# AN INTERACTIVE MOBILE LEARNING TOOL FOR LARGE CLASS-ROOM TEACHING AND ASSESSMENT

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Abstract: This paper presents a simple interactive m-learning tool for large class-room teaching and assessment. The problems occur in teaching a large class are discussed and using the m-learning tool presented is proposed as a solution. In teaching large classes, the teachers very often find it very difficult to know how much the students have learnt and their levels of understanding in the class. With the use of the m-learning tool, teachers can monitor the progress of students during class and know what the students need, hence adjust their teaching pace to adapt the students' learning ability. To access some of the effects, the m-learning tool has been modified to be used in a mobile quiz contest with participation of 17 secondary and primary schools. Feedbacks in the events are very encouraging.

## 1 INTRODUCTION

Over the past years, e-learning has adapted different advanced technologies such as using different learning platforms as learning tools or virtual class-rooms to provide students with different ways of learning. Some technologies have been used for interactive mobile learning (m-learning) (Zurita, 2008. Chang, 2008. Tao, 2008. Qi. 2008), but very few are dealing with the outcome and monitoring of students' learning progress during large class teaching. The Electronic Student Response Devices (Clickers) is an excellent tool for these (Goff, 2008).

Mobile phone is becoming a necessity for people in many places of the world. Many people carry their mobile phones all time and spend a lot of time on talking to someone using their mobile phones. Currently, the penetration of mobile subscribers in Hong Kong is over 150% which means that there are more mobile subscribers than the whole population. In view of these, few years ago, Cheung conceptualized the idea to design an interactive mobile learning tool so that mobile subscribers could use their mobile phones very conveniently to improve their learning in various subject areas such as Mathematics, Chinese or English, etc. anywhere and at anytime. The mobile learning tool must be interesting to students and could be used very conveniently by mobile subscribers who may be school or university students to improve their learning. As a result, a project was proposed to design and implement a simple wireless interactive tool or "game" for use in mobile devices. Since students normally find it boring in the learning process, one of the important objectives of the project was to help students learn through playing games. Then a project called **Wisdom** was successfully developed by an undergraduate supervised by Cheung (Ko, 2007). The technology used was simple and just a web-based system based on using the 2G/2.5G/3G networks

With the introduction of eduroam (EDUcation ROAMing) (EDUROM website, 2008) researchers, teachers, students, staff from different institutions over the world can easily and securely access the Internet from any eduroam-enabled institution. Then in Hong Kong, the Government has proposed a WiFi Programme to implement hundreds of hotspots for free and convenient WiFi access to the public, making headways toward becoming a ubiquitous society. Currently, hundreds of hotspots have been set up all over the Hong Kong for the programme. Y5ZONE is a company providing Broadband Wireless (WiFi) connectivity in Hong Kong (Y5ZONE website, 2008). It has over 2000 hotspots serving wide range of users, including mobile



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workers, students, professionals and roam-in business travellers. WiFi users can stay connected in popular shopping malls, restaurant outlets or fast food chains. In collaboration with The University of Hong Kong, Y5ZONE has agreed to provide free WiFi service to the university staff and students at their WiFi hotspots throughout Hong Kong. So university students and staff can have free WiFi service with any WiFi enabled devices at Y5ZONE WiFi hotspots. In return, Y5ZONE WiFi customers will have free WiFi service at the University of Hong Kong. PCCW is also a WiFi access provider in Hong Kong and has built more than 3,000 WiFi hotspots throughout Hong Kong, including entertainment and leisure stores, coffee shops, fast food chains, the airport, restaurants, shopping malls and MTR stations (PCCW website, 2008). In collaboration with The University of Hong Kong, PCCW has also agreed to provide WiFi access to the university staff and students at their WiFi hotspots. All these are providing a very good background for wireless applications. With all these WiFi infrastructures being made in placed, students in Hong Kong basically will have free access to the internet anywhere via WiFi hotspots using their WiFi-enabled devices. As a result, following the concept and design of the interactive m-learning game "wisdom", an "Interactive Wireless Mobile Learning System" is developed to facilitate large class-room teaching and assessment.

