Effects Of Mastery Learning Strategy On Changing The Attitude Of The Students Towards Mathematics Among Secondary School Students In Machakos County, Kenya

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Abstract: Mathematics is considered as a vital subject that supports the development of critical and logical thinking. It provides effective power to analyze, describe and understand the sciences hence fundamental subject in the school curriculum globally as an instrument for the development of all other sciences. However, majority of students across the world dislike mathematics and stay away from many careers related to mathematics. The students' lack of interest for mathematics could be attributed to poor quality of instruction and the instructional method deployed but not lack of student's ability to learn. The objective of the study was to investigate the impact of mastery learning strategy on changing the attitude of the students towards mathematics in Kenyan secondary schools located in Machakos sub-county. To achieve the objective a sample of one hundred and fifty four (154) form two students from two schools were randomly placed into either the group taught by using Mastery Learning Strategy (MLS), the experimental group or those taught using Conventional Group Learning (CGL), the control group. The two groups were subjected to an attitudinal test towards mathematics before and after the intervention of MLS. The Chi-Square and Z scores test statistics were used to test whether the two groups' level of attitude towards mathematics differed significantly at $\alpha = 0.05$ significance level.

The attitudinal test showed that 36.4% of the students from the experimental group had a negative attitude towards mathematics compared to 58.3% of students from the control group. The computed z score value of |-2.72|was greater than the critical value of z = 1.96 at 5% level of significance, therefore the proportion difference between the two groups was statistically significant. The Chi-Square test confirmed the two groups' level of attitude towards mathematics differed significantly at 95% confidence level.

Therefore the MLS was recommended for changed of attitude towards mathematics among the students. The study recommended a replication of the research to another region and respondents to ascertain the validity and reliability of the findings.

Keywords: Effect, Mastery Learning Approach, Attitude, Students

I. INTRODUCTION

Mathematics though a vital subject is in most cases poorly done and most students dislike it. Despite, the daily needs and the roles played by mathematics in the society, there has been persistent poor performance in the subject worldwide. In United States of America for example, the Program for International Students' Assessment (PISA), reported that students were graded beneath average in mathematics (Ginsburg, Lei wand, & Pollock, 2009). Also in India, students who sat for the same examination emerged second to last in global rating. In Africa, poor performance has also been registered in Mathematics at all levels of education with South Africa, Ghana, Morocco, and Botswana, students ranked

below average in 2010 and 2015 Trends in International Mathematics and Science study. Countries like Nigeria have reported a high failure rate in mathematics. Students in Kenya perform poorly in mathematics and sciences (Changeiywo, 2000). Needless to mention that in Kenya mathematics performance in the national examination is still wanting. The Kenya National Examination Council (KNEC) reported a failure rate of 74.4% and 72.1% in 2008 and 2009 respectively. Nearly ten years later the situation has not changed. The failure rate in mathematics at Kenya Certificate of Secondary Education (KCSE) examination in 2015 and 2016 was reported as 71% and 72.5% respectively.

In Machakos County, Machakos sub-county the situation is not different. The failure rate in mathematics is on average 72.64% meaning a pass rate of 27.36% between the year 2010 and 2017 as indicated in table 1 below.

Year	% Pass	Year	% Pass	Year	% Pass
2010	25.4	2013	28.1	2016	28.2
2011	24.4	2014	29.8	2017	25.7
2012	27.7	2015	29.6		

Source: Sub-County Director of Education Office, Machakos
Table 1: KCSE Mathematics Examination Results in Machakos Sub-County, 2010-2017

It is indicative from the table that something needs to be done about the teaching of mathematics in Machakos sub-county to improve the level of competence which is on average at 27.36%. A new method needs to be tried to see its effect on competence in mathematics in Machakos Sub-County. Otherwise, the students miss out the competencies needed to take their rightful place in the fields of commerce, industry, technology and science just to mention a few. In this technological era, mathematics literacy is a necessary component in that we are constantly called upon to carry out various calculation, make estimates, carry out measurements of various types, make predictions and make sense of the tremendous amount of data.

STATEMENT OF THE PROBLEM

The poor performance is an indicator that the learning of Mathematics may not have been sufficiently adequate. Teachers have potentially strong influence on students learning. As Wambugu observes the teaching approach that a teacher adopts is one factor that may strongly affect students' achievement (Wambugu, 2008). The teacher faced with the job of creating an environment in which each student can develop his potential and attain competence is confronted with a monumental task. This task may be impossible unless the teacher can employ instructional methods and materials sufficiently appropriate for each student to enable him to master the basics of the curriculum (Sharma, 1998). The study, therefore, investigated the Mastery Learning Strategy (MLS) as teaching approach to overcome the challenges faced in the learning of mathematics.

