Design an M-learning Platform for Engineering Mathematics

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Abstract --- Mobile learning (m-learning) brings a novel evolution in teaching and learning. The mobility and flexibility of m-leaning can conquer different study limitations such as leaning anytime and anywhere. Therefore, m-learning is becoming more popular.

In Hong Kong, enrollment of local university is mainly based on the Hong Kong Diploma of Secondary Education (HKDSE) examination results. However, the students enrolled to the engineering departments are usually lack of sufficient mathematics background. In order to tackle this problem, we have developed a mobile application (App) based on the students' needs for their study and revision. We have conducted two sets of questionnaire to define the most difficult parts of mathematics that students encountered from both teachers and students perspectives. This App was successfully published in both Apple IOS and Android platforms.

1. Introduction

The maturity of mobile technology significantly influences the penetration of mobile learning (m-learning). Mobile devices and infrastructures are critical for m-learning delivery. As reported by World Bank Group [1], the mobile cellular subscription is 89.3% globally in 2012. According to the 33rd statistical report on Internet Development in China released by China Internet Network Information Center (CNNIC) [2], the population of the mobile Internet users is 500 million and continuously growing. Therefore, it can be foreseen that m-learning will be important for future in both teaching and learning. Peng et al. [4] reported that the ubiquitous mobile technologies can help students to learn expediently, appropriately and learning immediately. Beth et al. [5] claimed that mobile devices are consumer-friendly because of its flexibility and high efficient. Subramanya et al. [6] pointed out that in terms of the computing power, portability and ease of use, mobile devices are clearly superior than carrying a laptop. M-learning can contribute a learner-centric conceptualization where knowledge can be enriching continuously and seamlessly [7]. The seamlessness of the mobile seamless learning (MSL) has been characterized by Wong and Looi [8] with a number of features. Wong [7] has further interpreted those features into an ultimate objective of MSL or m-learning is to achieve knowledge synthesis. M-learning enables learner to explore, identify and grasp the potential opportunities in daily lives, where learning and daily life can be integrated by the help of mobile technology.

Nowadays, there are quite a number of students who admitted to engineering programs do not have sufficient fundamental mathematics background. Although freshmen are required to take fundamental subjects in the first year, it is still a challenge for them to equip from the basics to the advanced level in only one year. Therefore, we proposed a student-oriented mobile application (App) which aims to enhance the learning motivation and effectiveness for learning engineering mathematics. The effectiveness of the developed application is justified by a post-survey study which was conducted among both subject teachers and students. The following sections in this paper will present which parts of mathematics techniques that students are not familiar with and the construction of the App.

2. Methodology

In order to decide the content of the learning platform from the teachers' perspective, we have designed and distributed a set of questionnaire to 7 subject lecturers in our department. This questionnaire is mainly focused on two areas: the required fundamental mathematic techniques and which mathematics techniques are the weakest links toward students. Table 1 shows that basic mathematics (including logarithmic functions, exponential functions, quadratic Functions, polynomial Equations, etc.) are the weakest part to the students.

Table1 Questionnaire results from teachers' perspective
✓represents the technique used in the subject.
× represents the technique is difficult to the students.
(1) Computer aided product design. (2) Integrated design for manufacture. (3) Mechatronics for products. (4) Applied mechatronics. (5) Advanced engineering modeling. (6) Design for manufacture and environment. (7) Product design for manufacture.

Topics	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Basic Maths	×	×	×	×	✓	×	×
Statistic	✓	×			×	×	
Matrix	×			×	✓		
Coordinate System	×			×	×		
Calculus–Differentiation			×		×		
Calculus–Integration			×		×		

In order to study the mathematical level of the students, another set of questionnaire has distributed to the engineering students. A total of 148 students who have taken the above courses have participated in this study. Figure 1 summarized the results. Around half of the students agree that the most difficult mathematic technique is matrix (including determinant, matrix inverse function and system equations or Gaussian elimination). They also pointed out that basic mathematics and statistics are difficult to them. Besides, 41% of the students suggest that exercises and notes are the major components in the mobile learning platform. Among some common mobile learning platforms such as App, Website, Backboard (university's internal learning platform), most of the students prefer to use mobile Apps. For the suggestions on the design of the mobile learning platform, most students prefer a simple, user-friendly with well-organized

structure App. Finally, over 58% and 25% of the students are Android and Apple IOS users respectively. Therefore, we developed both Apple IOS and Android platforms.

