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Effects of Mastery Learning Strategy on Mathematical Competence among Secondary School Students in Kenya

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Abstract: **-** Despite the fact that Mathematics is considered as a vital subject that supports the development of critical and logical thinking., 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 ability to learn. The purpose of the study was to establish the effect of Mastery Learning Strategy on Mathematical Competence among Secondary School Students in Machakos Sub-County Kenya. The objective of the study was to investigate the impact of mastery learning strategy on improving the students' mathematical competencies. 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 a competence test before and after the intervention of MLS. The Analysis of Variance (ANOVA) was used to test whether the two groups' level of competence test achievement in Mathematics, differed significantly at $\alpha = 0.05$ significance level. The analysis of variance indicated that the mean score difference was significant at $\alpha = 0.05$ as evident by the Fishers ratio and p-value of $F = 12.334 > F_{0.05,\ 1,\ 152} = 3.90$ and $(\Pr = 0.023 < 0.05)$ respectively. Therefore, the MLS was recommended for improved competence performance. The study recommended a replication of the research to another region and respondents to ascertain the validity and reliability of the findings.

Key Words: Mastery, learning strategy, competence test achievement, mathematical competence

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, Leiwand, Noell & Pollock, 2009). 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 (Tukur, 2018). Needless to mention that in Kenya mathematics performance in the national examination is still wanting. The Kenya National Examination Council (KNEC) reported a pass rate of 24.6% and 26.8% in 2019 and 2020 respectively. Kenya is divided into counties and Machakos County, where the researcher was conducting the study, is one of the forty-seven counties in Kenya. In this county, that is, Machakos County in Machakos sub-county the situation is not different. The failure rate in mathematics is on average 75.4% meaning a pass rate of 24.6% between the year 2017 and 2021 as indicated in table 1 below.

Table 1 KCSE Mathematics Examination Results in Machakos Sub-County,2017-2021

Year	% Pass	Year	% Pass
2017	25.7	2020	22.8
2018	26.1	2021	23.7
2019	24.8		

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 24.6% between 2017 and 2021. Explanations for poor performance in Mathematics have indicated that the following factors are significant: students' attitude and characteristics (Peker & Mirasyedioğlu, 2003) ;student entry behaviour (Bloom, 1976); use of recommended textbooks (Adedjei & Owoeye 2002) and teaching methods or the

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way the teacher presents an activity or concept, strongly influences the way the learners react to it Carabbacan (2003 in Ayap,2007). This study addressed only the teaching methods as a factor that leads to students' competence in Mathematics. As Wambugu and Changeiywo (2008) observes the teaching approach that a teacher adopts is one factor that may strongly affect students' achievement.

A new method, other than the conventional or traditional methods used by the teachers, needs to be tried to see its effect on students' competence or score 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.

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 & Changeiywo, 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/her to master the basics of the curriculum (Sharma, 1998).

The study, therefore, investigated the Mastery Learning Strategy (MLS) as a teaching approach to overcome the challenges faced in the learning of mathematics. Guskey (2007) reported that Bloom hypothesized that a classroom with a mastery learning focus as opposed to the conventional form of instruction would reduce the achievement gaps between varying groups of students. To facilitate this process, there are some common practices exhibited across mastery learning classrooms. First, complex full units are broken into smaller subunits that are short enough to measure understanding rapidly (Block 1971; Diegelmann---Parente, 2011). The subunits have discrete and measurable outcomes. The material for the students to learn is presented in a logical sequence that increases in conceptual complexity. Students remain with one skill or concept until they master it and then move on to the next subunit. Each subunit has a formative assessment attached to it to measure student mastery. If students show mastery, they move on to enrichment activities (Diegelmann---Parente, 2011). If mastery is not yet achieved, the teacher can target students who need reinforcement of concepts (Block,1971). In mastery learning classes, correctives techniques are adapted to the specific weaknesses of each individual student, while in traditional classes, no additional opportunities are provided for students to improve the course work (Mevarech, Kramarski, Lieberman, 2001).To be effective, these corrective activities must be qualitatively different from the initial instruction by offering effective instructional approaches and additional time to learn. Then another formative assessment is administered. Figure 1 below illustrates this instructional sequence.

