

Open Source Implementation of M-Learning for Primary School in Malaysia

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Abstract—With the proliferation of the mobile device technologies, mobile learning can be used to complement and improve traditional learning problems. Both students and teachers need a proper and handy system to monitor and keep track the performance of the students. This paper presents an implementation of M-learning for primary school in Malaysia by using an open source technology. It focuses on learning mathematics using handheld devices for primary schools' students aged 11 and 12 years old. Main users for this system include students, teachers and the administrator. This application suggests a new mobile learning environment with mobile graph for tracking the students' progress and performance. The purpose of this system is not to replace traditional classroom but to complement the learning process. In a testing conducted, students who used this system performed better in their examination.

Keywords—M-Learning, Automated Mobile Graph.

I. INTRODUCTION

EDUCATION is the instruction or teaching that one receives or gains. It involves activities through which knowledge is imparted, usually at schools, colleges or universities. Educators are discovering that computers and multi-based educational tools are facilitating learning and enhancing social interaction. With the use of mobile devices such as smart phones and PDAs (Personal Digital Assistant) to facilitate learning processes, the new trend of learning process has changed from electronic learning (E-learning) to mobile learning (M-learning) [1]. M-learning is becoming popular with the development of its content using the Open Source technology.

Open Source is a program in which the source code is available for general public to use or modify from its original design with free of charge such as PHP and MySQL. The development cost using the Open Source technologies being reduced with its policy. With this technology advancement, the government of Malaysia has taken step forward in promoting the use of Open Source technologies in any content development.

The government of Malaysia, under the Multimedia Super Corridor (MSC), has included the establishment of smart schools as one of its seven flagship applications. Those seven flagship applications were meant to accelerate the realization

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of Vision 2020. The establishment of smart schools includes the use of advance learning process such as the implementation of M-learning in the schools to complement the traditional based learning environment. Mathematics for Malaysian primary school students is the best subject to be implemented in M-learning since it is one of the core subjects to be mastered by the students aged 11 to 12 years old, who is preparing to sit for the *Ujian Pencapaian Sekolah Rendah* (UPSR) examination.

This paper presents the implementation of M-Learning for primary school in Malaysia. The module developed focuses on learning mathematics module through mobile devices such as PDA or mobile phone. The module includes learning mathematic for standard 5 and 6 of primary school, quizzes, tests and performance tracking with automated graph. The developed application allows the quizzes that were posted by teacher to be attempted online trough a student's mobile device. While attempting the mobile quiz, both student and teacher are able to monitor the progress and performance of the student regularly.

II. RELATED WORK

Several researches have been conducted on m-learning environment that includes m-learning model [2], design requirement [3], architecture [4] and current trend [5]. Some applications in the market allow users to manage online quizzes and monitor the progress of the student online, such as Alykko developed by Silander and Rytkonen [6]. It is an intelligent mobile tutoring tool for teacher that enables interaction and tutoring dialogue via mobile devices like mobile phones and PDAs. The tool contains semiautomatic and automatic guidance for learners' learning process, enabling automatic individualization of a learning process.

Alykko also contains ready-made-tutoring expressions and a documented tutoring dialogue for teacher's use, in order to reduce the teacher's cognitive load, needed just for memorizing. The tool was created based on the examination of the teacher's pedagogical needs. The development of this system is based on AEFIRIP pedagogical model for M-learning. This tool is to help teachers manage the tutoring activities via web and mobile technologies. It also enables communications between teachers and learners via either the system on personal computers or mobile devices. The technologies used are mainly open source technologies which are PHP, MySQL database, agent modules and SMS gateway.

SMS is used for communication between the learners and the teachers.

A project on M-Learning where it emphasizes on using PDA usage to collaborate on mobile learning tasks has been discussed by Black and Hawkers [7]. This system uses the client server approach for wireless communication where it is also designed to take advantage of mobility, where the students can be in different areas of the classroom or even in different locales altogether and still participate in collaborating mobile learning activities. This project was done to prove the importance of integration between collaboration learning, reading comprehension and Question-Answer relationship in M-learning implementation. The technologies used for this project are divided into two sides; the server side and the client side.

