Studying Learning Performance Using a M-Learning Approach

C.H. Wu[1] G.T.S. Ho[1] K.K. Tseng[2] W.H. Ip[1] W.L. Mou[1]

[1]Dept. of ISE, The Hong Kong Polytechnic University

E-mail: {chowu, george.ho, wh.ip, michael.mou}@polyu.edu.hk

[2]Dept. of Computer Science, Harbin Institute of Technology (Shenzhen Campus)

E-mail: kktseng@hitsz.edu.cn

Abstract

With an aid of portable and wireless devices nowadays, a mobile learning platform for delivering multimedia content can be easily created and this has greatly nourished the development of mobile learning these years. This paper presents a mobile learning platform as a motivational and interesting learning tool, which is capable in improving students' learning outcomes. Students will have no limitations in accessing online materials through such effective and always-available platform. This research aims to explore the potential of the proposed platform in improving student learning performance.

Keywords : Mobile Learning, Online Learning Interest-oriented Learning.

1. Introduction

Mobile learning is broadly defined as the delivery of learning content to learners utilizing mobile devices [1]. Kambourakis et al. defined it as "The point at which mobile computing and e-learning intersect to produce an anytime, anywhere learning experience" [2]. Users can access learning materials in any places without any physical restrictions [3]. A study shows that using mobile devices as a learning platform is an effective issue to deliver concepts with its mobility features, making learning a more natural process, and delivering concepts with interest [4]. A study disclosed that some students, who lose focus in a class, would tend to play computer games instead of the academic materials during the laboratory sections. The study reveals the potential of games may be useful to improve learning activities with its high commitment and motivation in learners [5]. This research, inspired by games, explores the feasibility of using a Mobile Learning Platform (MLP) to deliver knowledge actively from an one-sided approach to a two-sided approach.

2. Literature Review

Computer interactive platform is commonly used to deliver academic knowledge by leveraging students' enthusiasm with its interest-oriented characteristics [6]. Prensky notes that goals achievement, excitement of competition, and interaction of the platform are the main characteristics to engage and entertain the players [7]. Some researchers have also studied the impacts of playing games on education. They believe that interactive platforms can promote higher order learning, such as increased meaningful dialogues of learners on language studies [8]. Besides language studies, game education has also been proven impactful in promoting high quality learning performance on science studies [9].

Mobile learning platform can provide specific feedback to students immediately through the interactive platform. Students' weaknesses and mistakes are pointed out and collected by the system. The importance of specific, regular, and timely feedback to assist students in learning is definitely proved [10]. In addition to identifying students' weaknesses, adjusting teaching methods and pace accordingly is also important. To improve students' learning performance, students with similar weaknesses and mistakes are clustered into a same learning group using association rule mining.

K-means is a typical algorithm that solves clustering problems. The procedure follows a simple way to classify a given data set into *k* clusters [11]. With its simplicity and effectiveness, K-means algorithm was selected as the main clustering method in this study. On the other hand, association rule mining aims to investigate the interesting relationships among the attributes of repositories of data [12]. Association rules can be used to find out those hidden problems of students and then prevention can be made through advanced guidance. After grouping students into clusters, teachers may aggregate all the mistakes made by students of the same group and design suitable course scenarios for more effective guidance.

However, it is rather difficult to gather learning information of students in traditional classrooms. In general, the way of performance information collection is limited to the format of traditional tests and assignments. As a result, traditional

performance-assessment can hardly reflect the timely learning performance of students [13]. Therefore, a mobile learning platform can be a solution to act as an effective tool to collect and report students' learning performance in a 'clicks'.

3. Proposed Framework of MLP

With the capability of multimedia content delivery via mobile devices, mobile learning is feasible to contribute new benefits to learners. In order to raise the interest and bring opportunities to students in approaching both practical and abstract issues, a Mobile Learning Platform (MLP) is proposed. MLP targets at delivering different case scenarios with a simple-interesting method and initiates students to learn from the platform. In addition, with the portable feature of mobile devices, users can interact with the platform at anywhere, such as coffee shops, home, and parks. Users can choose a relaxing place to stay while accessing to the platform. This can definitely help raising learning interest of students. The proposed framework of MLP is shown in Figure 1.

