Effects of Mastery Learning Strategy on Pupils' Mathematics Achievement in Asante Akim North District

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Abstract:- The purpose of this study was to explore the effects of mastery learning strategy on pupil's mathematics achievement in Asante Akim North District. In the study, I used a quasi-experimental pre-test post-test, non-equivalent control group design. The respondents in the study were JHS pupils. The target population was 160 pupils from 2 JHSs. However, 24 and 30 pupils were purposively sampled and randomly assigned into experimental and control groups respectively. The instrument used for the study was MATs with r-index = .75. Data to answer research questions were analyzed using descriptive statistics (means, standard deviations, min. and max. scores). The findings of the study revealed that, MLS has positive effects on pupils' mathematics achievement. Again, pupils who are taught with MLS differ in terms of ability and that pupils with high ability excel more than pupils with low ability. It was recommended in the study base on the findings that, NaCCA through MoE should adjust the curriculum and ensure to plan instruction with MLS. Again, GES should provide TLRs to support teaching and learning with MLS. Lastly, mathematics teachers should embrace MLS in their instructions in order assist pupils gain mastery in content to aid achievement of learning objectives which in a long term will play vital role in the development of the nation.

Keywords:- Mastery Learning Strategy, Pupil's Mathematics Achievement, Enrichment, Remediation.

I. INTRODUCTION

Globally, education has been allotted a crucial part in stimulating quality in every domain of existence. Intellectual development of an individual is one of the key goals of education. However, the low academic achievement of pupils has appeared as a foremost hindrance in reaching the goal of scholarly improvement of pedants. This perhaps can be ascribed mostly to lack of prominence on abstract learning and the act of embracing on rote memorization by key educational players in various schools. Sood (2013) asserted that, in disciplines like mathematics, which is completely established on scientific and logical computations, key players in its instruction laid emphasis basically on remembering the concepts/theories and formulae but not on conceptual understanding (construct attainment) as well as their solicitation which tend to promote the attainment of learning objectives. Sood also avowed that, teaching and learning of mathematics in schools has become categorized instead of flexibility. Sood further stressed that, in order to emanate over such weird condition, an enormous amount of instructional tactics and policies have been established and time-tested out by instructors and teachers. Among the horde of such instructional tactics and policies used in the classrooms till date of which each asserted to be adept of executing certain functions or utilities, although no tactic or policy can vaunt of being the finest and proficient of reaching all the instructive outcomes in education (Sood, 2013). Out of such instructional tactics and policies, the foremost instructional schemes have been established under the preface of Mastery Learning Strategy (MLS). Mastery learning has been defined in several ways. Mastery Learning Strategy is defined as "strategy that aid each pupil to attain mastery when he is able to give at least 80 percent correct response on a formative or summative test that has been constructed on the basis of instructional objectives with respect to that unit which each pupil is expected to achieve" (Varughese, 2002).

Wambugu & Changeiywo (2008) argued that, either pupil who fails the summative test may obtain auxiliary or extra teaching till all pupils finally attain maxim understanding or the teacher resolves to move to the subsequent unit pending majority of the class masters the taught content or unit. Mayanchi, Anya, & Kainuwa (2017) also reported in their study that, there was an improvement in the experimental groups who were treated by MLS as compare to the control group. Their result was in agreement with the findings that asserted that, mastery learning use in schools for delivery have shown constructive cognitive learning effects on pupils (Aderemi, 2006, Akinsola, 2007). Similarly, Ogba (2000), Abadom (2002), Majidat (2002), Adeyemi (2007), Patricia & Johnson (2008) and Ogan (2012) in their independent research studies have supported the same findings with common assertion that, mastery learning strategy is vital and play crucial role in the teaching and learning of mathematics. Numerous studies have also shown that good instructional tactics are adept of refining the attainment of pupils in mathematics and other related-subjects (Ihendinihu, 2013). According to WAEC (2010),

the current results show that the conservative teaching tactic is incomplete in meeting the essentials of majority of pupils. WAEC further stresses that, the current practice of unconsciously application the similar procedures to dull, average as well as the bright learners could be accountable for considerable ineffectiveness of instruction specified in schools.