The rest of this paper is organized as follows. The problems of large class-room teaching and advantages of using m-learning in large class-room teaching are discussed in section 2. The challenges of designing m-learning tools for handsets are described in section 3. The system descriptions and architectures of the interactive m-learning game, Wisdom, are described in section 4. The system descriptions and architectures, together with the useful features for large class-room teaching, of the interactive m-learning tool, are given in section 5. Section 6 is Conclusions.

## 2 ADVANTAGES OF PROPOSED m-LEARNING TOOL IN LARGE CLASSES

In the old days, lectures and tutorials were given to only small classes of students and there was strong interaction between teachers and students. Nowadays, we have large lecture theatres which can accommodate hundreds of students. In teaching or lecturing such large classes, there is always a lack of student exchange, interaction and feedback. Studies have shown that the failures of the first year students in Electrical Engineering were linked to an almost complete absence of feedback on progress during the first term of study (Entwistle, 1989). However, it is not easy for teachers to know how much the students have learned and what the students' level of understanding are during large-class teaching. Is the teaching pace too slow or too fast? Are the materials too difficult for the students to understand? How much of the materials that the students have understood? Do the students feel easy about the lectures, etc? To find out the answers for all these questions, the teachers will have to ask students some quiz questions related to the materials taught in the class and analyse the answers from the students. In Hong Kong (probably in some other countries as well), students somehow tend to be a little bit shy and are afraid of being looked stupid or ignorant. They are reluctant to answer questions to the teachers directly in a large class. Thus asking students quiz questions in a class may not always work. Another possible method to assess the students learning performance during large class teaching is to spend some of the teaching time to perform a written test/quiz. The problem with this method is that it will unavoidably distract the teachers' concentration and students' attention. Moreover, after the written test/quiz, the teachers will have to devote a lot of time to mark and analyse the answers. In a large class, this will create much more workload for the already extremely busy teachers. The results obtained are not interactive. The teachers know the results after marking the test/quiz and analysing the results, so they can only take appropriate actions such as repeating the chapters or topics in the next class which may be a week, a month or even longer later. When repeating, the teachers will also have to spend some time to refresh the students' minds on these chapters and topics, significantly slowing down the teaching progress.

The m-learning tool proposed here can help teachers to perform simple tests/quizzes during large class-room teaching and assess the students' performances immediately after the tests/quizzes in a convenient way. Thus teachers can use the tool to closely monitor the learning progress of the students in the class, indentify any possible problems encountered if occur, and take appropriate actions needed. For example, if it is found that some topics or concepts, etc, which are misunderstood by many students in the class, the teacher can give further detailed explanations on them immediately to make

sure that the students understand them thoroughly. The standards of admitted students in different departments of universities vary from year to year, e.g. the standards of students admitted to do engineering in universities nowadays are not as good as those ten years ago. Teachers need to know their standards as soon as possible in order to adjust their teaching pace to adapt to the students' standards. The proposed m-learning tool will be very useful for this.

# 3 CHALLENGES IN DESIGN

Mobile handsets are usually small in sizes. For the reason of easy carrying, they are getting even smaller. As a result, small screen sizes are always the major challenge in designing applications for mobile handsets. How can we fit all the materials onto the small screens of the mobile handsets? The resolution of the mobile handset screens has no standard. How can we display the same image file on screens with different resolutions without getting distortion of the image? The keypad of a mobile handset has very limited number of keys, so inputting text is not an easy task. How can we simplify this process? It is nice to have visual richness, colours, animation and sound effects etc. to arise interests of the learners, but all these requires powerful CPU to run. Moreover, the large file sizes for these features take up too much bandwidth and too long to send to the mobile devices. How can we reduce the file sizes? Having considered these questions in details, we found that the answer to all these questions was to use questions in text and in the form of simple multiple choices.

