Development of an Online Platform for Understanding Students' Weaknesses

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Abstract
It is reported that many Hong Kong students do not have sufficient background to handle engineering problems in tertiary education. This came to light because a number of such students were admitted to engineering programmes. Although a number of teaching platforms have been developed to support the teaching of subject lecturers and the study of students, however the weaknesses of the students in solving engineering problems are not identified. This not only affects the efficiency of student study, but the teachers also are not able to deliver suitable teaching materials that focus on the weaknesses of individual students. For example, when students study engineering subjects such as computer-aided design, they are usually required to formulate the physical problem and then solve a set of linear equations by calculating matrix inverse. This involves a series of steps but the students are not able to identify their weak areas in solving these engineering problems. Therefore in this article, we propose to develop an online platform to understand the core factors leading to the weaknesses of students in solving engineering problems that require calculations. By understanding students' weaknesses, teachers can recommend suitable learning materials to individual students, efficiently and effectively. By strengthening the students' weaknesses, it is expected that the learning outcomes of engineering subjects can be improved. It is believed that the method is useful to enhance the teaching and learning efficiency and effectiveness.

Keywords: Students' weaknesses, engineering problems, learning efficiency, learning effectiveness

Introduction

In Hong Kong education system, students are required to take public examination before entering to colleges. The qualification attained in public examination is viewed as a ticket to university, but not an indicator of whether students are eligible to study in the fields. Students are eligible to be admitted into the college if their examination scores have reached minimum admission scores. Their scores will be calculated by different weighting. Students will have a higher chance to enter degree program if they obtained a higher grade in those subjects with heavier weighting. For example, when English and Mathematics subjects carry the same weighting for a program, the score will be affected by these two subjects more directly. If a student gets a grade 5 in English and a grade 3 in Mathematic, the chance for entering to an engineering program will be nearly the same as the student who gets a grade 3 in English and a grade 5 in mathematic. In other words, students' admission will be dominated by their examination scores instead of their ability on handling the knowledge.

This imply that some students may not have sufficient knowledge to handle the courses. The current way to ease this burden on their learning progress is to build a teaching platform to aid their study. These teaching platforms mostly comprise two types of learning materials. The first one is the materials which are related to the lessons they have, for instance, the videos of lectures' content and course notes. The second type is the out-of-classes exercises, which can provide a pool containing the materials for their self-study. These platforms will deliver most of the course materials for student to review and catch up with course content to enhance their learning progress.

Identifying students study weaknesses not only enabling teachers to arrange suitable teaching materials for them, this can also optimize the use of these learning materials, so does the students' study. In order to identify the level of knowledge comprehended by a student, an analytical methodology should be developed. The platform will first record the students' performance and analyze their performance by parts. Thus, students can get response and training materials from the analysis. Students are suggested to finish the new set of training materials as a mean to strengthen their weak areas. On the other hand, teachers can adjust their teaching progress depending on students' performance and design corresponding learning materials for students.

Therefore, this study aims to investigate the study weaknesses among engineering students and propose a platform for improvement. Calculations is a must for students to enroll into an engineering faculty, thus they need a strong foundation of mathematics including the use of matrix algebra. An online platform will be developed in order to track their learning progress and provide recommended teaching materials for their study. Students' ability of handling engineering problems through calculations is expected to be improved. Also, their learning stagey could be re-directed to an efficient and effective one.

Literature Review

To measure the weaknesses of a student, ability test should be performed. There are several qualitative and quantitative research methods to analyze not only student's performance, but also teachers' one. Qualitative research is used to understand the

problem and get the insight on the topic. The first method is observation. In the study done by Al-Qahtani (2013), they have used class observation, which was targeted on students in order to check the use of technology. E-learning is the mostly used resource among post-secondary education, but not everyone is reading these sources correctly and in details. Class observation can notice whether the students are on the progress through online resources. The result can show the relationship between use of online material and learning efficiency. Another method is discussion forum. (Durairaj, 2015) had held a forum in order to collect the opinion from the students. The contributor could share their thought and understanding based on learning content and subject achievement. The variety of the opinion collected would be wide and deep, and also more insight could be recorded since students study in an environment without pressure. On the other hand, survey targets on both teachers and students can be used. For the teacher survey, the questions could be set including demographic background and teaching method (Al-Qahtani, 2013). Therefore, the ways about how teachers prepare and conduct a lesson would be carried out. Besides teacher survey, a more objective survey would be student survey. (Chapman, 2013) has assessed the attitudes and opinions toward students. They had included the themes such as feeling and benefit obtained during the lessons in the survey study.