Henceforth, it has been established that an innovative proposal for change is what is imperative now; as well as a significant subdivision from existing practice and a rerouting of system of education in a nation (Sood, 2013), of which mastery learning strategy is an option. Sood defined mastery learning strategy as "an instructional strategy is based on the principle that all the pupils can learn a set of reasonable objectives with appropriate instruction and sufficient time to learn and that the additional time for learning is prescribed for those requiring remediation". Also, he asserted that mastery learning is an instructional tactic that is based on theory of behavioural learning (Sood, 2013). Behaviourists consider that, learning is swayed by the skills that pupils are showing to inside the atmosphere (Piaget, 1956). From this, it can be inferred that, mastery learning is explicitly essential in mathematics. Mathematical concepts can be perceived to have hierarchically planned in such a way that failure to learn required skills there is a possible inhibit to pupils' later learning skills. In mathematics, concepts are inter-related and inter-woven and any pupil who fails to master the pre-requisite of a particular theme may not be able to master it. In support of this, Overmayer (2010) stated that, the challenge of covering the complete mathematics curriculum while obliging the requests of struggling pupils would create a virtual appalling condition. WACE (2018) reported that, fewer than 40% of itemized applicant in BECE passed in mathematics. Olunloye (2010) also said that, there is ugly trend of high failure rate in mathematics is seen as a general calamity. A viable ways of improving the performance has therefore remained an area of prodigious concern to researchers. Moreover, the terrible state of mathematics achievement is attributed to a number of factors such as 'attitude of pupils' (Uhumuavbi & Umoren, 2005); 'lack of instructional resources' (Yara & Otieno, 2010); 'Instructional techniques' (Olulonye, 2010) among others. It has therefore become increasingly more imperative for researchers to conduct studies to examine the "effect of mastery learning strategy on pupils' mathematics achievement".

II. LITERATURE REVIEW

➢ The Achievement Motivation Theory

The study is supported by achievement motivation theory that was put forward by Atkinson, McClelland, Clark & Lowell in 1953. Singh (2011) defined motivation as effort to attain set goals and targets as well as a practice to maintain the effort. As indicated by McClelland *et al.,* the achievement motivation theory attempts to account for the determinants of the direction, magnitude and persistence of behaviour in a partial but very significant province of human activities. Considering the second objective of the study which seeks to examine the mathematics achievement of upper and lower grouped pupils who have been exposed to mastery learning strategy, the achievement motivation theory would be imperative to the study because, as pupils aim at passing their mathematics examinations and improving their academic achievement, there is an effort of motivation which determines their direction, magnitude and persistence of behavior towards the learning of mathematics.