To design the m-learning game "wisdom", we had considered using the following technologies: Multimedia Messaging System (MMS), Short Messaging System (SMS). Extensible HyperText Markup Languague (XHTML), Wireless Application Protocol (WAP), Java 2 Platfotm, Mobile Edition (J2ME), JavaScript and Flash. Finally, we decided to use J2ME to design the software for the mobile devices because it is the most common language currently used in mobile phones and also there are many free simulation tools available for developing applications using J2ME. Unfortunately, although J2ME is a standard, it is well known that the software developed using J2ME does not guarantee it can be operated in all devices supporting J2ME. In fact, with our experience, we can say that it is highly probable that it will not.

# 4 A INTERACTIVE m-LEARNING GAME - WISDOM

## 4.1 System Description

Wisdom is an interactive m-learning game which can accommodate a large number of interactive students via the 2G/2.5G/3G mobile networks. In wisdom, learning is performed in a form of game so that student will find it more interesting to learn. To play the game, students are required to pre-register with the game and have their mobile devices such as mobile phones or PDAs, etc. loaded with a client interface program written in J2ME. Students use their mobile devices to login the game, as shown in Fig. 1a, via the 2G/2.5G/3G mobile network in order to enter and play the game. A number of quiz questions in the form of multiple choices in different subjects such as Mathematics, English, etc., are prepared for the game and stored in a database of the server. In playing the game, all students will receive a set of about 30 questions, as shown in Fig. 1b, in text one after the other, each having 4 possible answers as multiple choices. Students have to select the correct answers from these choices within a limited period of time, say, 30 secs. If they select the correct answer, they stay on; otherwise they lose and are gone. The one who correctly and continuously answer the most quizzes is the winner. Since students can access the game via the internet in anywhere and at anytime, it is possible that they can be competing against tens or hundreds of students simultaneously over the world. This makes the game much more interesting and exciting than the traditional mobile quiz games.


Figure 1: a) login screen b) question screen.

To make the game even more interesting, before answering each question, each student is given 3 options to choose: Option 1) "Skipping", i.e. if the student is not sure about all the answers, he/she can

select this option to skip the question; Option 2) "50:50", i.e. if the student is not sure about the some of answers given, by selection this option, two incorrect answers (50%) out of the 4 given are removed so the student has a better chance to answer the quiz correctly; and Option 3) "Prolonging the Time Limit" which doubles the time limit to 60 sec. so that the student can have more time to answer the current question. All students will only have a limited number, say 5 times out of 30 questions, of having this option. At the end of each question, the correct answer will be displayed on their mobile devices, thus they can learn from this.

### 4.2 System Architecture

The wisdom system consists of the following components:

a) a game web server;
b) a number of mobile phones installed with a J2ME client interface program; and
c) an administration console.

The system architecture of wisdom is shown Fig. 2. Students use their mobile handsets installed with a client interface program to access the game server via a 2G/2.5G/3G mobile network.

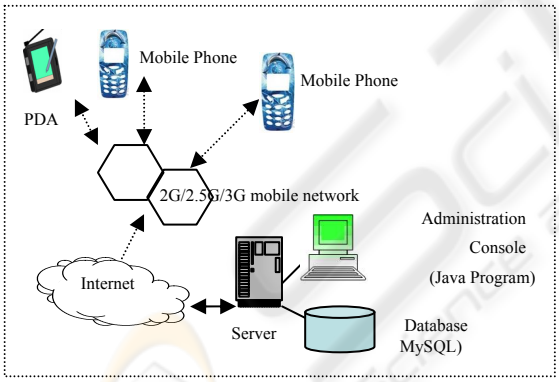


Figure 2: System architecture of Wisdom.

At the beginning of the game, the server waits until all clients have logged and then prompts all the clients with a question in the form of multiple choices. When the answers from all students are received, the server checks the returned answers against the correct ones stored in the data and sends the correct answer to the clients. The students with wrong answers will be stopped from playing the game further. When there is only one left in the game, it is the winner.