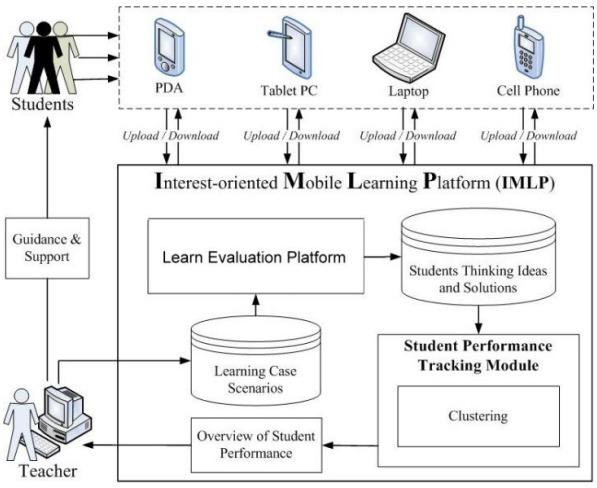

Figure 1. The Framework of MLP

After each trial, the performance of students will be translated into quantitative attributes and submitted to the Learn Evaluation Platform for further analysis. After evaluating the results collected, weaknesses and mistakes made by students will be associated together using the association rule method [12]. Students making similar pattern of mistakes will be assigned to the same group. Students will then be divided into *K* groups while students of the same group perform similarly. Based on the particular cluster, teachers specifically design a suitable case scenario to assist students to tackle their weaknesses and mistakes within the same group. It will help enhancing the efficiency of teaching and the effectiveness of students' learning performances. An electronic logbook for individual student is created to record one's learning behaviors, which combine to form the details of all interactions on MLP. As the interaction can identify users' weaknesses and mistakes, the information in the logbook can be used as the determinants to group students correspondingly into clusters. As a result, MLP will provide important information on both learning performance and teaching efficiency referring to a particular case scenario in the platform.

4. A Case Study

A topic from an undergraduate subject 'Logistics Facility Design' has been selected to be a trial test of the proposed platform. According to two former subject lecturers and two current subject lecturers of this subject, layout planning is a challenging topic for students. According to the experienced lecturers in teaching layout planning, there are three possible learning difficulties of students in this learning case scenario, namely, Work Experience of Facility Layout Planning, Concept Understanding, and Functional Unit Relationship Understanding. The lecturers were invited to assign ratings on the criteria through an Email interview. Two of the three criteria were selected in this trial test, which were Concept Understanding and Functional Unit Relationship Understanding. Students were then divided into groups to complete case scenario.

Concept Understanding and Functional Unit Relationship Understanding are the important criteria of effective layout planning. Concept Understanding was examined by the scores achieved in each case scenario. It was an all-round evaluation on aggregated application of different concepts learnt. This criterion revealed students' ability on applying learnt concepts in each scenario.

Functional Unit Relationship Understanding was examined by the number of mistakes made in the case scenario. This criterion revealed the ability on identifying the potential relationships among functional units based on the given information.

Based on the performance of students, the scores obtained and the number of corresponding mistakes made in each criterion in MLP were counted and used to differentiate students into two groups: 'advance' or 'poor'. On one hand, if more mistakes are made, the performance in the aspect of 'Functional Unit Relationship Understanding' will be defined as poor. On the other hand, if a low score is obtained, the performance at 'Concept Understanding' will be defined as poor. Students' performance can vary from different case scenarios and groups of students. To effectively divide students into learning clusters, K-means algorithm was used to divide students into two clusters in each criterion.

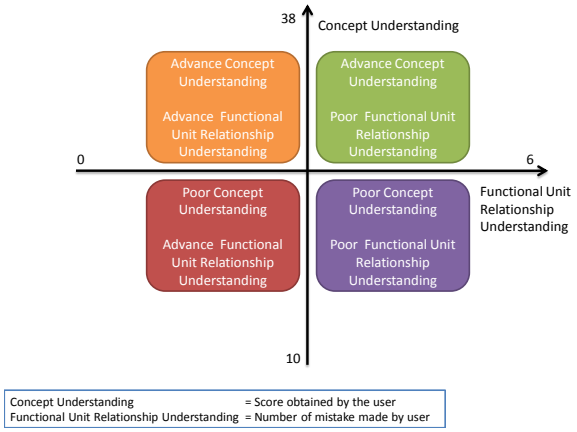

Figure 2. The 2-D K-means Method Dividing Students into Four groups

An evaluation case scenario is developed as a package based on students' preferences and learning difficulties. The package aims at delivering concepts and practical opportunities in a mobile platform. Students can consolidate their learnt concepts and gain the real life practical opportunities by playing a casual game on a mobile device. The package consists of three evaluation sections, namely Facility Layout Design Quiz, Multiple Choices Questions, and Boolean Questions. The evaluation package is available in MLP. The way to conduct evaluation and the way of weaknesses identification of the learning case scenario through the package in MLP will be discussed.

