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MASTERY LEARNING APPROACH (MLA): ITS EFFECTS ON THE STUDENTS MATHEMATICS ACADEMIC ACHIEVEMENT

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Abstract:
This study inquired on the effect of Mastery learning Approach (MLA) in enhancing the academic achievement of mathematics. Eighty first-year senior secondary schools (SS 1) students were used as subjects of the study. Mastery learning approach was used in the treatment group (N=40) while the traditional teaching method was employed for the control group (N=40). This investigation utilized the quasi-experimental design. The results of the study showed the students who were exposed to mastery learning had enriched academic achievement in mathematics. Apparently, results on the posttest mean scores of the students revealed that there is a significant effect on the academic achievement of the experimental group in which the MLA had been introduced. As such, students exposed to MLA performed better than students who were taught in the traditional teaching method. Moreover, results exemplify that there is a significant relationship between the students' attitudes toward mathematics and their academic achievement in mathematics.

Keywords: mastery learning approach, traditional method, academic achievement, senior secondary school

1. Introduction

Mastery learning has been one of the more recently developed instructional models and interventions used by teachers to for foster academic enhancement among students. Mastery Learning is one teaching model under the behavioral systems family of models (Joyce & Weil, 1985). It is an instructional strategy proposed by Benjamin in 1968 which upholds that students must attain a level of mastery in requirement knowledge before stirring to learn the succeeding information. If students do not succeed mastery in the test, they would be given extra support by reviewing the lesson and undergo retest.

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This exercise continues until the learner has mastered before moving to the next unit of instruction.

Mastery learning has been defined in many ways (Bloom, 1968). It is an instructional process that provides students with multiple opportunities to demonstrate content mastery (Candler, 2010). It is distinctive compared to the traditional method of teaching in that the unit of material is taught and students' comprehension is assessed before they are allowed to move on to the next unit. Students who demonstrate mastery on this test are assigned more challenging assignments so as to extend and deepen their content knowledge while those who do not pass this test at a designated level (80%) receive a corrective instruction, followed by a summative test. Wambugu & Changeiywo (2008) argue that students who fail the summative test may receive further instruction until all students finally pass or the teacher decides to move to the next unit until the majority of the class masters the unit.

In a contrary dimension, Bruce (1970) argues that the learner becomes strong-minded due to the experience she/he is exposed to the environment. Bruce further reiterates that mastery learning refers to an individualized educational approach that uses an organized curriculum divided into pieces of knowledge and skills for academic use. It is designed to ensure all students fulfill the behavioral objectives so as to allow each student ample time to do so (Block, 1980 & Bloom, 1981). As argued above, students look forward to mastering the learning aims before proceeding to the next unit and any student who does not get 80% score set, would not be permitted to proceed to the next unit. But if a student or a group's aggregate is 80% and above then that group is qualified to proceed to another subtopic. This shows that in Mastery Model, most learners would reach the mastery level only if the result of a learning period is elastic. Activities and tests must be organized by the teacher based on individual student's needs.

Block and Anderson (1975) summarize the Mastery Learning as a type of learning that follows a prescribed sequence of teaching, formative test, corrective instruction and summative test. The formative test would be used to find out if the learners have achieved an 80% mastery criterion while on summative tests the students who attained 80% or higher on the formative test would be provided with enrichment activities pertaining to the same units.

The mastery learning process is being represented as a model in Figure 1;