## 5 INTERACTIVE m-LEARNING TOOL

### 5.1 System Description

To facilitate interactive large class-room learning and assessment, the interactive m-learning game, wisdom, was modified to an interactive m-learning tool. The design of Wisdom was based on the 2G/2.5G/3G mobile networks which cost money to use. This will deter students from using it. Thus the interactive m-learning tool for large class-room teaching is designed for use in different wireless networks. Students still can login the system using their 2G/2.5G/3G mobile phones via the mobile networks. In addition, students can also login the system using WiFi-devices such as WiFi-enabled mobile phones, laptops, PSP or PDAs etc. via any access points inside and outside the campus.

### 5.2 Useful Features for Large Class-room Teaching

#### 5.2.1 Pre-registration

To use the m-learning tool for large class-room teaching, the students enrolled for the course are required to pre-register with the m-learning system. The name lists with passwords of the pre-registered students are stored in an excel file and then stored in the database of the system. The students are given the usernames and passwords in order to login the system. This prevents un-registered students to enter the system.

#### 5.2.2 Monitoring Attendance

In many universities such as the University of Hong Kong, students' attendance to classes is not compulsory. However, our experiences have shown that students with more than 75% attendance to classes normally perform much better than those with less than 25% attendance in the examinations. In small classes, it is easy for teachers to know who are absent from the classes, so students tend to make efforts to attend the classes. However, in large classes, it is very difficult for teachers to know who are present in or absent from the classes without taking attendances. As a result, some students tend to escape from large classes. Of course, teachers can always encourage students to attend classes by taking attendance in each class, but for large classes, taking attendance will take up some of the teaching time and also distract the teachers' concentration and

students' attention. When using this m-learning tool, students have to register with the system at the beginning of the class, so attendance with time-stamp is taken by the system automatically.

### 5.2.3 Easy Input of Prepared Questions and Answers

Teachers can prepare the test/quiz questions in the form of multiple choices beforehand and store them with the corresponding answers in different columns of an excel file which is used as the input file to the m-learning system. Different sets of test/quiz questions can easily be inputted to the corresponding excel files and stored in the database server implemented using an Apple Computer.

### 5.2.4 Automatic Marking

Since the system stores the answers as well as the questions in the database, during the test, after receiving the answers from students, it can check the answers and hence marks them. If a written test/quiz were used in large classes, the teachers would have needed to spend a lot of time to mark them. However, the proposed m-learning tool can provide the marks of individual students immediately after each question or test. In addition, it can also compute the distributions of answers for each question and display them on the computer screen for the teachers to analyse.

### 5.2.5 Monitoring Students' Progress in Large Classes

The forms of tests and quizzes can also be set in different forms and levels to serve different purposes. For example, teachers can prepare a whole set of questions and use it as a formal test. A time limit can be set to allow the students to complete the test. For tests/quizzes given to large classes and held in lecture halls, it is very difficult to prevent students from copying answers from their neighbors. The m-learning tool can be used to send the same set of questions to students in a random manner, stopping them from copying answers from neighbors. At the end of the test, the teacher can assess the students' learning performances through the scores obtained for individual students immediately.

Teachers can use regular tests/quizzes to monitor the students' performances through out the year and decide if the teaching pace is too slow or too fast.

### 5.2.6 Closely Monitoring of Students in Large Classes

Feedback on students' progress is an important factor for quality teaching (Entwistle. 1989). Small-class students tend to be satisfied with the feedback they received (Søndergaard. 2004). For large classes, students' satisfaction tends to fall.

In using the m-learning tool, question can be set to closely monitor the progress of students during teaching, e.g., to test if the students have understood the concepts of certain principles just taught, then a few easy and short questions could be enough. The questions can be presented to students one after the other and step by step in a logical way. When the answers are received back from all students (which can be checked by the system), the teacher can check the distribution of answers for each question and hence decide whether more detailed explanations or additional lectures are required for a particular topic of the course.

A user-friendly interface program has been developed for teachers to retrieve individual scores from the database and hence to check the performances of individual students during teaching.