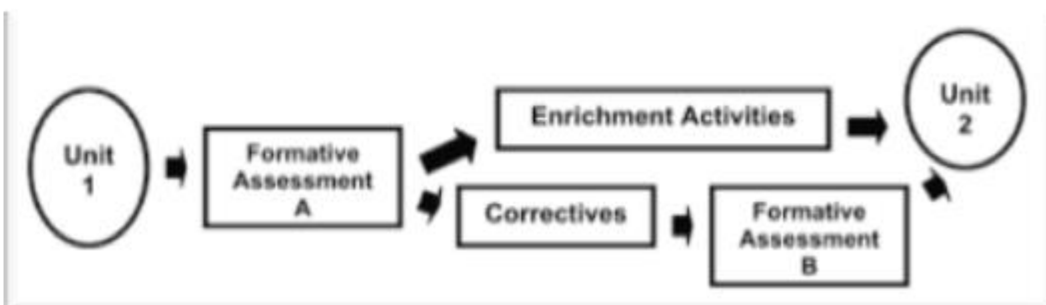

Figure 1: Mastery Learning Instruction Process (Guskey, 2005)

In the mathematics teaching strategy, teaching from simple to complicated, concrete to abstract, and real to imaginary has been recommended as the best course of action (Richardson,2020).

According to Stephen (2020), mathematics mastery is a teaching and learning strategy that enables students to gain a profound gra sp of mathematics rather than only being able to memorize formulas or rely on note-taking.

The findings of Furo (2014) and Lamidi, Oyelekan, and Olorundare (2015), who investigated the effects of mastery learning on students' academic performance in chemistry, discovered high academic achievement by students. Also an enhanced academic achievement was exhibited by students in geometry under the effect of mastery learning when Abakpa and Iji (2013) compared mastery learning with conventional teaching. In another study, Ihendinihu (2013) discovered that students who were taught using the MLS teaching method achieved statistically significant higher scores in the achievement test, not only for higher ability pupils but also for low achievers.

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Tukur (2018) conducted a similar study on the effect of mastery learning strategy in enhancing the academic achievement of Mathematics in Nigeria. The results of the study revealed that 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 was a significant effect on the academic achievement of the experimental group in which the MLS had been introduced. As such, students exposed to MLS performed better than those taught in the conventional teaching method (CGL).

This leads to the conclusion that mastery learning strategy can yield better results in the learning of mathematics than the conventional or the traditional method and therefore it can be used to improve the mathematics results in Machakos Sub County.

Objective of the Study

To compare the level of achievement on a mathematics competence test of students taught using mastery learning strategy and those taught using the conventional group learning or the traditional method.

Hypotheses of the study

There is no significant difference in the achievement of Mathematics competence test of students who were taught using the mastery learning strategy (MLS) and those who are taught using the conventional group learning (CGL).

II. Methodology

The study adapted Quasi Experimental Research (Solomon four non-equivalent group) design because of the non-random assignment of students to the groups. The design was also used to assess the effect of the treatment. The interaction between selection and treatment was controlled by ensuring that the administration of instruments across the groups was kept as similar as possible (Cohen, Manion, & Morrison, 2007). 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. This design has an advantage over others since it controls the major threats to internal validity except those associated with interaction and history, maturity and instrumentation (Wambugu and Changeiywo, 2008).

Solomon's Four Non-equivalent Control Group Design

The design helped to assess the effect of the experimental treatment relative to control conditions, interaction between pre-test and treatment conditions. Also to assess the homogeneity of the group before administration of the treatment and it offers the benefit of comparison between groups because of the naturally occurring treatment group (Cohen, Manion & Marrison, 2007). Solomon's four-group enables the researcher to make a more complex assessment of the cause of the change in the dependent variable and even tell whether changes in the dependent variables are due to the interactions effect between the pre-test and treatment (Randolph, 2008).

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_2	-	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

In Solomon's Four Non Equivalent Control Group Design the dotted lines signify that the four groups are non-equivalent. X is the treatment where students were taught using MLS. O_1 and O_3 are pre-tests while O_2, O_4, O_5, O_6 are post-tests.

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The respondents were randomly organized into four groups. Experimental groups as E_1 and E_2, control group as C_1 and C_2. Experimental groups I and III were taught using MLS while those in the control groups II and IV were taught using conventional teaching method. Prior to treatment only E_1 and C_1 were exposed to pre-test (O_1 & O_3) .After two weeks of instruction, all the groups were post-tested (O_2,O_4,O_5 & O_6). The post-test O_5 and O_6 helped the researcher to identify if there were any interaction between pre-testing and treatment. Pre- test and post-test helped in controlling the intervening variables of history and maturation of variables with the research period.

Sampling Techniques and Sample size

The sample is regarded as the representative of the population when the statistical inferences about the population can be made from the respondents of the sample. When dealing with people, it can be defined as a set of respondents (people) selected from a large population for the purpose of a survey or study.

