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Mastery Learning Assessment Model (MLAM) in Teaching and Learning Mathematics

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Abstract

This study examined the effectiveness of Mastery Learning Assessment Model (MLAM) in teaching and learning mathematics at a private university, namely UNIRAZAK, Malaysia. MLAM was based on repeating similar assessments through a mastery learning remodel from previous researchers. In this study presented herein, a sample size of 30 was collected and surveyed using continuous assessments and the findings showed that a positive correlation (r=0.77) exists between the MLAM score and the final exam result. Based on the Teaching Evaluation Results (TER), a majority of the students were also satisfied with this approach.

Keywords: Mastery learning; Low achiever students; Continuous assessment; Teaching and learning mathematics; Teaching evaluation results; Correlation

1. Introduction

Mathematics has been considered as a difficult subject matter to master by the students in school at practically all levels from primary school to university. Students who have low aptitude for mathematics typically as results of their own perception on the difficulty of mathematics or students who have been discouraged by the lecturers who are unable to deliver the subject matter due to lack of teaching skills in an eloquent manner will eventually lose interest in mastering mathematics. Typically, this results in low grade in mathematics for the students who have experienced one or both of these events. As such, mastery learning is an innovative method providing the opportunity to all the students who are taking mathematics subject with a plenty of time to understand any particular topic in a particular mathematics course based on the students' ability and capability to learn mathematics at a comfortable pace within the realm of the students' aptitude.

Mastery learning has been introduced over 80 year ago. It was initially proposed by John Carroll (Eisner, 2000). Carroll (1989) stressed that all learners have the potential to learn with different period of time to achieve a particular subject matter. He formulated and postulated the following model for degree of learning:

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$$\text{Amount of learning} = \frac{\text{Time Actually Spent}}{\text{Time Needed}} \qquad (1)$$

Mastery learning had been proven to be positive especially in the area of achievement, attitudes towards learning and the retention of the content (Davis & Sorrel, 1995) in a subject matter undertaken by the students. Mastery learning is potentially beneficial to the students at various aptitude levels. Mastery learning is especially beneficial for low aptitude students whose past experiences with failures on the subject matter have diminished their motivation on the subject matter (Ironsmith & Eppler, 2007).

In comparison with traditional approach on teaching which most educators are familiar with, mastery learning has been proven to be successful in various areas and academic courses such as science and technology education (Ozden, 2008) athletic training education (Schellhase, 2008), physics (Wambugu & Changeiywo, 2008), and biology (Ping, 1979).

Under the influence of Ralph Tyler, Benjamin Bloom recognized that students should not be compared through their academic achievements but rather the students should be helped to achieve the goals of the curriculum which they were enrolled (Eisner, 2000). Bloom outlined a specific strategy for using formative assessments to guide teachers in differentiating their instruction and this process of differentiation is labelled as 'mastery learning'. Bloom also recommended using classroom assessment as a learning tool, and then to follow through these assessment with feedback and positive corrective procedure (Guskey, 2005). In the mastery learning classes, correctives procedure were tailored to the specific weaknesses of each individual student, whereas in the non-mastery classes there were no additional opportunities to for the students re-do the course work (Mevarech, 2001). Mastery testing has the objective of learning through a process known as repeatability. Thus, mastery testing uses repetitions of up to two times for each chapter of the course work through alternate test that cover the same objective and content which was introduced by Martinez & Martinez (2001).

Hsein et all (2008) implemented the web based mastery learning for those who have failed on previous study. He created a remedial learning for those who are not mastery and again will repeat the assessment until the students have mastered the subject. The only issue is that the students cannot proceed to the next module until they have mastered the current module. This process is shown in Figure 1.
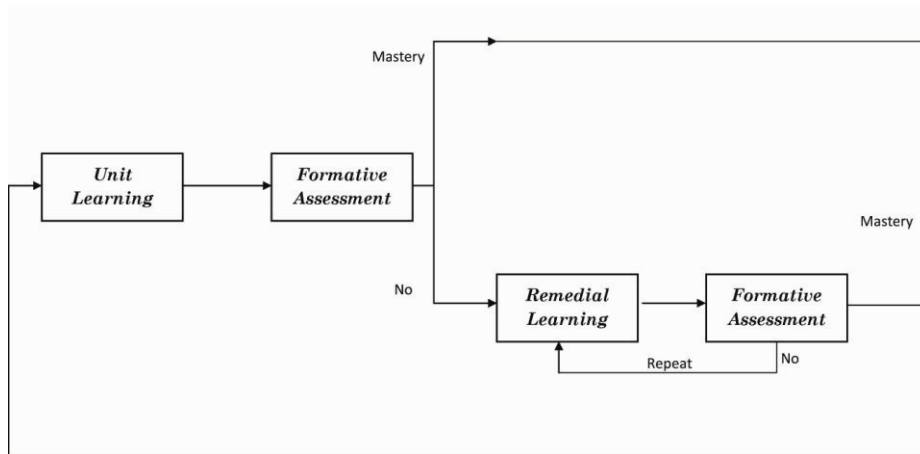