### 5.2.7 Engaging Students

Student engagement is a big challenge for quality teaching in large classes. When teaching large classes, it is not easy to generate in-class interaction with the students. The m-learning tool proposed here can be used to design different methods to get the students interact with the teaching materials. For example, quizzes can be set in a form of competition. Students who score the highest marks at the end of the class can win prizes. Their names can be displayed in the course website pages. Their scores can be accumulated until the end of the year and contribute to the final marks of the course.

## 5.3 System Architecture

Figure 3 shows that system architecture which consists of the following components:

a) the Mobile learning platform server;
b) Administration Console Portal (a web portal); and
c) A number of WiFi Access points.
d) A display program to display the percentage of correct answer for each questions and marks scored by each student.

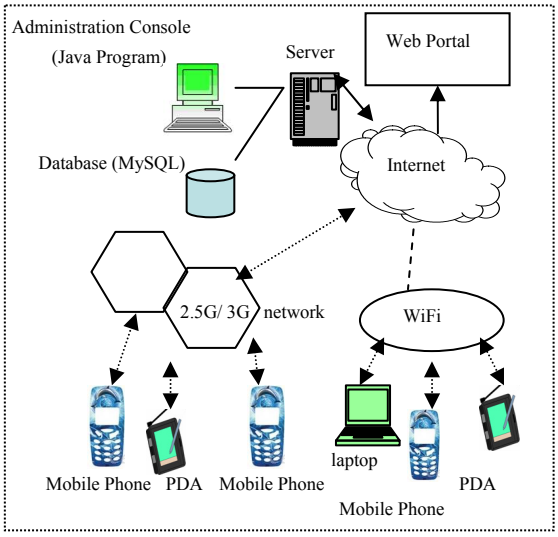


Figure 3: System architecture of Interactive Mobile Learning system.

Students use their mobile devices installed with an interface program, their usernames and passwords to access the system server via any WiFi access point in the campus or theoretically any mobile networks (which should be seldom used due to the high cost). For security reasons, the MAC addresses of the WiFi-enabled devices are also needed to register in order to gain access to the WiFi access points in the campus.

To promote m-learning and celebrate the Beijing 2008 Olympics and also, at the same time, assess the effects of the proposed m-learning tool, an Inter-school Mobile Quiz Contest was organised in July 2008. We modified the Interactive Mobile Learning Tool to be used in this contest which was held in The University of Hong Kong. There were more than 200 students and teachers from 17 secondary and primary schools participating in the contest. They were all seating in the same hall of about 250 seats.

The contest was divided into three quiz question sessions, with each having a specific theme. They were about the general knowledge on the Olympic Games, the Equestrian and The University of Hong Kong. Each school could nominate 4-6 students as the contestants to participate in each question session. These students were all pre-registered with the m-learning system. In each question session, there were about 25-30 quiz questions in the form of multiple choices and the contestants (students) were given 5-10 mins to complete all the answers. The quiz questions could be purely texts, with or without pictures. The contestant who could answer most questions was the Champion of the session.

Although the m-learning tool could support different kinds of wireless devices such as PDA, mobile handsets, PSP, etc. The contestants were all given the same type of WiFi-enabled device, a Sony PSP, to use in the contest, thus the contestants could not complaint that their different wireless devices affected their performances. To reduce the delays of sending the questions to the contestants due to congestion, three different access points with different operating frequencies were setup in the hall for the contestants to access the m-learning system.

During the quiz session, the scores for each of the contestants were displayed on a big screen in real time so that their supporters could see. This made the contest a very exciting event. We could see students stand up, shouting and screaming to support their school-mates who were playing the game.

At the end of the contest, students found the game very interesting and exciting to play. Teachers said the system would be a very useful tool to monitor the learning progress of the students during teaching.

## 6 CONCLUSIONS

In this paper, we have presented the design of an m-learning tool for large class-room teaching and assessment. The tool has different features targeted at large class-room teaching. The system has been used in an Inter-school Mobile Quiz Contest for more 200 students and teachers from 17 secondary and primary schools. Very good comments have been given by the students and teachers.

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