The sampling techniques used in this study include: purposive sampling and simple random sampling. Out of all the schools both public and private secondary schools the public secondary schools were purposively sampled and out of all these public secondary schools mixed secondary schools were purposively sampled. Two Mixed public secondary schools were then sampled through simple random sampling among those with at least two streams. Two form two streams were randomly sampled from each of the sampled schools. Out of the two sampled streams from each school, random assignment was done to allocate one stream to the treatment group and the other to the control group. So for each of the sampled school had one form two stream serving as a control group and the other as an experimental group. In total there were four groups where two were experimental and two were control. This gave a total of one hundred and fifty four (154) students. The teachers from the respective schools were teaching the control groups while the researcher was teaching the experimental groups to maintain uniformity in the MLS. The two groups were subjected to a mathematics competence test before and after the MLS intervention.

Research Instruments

Mathematics achievement test was used to collect the information. This instrument was designed in relation to the research objective. The conditions under which the instrument was administered was kept as similar as possible across the schools in order to control instrumentation and selection.

Reliability

Reliability in research is influenced by random error. Random error is the deviation from a true measurement due to factors that have not been effectively addressed by the researcher. The researcher used the split-half technique (Nkpa,1997). The test scores were divided into two halves: scores for odd-numbered items and scores for even-numbered items. Then the correlation between the two halves was determined by using Spearman Correlation Coefficient Formula which was 0.79.

Data collection procedure

The experiment was conducted in three phases. First, the administration of the pretest / entry behavior, then instructional program was conducted and finally the administration of the posttest.

Data Analysis

Analysis of Variance (ANOVA) was used to test whether the two groups' level of competence test achievement in Mathematics differed significantly at $\alpha = 0.05$ significance level and thereafter determine the relevance of treatment or MLS.

III. Research Findings

Respondents' Level of Achievement on a Mathematics Competence Test before the Intervention

The participating students were subjected into the entry competence test prior to mastery learning strategy intervention. The analysis of variance was conducted for both the control and the experimental groups and table 3 below gives the summary findings.

Table 3: Before intervention

Source of variance	Sum of Square	df	Mean Square	F_c	F_s	Pr(>F)
Between Groups	20.585	1	20.585	0.1995	3.90	0.743
Within Groups	15682.366	152	103.173			
Total	15707.768	153				

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Based on the variation between sample means to the variation within the samples ratio symbolized by F and the P-value, indicated that statistically there was no significant difference in performance between the control group and the experimental group at the entry level. This was because the F computed value 0.1995 was less than the F standard critical value 3.90 at $\alpha = 0.05$ and $(1,152)$ degrees of freedom. While the p-value 0.743 was greater than 0.5 implying the null hypothesis was true at $\alpha = 0.05$.

Respondents' Level of Achievement on a Mathematics Competence Test after the Intervention

The analysis of variance was conducted for both the control and the experimental groups and table 4 below gives the summary findings.

Table 4: ANOVA after the Intervention

Source of variance	Sum of Square	df	Mean Square	F_c	F_s	Pr(>F)
Between groups	1691.439	1	1691.439	12.334	3.90	0.023
Within groups	20844.851	152	137.137			
Total	22536.290	153				

The variation between sample means to the variation within the samples ratio (F) and the P-value, indicated that statistically there was a significant difference in performance between the control group and the experimental group at the exit level. This was because the F computed value 12.334 was greater than the F standard critical value 3.90 at $\alpha = 0.05$ and $(1,152)$ degrees of freedom. While the p-value 0.023 was less than 0.05 implying that we reject the null hypothesis at $\alpha = 0.05$.

Therefore, there was a significant difference in scores after the mastery learning strategy intervention. These findings were in agreement with Cronbach and Snow (1969), who emphasized on the fact that improving the quality of instruction can optimize the learning of particular learners. It confirmed that mastery learning strategy (MLS) yields better retention and transfer of material, yield greater interest and more positive attitude in various subjects than Non-Mastery Learning Approaches as earlier documented by Ngesa, 2002; Wachanga and Gamba, 2004 and Wambugu, Changeigwo, 2007 and Davrajoo, et al (2010). The study findings were in tandem with Wambugu & Changeiywo (2007) findings who opined that MLS helps the students to acquire prerequisite skills to move to the next unit. Moreover Hutcheson (2015), Tukur *(*2018) and Uchechi, Ezinwanyi and Ihendinihu (2013) studies revealed that there is a significant effect on the academic and mathematics achievement respectively for the students who were exposed to mastery learning strategy. Mastery learning strategy (MLS) can help the teacher to know student's area of weakness and correct it thus, breaking the cycle of failure.