The database and Java Servlets are used at the server side, while Java 2 Micro Edition (J2ME) technology is used at the client side. Client side refers to the end devices used which maybe mobile phones, PDA's and other mobile devices. Upon completion, the application was packaged into a JAR file that can be ported to and executed on the target device. The application environment was hosted by the PocketPC OS, which is Microsoft Windows for Mobiles where HP iPAQ PDA was selected for this project purpose. On the server part, it uses Linux network where all of the servlets were constructed in Java that enabling the environment to be easily ported to a variety of platforms and devices. The J2ME networking API and the Java networking API then were used to enable the communication between the mobile devices and the servers.

III. SYSTEM DESIGN

The architecture of m-learning application is adopted from the Alykko project developed by Silander and Ryttonen [6]. It uses WAP gateway to enable communication with the users which are student, teacher and administrator. The system was designed and developed for two learning environments which are web browser on personal computers and micro browser on mobile devices. Fig. 1 shows the flowchart of the proposed mobile application. From the main menu, there are 4 options for the end user to choose i.e announcement, progress tracking, contact details and attempt quizzes. Before a student take a quiz, the user has to login in order to load a user profile, capture activities and record the student's progress in the database.

The computer application is different from mobile application where the users have to login on the main page in order to differentiate the level of access privileged. After a user successfully login, the application gathers the necessary information about the user in order to append the appropriate content to its access role or layer. Once login success, the users are able to proceed with the provided functionality. The access of a student to the computer application is similar with access on mobile application. Teachers are able to set questions for quizzes and test, analyze the student performance

in student list and graph view and post an announcement. The administrator has a full privilege to control the system and user of the system.

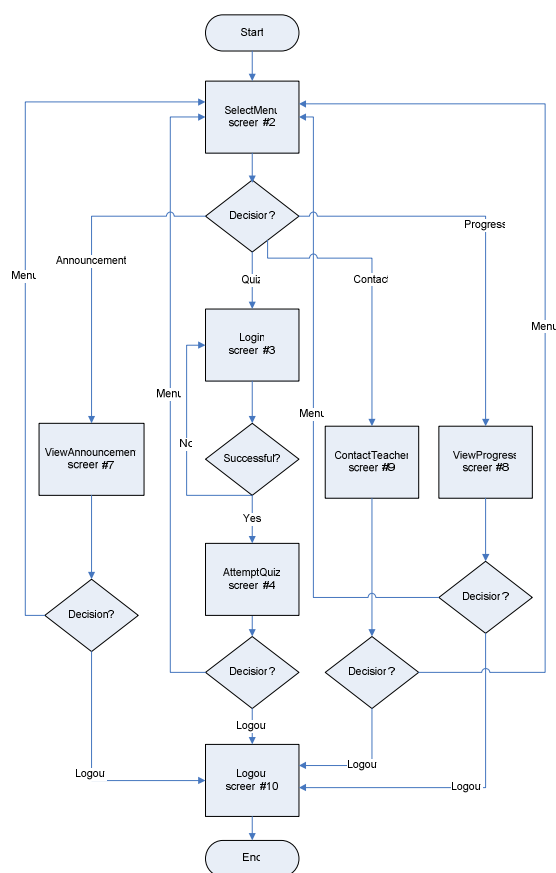


Fig. 1 Flowchart of proposed M-Learning Application

IV. SYSTEM IMPLEMENTATION

The development process was done modularly phase by phase. It was developed by adopting server side scripting concept using XHTML, WML, PHP and MySQL.

