MATH E-TUTOR: TOWARDS A BETTER SELF-LEARNING ENVIRONMENT

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Abstract

Math E-Tutor is a web-based tutoring system which aims to create a virtual teaching and learning environment that suits today's trend. This system focuses on the mathematical syllabus of lower secondary school which uses multiple choice questions (MCQ) as the mode of evaluation, known as *Penilaian Menengah Rendah* (PMR) in Malaysia. The system caters for three categories of users, the system administrators, the students and the parents. Teachers can play the role of the system administrators. They are able to facilitate the learning process and to observe students performance. The system provides the facilities for the teacher to maintain the teaching material such as notes and questions in the database. It also has a report generator that will provide the teachers with individual and class performance report as well as statistics on the questions. Students on the other hand, are provided with facilities which are available in the normal classrooms such as notes, tutorial session, examinations and performance report. As for the parents, they will be able to monitor their children performance based on the report provided by the system. The system can be further improved by adding a communication module and multimedia elements.

Keywords: tutoring system, e-learning, Internet, web-based.

1. Introduction

The internet is the largest, most powerful computer network in the world. With access to the internet, more possibilities are opened for educational purposes. With the current state of growth of the internet, more and more school work is being conducted online, and online course tools are becoming more and more popular [1]. The environment becomes a virtual classroom and the location becomes transparent structure. With the evolution of the internet we saw education being marketed as long distance learning, web based learner centered environments, internet based learning environments, and self instructed learning [2].

Self instructed learning or self-learning refers to a process whereby the learner participates actively in the act of learning, including planning, goal setting, progress monitoring, selecting learning strategies and controlling the learning environment (see e.g. [2]). Most of the Adaptive Educational System (AES) were developed to support the concept of self-learning.

Self-learning is a broad concept involving several phases and many inter-related components. The key components of self-learning are goal setting and planning, self-monitoring and evaluation, selection of self-learning strategies, self-managing, learning environment control, strategic help seeking, persistence on task and information processing. Self-learning is affected by a number of factors including the learner's motivation, meta cognition, self-efficacy and self-worth, appraisal on the possible outcomes, appraisal on the values, relevance and utility of the task, and attribution beliefs about success and failure [3].

The internet opened the way for the emergence of Web-based AES which is an inheritance of earlier AES i.e. Intelligent Tutoring System (ITS) or also known as Intelligent Computer Aided Instruction (ICAI). ITS uses the knowledge about the domain, the student, and about teaching strategies to support flexible individualized learning and tutoring [4].

This paper is organized as follows: in the next section, we discuss briefly in progression the systems which support self-learning. We then explain our Math E-Tutor system in details in section 3. In section 4 we suggest some improvements to the system as future works, followed by a concluding remark in the last section.

2. Self-Learning Systems

Let us begins by giving a broad introduction to computer-based systems which have been used as self-learning tools in education by reviewing the anatomy of CAI, ITS, and the extension and application of ITS into interactive web-based e-learning applications. Our research has been focused on the development of web-based tutoring system and its contribution towards self-learning, particularly in mathematics education.

2.1. CAI

What exactly is CAI? Basically CAI is a sequence of computer instructions that guide a student (user) to go through a lesson in the form of drill and practise. CAI has been around for some number of years. CAI is a means of helping students to master cognitive and academic skills through interactive computer programs. CAI can employ any variety of technologies, including web pages, sound, video and animation [5].

In a proper constructed CAI presentation, students can read a short explanation of subject matters and possibly look at images, listen and watch video that further explain the subject matters. Learner will progress to the additional subject matter after they do the assessment or tutorial correctly. Unlike standalone computer–based training, CAI is strictly not a self-

teaching medium but a better self learning tool. CAI system can be used by students for private study to individual PCs following the instructor taught lesson [6]. Thus, students will have freedom to study the subject whenever they like.

2.2 ITS / ICAI

Intelligent Tutoring System (ITS) also known as Intelligent Computer Aided Instruction (ICAI) has evolved from earlier systems i.e CAI and CBT (Computer-Based Training). Broadly defined, an ITS is an educational software containing an artificial intelligent component. The software track student works, tailoring feedback and hint all the way. By collecting information on a particular student's performance, the software can make inferences about strengths and weakness and can suggest additional work [7]. In its early days, ICAI was believed to augment or replace a human instructor in the teaching of new concepts. ITS relies on ideas developed in a variety of other important disciplines, especially artificial intelligent [6]. The main component of ICAI system is the expert model, the student model and tutoring strategies. The student model manages what the student does. The performances of ICAI systems depend largely on how well the student model approximates the behavior of the human student. ITS differs from CAI system in terms of the ability of ITS to assist teaching learning process in an intelligent manner. Thus, an ITS system would attempt to interpret student behavior over time to decipher the root cause of any misunderstandings [5].

