Chapter 2

Literatures Reviews

2.1 Introduction

In this chapter, literatures relevant to multimedia educational E-Learning system are reviewed to understand the trend and development of E-Learning systems. Investigation were performed by comparing features of different online learning systems, problems faced in developments, methodologies used, conceptual frameworks as well as design principles integrated in the process of development. Thorough literature reviews allow better comparative analysis to be done; thus, usefulness can be maintained, and uselessness can be altered.

2.2 Reviews

Of the 30 papers cited in this review, it can be highlighted that studies on enhancing the quality of web learning is burgeoning now and online learning has real possibility in becoming a dominant learning platform for future (WestBrook, 2006). Ideally, a successful web learning system will be able to identify individual learners’ needs (Martinez, 2000). Personalization undeniably came into mind when it comes to adapting to learners’ need individually. Field experiments done by comparing personalized and non-personalized systems show a significant improvement in learning achievement that inspire the continuity of research in personalized learning (Chen, 2005). Yet, still, how well the practicality of the diversify personalities to be catered in a virtual learning system are still debated today, as
usually learning model are more descriptive where they offered guidelines to what methods to use to achieve learning goal (Bristol et al., 2004).

Personalization is implemented through analysis which aimed at distinguishing a group of learners’ profile that represents various individual with similar interest and preferences. In a personalized learning environment, in the process of characterizes the learning environment to suit to the learners’ identity, often inadvertently neglect learners’ ability, where instead of creating a self-adaptive learning environment the learners are left in a self-motivate and self-manage situation (Martinez, 2000).

In a research done by University Technology Malaysia (Nor et al., 2007), in developing a personalized learning courseware, learners are allowed to choose their own topics of interest and forming their own learning materials list. This study emphasis on learners’ preferences, however, when learners are provided with choices, time is wasted in considering which topics that suit their needs especially when they are not exposed to the learning materials and have no ideas of the topics. As a normal human being, learners are reluctant and tend to avoid facing their weakest learning experience due to the inferior feeling and high self-esteem. In personalization learning environment, it is important to profile learners in term of expertise level and to keep track of browsing history in order to provide guidelines for lesson delivery purposes besides considering learners’ preferences and characteristics (Li and Chang, 2005). Figure 2.1 shows an example of basic user profiler substance in an e-learning model.
Tracing learners’ navigation history provides personal recommendation on learners’ learning resources is recognized as one of personalization type. Figure 2.2 shows the architecture of personalized e-learning system by tracing learning navigation history in a virtual learning environment. It shows that learners’ browsing activities is recorded and stored in learners’ profile and then the modeling agent will be abstracting the activities forming brief student module and lastly the planning agent makes the learning plans.

Figure 2.1: Basic User Profiler Substance (Adopted from Li and Chang, 2005)
A study done by Lu on a personalized e-learning recommender system suggested that the generation of e-learning materials based on learners’ need is either intentionally or extensionally expressed (Lu, 2004). In intentionally expressed like its name implies, preferences are obtained directly from the learners itself. Extensionally expressed is the other way round where the information is determined by investigating learners’ behavior which includes learners often reading materials and history of materials accessibility records.
Based on Figure 2.3, it can be summarized that at the preliminary stage, most learners’ profiles are intentionally expressed. Basically, learners interact with their respectively profiling to:

(i) View their current standing throughout the learning process

(ii) Edit personal information

(iii) Specify of personal’s interest in learning which includes:

a. Learning orientation

b. Media preferences

c. Favor teaching approaches

d. Current standing on the subject from a personal point of view

Changes will be tracked and be effective once it is validated (Lu, 2004).
Effective learners’ profiles can be created based on (i) the methods on how lesson plans is revised and modified to accommodate to different learners’ profile, (ii) factors that taken into account lesson generation that it is able to achieve learning outcomes that learner prefer, and (iii) customizations that are made using different types and level of learning materials.

Next, Adaptation is found as an important element to be integrated into personalized learning models and theories. In a study by Türker, Görgün and Conlan (2006) relating to challenges in creating learning content in a personalized learning environment, a model has been developed to illustrate how learners affect the choices of activities and concepts (see Figure 2.4).

![Figure 2.4: Models of the Learner Affecting the Choice of Activities and Concepts to be Covered (Adopted from Türker et al., 2006)](image)

Based on Figure 2.4, obviously adaptability of learner’s pedagogy and adaptivity towards learner’s knowledge is important. Pedagogical (learning styles, habitual properties, and general aptitude of learners) and contextual parameter (cultural background, place of study, collaboration, timeliness and hour of study) from learners is vital in determining the suitability and exactitude of the learning paths generated for learners (Brady et al., 2004).

