THE DESIGN AND DEVELOPMENT OF MATHEMATICS ONLINE SYSTEM (MOST) FOR SECONDARY SCHOOL: A SCENARIO IN MALAYSIA

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Abstract

Various technologies are emerging everyday focusing on enhancing the users experience on the Internet. These technologies can be exploited in the effort to further improve the implementation of ICT in the educational system in Malaysia to encourage a better learning process via the Internet. Online systems take the existing online learning websites one step further. This paper reports on a research project on the design and development of MOST (Mathematics Online System), using the approach of support system rather than a teaching module for the secondary school students in Malaysia. MOST uses the Internet and computer as a means of dissemination. It is an alternative tool to learning mathematics topics for Form 4 and Form 5 in an interactive multimedia environment and acts as a study companion for students. It is made up of 5 modules: User Profiles module, Topics Help module, Questions Bank module, Fun and Games module and Quick References module. The tool’s most important feature is the ability to track students’ progress which enhanced the existing online learning website and is placed in the User Profiles module. There is also administrator account feature to allow future maintenance and addition to the content of the system in order to keep track with the changes by the educational system. The objective of this project is to develop a viable system that focus on usability and accessibility based on the framework in the analysis stage.

Keywords: Online system, mathematics, secondary school, ICT, design

1.0 Introduction

With the evolving technologies of the computers and Internet, the online learning trend began to emerge be it in the industrial or the educational area. One of the most apparent advantage of online learning to traditional method is that education can be delivered where and when is demanded. What was time and place bounded instruction, is now free, exploratory and self paced constructive approach. However, without a considerable amount of careful planning during the transition of the traditional teaching to the online-based learning website, the primary goal might not be achievable and that is quite simply to enrich one’s knowledge.

This paper is about the design and development for the mathematics online system (MOST) for secondary school. It is a continuation to a previous paper which provides the explanation of the analysis stage. During that stage, a framework has been formulated. This framework is used as a mapping guideline in the design process of MOST. From there, modules for MOST are identified. This paper will narrated the process of turning the framework into a viable system through the design and developing phase. It will focus on usability and accessibility of MOST as an online learning support.

1.1 Significant of study

This study will provide valuable information to improve the usage of Internet among students to enhance their knowledge, and as a start, in mathematics subject. The Internet has been used to assist the educational system for some years but students and teachers are yet to use them at its fullest capability. This study will investigate the scenario behind this situation and use the findings to formulate a framework and later develop MOST based on it.

At the end of this study, the students will have an online learning system that act as a support to their learning. Teachers will also benefit from MOST by providing them with more time in class for other social activities since the revision can be done by the students themselves with their own pace.
ICT in education is not a new issue. The study and development of MOST help to strengthen the position of ICT in the society by increasing the Internet usage towards educational pursuit by the students.

1.2 Description of Study

The purpose of this study is to investigate and create a suggested solution to the problems that resulted in low to moderate percentage of satisfaction in the usage of Internet and online system for educational pursuit among teachers and students. Feedback is gained from an interview with 200 Form 4 and Form 5 students from three schools in Muar, Johor. These students will be taking the Malaysian Certificate of Education at the end of their Form 5 year.

In the analysis stage, the information and findings from the study are gathered and analyze. The results are concluded in forms of a framework which will be using as the guideline in the design process.

1.3 Justification of Mathematics as the Chosen Subject

Mathematics has been chosen as the subject for the system based on the following reasons. It is one of the compulsory subjects that the upper secondary school students required to take where they will be tested at the end of their Form 5 year in Malaysian Certificate of Education (SPM). By choosing a subject from one of the compulsory category, that would means that it can benefits up to that large number of participation which is larger compared to any elective subjects such as Physics and Biology. According to Lampert [1], many students appear to hold a lot of naivety and incorrect beliefs about mathematics. This kind of phobia is called ‘Mathematics Anxiety’ or ‘Math Anxiety’ which can be define as an “irrational dread of mathematics that interferes with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations” [2].

Furthermore, mathematics anxiety is said to be connected with test anxiety which may be driven by cognitive concerns about performance and emotional reactions to stress [3]. Test anxiety can be caused by other factors like poor test preparations and test-taking strategies, psychological pressures, and poor health habits. Whatever the reasons may be, they will only heighten the justification of choosing mathematics for this project. By having a learning support such as the online system, students can prepare themselves for tests and reduce their test anxiety level. It would then upped their confidence level when they achieve good results and later further reduce their mathematics anxiety level along the way.

2.0 MOST System Framework

Figure 1 shows MOST system framework. In this framework, students’ activities with the online learning can be divided into three different categories which are help with homework, revision and as recreational activities. Results from the analysis shows that students do not use the Internet for educational purpose only, but also for some entertainment. As much as this might sounds like a wasting time, they might do so as part of recreational activities.