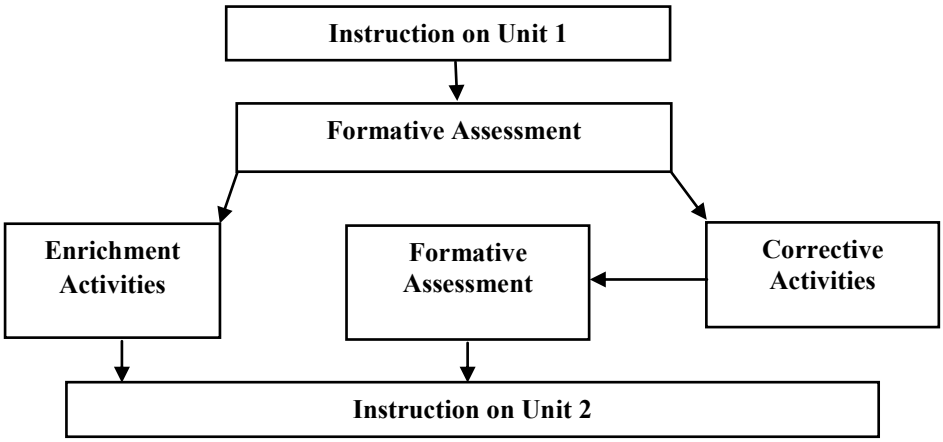

Figure 1: The Steps of conducting Mastery Learning

1.1 Application of Mastery Learning in Classroom

In the context of this study, the mastery learning teacher starts the lesson by presenting an overview of what the unit would entail in a simple form. Secondly, she/he would explain to the students what information is to be learned and what applications are to be used in teaching the content. Again, the teacher would teach the students on how the unit would be carried out.

Lastly, the master teacher would announce the planned dates for both formative test and summative test for the students. At the end of a learning unit, a diagnostic mastery test needs to be administered to the students in order to determine the next course of action. Students who are deemed to have mastered the learning unit can proceed to a new learning unit or be allowed to carry out further enriching activities. On the other hand, students who have not mastered the learning unit will be required to undergo remedial instruction.

1.2 Related Literature on Mastery Learning

Mastery learning refers to learning approach that teacher present unit of learning, give formative and summative tests to the students. At the end of a learning unit, a diagnostic mastery test would be administered to the students in order to determine the next unit. Students who are deemed to have mastered the learning unit can proceed to a new learning unit were allowed to carry out further enriching activities. On the other hand, students who have not mastered the learning unit will be required to undergo remedial instruction (Wachanga and Gamba 2008; Mehar 2013; Keter 2013; Sood 2013; John and Ng'eno 2014; Lamidi, Oyelekan and Olorundare 2015; Hussain and Suleiman 2016; Keter and Ronoh 2016; Filgona, Filgona and Linus 2017; Barr & Wessel 2018).

A lot of researchers had been nurtured to promote mastery learning in the classroom as Guzver and Emin (2005) who investigated the effects of mastery learning and cooperative, comparative and individualistic learning environment organizations on achievement and attitudes in mathematics on 158 students in mathematics. The results indicated that mastery learning improved students achievement and yields greater positive attitudes. Another significant study was undertaken by Wambugu and

Changeiywo (2008) investigated effects of mastery learning approach on secondary school student's physics achievement. The study used a total of 161 secondary school students in Kenya using quasi-experimental and Solomon four Non-equivalent control group design for the period of three weeks treatment. The results of this study revealed that mastery learning approach had higher achievement in physics compared to their counterpart in the control group. Another study was undertaken by John, Ananthasayanam, and Ravi (2009) on mastery learning through individualized instruction. The study applied the programmed instructional method and computer-assisted instruction method using the quasi-experimental research method. Moreover, Filgona, Filgona & Linus (2017) investigated a study on Mastery Learning Strategy and Learning Retention: Effects on Senior Secondary School Students' Achievement in Physical Geography. The results of the study revealed that Mastery Learning Strategy improved the students' learning retention and achievement compared to traditional method. In equally important, Hussain & Suleman (2016) reported that Bloom's mastery learning approach had a positive effect on students' academic achievement and retention compared to traditional learning approach.

