"The Development of a Web-Based Homework System (WBH) Via TCExam"

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Abstract

The aimed of the project is to develop and produce a web-based homework system (WBH) that can be embedded in teaching and learning process by school teachers. Homework takes a large amount of teachers' and students' activities. Homework is important, but its workload can be really time-consuming. The used of Web-based Assessment and Testing System (WATS), such as WebAssign, Webwork and CAPA (Computer Assisted Personalized Assignment), has widely been implemented in several countries. Several studies have shown that this method indirectly reduces teacher's workload. We believe that higher work load of teachers can be partially addressed by bringing teachers and technology together. The time that was used for grading and evaluating the homework can be utilised on other academic activities. However, most systems are beyond the capabilities of many schools due to the cost factors. Here in our contribution, we developed a cost effective Web-based homework system (WBH) by utilizing "the free open-source software, (FOSS) TCExam" (Asuni, (2008) which offers many advantages such as, user friendly, easy to use, and efficient grading system. The system enables the teachers to adopt it as an alternative to the existing pen and paper-based homework (PPH). The project is based on physics at the secondary school level. We have successfully developed the prototype of the system and it has been tested for use among conveniently selected teachers and their respective students. A simple survey has been done to study the perception of the users. The result shows that the users have a positive perception on the system. We anticipate that we can contribute to the schools and students by presenting them with quality educational materials (WBH) based on our school curriculum and syllabus.

Keywords: web-based homework (WBH); TCExam; pen and paper based homework (PPH).

1. Introduction

The advancement of internet has enables us to develop new teaching and learning techniques which are not possible previously, e.g using of simulations in teaching. The general trend seems to move toward the incorporation of computer in education (Carbone, & Schendzielorz, 1997). One of the areas of interest is the Web-based assessment. It makes the learning process more relevant to the students. Besides, easing teachers' workload and the Web-based assessment also improve the student's performance in the examinations (Cooper, 1989; Hussmann, Covic, & Patel, 2004). Although, Malaysia has a very wide coverage of internet and its infrastructure (Rizalman (2013), this approach is still not widely utilized in schools or higher educational institutions yet. This is due to the high cost and lack of available materials. Therefore, we have chosen "the open-source software, TCExam". It is free and functions with LAMP (Linux, Apache,

MySQL or PostgreSQL, PHP) technology (Asuni, 2008). It offers many advantages such as, user friendly, easy to use, efficient grading system and is able to provide unlimited set of unique questions through online or in PDF form. As a pilot project, we developed a complete set of a Web-based homework system that is suitable with Physic for Secondary School Level and it will be further developed to the next level and subjects.

2. Literature Review

There are various review articles that summarized the impact of homework and academic performance (Cooper, 1989; Paschal, Weinstein, & Walberg, 1984). One study concluded that the achievement of students is moderately effected by the homework done, especially the homework that has been graded by the teachers (Paschal, Weinstein, & Walberg, 1984). The result showed that homework has a positive impact on the students, e.g 70% of the students acquired effects favouring homework. Also, it has been reported that there is a positive correlation between time spent on homework and grades of high achiever students (Cooper, 1989; Tymms, & Fitzgibbon 1992). In other work, it was found that the time allotted on homework is the second most important factor that predicts the grade achieved by students after intellectual ability (Keith, 1982). The finding also demonstrates that homework appeared to have compensatory effects. Students with lower ability were still able to achieve equal grade compared to higher ability students by spending more time on doing homework (Keith, 1982). For example, by performing an average of 1-3 hours of homework per week, the average low ability student was able to accomplish grades equivalence with an average ability student who has not done any homework. Dufresne, Mestre, David, Hart, and Rath (2002) have compared the effect of Web-based homework (WBH) and pen and paper-based homework (PPH). They found that the usage of WBH in teaching and learning process resulted to better overall exam performance, e.g the mean difference between WBH and PPH courses was about one-third of a typical exam standard deviation.

Although, some studies have also shown that there is no significant difference in the students' performance (Bonham, Deardorff, & Beichner, 2001; Bonham, Deardorff, & Beichner, 2003) as compared to the method used by the students, but we believe that the Web-based homework can lead to positive impact on the students' achievement and performance (Dufresne, Mestre, David, Hart, & Rath, 2002) and also it will improve on their attitude and belief (Nguyen, Hsieh, & Allen 2006).

