Effects of Mastery Learning Strategy on Self-Efficacy Concept of Secondary School Mathematics 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 this study were to investigate the impact of mastery learning strategy on enabling the students improve on their self-efficacy when solving a mathematics problem in Kenyan secondary schools located in Machakos sub-county. To achieve the objectives 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 the level of self-efficacy test 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 self-efficacy differed significantly at $\alpha = 0.05$ significance level. Based on the study findings, slightly more than half, 60% of the control class had clear set self-efficacies elements compared to 91.8% of the experimental group. The proportionate difference was statistically significant at $\alpha = 0.05$ significance level with the calculated chi-square value $\chi^2 = 15.2$ which was greater than the critical value of 3.84 at $\alpha = 0.05$ with 2 *df*. Therefore the MLS was recommended as a sure strategy to boost the morale and self-efficacy 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.**

Key words: **Effects, Mastery Learning Approach, self-concept, learning outcome, mathematics 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 et al. (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.

Table 1: KCSE Mathematics Examination Results in Machakos Sub-County,2010-2017

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.

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. It means that the poor performance in mathematics will inhibit participation in many occupations and career development.

A Statement of the Problem

The poor performance is an indicator that the learning of Mathematics may not have been sufficiently adequate. Several factors have been proposed to contribute to poor performance by various studies; however the instructional practices have not been exhaustively established. An effort by both the students and the teachers towards improving this situation by use of conventional methods has not been impressive. 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 & Changeiywo 2008). Performance in mathematics examination, which is a reflection of the level of competence, has been consistently low as agued in the preceding section. The low grades may be improved if the learning of the subject is enhanced by improving the instructional practices. KNEC (2008) cites that ineffective teaching leads to inability to master simple and basic concepts as a reason for poor performance in mathematics. It was the purpose of the study therefore, to examine the degree to which mastery learning strategy influenced the learning of mathematics as compared to the conventional group learning. This method of teaching had not been tried out in mathematics teaching and learning in Machakos sub-county where performance in the subject has continued to decline. The current study investigated the effects of MLS on mathematics competence and as a teaching approach to overcome the challenges faced in the learning of mathematics in Machakos Sub-county, Kenya.

B. *Purpose of the Study*

The Purpose of this study was to investigate the effect of Mastery Learning Strategy on Mathematical Competence among Secondary School Students in Machakos Sub-County Kenya**.**

C. *Research Objective*

The objective of the study was to assess the variation in Self-concept between students taught using Mastery Learning Strategy and those taught using the conventional methods in mathematics.

D.*Research Hypothesis*

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

H_{04}: There is no statistically significant difference in self-efficacy 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 and Fathin (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. In the same vein, Wibler et al (1981) in Wambugu and Changeiywo (2007) opined that MLS helps the students to acquire prerequisite skills to move to the next unit.

Self-efficacy is about having the strong, positive belief that you have the capacity and the skills to achieve your goals. . The success in learners' lives depends not only on cognitive ability, but also on emotional skills. The quality of interactions may contribute or weaken the self-concept of the learner. Academic self-concept, or one's perception of self as learner, was considered part of the affect a learner brought to a task. Stevens, Olivarez, and Hamman conclude that "self-efficacy and the sources of self-efficacy were stronger predictors of mathematics achievement than general mental ability" (as cited in Siegle & McCoach, 2007). The finding indicated that teachers' positive feedback affects achievement of a student and has a big influence on the self-concept of a student. In MLS the teachers' feedback is frequently used during remediation. This means that the teacher should give feedbacks that enhance students' self-efficacy. High mathematics self-efficacy correlates with greater persistence on long and difficult problems, and greater accuracy of computation (Hoffman & Schraw, 2009). Compared to their peers, students with higher levels of self-efficacy also have higher levels of general achievement in mathematics, more easily overcome negative outcomes, display more positive attitudes towards mathematics, and possess a more comprehensive understanding of mathematics (Phan, 2012). It is particularly exciting to note that teaching strategies used in the classroom can and do make a difference to students' self-efficacy. (Fencl & Scheel, 2005).The study will investigate the impact of the MLS in teaching mathematics on students self-efficacy. No study has investigated the effects of MLS on self-concept in Machakos county. This study was conducted to address the gap.

A. *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 have a positive impact on students self-efficacy. 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.

A. 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 (Khandker, Shahidur R. et al.2010) The quasi-experimental design compared control groups, which was taught mathematics using the conventional teaching methods with experimental groups which was instructed mathematics using MLS.