ITS is a system that offers individualized learning. While using ITS, the students feel that they are given full attention by the system. Learner will receive the advice according to his capabilities and specific needs. ITS also have the features of online guidance. ITS contains knowledge of common mistake or misconceptions, so that when a learner makes such a mistake, the programs explain what is wrong with the supposedly faulty method used by the learner, and this cn be used as remediation [7].

2.3. e-Learning

e-Learning is really nothing more than using some form of technology to deliver training and other educational materials [8]. Since the current web-based learning system cannot adequately provide for interactive learning that is supported by dynamic feedback, it is important to extend the benefits of traditional ITS to a web-based system. The concept of e-learning have to encompase the concerns of ITS systems, namely: the content, convenience, community and centre of excellence. The content to be presented needs to be highly interactive and suitable for the target user. More importantly e-Learning should be available for access at convenience place and time. There should exist a community of e-Learning users who could interact with each other including the interaction between the student and the teacher. If an organization cannot afford to provide a dedicated system to each user, it is wise to have a centre of excellence where the facilities can be kept up-to-date and would be able to be shared among other users [9]. The learning experience could be enhanced if online interaction equipped with multimedia tools is facilitated

With the current state of growth of the internet, more and more school work is being conducted online, and online course tools are becoming more and more popular. There are currently many such commercial packages. Some cost a lot, and some require dedicated or

specific hardware. This lead to the proliferation of online applications such as e-Tutor. e-Tutor is a suite of open source online course tools. The individual pieces are very simple to configure and use. They do not require any special hardware [1].

3. Math E-Tutor

Today, web based educational system are becoming more and more popular and are used by heterogeneous user groups that differ in their goals, background, interest and knowledge [10]. Among these user groups are students regardless whether they are in the primary or secondary school or even in the universities. Math E-Tutor took advantage of this fact to optimize the efficiency and effectiveness of learning mathematics.

Math E-Tutor was developed with the objective to create a virtual teaching and learning environment and to support self-learning. It simulates the school environment with the presence of teachers, students and parents as users. It is focused on the mathematical syllabus of the lower secondary school which uses multiple choice questions (MCQ) as the mode of evaluation, known as *Penilaian Menengah Rendah (PMR)* in Malaysia. With the aim of helping students to be better equipped to sit for PMR and to increase their level of confidence, Math E-Tutor was developed to provide a self-paced tutoring system for revision purposes. Consistent to self learning, Math E-Tutor gives students the freedom to actively direct their action in the learning process. With the help of Math E-Tutor, it is hoped that students' achievement in the exam will be improved.

Math E-Tutor caters for three categories of users, the system administrators, the students and the parents. Teachers can play the role of the system administrators. The system consists of four modules i.e. notes, tutorial, test and report. Notes module provides facilities for teachers to maintain notes that are presented in the system and for students to refer during their revision session. The tutorial module enables the teachers to add more questions into the database and provides practice ground for the students before they proceed to the examination session provided in the test module. Test module provides three types of examination i.e. mid term, end of term and trial examination. The report module provides two types of report to the teachers i.e. students' performance report (individual and class) and statistical report on the examination question and the analyzer.

As mentioned before, there are four typrs of users to the system, i.e. the system administrator, teachers, students and the parents. The system administrator's role is played by a teacher. Before any teacher or student could start using the system, they should first register to the system. The registration process is done by the system administrator. The information about the parent of each student is also recorded. The system administrator is also responsible to register subjects' information and other relevant details such as total chapters in each subject, the title of each chapter and their respective years which are essentials for subject registration. Once the registration process is completed, users are free to use the system.

Each user is given a username and a password that can later be modified in their first system login except for the parents whereby their login identification would be their identity card number. Fig 1 shows the interface of the individual session when a user (in this case, a student) login to the system.
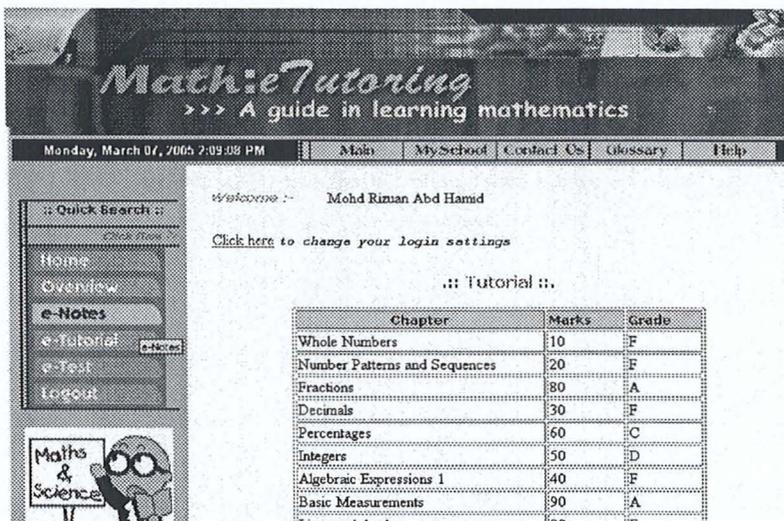
Fig.1 *Individual session's interface*