Quantitative research is to collect mass data from targets. The first method is to set a question paper about the subject area. (Hashemi, 2014) had designed a questionaire about conceptual understanding based on the tested area. The questionaire will test the ability of explaining the theory knowledge in students' own wordings. This was an open-end question paper, and students are welcome to try any possible answers. By calculating their masks, researcher would figure out weakest area, which is the lowest mark obtained, because students are not able to handle. (Tesoriero, 2008) have successfully provided information system with location-aware technology. By this system, the mobile devices including PDAs, tablets and smartphones can be automatically positioning by RFID. Therefore, the indoor collection of information is precise and accurate for those desirable ones. Afterwards, (Fardoun, 2012) have applied this technology on measuring the weaknesses among tutors' teaching performance instantly. Students can express their feelings about the teaching, and press the answer on their mobile devices to represent their mood.

No matter which method is used, they would be hard to collect opinion from students. Take online forum as an example, (Cheung, 2006) had pointed out that students rarely participate inside. Therefore, it is hard to collect the real thought and mass data for analysis. Same as online forum, instant response by mobile devices is also hard to monitor. Respondents could select whether they are going to answer or not. And the mobile devices are not easy to maintain stable connection with the system for a long time.

Methodology

This study investigated the study weakness of engineering students who have attended the post-secondary education institutions in Hong Kong. The students will be selected to enroll the online platform called 'ClassMarker', which is an online communication and testing channel between teachers and students. First of all, a set of analysis questions will be posted on the ClassMarker. Students are required to finish them in order to test their weak areas. The questions assessed their key skills in calculation

and application on matrix topics. It can also record their performance including time spent and marks obtained in the calculation. Then, their weaknesses will be evaluated by the teachers based on student's performance data. Students are able to access all the learning materials online.

Besides, students are required to complete an online feedback questionnaire once they have finished their matrix test. The purpose of the questionnaire is to collect their opinions on the system and study progress before test.

This study collects two data sets from the students. The first data set comprised their matrix test results, including the score obtained and time used during their answering time. The second data set was the post-test questionnaire surveys, which is conducted instantly when students finished their matrix tests. The data will be analyzed through the analytical software - SPSS.

Results

All students invited to join this study were studying in engineering undergraduate programmes in different Hong Kong higher education institutions. Most of them are required to take matrix algebra course in their first study year so that they could utilize engineering mathematic in their later study. They were required to study and test through the designed online platform.

To start the investigation, students were firstly enrolled and registered into ClassMarker. The platform allows teachers to create and design tests without any software installation. Students can answer the test papers at anytime and anywhere, the proposed answer could be retained and continued later in the system. Finally, student's test results were exported from the system after finished.

