Hybrid Teaching Assistant for Developing Students Interactivity and Comprehension

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Abstract

The hybrid teaching assistant for developing interactivity and comprehension is a model to enhance students' learning by involving them in different testing types and discussions, providing them with advices and allowing them to send their feedbacks. The system makes use of the Internet and Communication Technologies (ICT) to provide a reliable and secure environment. The system consists of exams, discussions, query, charts and feedbacks. Web and mobile phone SMS are used as a communication base among the system's users. The system is hybrid two directional because students can answer the questions using the web form or the SMS form. In addition, students can receive advices and send their comments in both ways. Experiments results showed that students were more enthusiastic during the lesson, they were totally involved in the class room and they achieved better grades. Answers charts improved students' cooperation since they need to discuss the choices to find the correct answer.

1. Introduction

Different teaching methods have been used in the conventional learning to enhance students' understanding, comprehension and acquisition. Tutors have used traditional exams and oral discussions to test students learning and to adapt their teaching ways and materials to fit students' levels.

The traditional method for testing and assessment is insufficient since it requires long time for answering and emendation. Collecting traditional pencil and papers test sheets waste papers and need much effort. In addition, tutors may want to give advices for their students to encourage them or solve their weakness based on the result of the assessment as soon as possible or he may want them to interact and cooperate in the class room, which is difficult to be achieved in traditional ways.

ICT technology facilitates education by providing electronic Learning (E-learning). The term E-learning refers nowadays to online courses and Learning Management Systems (LMS). Many systems have proved a success in this field to manage and deliver information. Learning Management System helps tutors to manage course material and distribute assignments. But these systems are still a single user and support little interactivity and stimulation for the student [1]. Some researches have showed that it is possible to understand student performance and comprehension in class, and give instant response without interfere the teaching process [2]. Siau, Sheng, and Nah [3] proved that technology can improve students' interactivity by applying the class room response system which uses clicker devices. Duncan [4] successfully adopted classroom response system into

engineering course [4]. Roschelle [5] proposed another way to implement classroom response system with mobile devices such as PDA. In such a way, more sophisticate and richer teaching content and activities can be adopted in class. Another technology that can help students learning is mobile phones. Mobile phones can be used as a tool to query about some information in short message format SMS [6]. Also it can be used in the discussion during the class or out of the class [7] [8]. Riordan and Traxler showed that students prefer to use mobile phones and SMS functions to help them in their education as library recalls, revision tips and assessments marks [9].

This paper describes the Hybrid Teaching Assistant System. The system is a hybrid which means that different ways such as web-based or SMS-based are integrated. As our system is a teaching assistance tool so this tool works in many ways to achieve what the tutor and student want. The system facilitates the testing and the discussion in the class room by using web pages through internet service (online testing and discussion) and mobile phones through SMS depending on the available technology. The system offers questions creating, editing, deleting, posting and displaying for the tutor besides query and managing services of his students. Students can answer via a web page or phone SMS. They can receive comments or hints about their answers which is teacher's advice and they can send their feedbacks by their mobile phones or email and. Answers correction, marking and advice are performed automatically.

2. Hybrid Teaching Assistant System

2.1 Overview

The hybrid teaching assistant system consists of pre-class test, post-class test, discussion and advice as shown in figure 1. The system makes use of the information and communications technologies to help tutors understand his students learning level and encourage them to interact and cooperate in the class room.

Pre-class tests: This test is taken before the start of the new lesson in the class room or out of the class room since the questions are available online. This test helps the tutor to see his students' preparation for the new lesson and their understanding of the previous lessons.

Post-class test: this is to test students' comprehension during the class and it is performed at the end of the class or after the class also the questions are available online.
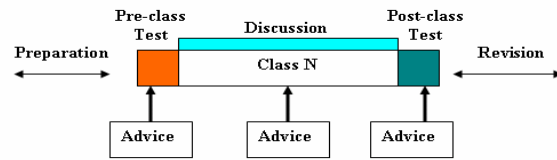

Figure 1. System main components

Discussion: the discussion session can be launched at any time during the class. The teacher needs to prepare the discussion questions before the new class starts. The discussion can be performed online if the students have computers connected to the internet inside the class room or by mobile phone in SMS format.