On the other hand, some researchers compared and contrasted various learning with mastery learning. Amiruddin and Zainudin (2015) conducted a study on the effects of a mastery learning strategy on knowledge acquisition among Aboriginal students. The study used a pre-test and post-test control group design on 80 Aboriginal students in Malaysia. The results showed that the mastery learning strategy was more effective than traditional learning approach in enhancing students' knowledge acquisition. In the same context, Masi, Dan, and Bodek (2015) investigated the comparison of mastery learning and traditional lecture –exam models in large enrolment physics course. The results revealed that the mastery-based, self-paced group mean was higher than that of the traditional lecture, recitation, and exam group. Also, compared mastery–based self-paced group and traditional lecture-recitation and exam group, observation and interview results revealed a greater prevalence of deep learning and strategic learning in favor of the mastery-based self-paced group. Along the same line of study, Shafie, Shahdan & Liew (2010) investigated the Mastery Learning Assessment Model (MLAM) in teaching and learning mathematics. The results showed that positive correlation (r=0.77) exists between the MLAM score and the final exam result. Also based on the Teaching Evaluation results indicated majority of the students were satisfied with the approach. Closely related was the study Damavandi, & Kashani (2010) reported that Mastery learning method was effective on the weak students' performance and positive attitudes.

In the context of learning, some researchers correlate mastery learning and attitude, academic performance among others. Mehar & Rana (2012) utilized the experimental and control groups to examine the effectiveness of Bloom's mastery learning model on achievement in economics with respect to attitude towards economics. The study was conducted on the students of 9th Grade from two different schools. At the end of the experiment, the results showed that the treatment group

significantly outperformed the control group and showed a positive attitude towards learning economics. Another experimental study by Davrajoo, et al (2010) reported that the experimental group improved considerably better than the control group in the study enhancing algebraic conceptual knowledge with aid of module using Mastery Learning Approach. Similarly, McCane, Meek & Robins (2017) investigated the Mastery Learning in Introductory Programming. The results showed that the mastery learning model had a significant positive impact on student learning, especially for weaker students. Barr & Wessel (2018) examined rethinking course structure: increased participation and persistence in introductory post-secondary mathematics courses. The study used a combination of mastery learning strategies together with the beneficial effects of small class sizes. Results showed that if the careful planning of the course structure, students can have both positive effect and attitude towards mathematics.

The available research appears to indicate that Mastery Learning is a very effective means for students to master the curriculum. *The review of related literature also showed that when students are provided with an enabling environment of mastery learning could attain a higher academic achievement.*

2. Theoretical Framework

The theoretical framework for this study is based on Behavioral System Family Theory (Bloom, 1968).

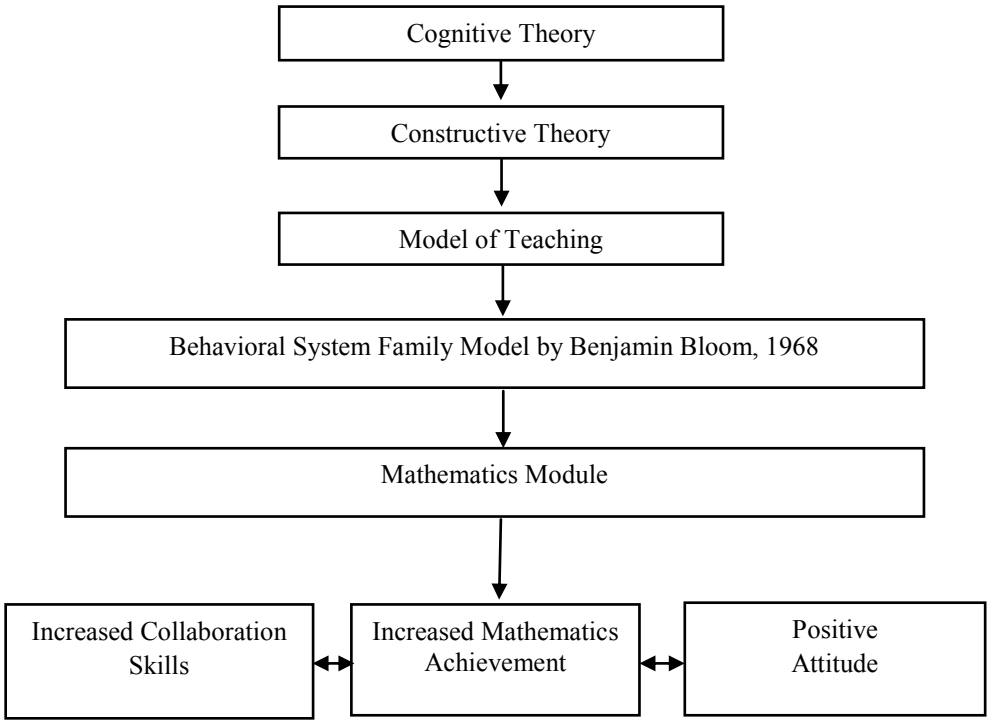

Figure 1.2: Theoretical framework

Figure 1.2 exemplifies an ideal constructivist's classroom where learning is best when there is a collaborative effort of students and classmate.