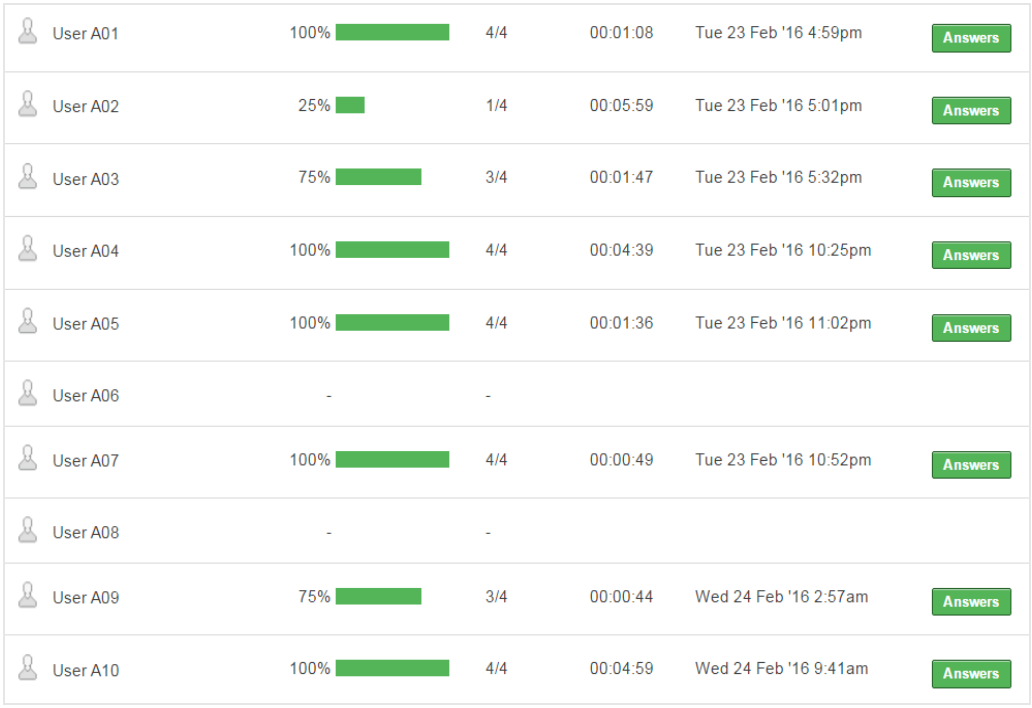

Figure 1: Student test results in administrator view

In order to collect data of students' performance, their score obtained and time used were recorded by the system. The system allows teachers and students to review their test results and time durations for each question of the test. For the sake of mending students' weakness, feedback should be provided instantly in order to show what had been wrong on their concept understanding. Therefore, students can rectify mistakes and errors throughout their calculations. Along with the instant feedback provision, the correct answer was marked next to the result sheet for their reference. Figure 2 shows the sample question of the test and suggested answer for the students.

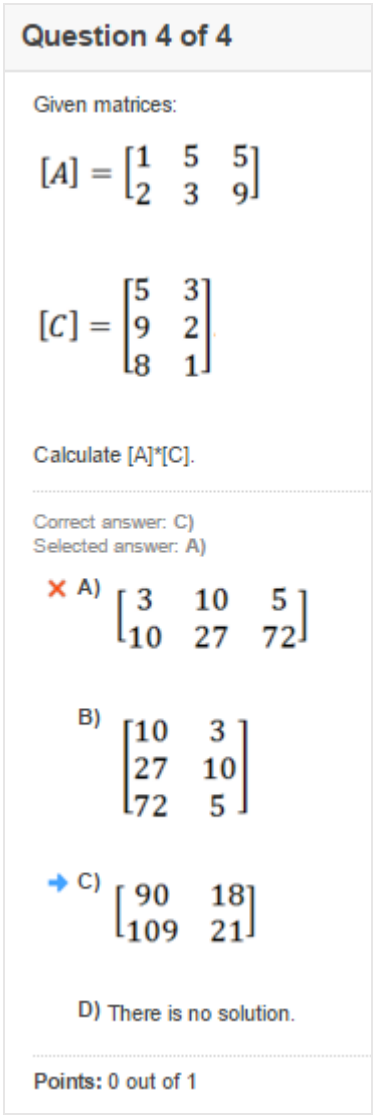

Figure 2: Sample question of the test paper and suggested answer.

Learning materials were designed to strengthen students' weaknesses. Thus, materials distribution system should be available to make them accessible. In particular, students were able to access the recommended teaching materials. In order to make individual recommendation to the students, teachers can post recommended materials to each student individually through message board. This can fit students' needs and therefore strengthen their weaknesses. Figure 3 shows the function of posting individual message to the student in the system.