RESEARCH OBJECTIVE

The objective of the study was to determine whether there is a difference in attitude towards mathematics between form two students taught using MLS and those taught using CGL.

RESEARCH HYPOTHESIS

The hypothesis was tested at $\alpha = 0.05$ level of significance.

H_{01}: There is no statistically significant difference in learners' attitude towards mathematics between students exposed to mastery learning strategy and those exposed to conventional group learning.

II. LITERATURE REVIEW

Mastery Learning Strategy is a model where students are expected to master a learning objective or goal, before they can move on to the next goal. Mastery learning is defined in terms of educational objectives which each student is expected to achieve. The term mastery was used by Morrison for the method of securing mastery of a subject matter, in which testing forms the beginning, middle and the end of the teaching-learning process so that teaching may be appropriately adapted to the needs of the learners (Good, 1967). The basic theoretical assumption of mastery learning is that students acquire a foundation of appropriate knowledge to master the next concepts. They are likely to fail if they do not acquire this pre-requisite knowledge, because they do not have the appropriate cognitive skills and sets of information, Mohd Hasril Amiruddin and Fathin Liyana Zainudin(2015). Mastery learning uses differentiated and individualized instruction, progress monitoring, formative assessment, feedback, corrective procedures, and instructional alignment to minimize achievement gaps (Bloom, 1971; Zimmerman & Dibenedetto, 2008).Then instructional and assessment procedures designed to maximize the likelihood that each student will arrive at the desired outcome are selected to help most students in a group to attain specific level of performance. Mastery of each unit is shown when the students acquire the set pass mark of a diagnostic test. Mastery learning strategy (MLS) can help the teacher to know student's area of weakness and correct it thus, breaking the cycle of failure. Results from research studies carried out on Mastery Learning strategy (MLS) suggest that mastery learning strategy (MLS) yields greater interest and more positive attitude in various subjects than Non-Mastery Learning Approaches (Ngesa, 2002; Wachanga and Gamba, 2004 and Wambugu and Changeigwo, 2007). Thus, the method used in teaching by the teacher in class can influence the learners' attitude positively or negatively. This is so because when students relate and discuss freely, there is a high propensity for them to unveil the areas of their learning difficulty which the teacher can utilize in order to improve his classroom teaching, thus, Bloom indicates that it is an effective way to improve student attitudes and interest toward learning, besides helping them to master in specific knowledge [Ozden,2008; Kazu & Ozdemir,2005]. Most of the studies done on MLS and CGL in Kenya focused mainly on achievement in physics, biology, economics to mention a few but not on attitude. These studies were carried out in other counties but not in Machakos County. This study was conducted to address the gap.

THEORETICAL REVIEW

This study was guided by behaviorist theory of learning as initially proposed by B.F. Skinner (1984) where the concept of mastery learning is attributed to the principles of operant conditioning. According to operant conditioning theory, learning occurs when an association is formed between a stimulus and response (Skinner, 1984). Operant conditioning requires the use of reinforcement and punishment. In operant conditioning, reinforcement increases the likelihood that behavior will be repeated (Ntim,2010).In line with the behavior theory, mastery learning focuses on overt behaviors that can be observed and measured (Baum, 2005). In order to demonstrate mastery over each lesson, students must be able to overtly show evidence of understanding of the material before moving to the next lesson (Anderson, 2000). This will build confidence in student especially when they qualify in a unit and move on to the next one. This is likely to motivate the student hence build a positive attitude. Mastery learning strategy (MLS) can help the teacher to know student's area of weakness and correct it thus, breaking the cycle of failure.

III. RESEARCH METHDOLOGY

The study employed quantitative research method since numeric data was required from the participants.

RESEARCH DESIGN

The study applied Quasi-experimental research in which the researcher used Solomon's four Non-Equivalent Control group Design. The design identified a comparison group that was as similar as possible to the treatment group in terms of characteristics. Also the design was employed because of the non-random assignment of students to the groups.

