International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:8, No:12, 2014

Development of Multimedia Learning Application for Mastery Learning Style: A Graduated Difficulty Strategy

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***Abstract*—**Guided by the theory of learning styles, this study is based on the development of a multimedia learning application for students with mastery learning style. The learning material was developed by applying a graduated difficulty learning strategy. Algebra was chosen as the learning topic for this application. The effectiveness of this application in helping students learn is measured by giving a pre- and post-test. The result shows that students who learn using the learning material that matches their preferred learning style perform better than the students with a non-personalized learning material.

***Keywords*—**Algebraic Fractions, Graduated Difficulty, Mastery Learning Style, Multimedia.

I. Introduction

LEARNING is facilitated and attainable when the teaching strategy is in accordance to students preferred learning style [1]–[4]. Studies have proven that by facilitating students with appropriate learning materials, their learning will significantly be improved [5]–[7]. Therefore, it is important to know the learning style preferences of each student when developing the learning strategy to enhance student's achievement.

The theory of learning style is influence by figures such as Carl Jung, Jean Piaget and John Dewey [8]. Carl Jung in 1921 described eight different personality types that can be concluded into four main categories: feeling, thinking, sensation and intuition [9]. Working from Jung's work and personality type, Kathleen Briggs and Isabel Myers expanded Jung's model into Myers-Briggs Type Indicator (MBTI) [10]. Since then, the personality type model has been adopted into more practical and classroom oriented model of learning styles by researchers. [11] in particular have developed The Math Learning Style Inventory (MLSI) for Mathematics learning.

The MLSI categorized the learning style into four: Mastery, Understanding, Self-Expressive and Interpersonal. The mastery learner like learning material consists of step-by-step instructions and procedures. The Understanding learners like to learn by looking for pattern and reasons why the mathematic works. The Self-Expressive mathematic learners like to solve problems creatively by visualizing and exploring alternatives. The Interpersonal learners like questions and learning materials that linked to real life problems. [12] believes that even though there is no person that is a perfect representative of a single style, people tend to have preference to specific learning styles. This paper reports a small part of a larger ongoing study and focuses on only one learning style, the Mastery Learning Style. Thus the objective of this study was to determine whether there was a difference in the achievement of mastery students who were presented with the mastery learning material and mastery math student who were not presented with the mastery learning material. There were three phases in this study. The first phase was administering a pre-test to the students followed by the MLSI to determine their learning style preference. The second phase was the first treatment followed by the post test and last, the second treatment preceding the post-test questions. Two intact classes of semester one engineering students who had enrolled in one of the Malaysian Polytechnic were the respondent for this study.

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II. Literature Review

Lecturers normally do not have sufficient time to guide students individually through every subject in a course especially mathematics which has been considered as one of the toughest yet fundamental subject for engineering students [13]. The concept of learning style is a relevant pedagogy concept as the number students in a class increases and is more diverse [14]. Teachers need to acknowledge the fact that individuals have diverse approaches to their thinking and doing mathematics [15]. Mathematics is a highly personalized activity requiring flexibility, and capacity for play and improvisation.

A personalized tutoring can particularly enhance interest and motivation in the teaching and learning process [16]. There cannot be the same learning for all students because each student has a different learning style [17]. Reference [12] has listed six types of learning strategy that is suitable for students with mastery learning style. The strategies are Convergence Mastery, Vocabulary Knowledge Rating, Procedural, Mental Math Strings, Graduated Difficulty and New American Lecture. All these strategies are based on a decade of study of mathematics learning in schools throughout United States of America. For this specific research, Graduated Difficulty strategy was chosen as the suitable strategy to develop the learning material since it offers tasks of various degrees of difficulty for the mastery learning style student.

Whenever in a mathematic classroom, students will usually function at different levels of proficiency and comprehension [18]. Since every individual is unique and the preliminary

knowledge are not at the same level, some students may fail to answer beginner level questions, while some may excel when given the same questions. This means that there will be some students who will be bored in class when given questions or concept that they have already mastered. In the graduated difficulty strategy, students have options to choose their level of understanding in the specific topic [12]. Options are based on a sequential analysis of the subject to be learned and the degree of difficulty of tasks to be performed. Students are responsible for assessing their own abilities and for choosing the task and level of performance they consider best suited to them.