A. URL Dialing Function

The URL Dialing function allows the students to contact their teachers while on the Web was done by the implementation of URL dialing. The whole module which enables the students to call his or her teachers is written in PHP and WML. Fig 2 shows the portion of the URL dialing function that was implemented in the application.

```

echo "<p mode=\"wrap\"". $1f;
echo "$line[teacher_name]<br />". $1f;
//allows the user to quickly dial on devices that
support URL dialing
Echo "<a href=\"wtai://wp/mc;$line[teacher_contact]\"
title=\"Dial\">";
echo "$line[teacher_contact]</a><br />". $1f;
echo " " <a href=\"home.php\"
title=\"Menu\">";
echo "[Home Menu]</a><br /><br />". $1f;
    
```

Fig. 2 URL Dialing Function

B. Session Handler

One of the most important aspects in the system functionality is the use of the session function to control users' browsing activities. The use of session enables the author to make the system more dynamic such as to enable the system to generate a graph automatically. Example of the session usage in this system is shown in Fig 3. The code segment is inserted in every page with the use of 'header' function:

```
<?php session_start(); ?>
<?php
    print '<small><p>Welcome to Mobile Math System , ' .
ucfirst($_SESSION['username']) . '!' . ' You have been
logged in since: ' . date('g:i a',
$_SESSION['loggedin']) . ' (<a
href="logout1.php">Logout</a></p></small>'; ?>
```

Fig. 3 Session Handler Scripts

C. Graph Generation

JpGraph module is used to implement the graph generating functionality. It is an object oriented open source library for generating graphs. GD1 and GD2 library are both supported by JpGraph. The portion of the code for generating the graph is as shown in Fig. 4.

```
<?php
$db = mysql_connect("localhost", "root","") or
die(mysql_error());
mysql_select_db("math",$db) or die(mysql_error());

//SQL statement to retrieve data from the database
$sql = mysql_query("SELECT test_title, test_result
FROM test WHERE test_id= '$_POST[test_id]' ORDER BY
test_title ASC" ) or die(mysql_error());

while($row = mysql_fetch_array($sql))
{
    $data[] = $row[1];
    $leg[] = $row[0];
}

// Variable initiation
$graph = new Graph(780,370,"auto");
$graph->title->Set($title);
$graph->SetScale("textint");
$graph->img->SetMargin(30,30,90,30);
$graph->AdjBackgroundImage(0.9); //setting BG type
$graph-
>SetBackgroundImage("linux_pez.png",BGIMG_FILFRAME);
//adding image
$graph->SetShadow();

$graph->xaxis->SetTickLabels($leg);

$bplot = new BarPlot($data);
$bplot->SetFillColor("darkolivegreen"); // Fill color
$bplot->value->Show();
$bplot->value->SetFont(FF_ARIAL,FS_BOLD);
$bplot->value->SetAngle(90);
$bplot->value->SetColor("black","navy");

//$graph->title->Set($title2);
$graph->Add($bplot);
$graph->Stroke();
?>
<?php
?>
```

Fig. 4 Graph Generation

V. THE APPLICATION

Mobile Math is a web application designed to run on both mobile device and personal computer. The application is designed to suit the learning environment to overcome the limitation of students owned a mobile device and focuses on the users experience and interaction. Unlike traditional design where the goal is to make the object or application physically attractive, the goal of user interface design in this system is to make the user's interaction experience as simple and intuitive as possible to enhance the display of the application. Besides, it helps non-technical skill people to use the application by simplifying the function in the application.

Fig. 5 shows the Mobile Math application on the main page, menu and login while attempting quiz for a student module. The students' login will differentiate the profile load in doing quizzes and progress tracking. Once login success, the users are able to proceed with the intended quiz.



Fig. 5 Teachers view for quiz setting

Fig. 6 shows the application interface for a teacher to post and configure the quizzes and tests. Teachers are allowed to create varieties of quiz and test questions that can be categories according to the topics and difficulty levels. It is important for a teacher to set the availability of these exercises, so the students are able to view and attempt the exercises when the setting is open or viewable. The system has the capabilities to randomize questions display to the user to avoid student cheat while doing these exercises as shows in Fig. 7 (a). The students are not restricted to question sequence and may choose the question to answer as shows in Fig. 7 (b). The result then will be displayed after the students have completed the exercises as shown in Fig. 7 (c).