2.1 Objectives of the Study

The study investigates the effect of the Mastery Learning Approach (MLA) on the students' mathematics academic achievement. Specifically, this sought answers to these questions;

1. What are the Pre-test and Posttest mean scores of students exposed to Mastery Learning Approach (MLA) and traditional teaching method?
2. Is there a significant relationship between the student's attitudes toward mathematics and their academic achievement in mathematics

2.2 Hypotheses

1. There is no significant difference between the pre-test and posttest mean scores of students exposed to Mastery Learning Approach (MLA) and traditional teaching method.
2. There is no significant relationship between the students' attitudes toward mathematics and academic achievement in mathematics.

3. Methodology

The study employed the used of both quantitative and qualitative approaches. The combination of the two approaches is significant for this study. For the quantitative method, the study utilized quasi-experimental design in the non-equivalent control group.

3.1 Non-equivalent Control Group Design

The Non-equivalent Control Group design consisted of a given Treatment and Control Groups, Pretest, Treatment Condition and Posttest. The formula is presented in Table 3 below;

Table 1: The Non-equivalent Control Group Design

Treatment group 1	O_1	X_1	O_2
Control group	O_1	-	O_2

Indicator:
X_1 = Mastery learning Approach,
O_1 = Pre-test, and
O_2 = Post-test

3.2 Treatment Procedure

The regular mathematics teachers of the sampled school were used to carry out the teaching. These teachers and students were trained by the researcher on how to use the module for one week to enable them to master the skills before embarking on the treatment. After this period, the pretest was administered to all the SS1 students according to the grouping. This was followed by the treatment session of the mathematics concepts which lasted three weeks of four lessons period as recommended in the SS1 mathematics syllabus (Gombe, Ministry of Education). Each group was taught using the same mathematics contents. The only difference was Mastery Learning Approach was used for the Treatment Group while Lecture Method was used for the Control Group.

The teacher of the respective group was supervised by both the researcher and research assistance in order to avoid deviation from the lesson procedure outlined. The lesson plans served as a major guide for all teachers in the groups. At the end of the treatment period, a post-test was administered to all the students in the two groups.

3.3 Instruments

There were two instruments used in this study, namely the pre-test and post-test (Indices, Logarithms, Algebra and Simultaneous equations) and Attitudinal Scale. The researcher developed pre-test and post-test based on senior secondary school one curriculum. The test items were derived from the mathematics topics: (algebra, simultaneous equations, indices and logarithms) past questions from West African Examination Council (WAEC) and it consisted of thirty (30) multiple choice items with four options (lettered A-D) which the students were asked to mark the correct answers from the options provided. The pre-test and post-test prepared were validated by four experts (3 senior lecturers and one associate professor) all were from School of Education and Modern Languages to check the grammar used and the content whether or not it reflected the SS 1 syllabus. The pre-test and post-test were based on a table of specification. This Pre-test and post-test were used to assess SS1 students mathematics achievement. The Students Attitudinal Inventory (SAI) was developed to get student response to the activities of the treatment. The instrument consisted of sixteen (12) items that required the student to tick the appropriate item to him/her. The draft of the items was validated by experts from the University of Utara. The final AI was tested for reliability using Kuder Richardson (KR 21) and the reliability coefficient obtained for the instrument was 0.867.

4. Results and Discussion

Results of this research work are presented according to questions asked and their corresponding hypotheses;

4.1 Research Hypotheses 1

There is no significant difference between the pre-test and posttest mean scores of students exposed to MLA and traditional teaching method.