Group	Design	Group	Pre-test	Treatment	Post-test
I	Experimental	E_1	O_1	X	O_2
II	Control	C_1	O_3	-	O_4
III	Experimental	E_2	-	X	O_5
IV	Control	C_2	-	-	O_6

Table 1: Solomon's Four Non Equivalent Control Group Design (as Adapted from Shuttle worth 2009)

SAMPLING TECHNIQUES AND SAMPLE SIZE

Two public secondary schools in Machakos County were sampled through simple random sampling among those with at least two streams. Two form two streams were randomly sampled from each participating school which had more than two streams. Out of the two sampled streams from each school, random sampling was done to allocate one stream to the treatment group (E_1&E_2) and the other to the control group (C1 and C2) to a total of at least one hundred and sixty (160) Form 2 mathematics students. Finally, the Mathematics teacher of the stream that acted as the control group in each school was purposively sampled. These particular teachers were involved because the study required the teacher who had

been teaching a given class to continue teaching the same class during the period of the study.

RESEARCH INSTRUMENTS

The respondents were subjected to likert scaled questionnaire to reveal and establish their attitudes towards mathematics. The scale was developed and standardized by Bedi (1992). It was adapted by the investigator.

QUESTIONNAIRE FOR STUDENTS

The students' questionnaire reflected a Five Likert Scale where they ticked in the choice box that matched their reponse on attitude towards mathematics from the five given responses that included Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree(SD).The instrument had 21 closed ended questions on attitude. The minimum score for each item was 1 and the maximum was 5.

IV. RESEARCH FINDINGS

The guiding objective of the study was to determine whether there is a difference in attitude towards mathematics between form two students taught using MLS and those taught using CGL.

The Z scores test statistics, Analysis of Variance (ANOVA) and Chi-Square were used to test whether the two groups' attitude towards mathematics differed significantly at $\alpha = 0.05$ significance level and thereafter determine the relevance of treatment or MLS. The respondents were subjected to likert scaled questionnaire to reveal and establish their attitudes towards mathematics before and after the MLS intervention.

THE PROPORTIONS OF THE STUDENTS WITH NEGATIVE ATTITUDE PRIOR TO MLS

The analysis of the student's attitude towards mathematics was conducted using each student response on the questionnaire items prior to the mastery learning strategy introduction. The result findings are summarized in table 2.

Attitude	Class		Total
	Experimental	Control	
Negative	27	47	74
Positive	47	33	80
Total	74	80	154

Table 2: Attitude towards Mathematics per Class

The results after carrying out the computation to determine the attitude of the respondents towards mathematics are given in table 2. The number of students with a negative attitude from the experimental class was 27 out of 74 randomly sampled students forming 36.4% while those with a negative attitude from the control class was 47 out of 80 randomly sampled students' constituting 58.3%. Taking the hypothesis that there was no significant difference in the attitude towards mathematics between the two samples of the

students, i.e., $\pi_1 = \pi_2$. Z statistics was used to test the hypothesis;

$$H_0 : \pi_1 = \pi_2 \quad versus$$

$$H_1 : \pi_1 \neq \pi_2$$

The computed value of z=-2.72 was greater than the critical value of $z = 1.96$ at 5% level of significance, therefore, hypothesis is rejected. Hence, there is significant difference in attitude between the control and the experimental class with the control group having the higher proportion of students with negative attitude towards mathematics compared to the experimental group of students.

THE PROPORTIONS OF THE STUDENTS WITH NEGATIVE ATTITUDE POST THE MLS

The analysis of students with the negative attitude towards mathematics was conducted per class. Table 3 gives the summary of the respondents' distribution per class and the attitude distribution.

Attitude	Class		Total
	Experimental	Control	
Negative	13	53	66
Positive	61	27	88
Total	74	80	154

Table 3: Attitude per Class

The number of students with a negative attitude from the experimental class was 13 out of the 74 randomly sampled students forming 19.7% of the students with a negative attitude towards mathematic after the MLS implementation. The control class had 53 out of the 80 randomly sampled students constituting 80.3% of the students having a negative attitude towards mathematics after the MLS intervention. Taking the hypothesis that there was no significant difference in the attitude towards mathematics between the two samples of the students from the two classes, i.e., $\pi_1 = \pi_2$. Z statistics was used to test the hypothesis;

$$H_0 : \pi_1 = \pi_2 \quad versus$$

$$H_1 : \pi_1 \neq \pi_2$$

The computed value of $z = -6.103$ was greater than the critical value of $z = 1.96$ at 5% level of significance, therefore, the null hypothesis was rejected. Hence, there was significant difference in attitude between the control class and the experimental class, whereby the control class had the higher percentage of the students with a negative attitude towards mathematics after the MLS implementation.