From MOST’s side, it provides feedback in forms of immediate response, tracking progress record and updated student’s profile at each visit. Every time they take tests or examination within the system, their results will be recorded and it will be added to their progress chart when they logged-in to MOST in their next visit. Each individual student’s profile will show the average grade of the student’s overall performance in the system so far. This is only to encourage them further without any peer pressure present.

MOST will be made in the online environment to allow a greater number of people to use it simultaneously. Whatever changes or addition by administrator will affect the whole system immediately. Offline materials take a long time to distribute and are quite costly. With online environment students need only to have a computer with an Internet connection to experience it.

In the design and development process that follows, the framework explained here will be use as the guidelines. All activities from the user and feedback types from the system will be integrated during these processes.
3.0 Design Process

The purpose of this process is to draw up a clear explanation on the design details. This process aims to address the system flowchart, navigational structure, system development tools and system architecture.

3.1 System Flowchart

Figure 2 below shows the system flowchart for MOST. It provides with a roadmap of events that happens when a user begins entering MOST until the end.
Upon entering the website, they will come to the Main Page where it will determined whether they are a registered user or a new comer. If they are a new visitor, they will be asked to register to receive the full benefits of MOST. If they are a new visitor, they will be asked to register to receive the full benefits of the system.

Clicking on the registering button, the system will take them to a Register page. Here, they will fill in the details as requested. After they submit their registration, they will have to take a quick test where they will have to answer some questions to set their progress chart. When they finished, they will be taken to their first display of progress chart. A registered user who had successfully logged in to MOST will be taken to their own progress chart which will show them their performance level until up to their last visit.

After they had finished viewing their progress chart, they may continue to the other modules within MOST. These modules provides their learning and revision process. If they had taken any tests or examination within MOST, their results will be recorded and it will be added to their progress chart when they login to MOST in their next visit. After they had finished with their learning session, they will click on the logout button and that marks their end session with the system.

### 3.2 Navigational Structure

The navigational structure is created to articulate a clear navigational strategy, including the link structure and feature that would avoid cited problems associated with online system such as ‘disorientation’.

Figure 3 shows the navigational structure for MOST. It started off with a login page and upon login; student will be taken to the first module which is their User Profile section. In here, they will be showed their progress chart and profile information. From there, they may proceed to the four main modules provided in MOST namely; Topics Help, Questions Bank, Quick References and Fun and Games.

![Figure 3: Navigational Structure of MOST](image)

These four modules are decided from the framework in the earlier section. Topics Help will cover for students need for help with homework and revision while Questions Bank will provide them with many set of questions for them to drill and practice. The Quick References section emphasis on MOST as the learning support where they can find a lot of references related to mathematics subject such as an English to Malay
dictionary – a mostly sought after list ever since the transition of teaching mathematics and science in English – and mathematics tips and tricks. Included are study and motivational tips. Fun and Games section covers the recreational activities such as puzzles and riddles, games and mathematical fun facts.

When the student had finished with their session on MOST, they need to logout in order for their activities recorded by the system and they can view it in their next visit.

3.3 System Development Tools

There is several development tools brought together for this online system. Macromedia Flash MX Professional is used as MOST authoring tool. Since MOST is developed to be viewed online, some issues on slow connection long delivering time might cause problems. To address that, MOST will be divided into small files or ‘chunks’ and these files will only be uploaded upon request from the students. The basic main page of MOST will be small in size to allow faster content delivery.

MySQL is used to generate SQL statements and codes to allow communication between the system and the database. The database contains students’ profile information and their history of visits to the system. SQL statements have to be embedded inside another file extension in order to allow Flash to communicate with it. In this case, SQL statements will be created within PHP files. The result generated from the query will then be accessed by Flash files to be used inside MOST. PHPMyAdmin is a tool written in PHP intended to handle the administration of MySQL over the Web. It will monitor and managed these queries between files.

The Apache HTTP Server helps to maintain an open-source HTTP server for operating systems. MOST will use this server protocol when implementing it online.

3.4 System Architecture

All of the above tools can be mapped in into below diagram to see how each of them connected. This will also define the system architecture.

In Figure 4, the process started when a user request for a page from the main MOST page. Since the most challenging issue when delivering contents online is the long amount of time to download, MOST have been divided into small ‘chunks’ of files and these files will only be loaded upon request. There are two types of files which are the Flash files itself and the PHP files, which are used to communicate with the database.
When a user requested for a Flash file, the web server will look for the file in the parent directory of MOST and upon finding that file, it will be return back to the main page. However, when there is a request for data, PHP files will be invoked. When this happen, the file will be send to Apache Server for the SQL statements to be executed. The data will be searched from within the appropriate databases.