In Malaysia, most teachers use PPH as their main mode for providing homework to students. Normally teachers use commercially available workbooks or handouts as student homework. Although the practice is beneficial to the students, it also has some issues and constraints that need to be addressed. Besides teaching, teachers are required to perform other responsibilities, including participating in co-curriculum activities. Furthermore, some of the workloads have to be taken home, such as reviewing and monitoring students' assignments and also teaching preparation. A lot of teacher's working hour has been consumed just to evaluate the students' homework. More time is needed if more homeworks or assignments are given. Hence, homework becomes ineffective tool as the monitoring process cannot be done quickly. Due to lack of monitoring, the students are unable to improve and to correct the mistake that they did by themselves. Hence, the remedial process does not happen immediately. PPH also uses a lot of paper. The school's financial resources are limited and therefore we believe that by using WBH the cost of printing will be reduced. We believe that a significant cost saving can be achieved in moving from PPH to WBH. In addition, WBH creates more opportunities for the students to do their homework. It permits students to have more practices, both in quantity and frequency. The students will receive feedback immediately and, hence enable them to master the material by doing the correction themselves. As the result, the students will develop the believed that they are more able to solve mathematical problems themselves (Nguyen, Hsieh, & Allen 2006).

Thus, this project addresses the issues concerning the existing homework system PPH by developing a system that embedded technology into it. The developed system is user friendly, intuitive, easy to manage and interesting. Grading will no longer be a process that takes a long time but has been integrated in the system. The grade will be available immediately. In addition, student grade will also be sent to parents' e-mail automatically. This means that two-way monitoring occurs, e.g the teacher-students and parent-student.

3. Implementation

In this project we have reviewed several applications that are available and have chosen TCExam (http://www.tcexam.org) as it suits our criteria. It is a free software application (Nicola, 2008) that allows administrator to create, schedule, and deliver online homework. TCExam is also able to grade and evaluate the homework automatically (Nicola, 2008). The application also can generate information and statistics associated with the homework. Another

advantage is its ability to incorporate mathematical symbols in the questions which is useful for science-based courses. However, additional software LaTeX is required and can be downloaded at (http://www.latex-project.org/) or MiKTeX (http://miktex.org/). Basically, the main structure of TCExam is divided into two main sections: public and administration (Nicola, 2008). The public area is where the users perform the tests or assignments. The administration section consists of the interfaces that control the system, including the user and database management, the generation of the tests and the results. The security is enhanced by separating the administration and public areas physically as shown in Figure 1. It also can produce a unique test for each student. In other words, this application has a high degree of reliability.
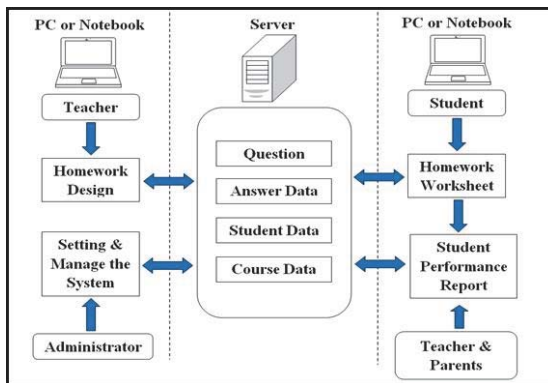
Figure 1: The structure of TCExam (adapted from Nicola, 2008)

The project was developed into 4 stages; the development of the questions bank, uploading the questions into the system (TCExam), the application of the homework by the users, and a simple perception study. The emphasis was given on the first three aspects, namely the development of the questions bank, uploading the questions into the system (TCExam), and the application by the users, e.g teachers and students, as our main aim at this stage is to produce a high-quality web-based homework system (WBH). In order to obtain and evaluate feedback from the users towards the system, a simple perception study has been carried out on pre-service teachers. The perception is divided into four themes, namely the suitability of the questions, the accessibility, and the quality of the monitoring and the usability of system. Several aspects of preparation, such as the selection of the questions, the types of the questions, the level of the questions, and the topic chosen have to be agreed upon in order to produce a quality material. Figure 2 below shows the sequence of the development process of the web-based homework system (WBH).
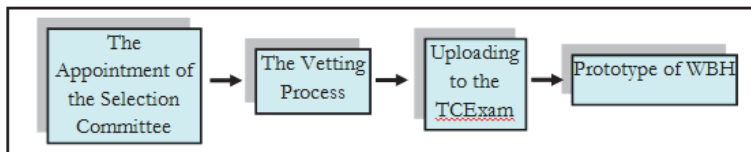

Figure 2: The development process of the web-based homework system (WHS)

3.1 The Selection Process of Questions

The web-based homework was developed using questions that are suitable with secondary school Physics syllabus as issued by the Ministry of Education (MOE).
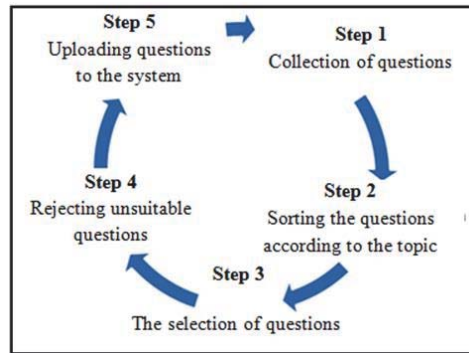
Figure 3: The selection process of questions

For this project, we only developed MCSA (Multiple Choice Single Answer) questions even though the application supports 4 types of questions; MCSA (Multiple Choice Single Answer), MCMA (Multiple Choice Multiple Answer), ORDER (Ordering Answers), and text-based questions. A selection committee was appointed to advice and chooses the suitable questions that will be uploaded into the system. Each question chosen was based on its validity, reliability and level of difficulty. Figure 3 shows the flow of selection process of the homework questions.