A tremendous improvement of and a huge shift of the students was noted from negative attitude to positive attitude towards mathematics among the students in the experimental class. Initially 36.4% students had a negative attitude but after the MLS intervention the percentage reduced to 17.6%. These findings were in tandem with Emin (2005) results after investigating the effects of mastery learning and cooperative, comparative and individualistic learning environment organizations on achievement and attitudes in mathematics on 158 students in mathematics. His results indicated that mastery learning improved students achievement and yields greater positive attitudes.

CHI-SQUARE ANALYSIS ON GROUPS' ATTITUDE

A Chi-square test was conducted between the control and the mastery learning strategy group's attitude difference. The observed and the expected values were entered as in table 4.

Class		Attitude		Total
		Negative	Positive	
Experimental	**Observed**	13	60	**73**
	Expected	31.9	41.7	**73.6**
Control	**Observed**	54	27	**81**
	Expected	35.1	45.3	**80.4**
Total		**67**	**87**	**154**

Table 4: Contingency Table on Attitude Proportions

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} = \frac{(13 - 31.9)^2}{31.9} + \cdots + \frac{(27 - 45.3)^2}{45.3} = 35.48$$

The calculated chi-square value was 35.48 which was greater than the tabulated chi-square value at 5% significance level with 2 degree of freedom (3.84). Therefore there was statistically significant difference with regard to attitude towards mathematics whereby the control group had more students with negative attitude compared to the group taught using the mastery learning strategy.

Test statistics	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	35.470[a]	1	0.000		
Continuity Correction[b]	34.556	1	0.000		
Likelihood Ratio	37.355	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-Linear Association	36.231	1	0.000		
N of Valid Cases	154				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.35.

b. Computed only for a 2x2 table

Table 5: Chi-Square and P-value Table on Attitude Proportions

Based on the P-values (0.000) which was less than the critical value 0.05, the null hypothesis that stated that, *there is no statistically significant difference in learners' attitude towards mathematics between students exposed to mastery learning strategy and those exposed to conventional group learning* was rejected at $\alpha = 0.05$ and the conclusion was there was statistically a significant difference between the two groups with regard to their attitude towards mathematics.

According to many researchers in the field, the positive or negative attitudes of students affects their success levels in mathematics classes in a positive or negative way (Peker & Mirasyedioğlu, 2003). Perhaps the most important factor which influences mathematics success levels of students is the students' attitude towards mathematics classes. As educators

we always seek to improve the student learning experience. One way to tackle this issue is to consider students' attitudes towards mathematics. Motanya (2018) in his study discovered a direct relationship between performance in mathematics and the attitude of a student. Student with positive attitude perfom well in mathematics while those with negative attitude perform poorly and they even lack basic mathematical concept. Tukur *(*2018) conducted a study on the effect of mastery learning strategy in enhancing the academic achievement of mathematics in Nigeria. The results exemplified that there is a significant relationship between the students' attitudes toward mathematics and their academic achievement in mathematics. The results, therefore, indicated that mastery learning improved students achievement and yields greater positive attitudes.

V. CONCLUSION AND RECOMENDATIONS

CONCLUSIONS

The summary of the findings above indicate that the Mastery Learning Strategy (MLS) influences the students attitude towards mathematics positively. This is because the MLS aids the students in securing mastery of a subject matter. The basic theoretical assumption of mastery learning is that students acquire a foundation of appropriate knowledge to master the next concepts. They are likely to fail if they do not acquire this pre-requisite knowledge, because they do not have the appropriate cognitive skills and sets of information required. Also Mastery learning strategy (MLS) can help the teacher to know student's area of weakness and correct it thus, breaking the cycle of failure. This yields greater interest and more positive attitude towards the subject. This is so because when students relate and discuss freely, there is a high propensity for them to unveil the areas of their learning difficulty which the teacher can utilize in order to improve his classroom teaching.

RECOMMENDATIONS

Based on the study findings and the preceding conclusions, the following are recommended.

POLICY RECOMMENDATIONS

The mastery learning strategy implementation impacted the negative attitude towards mathematics significantly. The positive attitude towards mathematics motivates the students to learn and improve. Therefore the mastery learning strategy that focuses and advocates on encouraging a variety ways of teacher-student interaction should be practiced.

KICD to introduce and develop a programme for the induction and mentorship of mathematics teachers on the implementation of MLS.

RECOMMENDATIONS FOR FURTHER RESEARCH

The study can be replicated in other counties in order to give a reflection of the whole country. This will facilitate better decision making on ways of improving mathematics competence among the students.

The investigation of this study was carried out for mathematics performance. It can also be carried out for other subjects in the school curriculum and more variables may be included since there is enormous scope and need for further work in all areas of the curriculum.