Teachers are given full control of the teaching material or notes submitted to the system. They could add or change teaching material through the facilities provided in the notes module. This ensures the teachers are in control of their students' understanding of any particular chapter. Teachers could upload notes from different format and not only in word documents. Other format such as Macromedia Flash files (.swf), Microsoft Power Point files (.ppt), PDF and etc. are supported by the system. Each chapter in a subject could have a subchapter or topic. Teachers are able to upload notes for these topics to further enhance the students' understanding on a particular concept in a chapter. In the tutorial and test module, teachers are able to add question into the database. These questions will be used in the tutorial session.. Later, when the students had undergone the tutorial and examination provided by the system, teachers could retrieve full report of students' performance and generate question statistic in the report module. Students' performance report is a report that shows students achievement in the tutorials and also the examination. This report comes in two type i.e. individual report and class report. Individual report is simply a table of tutorial chapters that the student have done and their marks for the tutorial. Their achievement in the examination will also be in the report if they had sat for the examination. Teachers could learn the weaknesses of a student through this report. Class report on the other hand, is presented by a pie chart that shows students' performance in a particular class. Through this report, a teacher can track any student who have not sat for a particular tutorial or examination. The analyser shows a statistical report on respective questions that shows students' attempt and their answers and based on that it rates the question as hard, medium or easy. For example if the number of students attempt is ten and the number of correct answer is 5 then the question will be rated as medium. In addition, several suggestion are given to the teachers by the analyzer such as "The topic of this question should be revised in the class". The question statistics is presented in the form of tables and pie chart. Fig 2 shows the questions statistic for one of the question in the topic "Combined Operations" in chapter 1, i.e. "Whole Number".
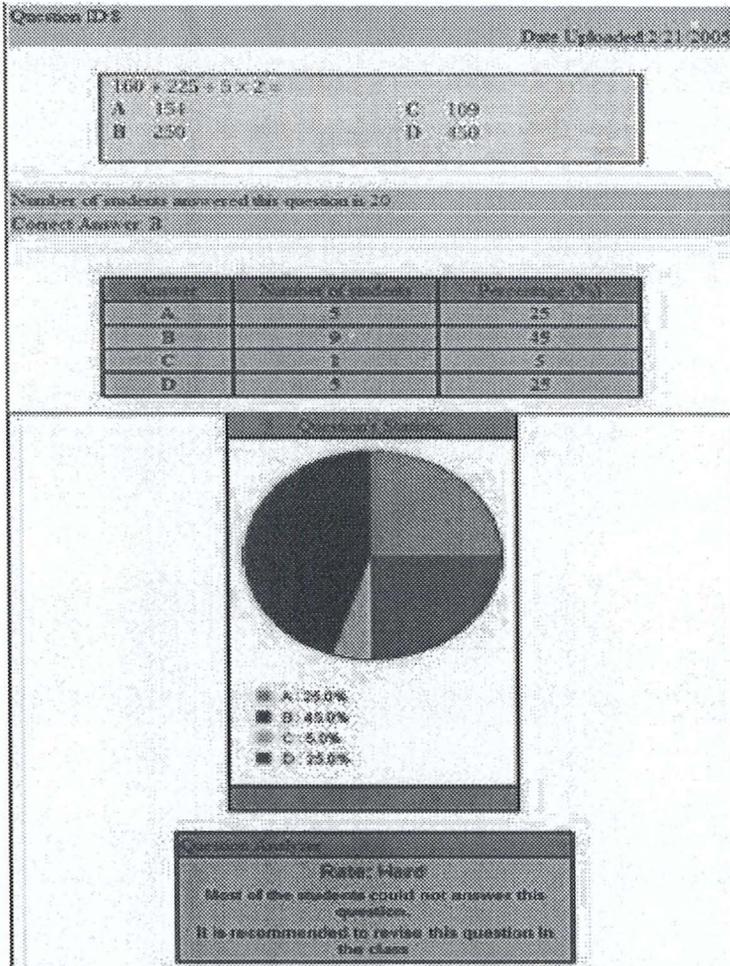
Fig.2 *Question Statistic and Analyzer*