Algebra is a branch of Mathematics that deals with symbolizing and generalizing numerical relationship [19]. There are basically two fundamental concept of algebra: variables and equations. Therefore, some students would find it difficult to accept the concept of algebra when first introduced to it. The failure to understand the basic concept of Algebra has led to further failure when these students encounter more challenging problems. As for Malaysian polytechnic students, they need to understand and pass the subject before completing the three years of diploma studies in the engineering field [20].

Multimedia has a good track in helping mathematic students learn well. Applications such as e-WayCOOL [21], UZWEBMAT [22], CDiCL [23] and iMLc 2.0 [24] have been proven to help students from primary schools to higher education in learning mathematics.

III. System Architecture and Design

The multimedia application is divided into four main sections as illustrated in Fig. 1.

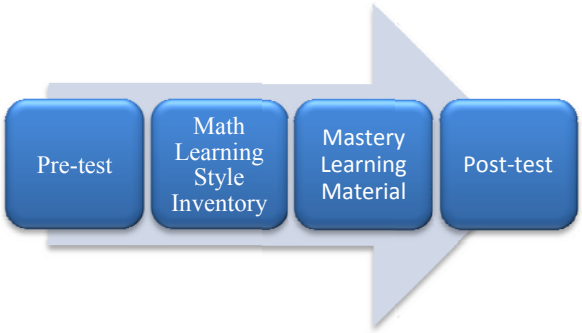

Fig. 1 The sections in the multimedia application

A. Pre-Test

The main section was the pre-test. For the pre-test, 10 sets of algebraic fraction questions were given to the students. They have to choose the correct answers from four options given in a limited time. All the questions required them to simplify algebraic fractions. These questions range from simple monomial fractions to polynomial fractions with multiple parentheses. Fig. 2 shows one of the questions in the pre-test section.

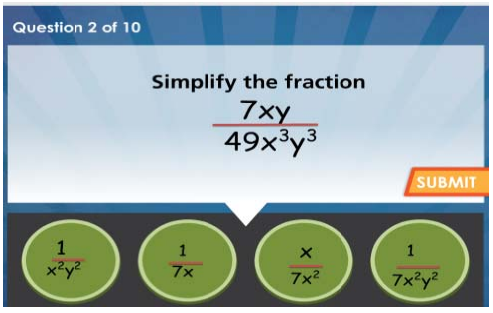

Fig 2 Pre-test question

B. Math Learning Style Inventory

The respondents have to complete a set of MLSI with questions like Fig. 3 in order to know their learning preference. The inventory has been translated into Malay Language because most of them have difficulty to understand long instructions and words in English. On the contrary, the pre-test and the learning materials are in English language because the questions and materials are taken out from their official mathematics module. Adding to that, most of the terms in the test questions and learning style are terms that they have got used to in ordinary classrooms.

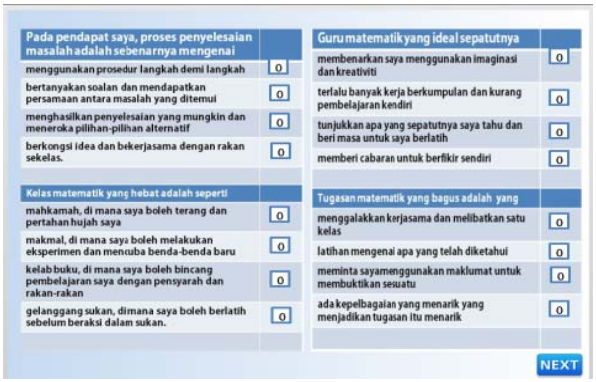

Fig. 3 The MLSI

C. Mastery Learning Material

The Mastery Learning Material (MLM) consists of six main sections that have been illustrated as six library books that have been placed on the shelf in the application (see Fig. 4). There are three levels of difficulty for learning the algebraic fraction: beginner, intermediate and expert. In each level, one learning material and one self-assessment are given. By applying the Graduated Difficulty strategy, the mastery learning style students are free to choose any books to learn the topic based on their level of understanding. In this section, students with Mastery learning style were also given the Randomized Learning Material (RLM) that are not matched to their preferred learning style. The RLM is the learning materials that are developed to facilitate students with Understanding, Self-Expressive and Interpersonal learning styles.