Advice: this is to help students know their weakness points after taking the test. The advice can be sent automatically to student's email or student's mobile phone as a short message after the automatic correction of the answers. The advice may contain the chapter number, chapter name, key points or any useful information prepared by the tutor.

The answer for the tests and the discussion is in multiple choice formats or true false question. The system lets students answer each question one time and provides a notification if a student forgets to answer some questions. Student can choose the method to receive the advice by email, by phone or both in web page answering. While in SMS answering they will receive the advice with SMS by default. In SMS answering the answer format must contain key value for security issues followed by space then the answer letter (a, b, c, d …) respectively. Students also can send any comments or feedback via SMS to the server. The new received comments will appear on the screen as a pop up window to inform the teacher directly.

2.2 Software architecture

The software components are shown in figure 2. The figure also describes the use cases for both tutors and students. The figure shows the processes that are needed to complete the hybrid teaching assistant session. At the beginning both tutor and students need to log in the system using their account number and password. After that the system will display the tutor's page for the tutor or student's page for the student. Both need to choose the class name because the teacher or the student may have more than one class in one semester. The following summarizes the steps required in the system.

Tutor: The tutor creates the test by entering the new questions, possible answers, advice, test type (pre-test,

post-test or discussion) and the mark for each question. Then he can edit the test if there is any error or if he needs to add something to the test. Then he needs to post the test after he prepared all the questions and determined the post date. Students can not preview the questions of the test if the tutor does not post them. This guarantees students can answer only the questions related to a specific discussion session. Also the post date limits the time of the answering. The tutor can delete any question if needed. He can make the questions displayed on the web page before the class starts to avoid any problem in the class room. The tutor can also preview the students in the class and manage their accounts, and preview students result individually or totally by displaying a bar chart showing the percentage of the correct and wrong answers.
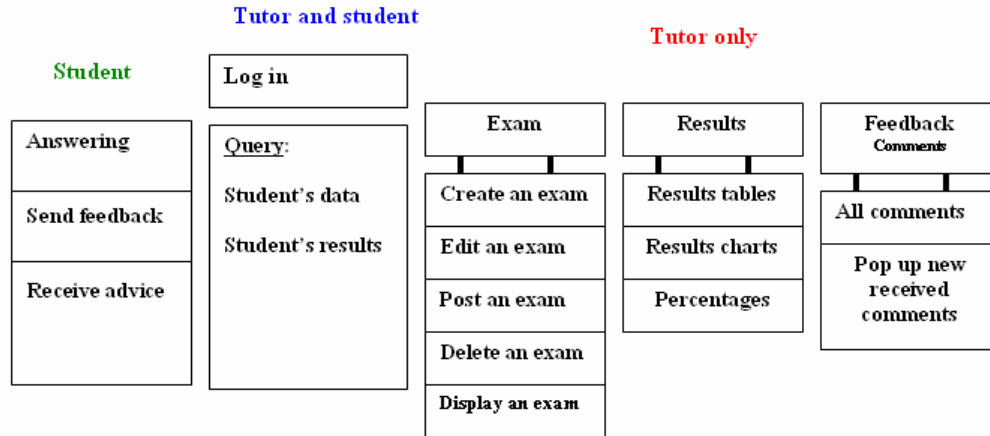

Figure 2. Software architecture.

Student: The student can query about his marks of any test to check his performance. The student can also display the test and answer the posted questions. Before answering he can choose to receive the advice by email, SMS or both. If the student does not have a computer connected to the internet he can send the answers as a short message SMS to the system and in this case the system will send the advice back in the form of SMS.

The hybrid teaching assistant system was built by .NET framework and other components were included such as Mcore library [10] that is used to send and receive SMS messages and net charting [11] that is used to graph the answers data and display them in a web page. And the database used is Microsoft access. Figure 3 shows the complete architecture of the system.
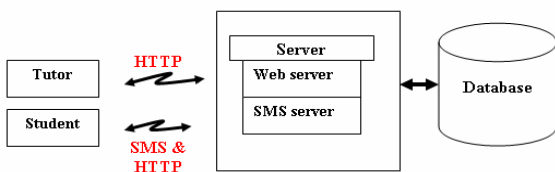

Figure 3. System Communication

2.3 Security issues

Tutors and students data require a high security to protect the individual privacy and to prevent the irruption intrusion of the system, so student can not view the answers before the test. In order to achieve that users data, questions and answers must be coded. A hashing function that supports MD5 is used to encode the data before storing in the database.