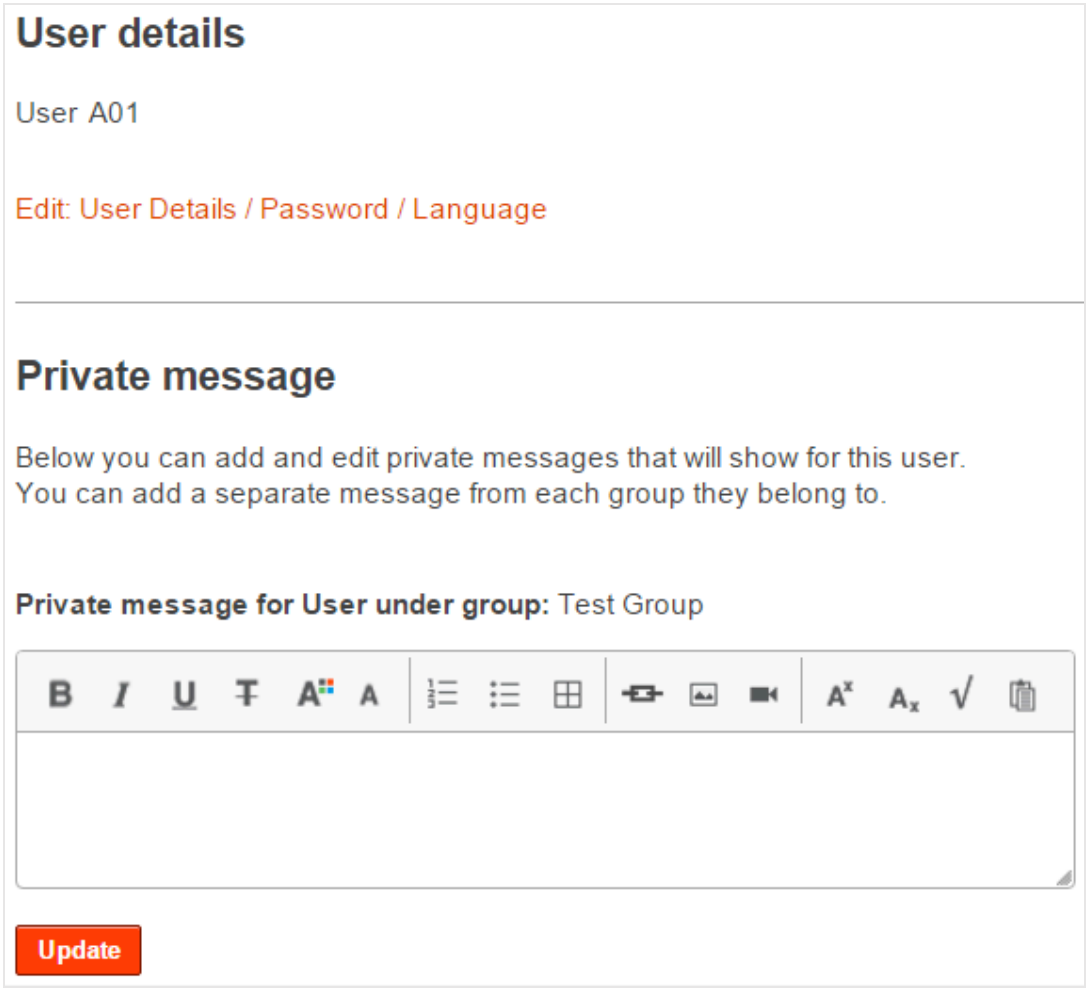

Figure 3: Function of posting individual message to the student.

Besides the online test, questionnaires were used to collect students' opinions and feedbacks. Following are some of the main points suggested by the students:

- Install an online discussion board so that students can raise questions among classmates, exchange ideas and opinions
- Deliver learning materials in a more user-friendly way so that students can preview the learning materials easily
- Build an in-web learning content board in order to provide convenient experience for students to check the useful learning materials.

Conclusion

In order to get rid of common study weaknesses, an online platform was constructed with the functions of distinguishing weak points of students and providing means for self-improvement. Students are required to do an assessment to check the weaknesses in certain topics. Then, their results were reviewed. Finally, recommendation and suggested learning materials were delivered to each student.

In this study, an online platform for evaluating students' matrix algebra ability was constructed. The platform includes a test which cover foundation matrix calculation and advanced linear system calculation. The system also provides functions of sending individual messages and delivering teaching materials. This not only make

students' study effectively, but also efficiently. Despite the platform has been successfully developed; there are still a lack of interactive functions and user-friendly interface in the platform. They were not able to voice out the problems encountered during the test or learning progress. The online platform also difficult to collect instant students' problems. These could be the development directions in the future.

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