Once the data is found, it will be return back to Apache Server and a new html file will be generated to be returned to the main page. MOST will extract the data returned in the new generated file and display it on the screen.

4.0 Development Process

In the development process, MOST is being built up progressing from the design process. The first step is by justifying for all of the modules selected. In MOST, five modules had been identified and they are; User Profile, Topics Help, Questions Bank, Quick Reference and Fun and Games. Next, storyboards for all five modules are depicted. The development process continues by using the storyboard-approach and turns them into a working module.

4.1 Justification for the Modules Selected

In the analysis stage, there are several findings that had been discovered which will be put to use in the developing stage. They are the best practices and guidelines to develop MOST and they will be explained in details below.

4.1.1 The Need for Account Registration

There are two ways to track visitors and keep their profile for the second time visit and they are by having the visitors to register themselves and get a personalized account or by using cookies.

A cookie is a piece of data stored on the user's hard drive containing information about the user's visit using the computer’s IP address [4]. However, IP addresses are not linked to personally identifiable information, especially when the computer is shared with many other people.

A registered account will keep user’s information in a server for updating and extraction when they log-in to the system again. The user can log-in from any other computers and the server will recognize him/her as the owner of the account. An example to this is the e-mail account. Users can log-in to their e-mail account from any computer they like as long as they have the correct username and password. Since this system is targeted to 16 to 17 years old students, the likelihood of them to owning a personal computer is very thin. Thus, MOST will implement registered account to keep students’ profile and track their progress.

4.1.2 The Need for Tracking Record

In the traditional instruction, several researches indicate that competition can lead to negative attitudes and affective responses. Van Eck [5] stated that, ‘those who are not good at content, or who cannot beat other players with faster reaction times may consistently ‘lose’, leading to disaffection’. Using that concept in classroom environment, when the students are not sorted by their performance level, there will be a few star students who are constantly at the top of their class. This would affect other students’ motivation level and lead to negative attitudes. This type of competition can result in confounding emotional responses.

On the other hand, on the perspective of the star students, competition does promote motivation, performance, and learning, but it is enough for them to perform at less than their maximum level [5] due to noncompetitive conditions. This would mislead these students in a long run. Imagine when they are accepted to a higher education institution where everyone is as excellent as they are. Their habit of not little effort in studying might not work this time and they would be left behind because of changes in competition environment.

For competition to work, it has to be in situation where the students are expected to an ‘uncertain outcome’ but not so much that they begin to doubt their ability to accomplish. In other words, to avoid competitive
environment to invoke negative attitudes, students would gain more benefit by competing with their own
self. And this is where a tracking progress record comes in, in MOST.

As the students learn, MOST will continually evaluate their progress. Every time the student logs-in to the
system, it will show a progress chart with weak and strong topics and recommending the direction of
learning. Along with these, it will also encourage the students with words of wisdom and phrases of
motivation. This would reduce their level of mathematics anxiety and relieve the teachers off some burden to
remember each and every progress of their students. And this is also how MOST helps the students to revise
their own learning pace.

4.1.3 Usability is the Key

To make certain that the students are able to learn and get comfortable with MOST in a very short time, the
content should be organized in a ‘conventional’ yet flexible way. Each lesson will be segmented into
‘lessons’, follows by further examples, self-tests and lastly, exercises. This is to facilitate the students to
identify reference points later on.

In order to ensure that the students who access through a low connection Internet, multimedia objects will be
use sparingly due to their large sizes and long download time. Additionally, it is expensive and time-
consuming to develop audio and video objects, most of which may not really be helpful for subject matter
that is heavily based on text, symbols, and graphs. Small and relatively low resolution still and animated GIF
images will be use to present formulas, figures and graphs.

4.1.4 ‘Drill and Practice’ Emphasis the Need for Questions Bank

One of the findings in the analysis stage identified that most students strongly agree that one effective way to
master in mathematics is through ‘drill and practice’. By taking a lot of exercises, students will be able to
grasp the concept better. This module provides the students with a lot of practices and they come in three
different types which are as follows,

1. Exercises – a list of questions based on each of the topics in the syllabus. This is different from
those in the ‘Topics Help’ module in the way that those exercises will not be recorded and
compiled in the progress chart but these in here will.

2. Tests – a list of questions from all topics but not in the format of the real Examination papers
and does not take as long to complete.

3. Examination Papers – a list of questions from all topics in the format of the real examination
papers as outlined by the Malaysian Examination Association (LPM). There are two types of
papers. Paper 1 takes an hour and a half while Paper 2 takes two and a half hour to complete.
There will be a timer utility to assist students to keep up to time as though they are taking real
examinations.

All activities in this module will be recorded and compiled in the Progress Chart.