5. Trial Test and Preliminary Results

60 students studying Logistics Engineering and Management at The Hong Kong Polytechnic University, who had learnt the facility layout planning by attending the subject 'Logistics Facility Design', were invited to attend the trail test. A tablet with the preinstalled package was used as an interactive platform for collecting students' scores and mistakes. The trial test for the evaluation of platform was performed on 28th January 2014. 60 students were given an introduction about the purpose and operation of MLP and the package before starting the evaluation, which included the Facility Layout Design Quiz, Multiple Choices Questions, and Boolean Questions. After distinguishing the determinants level of learning performance, two K-means clustering have been performed, so that the two evaluation criteria were aggregated. Two distinguishing lines of the two evaluation criteria were used to separate students into four clusters, namely four groups of students with different performance (Figure 3). The numbers of students per group are shown in Table 1. Four teaching strategies were therefore proposed to the students of different group.

Advanced case scenario for group 1: The students in group 1 were capable of mastering the knowledge learnt in the lectures. They had achieved the best performance among the other clusters. The pedagogic direction for this cluster is to consolidate their performance and support them to achieve a deeper understanding on the topic. A level-up case scenario with an increased number of functional units and hidden information is suggested to be distributed to students in group 1 so as to sustain their well performance. More complex concepts will be assessed within the group.

Similar case scenario for groups 2 and 3: The students in groups 2 and 3 could master most of the concepts and put them into applications. Most students in these clusters had made careless mistakes on either calculations or relationship recognitions of the functional units. The pedagogic direction for these clusters is to improve their calculation accuracy and relationship identification technique by intensive practices on similar learning scenarios. Two case scenarios with the same difficulty are suggested to them. The same concepts and ideas will be assessed in similar case scenarios. By modifying the numbers and relocating the relationship of the functional units, students may find it easier to get use of the calculation operations and relationship recognition to minimize the careless mistakes made in the assessments.

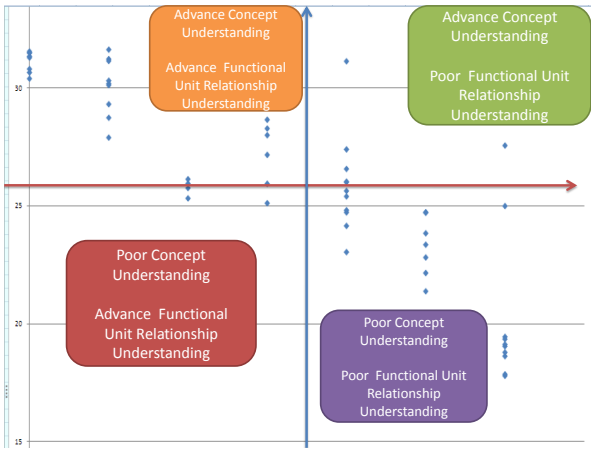

Figure 3. The Result of Dividing Students into Four groups based on their Learning Performance

Intensive tutorial for group 4: The students in group 4 could not effectively apply what they should have learnt in the case scenario. They may have some difficulties in understanding the concepts and applications during lectures. Some of them had made 6 mistakes and scored lower than 20. The pedagogic direction for this group of students is to provide extra

guidance and illustration on concepts and the applications.

Table 1. Number of Students of Each Group

Group	Concept Understanding	Functional Units Relationship Understanding	Number of Students within the Cluster
1	Advance	Advance	29
2	Advance	Poor	6
3	Poor	Advance	3
4	Poor	Poor	22

6. Conclusive Remarks

According to the preliminary results, MLP could identify students' weaknesses and divide them into several learning groups effectively. Most students enjoyed the learning experience delivered by the mobile platform. MLP could be rewarding to both students and lecturers. Referring to the results, tutorial in a small group has been offered to the students of group 4, which students were allowed to discuss the concepts and applications with each other and the tutors. Some studies indicate the collaborative peer discussions can support reflection and absorption of knowledge (Lai et al., 2009). We believed that it can be an effective way to help students to develop knowledge in their own pace. Thus, we are looking forward to conduct more trail tests in order to see how the students' performance can be improved, e.g. second trial test with a similar layout planning quiz with alternated numbers on material flow rate can be adopted to evaluate students' learning performance and see if there is any improvement after adopting the teaching strategy.

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