Figure 1: Mastery Learning Process (Hsein, 2008)

2. Methodology

This study was initially conducted at University Tun Abdul Razak (UNIRAZAK) located in Kelana Jaya, Selangor, Malaysia. The experimental study and course was based on a course entitled "Discrete Mathematics (PMB 3024)".

Students who have attended this class were majoring in mathematics under the Bachelor of Education programme. The sample size used for this study was 30 students.

Figure 2 below showed how MLAM was implemented in the study. The class was conducted through usual conventional method and at the same time, mastery learning process was also introduced to the same class. The course was divided into *n* units. This division of the course was essentially based on the topics of the subject. For instance, students who have scored 80% marks for the assessment on a particular unit have been considered to have mastered that particular unit and can proceed to the next unit. The process described herein differs from Hsien et all (2008): students who have scored less than 80 % marks will repeat the same unit but will be allowed to continue at the same time to the next unit. Students were supposed to repeat their assessment on a particular unit until they have the mastery of the repeated assessment unit within the stated time frame. This process is shown in Figure 2.
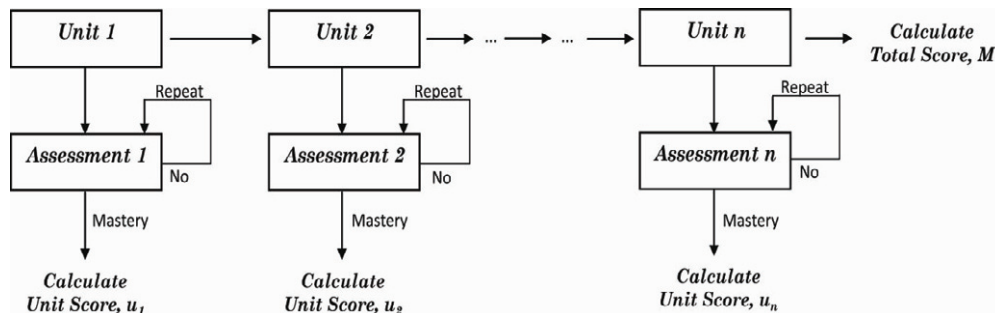

Figure 2: Mastery Learning Assessment Process

The suggested mastery assessment model to calculate their mastery score is shown in equations 2 and 3, respectively as follows:

Let

a_i = score for i^{th} unit (%),

u_i = mastery learning score for i^{th} unit, where $80\% \leq u_i \leq 100\%$ and

w_i = weight for i^{th} unit, where $0 < w_i < 1$, $\sum_{i=1}^{n} w_i = 1$

then

$$u_i = \begin{cases} 100\%, & i = 1 \\ \text{maks}(a_i), & i \neq 1 \end{cases} \; ; \; i \in Z^+ . \tag{2}$$

Total score for the mastery learning assessment, $M = \sum_{i=1}^{n} w_i u_i$ (3)

To encourage the students from repeating the assessment, students who have achieved the mastery of a particular set unit for the first time will be given full marks. Each set unit will carry a weightage factor. The weightage of each unit shall be based on the hierarchy learning objective (Highley & Edlin, 2009). The questions for the assessment have been set to understand the concept but not through memorising the contents. For instance, the following are one of the questions from 3 sets of similar assessment questions that have had been tested on a topic related to the counting technique:

Set 1*: Q1. How many different arrangements of the letters in the words 'UNIRAZAK' can be formed if:*

    i.   *'K' is the first letter?*
    ii. *all 'A' must be kept next to each other?*
    iii. *all the vowels are on the left?*