4.1.5 The Role as Learning Support

One of the roles of MOST is to act as a learning support to the students. This role emphasis the need for a
module that provides references, hence Quick Reference. This module will complete the system as a
comprehensive learning tool. There are four items in this module and they are as follows,

1. English to Malay Dictionary – since the implementation of teaching and learning
Mathematics and Science in English, many had claimed that Mathematics had turned into an
even harder subject. When one look at it carefully, one would realized that Mathematics does
not play with a lot of words but numbers. All that is needed is a good dictionary to translate
certain terms.
2. Mathematics Tips and Tricks – There are many tips and tricks in mathematics. Some helps students to count faster and save a lot of time for other questions. This part dedicated to aid students in that way.

3. Study Tips and Motivational Tips – In some cases, students might get discourage after failing to answer certain questions. This part is aim to help them with some famous quotes on success and failure, study tips and motivational tips to encourage them not to quit just yet.

4.1.6 Recreational Activities in Fun and Games

One of the result from the analysis process shows that students go to the Internet for entertainment purposes as much as for educational purposes. Admittedly, after a long session of studying, these students deserve some time off to unwind and thus the entertainment pursuit. This is part of the reason why this module is created. Granted, students may find other means of entertainment which will suit their need than this, but this does not mean this system cannot provide some constructive recreational activities for them. There are three types of activities provided and they are as follows,

1. Mathematical Games – Games that are related to doing some mathematics work. These are good exercises towards calculating with mind rather than using calculator.
2. Mathematical and Logical Puzzles and Riddles – This is self-explanatory. This part compiles all sort of mathematical puzzles and riddles for the students to try out.
3. Fun facts – This is a compilation of interesting facts of mathematics. There will be some experiments that they can try out on their own.

All of the activities here will not be recorded for the progress chart to further affirm that they are meant for recreational activities only.

4.1.7 Including Web Resources In

Most online system would include a section where a list of outside resources in a form of links. While this can provide learners with limitless information resources, one important aspect that should not be forgotten is the appropriateness of age group of targeted users. Students in Form 4 and Form 5 have other subjects besides mathematics and to expect students to visit and integrate all of the additional information in a meaningful way may not be realistic. MOST will be developed in a way where students need only to visit MOST and they will find all of the necessary information there. Still, links can be included provided that they are pre-selected first and only those that truly benefit the students should be included in. To assist students to find what they need, a short summary of what the other website offers need to be included in underneath the link. This would also prevent the student from getting unnecessary headache due to ‘information overload’.

Another important factor is to constantly verify the legitimacy of these outside resources. Getting error messages would certainly put off students’ mood to carry on. However, to set a constant check on these links might be a bit of a tedious task after a while, so a solution to this is to provide a feedback form where the students may contact the administrator of any broken links.

4.1.8 Administrator Control

An important consideration pertaining to information is that of quality. Providing information of high-quality is important to ensure users get the most accurate and reliable information for their use. To help this process, an administrative account will be created and by logging-in to this account, the appointed administrator can change the learning materials, the scope of the syllabus and other contents.

Administrator to MOST has to be pre-selected in order to ensure quality. They will be selected based on several criteria. The most important of them is, they has to be someone who teaches Form 4 and Form 5 Mathematics subject in order to ensure they know the in-depth content of the said subject. Another criteria is that they has to be comfortable with using the computers and has a basic knowledge with them. The administrator controls will be structured in ‘select and edit’ format. All they have to do is to select whichever
part of MOST that they want to change or add, and edit the text from the text fields. An administrator manual will be provided for further assistance.

By having this control, MOST becomes a maintainable and upgradeable online learning support for future maintenance.

4.2 Sample Screen Layout

Figure 5 below shows the screen layout for User Profile with the tracking progress record in it. In this module, all students’ progress will be recorded and the display will be from the recent progress in each of their visit. This module contains the individual student’s profile such as user ID, password, full name, address, age and which form they are in.

The main function of this module is to record and display student’s progress in a graph. An average grade for student’s overall performance will be placed beside the graph as a mean to encourage them further. All tests and examinations that students had taken will be displayed in that graph. Accompanying the graph are student’s weak and strong topics. This will make it easier for students to decide the direction of their next revision session. A record of how many tests and examinations they have taken will be displayed next.

![Figure 5: Screen Layout of User Profile](image)

5.0 Conclusion

This paper describes the details for the design and development process in turning the formulated framework into a viable mathematics online system (MOST). The design process had outlined the system flowchart, navigational structure, system development tools and system architecture. The development process uses the best practices and system framework founded from the analysis stage to develop each and every module of MOST.

The outcome for this study is a working system ready to be evaluated by students. The evaluation process will then decide the success rate of MOST.

6.0 Reference