The results are presented in Table 2. The results indicate that control group had a mean achievement score of 8.050 and a standard deviation of 3.096 in pretest while treatment group had a mean and standard deviation of 8.475 and 3.021 respectively in the pretest. Similarly, in posttest, mean achievement score and standard deviation of the control group are 11.375 and 3.801 respectively while mean achievement score and standard deviation of experimental group are 14.850 and 4.555 respectively. The mean difference between pretest and posttest for control and treatment groups are 0.425 and 3.475 respectively. This implies that students taught mathematics using MLA improved in mathematics than those taught with the traditional method.

Table 2: Descriptive Statistics

Teaching Method	N	Mean		Std Deviation	
		Pretest	Post-test	Pretest	Post-test
Mastery Learning Approach (MLA)	40	8.475	14.850	3.021	4.555
Traditional Method	40	8.050	11.375	3.096	3.801
Total	80	8.263	13.113	3.047	4.520

The result of ANCOVA in Table 3, showed that there was a significant relationship exists between pretest (Covariate) and the dependent factor (posttest), $[\![F(1,77) = 5.857,\ \rho < .05]\!]$. However, there was no main effect of fixed factor (Teaching method) and the dependent variable (posttest), $[\![F\ (1,77) = 13.243,\ \rho < .05]\!]$. Therefore, when pretest is statistically controlled teaching method has influence on posttest test. The effect size as indicated by the corresponding partial Eta squared value was $\eta^2 = .147$ which was a medium effect size according to Cohen's conventions (Ary et al. 2010). This value also indicated how much of the variance in the dependent variable was explained by the independent variable. It was also showed that only 7.2% of the variance of the posttest was explained by the variable of teaching method.

Table 3: Analysis of ANCOVA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	338.528[a]	2	169.264	10.219	.000	.210	20.437	.984
Intercept	962.066	1	962.066	58.080	.000	.430	58.080	1.000
PR	97.016	1	97.016	5.857	.018	.071	5.857	.666
GR	219.369	1	219.369	13.243	.000	.147	13.243	.949
Error	1275.459	77	16.564					
Total	15369.000	80						
Corrected Total	1613.988	79						

a. R Squared = .210 (Adjusted R Squared = .189)
b. Computed using alpha = .05

4.2 Research Hypotheses 2

There is no significant relationship between the students' attitudes toward mathematics and academic achievement in mathematics.

Table 4 showed that the mean scores of students' attitude from the treatment group were 12.325 and SD was 1.639. Hence, the mean of students' attitude 12.325 was greater than the hypothesized mean 66. This indicated that students have a positive attitude towards MLA in learning mathematics. There was a significant difference between the sample mean and hypothesized mean on students attitude towards MLA in learning mathematics, t (39) = 47.558, $\rho < .05$, this indicated that students enjoying using MLA.

Table 4: One-Sample t-test on students' attitude

	T	df	Sig (2-tailed)	Mean difference	N	Mean	SD
Students Attitude	47.558	39	.000	12.325	40	12.325	1.639

5. Conclusions

Assessing mathematics students' achievement and attitudes towards the employment of MLA strategies in mathematics contents is useful as it can help enhance the students' academic achievement. The current study has important pedagogical and research implications. Mathematics teachers should discuss the benefits of the strategy and provide opportunities whereby they could use it efficiently in practice.

However, no generalization can be made to other mathematics contexts as we are restricted by our sample size and the sampling procedure confines us from generalizing the findings. Future research could involve a larger sample size, randomly selected subjects and from different country backgrounds. Besides, this study evaluated the learning outcomes of the students using objective multiple-choice items. Therefore, the form of assessment such as essay items could be used to evaluate the learning outcomes of the students.

Finally, the present study is therefore limited to evaluate the learning outcomes of this study immediately after the completion of the treatment. Therefore, it was not possible to find out whether the learning increased reported in this study was a result of short period. To address this, there is the need to conduct a research on a comparison of the level of knowledge retention, between control and treatment group.

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