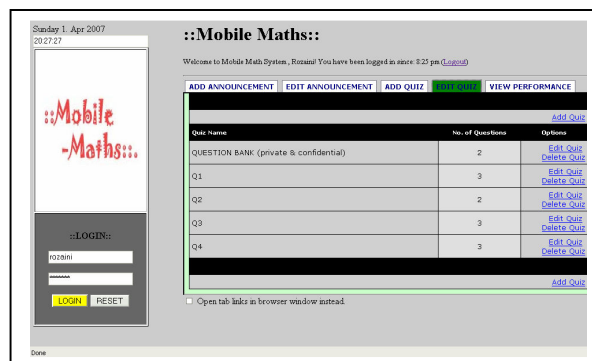


Fig. 6 Teachers view for quiz setting

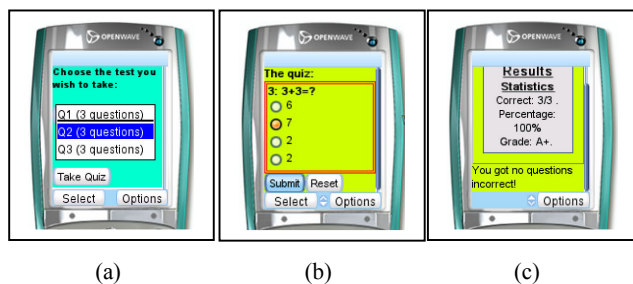


Fig. 7 Student attempt quizzes page

The application provides progress tracking function that allows users to view the progress and performance of a student from time to time. It is an automatic mobile graph that displays the achievement of the student in doing quizzes and it has been personalized for each student in the mobile application through login function. Fig. 8 (a) shows the student's view of progress tracking on a mobile device. On other hand, running on a web browser, teachers can view and get the updated performance of their students into two types, graph analysis as shows in Fig. 8 (b) and student list as shown in Fig. 8 (c).

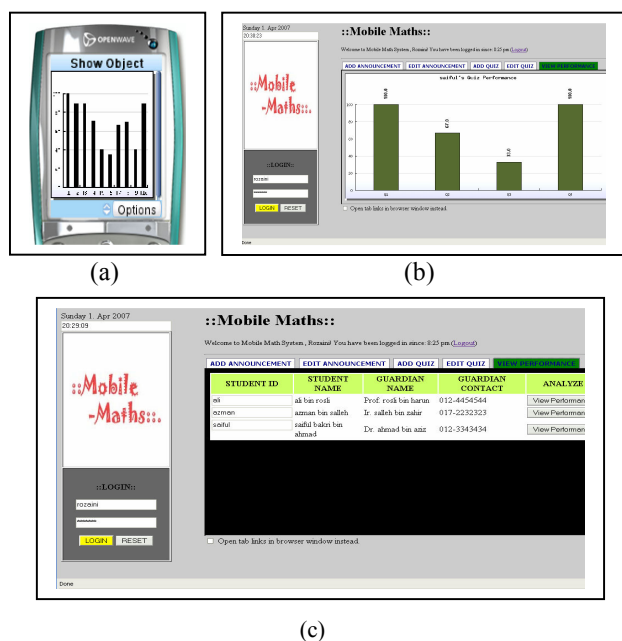


Fig. 8 Progress tracking

The other functions of the Mobile Math application are announcement and contact. The announcement function allows teacher to post any news or update about the course. Fig. 9 shows the teacher view on this function. The student could view the announcement via mobile and web browser. Fig. 10 (a) shows the announcement view via mobile application. The display will show the announcement according to the latest news on top of the list. Contact module view is shown in Fig. 10 (b). At any time the student who are having problem could view the contact information and directly call their teacher through the system by clicking on the dialing button.