Table 2: Solomon's Four Non Equivalent Control Group Design (as Adapted from Shuttle worth 2009)

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	X	X	O_5
IV	Control	C_2	-	-	O_6

Key: E_1 & E_2 - Experimental group
     C_1 & C_2 - Control group
     O_1 & O_3 - Observation at pretest phase
     O_2, O_4, O_5, O_6 - Observation at post test phase
     (X)   - Indicates treatment
     (----)   -Indicates the use of non-equivalent group

B. 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 which lasted for two weeks.

C. Research Instruments

The instrument used in this study was a students' questionnaire on self-concept. The student questionnaire reflected a five Likert scale where the students ticked against the square of the question a choice marching their self-concept attributes from five given responses which included Strongly Agree (SA), Agree (A), Not Sure (NS), Disagree (D), and Strongly Disagree (SD). The instrument had a total of 15 closed-ended questions items adopted from National Foundation for Educational Research of the University of London. The minimum score for each item was one (1) and the maximum score for each item was five (5).

Self-concept consists of four indicators: self-image, self-identity. self-esteem and role-perfomance as indicated in table 3. It was adapted from the National Foundation for Educational Research of the University of London and was filled out by each student.

Table 3: Respondents Self-Concept test

	STATEMENTS OF SELF CONCEPT	SA	A	NS	D	SD
	Scale 1:Self –Image	5	4	3	2	1
1	Success in the life of a student is achieved through positive thinking.					
2	The use of mastery learning strategy enhances the way I see myself.					
3	The use of mastery learning strategy provides a good learning environment for me.					
	Scale 2:Self-Identity					
4	I perform well because I believe in my ability.					
5	Mastery learning strategy stimulates my coming up with new ideas which makes me proud of mathematics.					
6	The style of thinking and working in mathematics makes me like the subject.					
7	Learning occurs when I am actively involved in finding out.					
	Scale 3:Self Esteem					
8	My liking of mathematics is improved by Mastery learning strategy which I enjoy most.					
9	Feedback/corrections and reinforcement based learning builds my confidence.					
	Scale 4:Role Performance					
10	The teachers' response to my question in class when am performing a practical activity affects my achievement.					
11	I believe that participation in learning develops knowledge which guarantees me the highest level of development.					
12	My mathematics teacher has played an important role in boosting my performance in mathematics.					

Data Analysis

The quantitative data was generated by the study. Data from the questionnaire was sorted, edited, coded and analysed by the researcher. The Z scores test statistics and Chi-Square were used to test whether the two groups' level of self-efficacy differed significantly at $\alpha = 0.05$ significance level using the Statistical Package for Social Sciences (SPSS) and thereafter determine the relevance of treatment or MLS.

IV. RESEARCH FINDINGS

The guiding objective of the study was to assess the variation in Self-concept between students taught using Mastery Learning Strategy and those taught using the conventional methods. The hypothesis was examined by the percentage frequencies, the Z-test and the Chi-square.

Table 4 gives the summary of the status of the respondents' self-efficacy per class.

Table 4: Self Efficacies per Class

Self-Efficacy	Class		Total
	Control	Experimental (MLS)	
High	65	40	105
Low	40	09	49
Total	105	49	154

Based on the self-confession as reflected in the completed questionnaire the respondent could be categorized into two groups; those with a strong, positive belief that they had the capacity and the skills to achieve their goals, termed as having high self-efficacy and those who did not have, termed as having low self-efficacy. Slightly more than half, 62% ($\frac{65}{105} \times 100\%$) of the control class had high self-efficacies elements. However, the experimental class had a higher percentage of 81.6% ($\frac{40}{49} \times 100\%$). Taking the null hypothesis that there was no significant difference in the level of self-efficacy towards mathematics between the two samples of the students, i.e., $\pi_1 = \pi_2$. Z statistics was used to test the hypothesis;

$H_0 : MLS = Conventional \ \ versus$

$H_1 : MLS \neq Conventional$

The computed value of *z*= -4.587 was greater than the critical value of $z = 1.96$ at 5% level of significance, therefore, the null hypothesis was rejected.

Table for values of z at 5% significant level

Computed value	Critical value
-4.587	1.96

Hence, there was a significant difference in self-efficacy towards mathematics between the class taught by MLS and the

class taught using the conventional method with the students taught using the MLS having higher self-efficacy.