REFERENCES

[1] Anderson, L. (2000). An empirical investigation of individual differences in time to learn. Journal of Educational Psychology, 68, 2, 226-233.

[2] Baum, W. M. (2005). Understanding Behaviorism: Behavior, Culture and Evolution. Malden, MA: Blackwell Publishing.

[3] Bedi, S. (1992). Classroom interaction pattern in relation to some teacher characteristics and their effect on learning outcomes of science students at high school level, Unpublished Doctorial Dissertation, Department of Education, Panjab University, Chandigarh.

[4] Bloom, B. (1971). Mastery learning and its implication for curriculum development; In E.W. Eisner (ed.). New York: Holt, Rinehart, & Winston.

[5] Changeiywo, J.M. (2000). Students' image of science in Kenya: A Comparison by gender difference of Schooling and Regional Disparities. Unpublished PhD Thesis, Egerton University Kenya.

[6] Ginsburg, A., Leinwand, S., Noell, J., & Pollock, E. (2009). Reassessing US international mathematics performance: New findings from the 2003 TIMSS and PISA. Collection Digital Eudoxus, (22).

[7] Good, R. & Cox, D. and (1967) How to Build a Marketing Information System. Harvard Business Review, May-June, 145-154. ftp://donnees.admnt.usherbrooke.ca/Mar851/Lectures/IV

[8] Kazu I. Y., Kazu H., and O. Ozdemir, 2005. "The effects of mastery learning model on the success of the students who attended: usage of basic information technologies course," Educational Technology & Society, vol. 8 no. 4, pp. 233-243.

[9] KNEC (2008). Kenya certificate of secondary education examination report. Nairobi, Kenya: Kenya National Examinations Council.

[10] KNEC (2009). Kenya certificate of secondary education examination report. Nairobi, Kenya: Kenya National Examinations Council.

[11] KNEC (2015). Kenya certificate of secondary education examination report. Nairobi, Kenya: Kenya National Examinations Council.

[12] KNEC (2016). Kenya certificate of secondary education examination report. Nairobi, Kenya: Kenya National Examinations Council.

[13] Mohd H. A. & Fathin L. Z.(2015). The Effects of a Mastery Learning Strategy on Knowledge Acquisition Among Aboriginal Students: An Experimental Approach. International Journal of Vocational Education and Training Research. Vol. 1, No. 2, pp. 22-26. doi: 10.11648/j.ijvetr.20150102.12

[14] Motanya, B.N. (2018). Impact of students of students' attitude on mathematics performance among public secondary school students in Masaba North Sub-Couty, Nyamira County, Kenya. PGD in Education Project. Nairobi University.

[15] Ngesa, F.U. (2002). Impact of Experiential and Mastery Learning Programmes on Academic Achievement in Secondary School Agriculture. Unpublished PhD Thesis, Egerton University, Kenya.

[16] Ntim, S. K. (2010). Theory and Methods of Education: Psychological Perspectives on Learning. Takoradi: St. Francis Press Ltd.

[17] Ozden M., 2008 "Improving science and technology education achievement using mastery learning model," World Applied Sciences Journal, vol. 5 no. 1, pp. 62-67.

[18] Peker, M., & Mirasyedioğlu, Ş. (2003). Lise 2. sınıf öğrencilerinin matematik dersine yönelik tutumları ve başarıları arasındaki ilişki. Pamukkale Üniversitesi Eğitim Fakültesi Dergisi. 14(2).

[19] Sharma R. (1998). The effect of mastery learning strategies on the learning outcomes on secondary students in relation to stress in Chandigarh, India. Unpublished Ph.D. thesis. Panjab University.

[20] Tukur M. Y. (2018). Mastery Learning Approach (MLA): its effects on the students mathematics academic achievement. European Journal of Alternative Education Studies: Volume 3, Issue 1

[21] Wachanga, S.W., & Gamba, P.P (2004). Effects of Mastery Learning Approach on Secondary School Students' Achievement in Chemistry in Nakuru District Kenya

[22] Wambugu, P.W., & Changeuywo, J.M., (2007). Effects of Mastery Learning Approach on Secondary School Students' Physics Achievement. Journal of Educational Research, 4, 185-201.

[23] Wambugu, P. W. & Changeiywo, J. M. (2008). Effects of mastery Learning Approach on Secondary School Students' Physics Achievement. Eurasia Journal of Mathematics, Science & Technology Education, 4(3), 293-302.

[24] Zimmerman, S.K., & Dibenedetto, G.T., (2008). Mastery learning and contemporary issues in education. Action in Teacher Education, 23(1), 42-51.