An Intelligent system for Personalized Instruction in a Remote Environment (INSPIRE) (Grigoriadou et al., 2002) was then introduced as a learning system where
lessons are generated based on learners’ knowledge level, learning style and learning goals. According to the authors, this approach emphasized on the fact that different learners have different interpretation and understanding over the same piece of information or learning materials. End users have control over the lesson generation process by updating their characteristic accordingly on the learning model. Lessons can be shaped accordingly to their learners’ knowledge level, learning styles and learning goals.

![Figure 2.5: INSPIRE’s Components and Interactions with Learner (Adopted from Grigoriadou et al., 2002)](image)

Interactive Ontology-Based Student Modeling (STyLE-OLM), (Denaux, 2004), is an improved version of INSPIRE, where integration of Interactive Ontology-Based Student Modeling (STyLE-OLM) and adaptive learning management system are used for user modeling in personalized learning content management. This study raised some issues through some simulated real life learning scenarios such as accuracy of learners’ profiles. STyLE-OLM is a learner model which is created through diagnosis on active interaction
between learners and the learning system. This advanced feature allows learners to discuss their domain knowledge and it has influence the content of learning built for them through discussion using STyLE dialog strategy in the form of short dialog as interaction medium. Effects of learning are validated through learners’ self-review upon request. Preview of learning content is built for each individual; however, if there are disagreements, then dialog is initiated and the model will be re-defined.

![Figure 2.6: Integration of STyLE-OLM and User Modeling Component in Adaptive Learning System (Adopted from Denaux, 2004)](image-url)
Figure 2.7 shows another instance of lesson generation model which produce evaluation result closer to represent the knowledge level of the learners.

Figure 2.7: Lesson Generation Process Model (Adopted from Magoulas, 2000)

The distinctness of the lesson generator as shown in Figure 2.7 from INSPIRE is, it generates lessons by stages and it is done through evaluation of learners’ performance while INSPIRE by DISCUSSIONS. In addition, it provides authorization for learners in choosing the learners’ goal in the first stage. The common feature which both systems shared is the learning preferences, which undeniably a key and essential element in personalized learning.

With continuous efforts of researchers contributing towards developing personalized online learning system, a mechanism to construct curriculum with difficulty parameter corresponding to learners’ performance individually is adopted to support the differential in learning ability of each individual (Huang et.al, 2007).
It differs from the previous studies where it takes into consideration the curriculum difficulty levels meanwhile proposed learning paths that are suitable for learners’ performance after the assessment. Curriculum Modeling Process presents a detailed curriculum design procedures to establish the difficulty parameters of the curriculum and the curriculum contents for personalized curriculum generation as shown in Figure 2.8.

- Procedure 1: Curriculum experts were gathered to analyze the learning concepts or objectives.

- Procedures 2, 3, 4 and 5: pre-tests were then conducted covering those learning concepts and test data was analyzed according to Item Response Theory (Baker, 2001).

- Procedure 6: Curriculum Modeling Process established the appropriate difficulty parameters of each of the curriculum test items.
Procedure 7: Appropriate difficulty parameters are used to generate curriculum materials to learners based on individual learner requirements and to help them to learn more effectively (Huang et.al, 2007).

Figure 2.9: Personalized E-Learning System Based on Item Response Theory (PEL-IRT)  
(Adopted from Chen et al., 2005)

Next, this study investigates further by studying the learning materials’ difficulty in accordance to learners’ ability. Item response theory (Baker and Kim, 2004) is a robust theory in education measurement. Referring to Figure 2.9, items are labeled with a single difficulty parameter to indicate the difficulty level of the learning materials. In this case, instead of assessment to determine course material difficulty level, feedbacks from learners are gathered through questionnaires after learners have gone through the provided learning
materials. In PEL-IRT, personalization implemented with different difficulty level of materials is subjectively judged by learners itself.

Personalized learning has evolved through time and many efforts were made by researchers. New ways in looking into the personalization models are needed aimed to discover the neglected areas to seek for improvement in methodologies and to upgrade the learning quality.

Each phase makes progress toward better adaptive learning environment. Starting from a basic personalized learning model with user profiler, and considering the adaptability of learners’ characteristic, preferences, learning styles during the lesson generation process until the invention of system architecture that construct educational materials with difficulty parameter to ensure appropriateness of course materials closer to learners’ ability.