Another issue is the number of answering trials. The system does not allow students to answer the same question for more than one time. The multiple answers may affect the overall results and decrease tutors understanding of his students' performance. So a random generated key value is used for each test or discussion session. The key value consists of 3 alphabets letters taken from the combination of the first letter on each phone key. They are (a, d, g, j, m, p, t and w). The use of these letters makes it easy for a student to write the key value quickly since other letters not in the combinations require many key presses to find the letter.

3. System evaluation

Two pilot teaching experiments were conducted at an institute of technology to understand student attitude about system implementation. The purposes of these two experiments were to: investigate student attitude on using SMS in class; check the implementation issues about SMS; and check the effectiveness on student learning. One experiment was on the course entitled "Introduction to Computer Science", in the fall semester of 2006 and the approach used was SMS, and the other experiment was on the subject entitled "Programming Language and Practices" in the spring semester of 2007 and the approach used was web-based. Students participated at these two experiments are freshmen and at the same class, but the number of students was 48 and 45 respectively. At the experiment associated with SMS, students were asked to bring their mobile phone to classroom, which is a normal classroom without computer and network facility, and participated learning activity by sending SMS message based on teacher's instruction. The teacher paid students small amount of money to compensate the SMS fee. The objective was to understand implementation issues; there is no formal arrangement for quantitative or qualitative measurement. In contrast, the experiment associated with web-based was on a classroom with computer and network facilities. The objective of this experiment was to let students have experience on both implementations.

Design and Procedures

In the SMS based testing and discussion was run, 97% of students had mobile phones. Students had to answer questions posted in the web site using their mobile phones and typing SMS. Questions were previously prepared by the tutor and they are suitable to the lecture's topic.

Students had to write the SMS answers in specific format. A key value followed answer letters had to be written. An example, if the session contains 4 questions with four possible answers and the key value is TAD. The student should write TADBCCD. BCCD are the letters of the corresponding answer. If a student makes any mistake in the format, he will receive a message telling him about the error. Students also can send any feedback or comment to the system using their phones SMS. The system will display these comments in a pop up window to inform the teacher that some comments or questions have been received.

In the experiment of second semester, two groups of students were taken the same course. In this part we wanted to investigate the online testing and discussion

to compare it with the result of the first semester experiment which was run by SMS. The course was lectured in the computer lab. Students were distributed into two groups. The first group took the course using the conventional learning where paper exam and oral discussions were used, while the second group was allowed to access the internet and take the online exam and participate in the online discussions. Bearing in mind students can answer each question only one time.

In SMS based and web based students answers can be viewed anonymously in the form of tables or charts. The site provides the teacher with a tool to view answers for each question (number of correct and wrong answers), view number of answers for every choice and view each student's answers. Students also can send and receive comments by email and SMS.

4. Results

Questionnaires and Statistical analyses are the instruments for getting students and tutors responses about the system. Questionnaires targeted to test system's usability and benefits. Another instrument was used which is the daily tutor's comments about his students behaviour, interaction, collaboration and understanding.

SMS based discussion

In "Introduction to Computer Science" course during the first semester, 97% of the students in the class had mobile phones. The experiment's data shows that at the beginning 53% answered the quiz via their phones SMS regardless correct or wrong answer, while the other 47% did not answer due to error in the format or students were not enthusiastic to participate in the discussion. The high failure percentage forced us to add new function in the server to know the reason by tracing the message flow. At the end of the semester, students became more enthusiastic and involved in the discussion. Records in the database shows that 86% participated in the sessions, 70% answered successfully, 30% failed to answer due to the format restrictions. 14% did not participate because some of them were absent and the others did not bring their phones to the class room.

Obviously, the message format had restricted students since they had to write the answer in a very specific format which reduced the number of the successfully received answers. Other reasons such as text input function in phone SMS and screen size made the answering process not easy.

Web based exam and discussion

Students were in two groups at the web based experiment. One was in control group which was conventional teaching and the other was experiment group which took the online exam and participated in the online discussions. At the experiment period, the teacher taught programming knowledge of C program to both of groups.