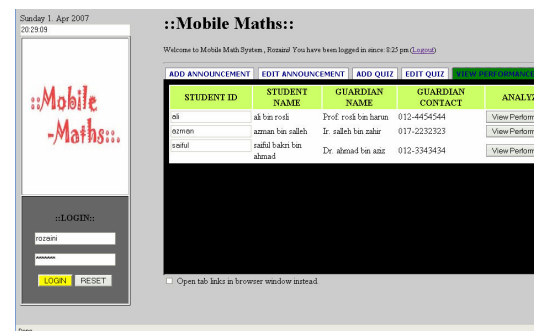


Fig. 9 Teacher's view on Posting Announcement

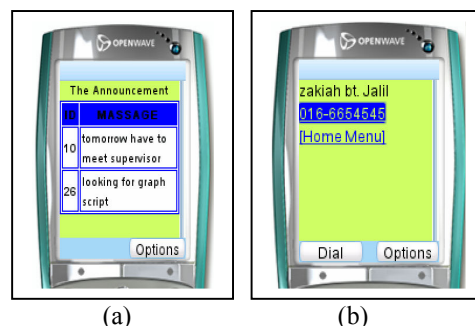


Fig. 10 Announcement and contact page

VI. SYSTEM TESTING

It was divided into two parts, which are developer testing and user testing. The testing comes with the intent to ensure that the system meets identified requirements stated in the early stage.

A. Developer Testing

The data entered by the user is stored in MySQL database. Since the transactions involve a lot of the database interactions, so it is crucial to test the performance of the database used. A group of 100 to 1000 records were inserted to measure the reliability of the developed MySQL database. Beside, the testing also involves syntax, functionality and logical errors. No major problem found in this testing.

B. User Testing

This testing is done after the development of the software is completed. The users were given training on how to use the application and interact with the application. The users' comments pertaining to the application such as errors related to the software interface, functionality errors, command structure and entry errors were recorded. It was done to the selected target users which are 20 primary school students aged 12 years old. This group of selected users was preparing for their UPSR examinations at the end of the year. The users were selected randomly from a class without considering their level of skills in the subject of Mathematics. This testing was done to compare the effectiveness of learning Mathematics for primary schools students using this application.

The procedure taken in conducting the user testing as below:

- The users were divided into two groups namely mobileM and traditionalM. The mobileM were trained to use the M-learning system to attempt the mathematics quizzes using a mobile device. While the traditionalM were not being introduced to the m-learning and the application specifically and the users were grouped to attempt the quizzes by paper based.
- The selected users were taught three new chapters in the subject of Mathematics and the questions for this quiz were selected from these chapters.
- mobileM group then attempting the quizzes using the M-learning system while the traditionalM users attempted the quizzes on paper. There were 20 objective questions given to the students.
- A set of multiple choice written test was conducted after 2 weeks time given to the users in attempting the quizzes. The number and percentage of their achievement in the test were captured for analysis.
- A set of questionnaire were given to the users to obtain information about their satisfactions and performances toward learning mathematics after the user completed the exercises. The users' comments on Mobile Math were recorded.

VII. RESULTS AND DISCUSSION

Table I shows the result of the user testing. The rating is from 1 to 5. Rating 1 signifies the lowest users' satisfaction or performance and 5 signifies the highest users' satisfaction or performance. The mean for the first criteria, satisfaction is 4.13 for mobileM and 3.30 for traditionalM. Users' excitement for the first time using such mobile learning technology may lead to the higher rating for mobileM as compare to traditionalM. For the second criteria, performance, the mean value for mobileM is 3.25 and for traditionalM is 2.50. It shows a coherent finding that the participants were agreed with the satisfaction and achievement towards Mobile Math application that contribute to m-learning environment.

TABLE I
 OUTCOME OF USER TESTING

Criteria	Mean	
	traditionalM	mobileM
Satisfaction	3.30	4.13
Performance	2.50	3.25
Average	2.90	3.69

The developed Mobile Math could be enhanced in the future in order to add its capability to be the preferred learning environment for primary schools. More research on rendering mathematical symbols and displaying information on small screen mobile devices should be done. This will definitely support more advance topics which involve complex equations to be able to run on M-learning successfully. Besides that, teleconferencing could be implemented to enhance the interaction between the students and teachers, and also among the students themselves.

VIII. CONCLUSION

The development of this m-learning application using an open source technology contributes and improves the education environments from the perspective of Malaysian schools. It provides a mobile learning environment with monitoring and tracking of student performances at very minimal cost of implementation. The conducted user testing has shown a significant improvement in terms of student satisfaction and performance for mobile learning environment compared to traditional approach. Mobile learning shares the advantage of the mobility of the device itself that gives value and freedom to be accessed at anytime and anywhere.

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