IV. Recommendations

Since there was a significant improvement in mathematics performance both the teachers and the learners should be exposed to MLS which helps the teacher to know student's area of weakness and correct it thus, breaking the cycle of failure in mathematics.

The study recommended a replication of the research to another region and respondents to ascertain the validity and reliability of the findings.

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. Abakpa, B. O. & Iji, C. O., (2013). Effect of Mastery learning approach on senior secondary school students in geometry. *Journal of Science Teachers Association of Nigeria (STAN)*. 12(1), 1-11.
2. Adedeji S. & *Owoeye* J. (2002). Teacher quality and resource situation as determinants of students academic achievement in Ogun State secondary schools. Journal of Educational Management.
3. Ayap, Liezl S. (2007). Factors Affecting Mathematics Performance of Students of Cabarroguis National School of Arts and Trades. *Master's Thesis.* Philippine Normal University, Isabela.
4. Block, J. H. (ed.) (1971). *Mastery learning: Theory and practice*. New York: Holt, Rinehat and Winston.
5. Bloom, B. S. (1976). *Human characteristics and school learning*, New York: McGraw-Hill.
6. 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.
7. Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. New York: Routledge.

ISSN No. 231-2705 | DOI: 10.51244/IJRSI | Volume X Issue III March 2023

8. Cronbach, L.J., and Snow, R.E. (1969). Individual differences in learning ability as a function of instructional variables, Final Report, USOE, Stanford, California: Stanford University, School of education, in Block, J.H. (ed.). Mastery Learning: (theory and practice): New York: Holt, Rinehart and Winston, inc., pp.112, 1971.
9. Diegelman, B., Parente, A. (2011). The use of mastery learning with competency---based grading in an organic chemistry course. *Journal Of College Science Teaching*, 40(5), 50---58.
10. 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).
11. *Guskey, T.R. (2007). "Closing Achievement Gaps:Revisiting Benjamin S. Bloom's "Learning for Mastery". Journal of Advanced Academics. 19: 8–31.*
12. Hutcheson, P. J. (2015). The Effect of the Mastery Learning Approach on Student Motivation in Middle Level Science. *Hamline University, Saint Paul, Minnesota.*
13. Ihendinihu, U.E. (2013). *Effects of guided scoring instructional strategy on the performance of secondary school students in mathematics in Abia state*. Unpublished M.ED Dissertation submitted to the faculty of education, Abia- state University Uturu.
14. KNEC (2015). *Kenya certificate of secondary education examination report*. Nairobi, Kenya: Kenya National Examinations Council.
15. KNEC (2016). *Kenya certificate of secondary education examination report*. Nairobi, Kenya: Kenya National Examinations Council.
16. Lamidi, B. T., Oyelekan, O. S. & Olorundare, A. K. (2015). Effects of Mastery Learning Instructional Strategy on Senior School Students' Achievement in the Mole Concept. Electronic Journal of Science Education, 19 (5), 1-20.
17. Mevarech, Z.R., Kramarski, B. , Lieberman, A. (2001). Effects of multilevel versus unilevel metacognitive training on mathematical reasoning. The Journal of Educational Research 94 (5), 292-300.
18. Ngesa, F.U. (2002). Impact of Experiential and Mastery Learning Programmes on Academic Achievement in Secondary School Agriculture. Unpublished PhD Thesis, Egerton University, Kenya.
19. Nkpa , N (1997). *Education Research for modern scholars*. Enugu: Fourth Dimension Publishing co.
20. Peker, M., & Mirasyedioğlu, Ş. (2003). Lise 2. sınıf öğrencilerinin matematik dersine yönelik tutumları ve başarıları arasındaki ilişki. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi. 14*(2).
21. Randolph, J. (2008). *Multidisciplinary Methods in Education Technology Research and Development.* Hmk University of Applied Science.
22. Richardson D.S. (2020). Fulfilling the promise of the differentiated classrooms; strategies and tools for responsive teaching Alexandria, V.A; association for supervision and curriculum development.
23. 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.
24. 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*
25. Uchechi,J. Ezinwanyi,D. & Ihendinihu, L. (2013) Enhancing Mathematics Achievement of Secondary School Students Using Mastery Learning Approach. *Journal of Emerging Trends in Educational Research and Policy Studies*
26. Wachanga, S.W., & Gamba, P.P (2004). Effects of Mastery Learning Approach on Secondary School Students' Achievement in Chemistry in Nakuru District Kenya:
27. 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.
28. 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.