Fig. 4 The MLM section

D.Post-Test

The last section is when their understanding is measured. After completing the learning material and self-assessment, the students have to answer a set of post-test questions. This post-test as in Fig. 5 has the same level of difficulty with the pre-test. The difference between pre-test and post-test are used to measure the understanding of the material presented to them.

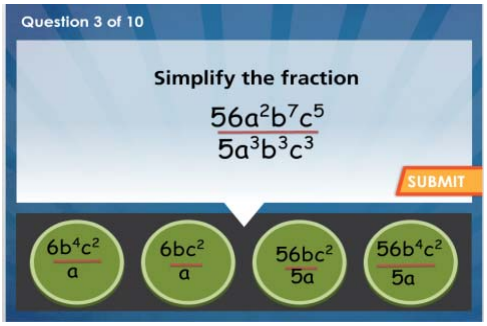

Fig. 5 The post-test

IV. Result

In order to answer the research question, two classes of semester one engineering student from one of the Malaysian Polytechnics were chosen as samples. The total number of students for these two classes is 78 students. They are given the Multimedia application in two computer lab sessions. The result shows that 30 students from these two classes preferred Mastery learning style as their learning style preference.

Repeated measures were conducted on the thirty Mastery learning style students whereby they were given the MLM material first, then tested followed by the RLM material and once again tested at the end of the treatment. From the 30 students, 47% or 14 of them that have been giving the MLM showed an increase in the result from pre-test to post-test. Thirty-three percent or 10 of them showed an increase in the achievement test when learning from randomized materials. The remaining 20 percent or 6 of them show no differences in the test. The students that were given the learning material matched to their learning style had an average mean result of 51 which is higher than the result from the pre-test which is 44 and with the randomized learning material, M=50. Figs. 6 and 7 show the comparison of result between MLM and RLM.

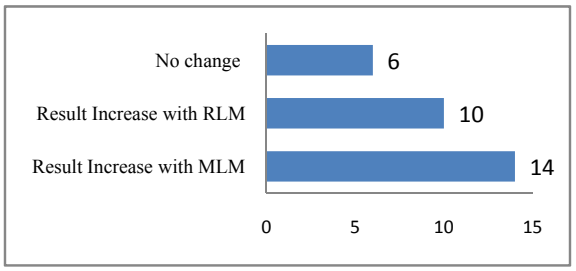

Fig 6 Students' Result

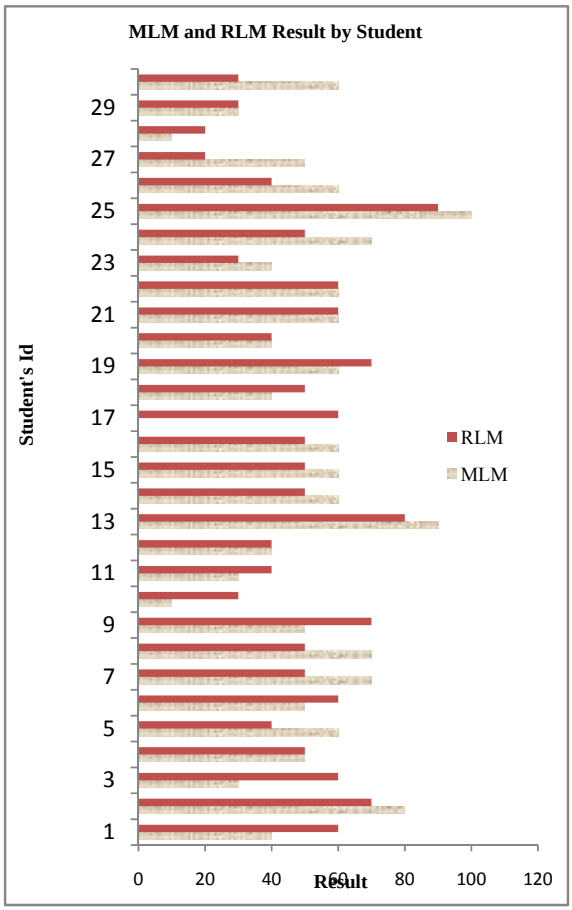

Fig. 7 One to one Students' Result

V. Discussion

This study shows that students that were presented with the MLM obtained better results in the post-test rather than the RLM. Nevertheless, further research must be done on this topic to give more insight and to get better results. It is hoped that the result from this study can be a starting point for researchers, especially for the Polytechnics in Malaysia to do more study in the area of learning styles in order to improve students' performance.

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