Set 2: *Q1. How many different arrangements of the letters in the words 'UNIRAZAK' can be formed if:*

    i.   *'R' is the first letter?*
    ii. *'R' and 'Z' must be kept next to each other?*
    iii. *all the consonants are on the left ?*

Set 3*: Q1. How many different arrangements of the letters in the words 'UNIRAZAK' can be formed if:*

    i.   *'A' is the first letter?*
    ii. *all 'vowels' must be kept next to each other?*
    iii. *all the vowels are on the right?*

Upon completion of the assessment, the errors made by the students will be discussed thoroughly. The mistakes made by the students will be made known repeatedly. The discussion on students' errors was important for clarification of concepts and improvement on the ability to reflect (Leu &Wu, 2005).

3.   Findings

Based on the above description and method, the analyses were made on the results of the assessment to ascertain the correlation between the MLAM score and the final exam score. This correlation is shown in the form of a scatter diagram shown in Figure 3 below. The finding showed that there was a positive correlation between MLAM score and the final exam score with a correlation value of $r = 0.77$. The analyses also indicated that 90 % of the students who have undergone MLAM were successful in completing their course work. In addition, 70 % of the students who have undergone MLAM eventually secured an overall course grade of A and above in their final exam. It needs to be pointed out herein that the failure rate of 10 % was noted for the students who have undergone MLAM in the course under study. Further assessments on their failures were made. It was found that students who have undergone MLAM process and who have failed to achieve the passing grade set forth by the UNIRAZAK had done through their accord i.e., negative attitude on the subject matter and lack of seriousness in class as is typical of any classroom activities in a university settings.

From the observation made throughout the assessment process, most of the students have asked a lot of question before the commencement of the assessment despite going through several couple series of assessments in the past. These showed that instead of having remedial class, the students did study by themselves. The following are the comments from students regarding the MLAM method. We included both the very positive comments and the negative ones. But the majority of the students give a very good feedback.
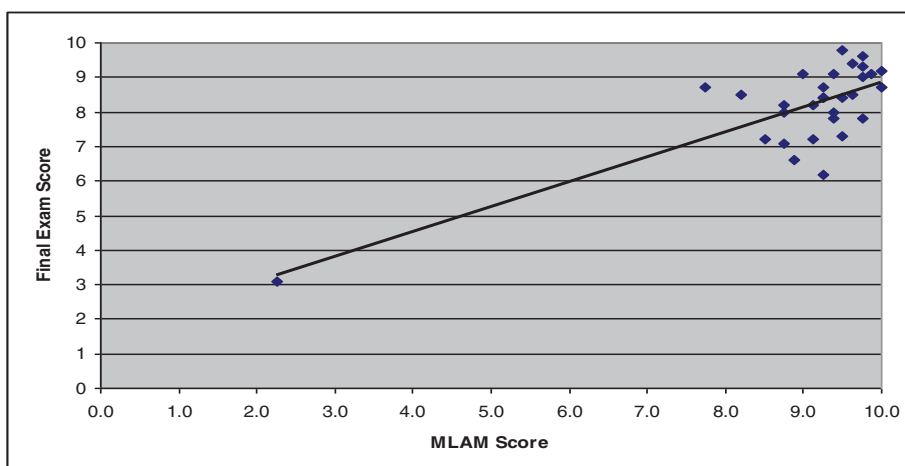
Figure 3: The correlation between MLAM score and the Final Exam Score

" I felt distracted to continue with the next topic and yet to repeat the previous chapter's assessment"

" In the first place, I felt this method was not suitable because there was a lot of thing to study at the same time but in the end I believe that I understand most of the topics"

"This method was very good because it was forcing me to study by myself"

" I love this technique because the repetition made me memorized"

" This method made me scored"

It was noted that the obtained TER result was 95.6%. The Teaching Evaluation Results (TER) used to measure the lecturers' commitment and students' performance respectively was also studied (Liew & Shahdan, 2010)

4. Conclusion

Based on the above findings, the future trend in education on some subjects may exclude final examination   since the students have been tested on the continuous assessment process. Nevertheless, other than a web-based mastery learning to help lecturers implement the mastery learning, a new method should be explored to reduce burden on lecturers.

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