Studies of literatures, articles and books relating personalization in learning, reviews of available personalized learning frameworks and models indicate that there is a tendency to indulge learners with informative educational materials rather than involving them in practical training to help learners to strengthen their capabilities especially in the area of learning that they are weak in. Practicality in term of providing sufficient and right amount of practice encourage learners in taking part in it; hence increasing learners’ analytical ability and problem solving skills.

Thus, apart from implementing personalization that suit to the learners, in this research we proposed a personalized assessment model with allocation of questions in an assessment module are determined by the scaled Capability versus Proportion of Question Table (CPoQ) as shown in Figure 2.10. This is to promote learners’ analytical ability and problem solving skills by designing curriculum which unlike the personalization methods that had been implemented in others earlier researches, it ranks learners’ ability into
categories by using evaluation tools in real time response to the dynamic changing
performance of learners individually. It focuses on enhancing learners’ ability by
confronting learners to their learning difficulties, providing them with determined
proportion of questions based on CPoQ Table.

Design Multimedia Learning Contents and Assessment Modules
Categorize and Section Quiz Questions
Design Capability – Proportion of Question Table (CPoQ)
Perform Strength and Weaknesses Analysis
Design Assessment Module

In Test N, with Section, s and
Number of question for each
section:
Section, s = 1
Q1
Q2
Q3
Section, s = 2
Q1
Q2
Q3
Section, s = 3
Q1
Q2
Q3
Q4

Competency Level, C:
- Excellent
- Moderate
- Weak
(Assumed 10 as total
questions)

In Test N+1, with Section, s and
Number of question for each
section:
Section, s = 1, C = Excellent
Q1
Q2
Section, s = 2, C = Moderate
Q1
Q2
Q3
Section, s = 3, C = Weak
Q1
Q2
Q3
Q4
Q5

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Proportion of Question, x (Ratio: x/10)</th>
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<tbody>
<tr>
<td>Marks</td>
<td>Grade</td>
</tr>
<tr>
<td>0-50</td>
<td>Weak</td>
</tr>
<tr>
<td>50-80</td>
<td>Moderate</td>
</tr>
<tr>
<td>80-100</td>
<td>Excellence</td>
</tr>
</tbody>
</table>

Figure 2.10: EMMLLS Conceptual Design

Figure 2.10 shows the EMMLLS conceptual design. It consists of Learning
Capability versus Proportion of Question Table (CPoQ) matching with learners’
performance which will be deployed in the design of personalized learning assessment module in EMMLS. Before constructing the personalized assessment module, a test bank with mathematical questions is categorized accordingly based on the Integrated Mathematics Curriculum in Malaysia. Each learner will be evaluated for each of the section. When a learner perform poorly in an assessment at that particular section, in the next assessment module, the proportion of questions for that particular section will be increased based on the CPoQ table. This is important to rectify learners from the incorrectness of the response questions so that they will have a deeper understanding on how to solve a question, and what theories to apply. It is also hope that the learners are able to recognize the pattern and key words through repetition of exercises (Mayfield & Chase, 2002; Usnick, 1991; Ornstein, 1990; Hardesty, 1986; MacDonald, 1984; Good & Grouws, 1979). This is essential in developing and enhancing problem solving and analytical skills.

In addition to that, to not lose learners’ interest in learning, in EMMLS, lessons were developed by employing the combination of multimedia components such as animation, text, sound effects and interactive elements. The effectiveness of multimedia design and development in Mathematics learning courseware has been rated highly (Muda & Mohamed, 2005; Devadason et al., 2009; Zydney, 2010; Maag, 2004; Park & Lim, 2005). Through multimedia, learners get to extract information by interacting with the real event especially when the learning contents were simulated with real life examples. Most learners believed that multimedia is an essential component in their learning. It helps them understand, learn and visualize Mathematics concepts better (Devadason et al., 2009).
2.3 **Chapter summary**

Literatures reviews is a useful way to have a holistic view of the current research position, the latest technologies used and the principles and frameworks adopted. Throughout the reviews, it reveals that personalized learning did enhance learning achievement significantly. With the diversify personalities in e-learning environment, the practicability of personalization methods to accommodate diversify of learners’ need are still debated. Personalization is no more a matter of preparing informative learning materials or assessment that suit to the learners’ need individually, but the ability to develop analytical skills, and enhancing the potential of becoming competent learners. In relevance to that, personalized assessment modules emphasized in this study is to foster problem solving and analytical skills especially in areas where students are weak in order to promote one’s learning competency.