CHAPTER 1

Introduction

1.1 Background

Every fact of life on earth uses mathematics and undoubtedly in daily life, a person is required to posses at least the basic knowledge of Mathematics. Learning Mathematics may be problematic for some children nowadays; thus, it is crucial to make efforts to increase the teaching and learning efficacy. With the rapid development in technology, multimedia has becomes important as a medium to deliver educational materials and to provide a fun and interactive learning environment compare to traditional teaching methods which can be dull.

Multimedia is a computer-mediated software where in integrates text, color, graphical images, animation, audio sound, and full-motion video in an application (Yusoff et al., 2003). According to Mayer and Moreno (2002), multimedia learning system consists of animations and narrations improve learning quality.

From the research findings (Martinez, 2000), it shows that besides adopting the best arrangement and presentation of multimedia materials, major attention is now inclines towards personalized research as an addition to enhance learning quality, which includes (i) understanding how different people learn in different ways and (ii) how they learn best and environment / circumstances affecting and improving one’s learning progress. According to Martinez (2000) most of the developments of e-learning applications are emphasize on how learners process, build, and store knowledge, where these offered a restricted view of how people learn and too often lead to unstable or ineffective online learning. A more all-
rounded learning application should include how people want or intend to learn was ignored. Present learning web courses lack of adequate support for how people learn differently; hence ending up with learning product that turned out to be more informational than instructional. Martinez (2000) also mentioned that many online learners are not prepared for self-managed online learning. In addition to that, according to a Teaching and Learning Research Program (TLRP) in United Kingdom (Hofkins, 2007), personalized learning recognizes that the quality of learning is shaped by learners’ experience, characteristics, interests as well as aspirations. A successful teaching explicitly builds on learners’ need and be able to respond to it persistently. Based on a research done by University Technology Malaysia, personalized learning environment is now a new trend for online learning environment (Halim et. al., 2010). In addition to that, based on the another publication, personalized learning environment is believed able to accommodate individual differences in online learning (Halim et. al., 2011).

In a further study into personalization (Martinez, 2000), basically there are five types of personalization, namely name-recognized personalization, self-described personalization, segmented personalization, cognitive-based personalization and whole-person personalization. Name-recognized personalization is easy to implement and powerful as most people value are being acknowledged as an individual. Self-described personalization in the other hand identifies learners’ preferences through questionnaires, surveys, comments or registration forms. Segmented personalization grouped learners into more manageable groups based on common attributes, demography or surveys to group or segment learning populations while cognitive-based personalization emphasize on the use of information about strategies, cognitive processes and ability in order to deliver specific content for specific group of learners. Lastly, whole person personalization uses learners’ orientation to assist learners to achieve learning objective from whole person perspective.
Further descriptions for each of the personalization type can be referred to Table 1 in Appendix A. Among all, the whole-person personalization is accord with the main objective of this research aimed to present an e-learning solution which is able to tailor to individual’s differences in term of capability in learning, thus enabling them to overcome the difficult problems in the pace which they are capable to handle. In whole-person personalization, it modifies the response to learners dynamically throughout the learning experience in real time. Hence, E-Multimedia Mathematics Learning System (EMMLS) is designed to accommodate various learners’ ability in learning individually using Whole-Person personalization method specialized in assessment modules. This thesis uses students and learner interchangeably.

### 1.2 Problem Statement

The purpose of this study is to identify the issues students faced in solving mathematical problems and propose a solution accordingly using personalization approaches. It examines each individual’s weaknesses, considering each learner’s ability before providing a solution to it.

The most common issues found in learning mathematics are listed as below:

i. Unable to remember or apply the learned math formulas, rules, procedures and concepts (Yeo, 2009).

ii. Unable to identify the test questions with similar patterns with previously encounter patterns and make connection between them (Yeo, 2009).

iii. Having difficulty to identify and remember the pattern and theoretical concepts of solution of previously made mistakes (Yeo, 2009).
iv. Incomplete understanding of language. Some students having difficulty in learning mathematics due to their disability in either reading or speaking, or writing (Nordin, 2005).

v. High self-esteem and de-motivation holds students to keep on trying when continuously defeated by problems in math (Yeo, 2009).