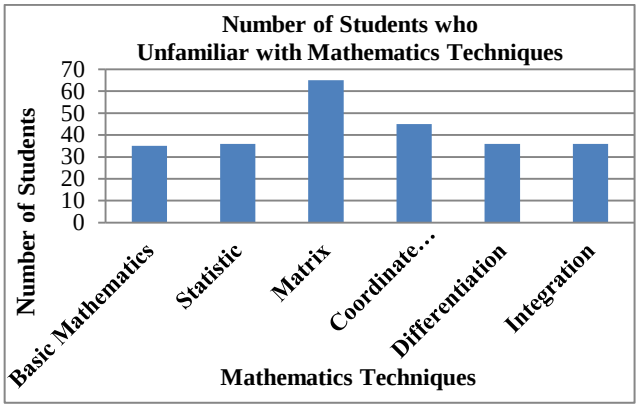

Figure 1. Questionnaire results from students' perceptive

We have also referred to the suggestions of Pelton, T. and Francis Pelton [9]. The design of education app is simple. Distractions like background music and flashing effects are minimized. The App also provides useful models or manipulative such as examples and descriptions, for a more comprehensive understanding. The App is user-friendly, less stress and success-oriented, which can build up the students' confidence and increase their study motivation. The designed m-learning platform can be fitted into the Double-loop learning model [10].

3. Results

The survey results and the literatures provided directions for the development of the App. The App consists of two major components, brief introductions in each topics and self-practice tasks. We focused on two mathematics topics, basic mathematics and matrix, which are unacquainted to the students. Those topics have been divided into a total 22 sub-topics with brief summaries and examples for better understanding. In order to cater the students' using habit, the App was designed in a simple structure. All the sections are listed in one main page with collapsible index for a quick access. To encourage the self-learning environment, a total of 8 exercises and solutions are embedded into the App that is corresponding to the topics. This App is free for download in both Apple IOS and Android platforms.

4. Conclusions

In this paper, a student-oriented App is designed and developed. This App is anticipated to enhance learning efficiency in engineering subjects and to draw the learning distances between different mathematics background students. Students can be equipped well to tackle their engineering issues in the future.

For future study, it is expected to extend the study to further investigate how the learning motivation is enhanced by applying the m-learning., and how the m-learning can be applied to a wide scope.

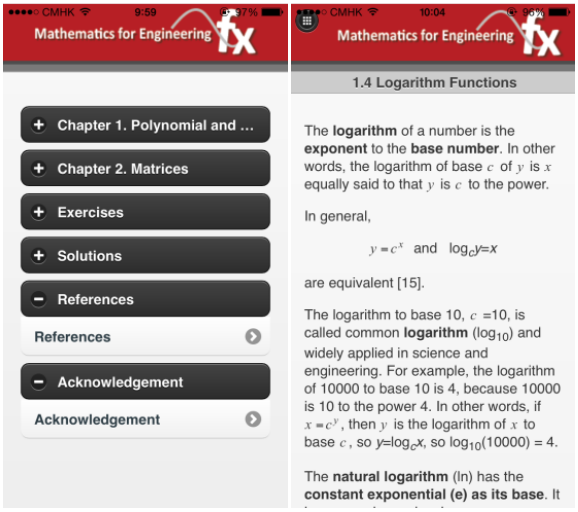

Figure 2. Snapshots of mobile application. (Left) Main page with collapsible index. (Right) Descriptions and examples.

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