Figure 4: The example of one of the source question.

3.2 Uploading Questions into The System

The questions were transferred to the system by the administrator. The summary of the steps are as followed:
- Uploading the questions- develop the questions, choose the types of questions and give the answer of each question.
- Homework Management –set the date and marks, student groups and etc.

The example of one of the source question used is shown in Figure 4. In order to upload the questions, administrator has to log into the admin interface. It has two major areas - a central work area and a navigation panel on the left as shown in Figure 5. The question is uploaded in the working area of the question management section. The properties of the question, such as answer types and difficulty levels, were added in this section. Images also can be inserted here. The end product as seen by the users is shown in Figure 7.
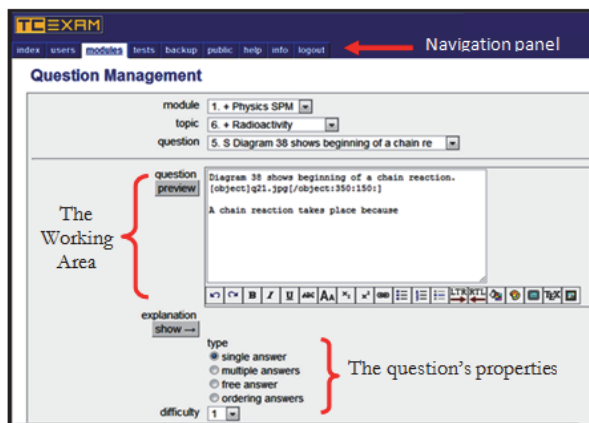
Figure 5: One of the administration interface of TCExam-the question management interface. The questions and its properties are uploaded in this section.

3.3 Management of the Homework.

Before implementing the homework, administrator need to provide the relevant information required regarding the assignment, such as the period of the homework, total homework time, and total score. Administrator can choose to randomly select questions from the uploaded questions of the planned homework, so that each student will answer different questions. The control panel to design the homework is shown in Figure 6.
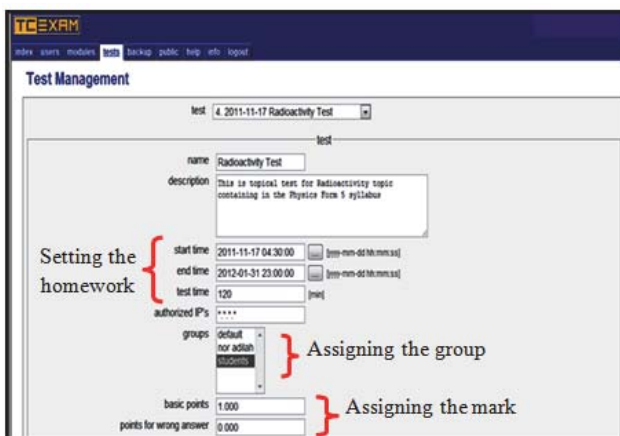
Figure 6: The information of the homework is controlled by the administrator in the test management interface.

4. The Implementation of the Web-Based Homework.

The students will be provided with the "username" and "password" before they can execute the homework given to them. They can perform the homework virtually at any time within the period decided by the administrator. The following images shown in Figure 7(a) and 7(b) display the user interface taken from sample questions of two set of homeworks.

Figure 7: The user interface of the completed web-based homework system (a) A sample question on Radioactivity (b) A sample question on Force and Pressure

4.1 Monitoring Of the Completed Homework

Once the homework is completed, the system will generate the result accordingly to the users as shown in Figure 8. The administrator also can access and view the result individually as shown in Figure 8(a) or in group as shown in Figure 8(b).

Figure 8: The result (a) Individual result- student (b) Group result-teacher

Beside, they can send the result to the users and in our case, to the parents, as a PDF form through e-mail. The system not only allows the students to learn at self-paced learning through practice of the problems set, but it also releases staff time by setting homework that could be marked by the software. Besides, all other statistic related to any questions in the homework, such as the difficulty of each question, can be accessed from the system.

5. Perception and Conclusion

A simple study on perception has been carried out on pre-service teachers in order to obtain the opinion of the users. The data were derived from the analysis questionnaires using percentage and mean on four major themes, namely the suitability of the questions, the accessibility, the quality of the monitoring and the usability of developed homework system. The result shows that 95% agree that questions of the homework are suitable for the students, 70% agree that the system can be accessed easily, 95% agrees that the monitoring quality of the system is really good and 80% agrees that the homework system is usable in Malaysian secondary schools.

It can be concluded that the users view the developed homework system positively. It can be seen as encouragement that it should be further developed and improved for the benefit teachers and students.

6. Acknowledgement

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