To date, numerous e-learning systems can be found with flamboyance interfaces and attractive learning contents. Most of them use multimedia as a medium intended to provide attractive fun learning environment to replace the dull boring lessons in class. Many researchers put in efforts integrating educational characteristic of multimedia and teaching pedagogies into the development of e-learning systems but less focus on individuality in learning. A research done by Nor, Shukri and Tasir (2007) incorporated personalization in learning by allowing learners to customize their own tables of content, aimed to concentrate one’s focus on their topics of interest. On one hand, it may effectively increase one’s competency in something they already good at, but, as is known to all, it is human nature in avoiding problems, on the other hand, weaknesses are left uncared. Apart from that, current personalized learning system is more informational but does not apply practicability approaches to sharpen learners’ ability. Most of the educational materials such as lessons are designed to accommodate learners incompetency in learning but not practically to initiate learners in taking part in more exercises which implicitly will enhance their understanding and analytical ability. The core idea of newly presented learning system in this study differs from previous research whereby it offers a personalized assessment used as a medium to improve learning competency.
1.3 Research Significance

"Unlike other areas of study, one can’t just pick up a Math book at the college level and begin unless the proper sequences of preliminary courses have been taken. This is because the study of Math is the study of a procedure and of a methodology -- not a set of facts or opinions. A body of facts, such as History or Geography, can be entered at many points. " (Boley, 1999)

It is critical to build a strong basic mathematics foundation today especially at the very beginning of the learning stage. This study focuses in learning Mathematics based on the syllabus and curriculum of Malaysian public school. The study proposed a prototype system with multimedia learning contents. The system named as E-Multimedia Mathematics Learning System (EMMLS) emphasizes on the interaction of the learners with the system through personalized assessment module. The aim of the assessment module of EMMLS is to improve one’s learning efficacy. As mentioned earlier, different people have different learning ability; however, a learner’s learning interest can be cultivated and motivated when one’s efforts are ascertained throughout the learning process. It is important as well to stay focus on learners’ needs to keep them interested. Hence it is important to help each learner understand their strengths and weaknesses and provide them with sufficient practices especially problems they are incapable to solve. This sharpens their analytical capability and implicitly learners will have a deeper understanding on steps and methods required in problem solving. EMMLS evaluate each learner’s performance continuously in real time to understand the current learners’ progress individually and develops learning strategies for the learner. This is done by the system by reconstructing the assessment module depending on the competency of a learner. Each learner will have to confront the inferior feeling towards difficulties faced in learning and overcome it in
order to gain more confidence in learning and to be motivated to continue to improve their competency in learning. Appropriate assessment is important as it helps to enhance learner’s ability as it brings out one’s potential capabilities, and contrariwise, the incommensurateness will lead to dissatisfactory learning outcomes. Appropriate assessments acted as stimuli to attract and keep learners active throughout the teaching contents and completing the learning process.

1.4 Research Objectives

The objectives of this research are as follows:

- To develop a prototype of EMMLS that emphasize on interactive learning environment where students are provided with instant and continuous feedbacks responded to each learning individual’s weaknesses in learning Mathematics in order to improve each individual learning ability and competency in problem solving skills.

- To examine the effectiveness of the use of various combination of multimedia component such integrate audio and video elements, graphics and animation, and multimedia design principles into the learning content in improving students’ Mathematic academic performance.

- To accommodate students flexibility in learning by providing interactive learning modules and assessment modules which are accessible in 24 hours time.

- To implement personalization in learning Mathematics and to identify learners’ weaknesses individually can be effective in fostering learners’ ability and competency in problem solving where learners are weak in.
1.5 Scope and Limitations

1.5.1 Scope

This study studies on enhancing learning effectiveness through identification of each student’s identity. It mainly emphasized on improving learners’ learning progression through personalized assessment modules. This research is targeted on students of age 13 to 15 of Malaysian public school. Mathematics is chosen as the subject in this research as it is a fundamental subject in Lower Secondary Form and students are tested in public examination Penilaian Menengah Rendah (Lower Secondary Examination) when they are in Form3. Combinations of various multimedia components are used in the creation of EMMLS learning contents which integrate five major design principles, namely the Multiple Representation Principle, Contiguity Principle, Split-Attention Principle, Individual Differences Principle and Coherence Principle (Mayer and Moreno, 1997). Learning contents encompassed complete Form1 Mathematics syllabus for Malaysian Public School with integrated assessment module for each of the chapter.

