-time Formative Assessment

Formative assessment can be done in two manners: during a lecture or between lectures. JiTT [5] and Wireless Quizzing [4] take place between lectures in or out of the classroom. Although this type of assessment helps, it is often necessary to closely monitor student understanding while a class is in session. Complicated class topics can easily leave many students behind without letting the instructor become aware. The monitoring efforts put in during the lectures can be titled as *real-time formative assessment of student.*

Real-time student assessment, however, can be a great burden for instructors in preparing the assessment apparatus-questionnaire, tallying method, etc. Students can also easily distracted by responding to the instructor's frequent questioning and polling. It will be ideal if the system works as transparent as possible while providing appropriate input to the instructor on the students' understanding and progress.
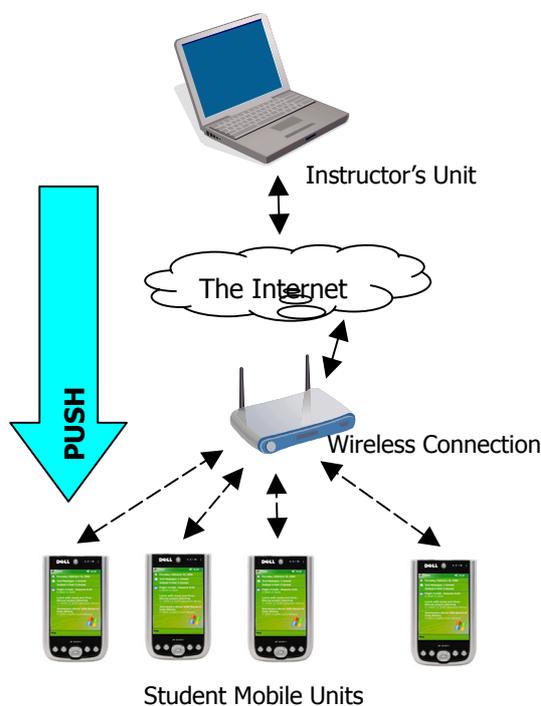

Figure 6. Hardware Configuration for Real-time Formative Assessment

A framework similar to what is presented in the previous section of this paper can be utilized for real-time assessment. The instructor can prepare questions before each class. Instead of presenting the questions at once, each question can be sent to the student mobile units. Often this is referred to as "Push" technology which automatically sends data upon the availability. The instructor "pushes" the question to the students and the students can submit their responses. The instructor's unit can cumulate the responses and process them to assess the students.

The instructor can make an adjustment according to the response by re-elaborating the topic, adjusting the difficulty, or skipping redundant explanations. This all should happen instantly without hindering the progress of lecture.

Figure 6 presents the hardware configuration of real-time assessment. The assessing questions can be "pushed" to the student units which usually ask for simple answers. In most cases, students can pick between *Yes* and *No*, or a few multiple choices. Any subjective or open-ended questions should be discouraged to avoid interference.

4.5 Conclusion

In this research importance of formative research is emphasized. Faculty need to consistently monitor student understanding and modify lecture contents and classroom

activities to maximize the performances.

The use of mobile computers in classrooms for formative assessment is proposed. A database framework for wireless exams is presented.

In order to constantly perform formative assessment, the application of real-time based assessment is necessary. A hardware configuration for real-time based formative assessment is presented in this research.

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