These findings were in tandem with Green et al. (2006), report that positive self-concept is an extremely important goal for educational programs to promote and help to link positive outcomes including higher academic achievement and effort. The study findings confirmed; Hendy et al. (2014) recommendations that MLS should be deployed as a teaching strategy to boost self-efficacy of the students in mathematics achievement. Slightly more than half, 60% of the control class had clear set self-efficacies elements. However, the experimental class had a higher percentage of 91.8%. About less than half, 44.8% of the control class confessed role performance affected their mathematics performance. However, the class taught using the MLS had a higher percentage of 95.9%. The self-identity presence was quite evident to 91.8% of the students taught using MLS compared to 68.6% of the students taught using the conventional methods. About half, 53.3% of the students taught using the conventional methods had a positive self-image compared to 89.8% of the students taught using the MLS. These findings were inline with Faithi-Ashtiani *et al*, (2007) documented findings that academic achievement of students with low self-esteem is perceptibly less than the average of those with high self esteem.

Chi- Square Analysis on Self-efficacy

Self-efficacy analysis was carried out among the respondents using the Chi-Square test statistics and table gives the summary of the observed and the expected values of the respondents' self-efficacy per class.

Table 5: Contingency Table on Self Efficacies per Class

Class		Self-Efficacy		
		Clearly Set	Not Clear	Total
Experimental	Observed	45	4	49
	Expected	34.7	14.2	48.9
Control	Observed	64	41	105
	Expected	74.3	30.8	105.1
Total		109	45	154

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} = \frac{(45 - 34.7)^2}{34.7} + \cdots + \frac{(41 - 30.8)^2}{30.8} = 15.2$$

The calculated chi-square value was 15.2 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 self-efficacy towards mathematics whereby the group taught using the MLS had a bigger proportion of the students with clearly set self-efficacy compared to the group taught using the conventional ordinary methods.

Table 6: Chi-Square and P-value Table on Self Efficacies

Test statistics	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.228[a]	1	0.002		
Continuity Correction[b]	17.740	1	0.005		
Likelihood Ratio	20.822	1	0.001		
Fisher's Exact Test				0.002	0.002
Linear-by-Linear Association	19.120	1	0.003		
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

Based on the P-value (0.002) which was less than the critical value 0.05, the null hypothesis was rejected at $\alpha = 0.05$ and the conclusion was there was statistically a significant difference between the two groups with regard to their self-efficacy towards mathematics.

It is particularly exciting to note that teaching strategies used in the classroom can and do make a difference to students' self-efficacy (Fencl & Scheel, 2005).This was the case in this study where MLS had a positive impact in teaching mathematics on students self-efficacy. Bandura(1997) also noted that "The most effective way of developing a strong sense of efficacy is through mastery experiences". Therefore the null hypothesis, H$_{04}$: *There is no statistically significant difference in self-efficacy towards mathematics between students exposed to mastery learning strategy and those exposed to conventional group learning* was rejected.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

A. Summary

1.*Difference in self-efficacy between students taught using MLS and those taught using CGL*

The study investigated the effect of mastery learning strategy on students' self-efficacy and found out that 62% of the students in the control group had a positive self-efficacy but the experimental group had a higher percentage of 81.6 %. The difference was statistically significant at 5% level of significance given that the computed *z* value (|-4.587|) was greater than the critical *z* value (|1.96|) implying that there was a significant difference in self-efficacy towards mathematics between the class taught by MLS and the class taught using the conventional method with the students taught using the MLS having higher self-efficacy.

Further Chi-square tests analysis confirmed the significant difference in self-efficacy towards mathematics between students taught using MLS and those using CGl. A computed Chi-square value of 15.2 and a P-value of 0.002 surpassed the critical values of 3.84 and 0.05 respectively. Hence statistically

there was a significant difference between the two groups with regard to their self-efficacy towards mathematics.

B. Conclusion

The summary of the findings above indicate that the Mastery Learning Strategy (MLS) influences the students' self-efficacy towards mathematics positively. In that in MLS the teachers' feedback is frequently used during remediation. This means that the teacher should give feedbacks that enhance students' self-efficacy. The teachers' positive feedback affects achievement of a student and has a big impact on the self-concept of a student. In mastery learning strategy students are expected to master a learning objective or goal, before they can move on to the next goal. This did build the students' confidence and hence their self-efficacy which led to an improvement in mathematics performance as indicated in the students' exit performance after the MLS implementation that brought mastery experiences**.** Bandura also noted that "The most effective way of developing a strong sense of efficacy is through mastery experiences,". That Students' successful experiences boost self-efficacy, while failures erode it. This is the most robust source of self-efficacy. This is in line with MLS which advocates the mastery experiences where by a student progresses to the next unit after mastery of the previous unit.

C. Recommendations

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

1.*Policy Recommendations*

One of the mastery learning strategies is to build and boost the learner self-efficacy, morale and confidence in handling mathematical challenges and problems. It is recommended that the teachers of mathematics should be taken through the mastery learning strategy content through in service training to improve on how to handle especially slow learners in a classroom set up.

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

2.*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..

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