Students as the main user of this system can read notes that were uploaded by the teachers. They can practice by going into the tutorial session provided by the system for each chapter. Each tutorial session consists of ten objectives questions. These questions are picked randomly by the system from the database. Students are allocated one minute and thirty seconds for each question. If within one minute the student still has no answer, a pop up hint will be displayed to assist the student to answer the question. Result of the tutorial will be displayed after the students have finished answering the ten questions. Marks will be graded and kept in the database. Students can later review their answers and compare them to the correct answers given by the system. Students will only be entitled to sit for respective examination if they fulfill certain requirements. For example, to sit for a mid term examination, a student must have done the tutorials for the first half of the total chapters in a particular year. For example, if student P is in year one and the total chapters for the subject in year one is 12, then student P must finish the tutorials from chapter one

to chapter six before being able to sit for the mid term. The same thing goes to the final term where he/ she must have finished all the 12 chapters and had previously sat for and passed the mid term examination. The trial examination requires a student to be in year three and finishes all the chapter tutorials in the subject and has sat for the final term for year three. Since Mathematics contains 40 chapters all together from year one to year three then the student should cover all the chapter tutorials as well as the mid term and final term for year three to be entitled to sit for the trial examination which is the last preparation before sitting for PMR. Questions in the examination are randomly picked and are equally balanced among the chapters involved. Result of the examination will also be displayed as in the tutorial with addition of comments on student's performance for each of the chapters involved. The comments are given by the system after analyzing student's answer and their tutorial performance record. Students will be updated with their performance report each time they login into the system. This report is the same individual report that is presented to the teachers. Fig 3 shows the interface for the tutorial session provided by the system.
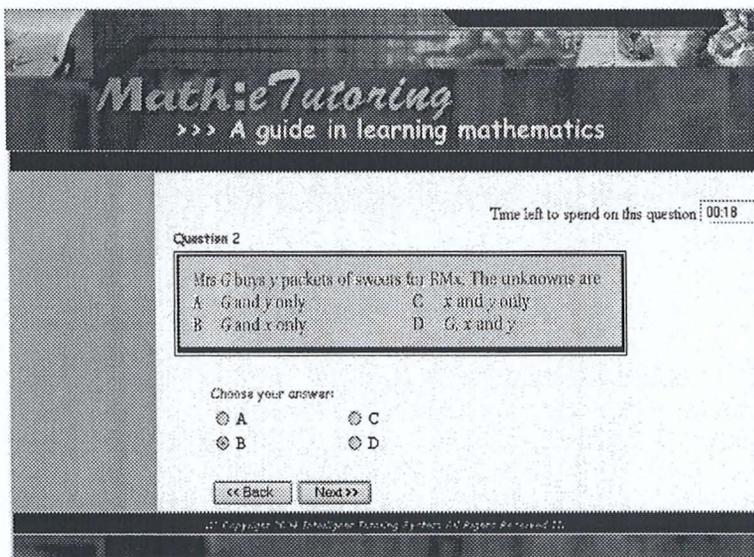
Fig.3 *Tutorial session's interface*

Parents have the least activity in the system. As their presence in this system is to observe their children performance, they will only be presented with their children latest performance report each time they login into the system.

4. Future works

As you could notice, Math E-Tutor is lacking in intercommunication between users. Thus for future consideration a communication module is needed. This module could include communication features such as discussion lounge, internal e-mail system, and alarm system. Discussion lounge is necessary to enable teachers to facilitate the learning process effectively. Via the discussion lounge students will be able to ask question to any of the

users. Internal e-mail system will comfort parents as they would not have to spent time to meet the teachers if they notice bad changes in their children performance or behavior, they will only need to e-mail the teacher to discuss the matter. Alarm system is for alerting teachers on students that need extra attention. In order to do this, intelligent programming is required. Multimedia elements can be installed to make the system more attractive especially in the notes presentation.

5. Conclusion

The new Malaysian government policy that makes the teaching of mathematics and sciences in English as compulsory has widen the gap between the students in rural areas and the urban areas as it is generally observed that the students in rural areas are very much lacking in their mastery of English. Most students dread mathematics, what's more if the subject is thought in a foreign language, therefore teaching mathematics in English to non-English speaking students is quite a challenging job for most of the teachers [4]. This is another motivation for developing Math E-Tutor. We hope the system will encourage the students to practice as much as they could and indirectly they will get used to learning Mathematics in English. Undoubtedly e-Learning softwares like Math E-Tutor can be used to promote and to enrich self-learning environment for the students, thus giving an added value to their resourcefulness.

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