1.5.2 Limitations

i. Collected data may not be accurate as users are not monitored throughout the whole learning process. Users are allowed to access to the learning system at any time and any place they want.

ii. Responses received in this study were from students of Sekolah Menengah Kebangsaan Assunta. The feedback obtained might be localized and do not represent the students in the nation.
1.6 Research Methodology

This study adopted mixed methodology. Interviews were conducted with teachers teaching Mathematics for lower secondary form in order to investigate teachers’ perception on how learning efficiency can be improved, teaching pedagogies, and problems faced by students in learning Mathematics. Observations were also conducted on five classes at Sekolah Menengah Kebangsaan Assunta. Questionnaires were distributed to students from lower secondary form in Sekolah Menengah Kebangsaan Assunta to gather users’ requirement and learners’ preferences on the design of the proposed learning system. Reviews of literatures, conferences and journal papers helps to understand better the efforts done by previous researchers and to gaining more knowledge regarding the research topics.

1.7 Expected Outcomes

At the end of this research, the expected outcomes are:

i. A 24-hours accessible EMMLS to provide time flexibility in learning Mathematics.

ii. Interactive multimedia learning modules with completed Form1 Mathematics syllabus and learning contents which contain audios, videos, animations accord with lower secondary form standard with embedded interactivity elements.

iii. Precise and personalized designation of assessment modules based on each learner’s learning competency and weaknesses.

iv. Detailed graph of analysis which allows students to chart the achievement of each individual throughout the whole learning process.

Learning activity that commences for the first time most likely will not show significant improvement, thus students’ performances are expected to decline at the
beginning stage in using the personalized learning system but showing positive increment in learning performance at the end through continuous assessments. Repetitions and practices are likely to gain people more confidents and knowledge and will eventually result in a more efficient and rapid improvement. Several research studies have shown that students who are taught with a mathematics curriculum that uses continual practice and review demonstrate greater skill acquisition and math achievement (Mayfield & Chase, 2002; Usnick, 1991; Ornstein, 1990; Hardesty, 1986; MacDonald, 1984; Good & Grouws, 1979). Statistical interpretation of response and performance of students will be displayed using charts in Chapter 7 to govern the effectiveness of EMMLS.

1.8 Research Outline

This thesis is divided into seven chapters:

- Chapter 1: Introduction
  
  In this chapter, it includes a brief overview on the research background in ICT-Educational field, statements of problems, discussion about the significance of developing E-Multimedia Mathematics Learning System (EMMLS), research methodology adopted as well as the expected end product.

- Chapter 2: Literature Reviews
  
  In this chapter, literatures that relevant to online educational learning system are reviewed and compared.

- Chapter 3: Research Methodology
  
  This chapter presented research methodologies employed in developing E-Multimedia Mathematics Learning System (EMMLS). It will cover the
targeted respondents, research methods, research materials, data collection and analysis techniques and software development methodology.

- Chapter 4: Data Collection, Analysis and Findings
  In this chapter, it describes about the data collection, analysis and findings. Research methodologies adopted such as questionnaires, observations and interviews is further elaborated and the results and outcomes are analyzed and summarized.

- Chapter 5: System Analysis and Design
  The formation of system requirements of EMMLS which lead to system design will be discussed in Chapter 5 where the functional and non-functional requirements are defined and system design is depicted using a series of diagrams.

- Chapter 6: System Development, Implementation and Testing
  This chapter covers the development, implementation and testing issues of E-Multimedia Mathematics Learning System (EMMLS) such as platform installation, the development tools and technologies used, coding styles and approaches, the test cases and unit testing.

- Chapter 7: Results, Discussions and Conclusion
  Results and discussions will be carried out in Chapter 7, following the implementation of E-Multimedia Mathematics Learning System (EMMLS). Comparisons with other solving methods will be done to evaluate the performance of the proposed method.
1.9 Chapter Summary

In this chapter, background of current research trend in ICT-Educational field is discussed. Personalized learning is believed to be able to enhance learning quality effectively. Learning Mathematics can be problematic for some students, thus, it was chosen as the main subject integrated in the implementation of personalized Mathematics multimedia learning system, EMMLS. This research aimed to improve students’ learning competency in Mathematics through the development of Mathematics learning model using Whole-Person Personalization. The end product encompasses the Form1 Mathematics syllabus learning contents with assessment modules for each chapter using multimedia components. Students are expected to achieve higher learning competency using the personalized mathematics multimedia learning system.