A t-test was conducted prior to experiment began to verify the difference between these two groups before the experiment. The t-test result is shown at table 1. The mean value was calculated for the average scores before the experiment. The result showed that no significantly difference between these two groups according to P (T<=t) two-tail =0.71.

Table 1, T-test of scores–before the experiments

	Control group	Experiment group
Mean	36.1	37.3
Variance	133.2	139.6
No. observed	22	23
D.of freedom	43	
t value	-0.38	
P(T<=t) two-tail	0.71	

The web based system was used during discussion period for the experiment group. The teacher used this system to verify student's comprehension about the concept just taught for students at experiment group, while students at control group took the exam with paper and pencil and did not participate the web based discussion activity. The teacher showed a satisfaction of his students' results after using the system. He mentioned that students have become more interactive. The pre-class test and post-class test have developed students' revision and preparation for the class. Discussions questions and answers always unknown, so when the teacher displays the answers chart, students will start to think and discuss together to find the correct answer which achieve better cooperation among students.

A t-test was applied after the experiment for these two groups. The result indicated that it achieved significant difference statistically between these two groups with P (T<=t) two-tail = 0.05. That means this system promote the student comprehension on learning topics.

Table 2 T-test of average scores - after the experiments

	Control group	Experiment group
Mean	48.1	59.6
Variance	416.2	313.4
No. observed	22	23
D. of freedom	43	
T value	-1.996	
P(T<=t) two-tail	0.05	

The figure 4 bellow shows an image captured from the online exam after answering the question.
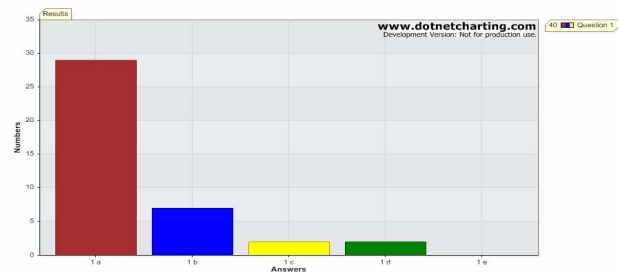

Figure 4. Real time chart

Student feedback function

Students always afraid of others criticism, shy and would not want to ask if they think it is obvious and they should know. The system provides a tool for students to come over their shyness. In the first stage of the experiment, students used to send their comments or feedback by SMS. While in the second stage, they used the online system or their emails since they are connected to the internet. Students preferred to use the online system to send their comments on the SMS system. The reason for that is that they used to type using the PC keyboard. Mobile phones have limited screen size, limited input characters. The majority of students see that the online and the SMS feedback system are better than the oral discussion.

Tutor's advice

Students need hints related to their assignments or exams. At the same time they need an advice to show them their mistakes in the exams and tell them where to find the correct answer. The SMS and email advice functions were accepted by all students. Some students preferred the email on SMS because of the message length. Students would like to receive a more detail advice in their email inbox from their tutors. On the other hand, most of the students try to avoid the oral advice.

5. Conclusions

With these two pilot experiments, some conclusions were drawn. First, SMS is one of useful tools to promote student learning in classroom,

although it has shortages such as cost and message length limitation. It is particular suitable for activities held at places where no Internet access or other devices available. Second, web based system is a more convenient way to conduct such an activity if both Internet and SMS access are available. Third, ICT technology does promote student's participation and learning comprehension with properly setting and introducing.

In summary, a teaching system has been improved by using technology and communication. ICT and mobile development has helped to increase students understanding, comprehension, cooperation, interactivity and learning. Tutors and teachers consume large efforts and time in traditional teaching systems especially testing and discussions on paper collecting, correcting and oral question. But with technical methods their effort will be redirected to develop their skills, prepare better learning resources and references and focus on students needs. The use of the hybrid teaching assistant system in one of the major course in a college saves teachers time and effort and improves students' interactivity and understanding. The system contains new features in the learning research fields which can be summarized in ubiquity, feedback and students advice; it represents a two directional ubiquitous tool which helps students test their learning levels in classrooms, campus or homes and receive advices or hints about their mistakes and weakness points.

Improving questions format by adding more questions forms and adding more features such as multimedia to the system are our future work to enhance our system.

Acknowledgement

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