➢ Concept of Mastery Learning Strategy

The concept of mastery-learning strategy was presented in school in America in 1920's. The strategy was revived in the form of automated instruction in the late 1950's in an effort to offer students with instructional resources that would permit them to learn at their own pace and receive persistent and prompt response on their level of mastery (Sood, 2013). During the 1960's Benjamin Bloom formulate the act of learning for mastery, of which attention and philosophy of new Mastery learning strategy focused. He believed that by using the tactic practically, all learners could learn excellently and truly master content and concept (Bloom 1971). Bloom stressed that, the Mastery learning strategy divides subject matter into units and each unit has a specific module to complete with predetermined objectives. Thus, in performing the unit tests, students should achieve mastery, before moving on to the following units. It was finally establish that at the end of a learning unit, a diagnostic test needs to be administered to students in order to determine the next course of action when mastery had inveterate. It can be noticed that, pupils who deemed to have mastered the learning content can ensued a new learning content or be allowed to convey out advance enriching tasks. In support of my earlier assertion, Yemi (2018) said that, pupils who are unable to master a learning content would be required to undertake counteractive instruction. Yemi again said that, Mastery Learning Strategy has basic elements including formative assessment to check mastery level, enrichment activities (self and peer assessments) to strengthen pupils with mastery, remedial activities (re-teaching) to assist pupils who could not achieve mastery before instruction on second content is given. It can therefore be noticed however that, the pupils who obtain remedial lesson are exposing to two series of formative assessment. Figure 1 gives an illustration on application of mastery learning strategy.
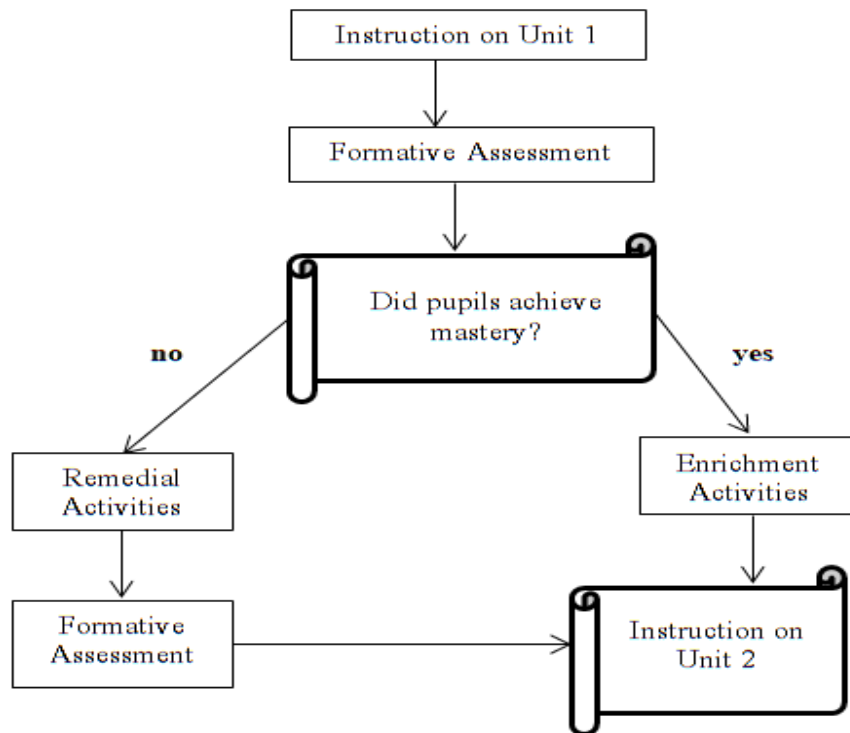
Fig 1:- *Basic Elements of Mastery Learning Strategy*
Source: Adapted from (Liban, 2013 as cited in Bala, 2019)

➢ *Effect of Mastery Learning Strategy (MLS) on Academic Achievement*

In fact, in this study's literature review it can be observed that, the pupils who are taught through the mastery learning strategy teaching technique attained statistically substantial greater marks in a post achievement tests related to those are taught through the conservative teaching tactics (Ihendinihu, 2013; Sood, 2013; and Mayanchi, Anya, & Kainuwa, 2017). This implies that MLS teaching method is more effective in enhancing students' achievement. Wachanga & Gamba (2004) who asserted in a study with general objective as "effects of using MLS on secondary school students' achievement in Chemistry" that, MLS enables learners to learn chemistry as well as other related-subjects like mathematics enhanced than using the consistent instructional technique. Their finding agreed with assertion by Ngesa (2002). He reported that MLS ensued among upper grouped student in Agriculture than the consistent teaching system. He also argued that, students' results are substantial with respect to classroom teaching and teacher education in Agriculture and its content.

➢ *Mastery Learning Strategy (MLS), Pupils' Ability and Academic Achievement*

Ihendinihu (2013) in a study found out that the students who were taught through the MLS teaching method achieved statistically significant higher scores in the achievement test not only for the higher ability pupils but also for the low achiever. Similarly, McCane, Ott, Meek, & Robins (2017) who found out that the Mastery learning strategy model has a noteworthy encouraging influence on student learning, especially for lower group learners.

➢ *Problem statement*

There has been low achievement in mathematics in basic schools which is due to inability of pupils to understand and master topics and concepts in mathematics before proceeding to higher levels as indicated in the introduction (Example Sood, 2013). For a long time, Mathematics has been mystified as a difficult core subject henceforth pupils have shun Mathematics particularly algebra when given an option (Aduda, 2003). Many institutions of higher learning as well as professional bodies also insist on a minimum credit pass in Mathematics for admission or employment in spite of Aduba's assertion. I am of strong conviction although the concept of Mastery Learning is not a new one in the field of education but since it is based on the idea that all pupils can learn when appropriate teaching environment provided to them according to their abilities and needs, it would aid in averting the current dire state in mathematics. Another reason that makes this study very imperative and timely is the Chief examiners' report. Also, from the review of studies on mastery learning as show in literature, there have been several existing works on mastery learning and academic achievement but were conducted in other geographical setting other than Asante Akim North. To fill these gaps, I decided to conduct the study to investigate the effect of mastery learning strategy on pupils' mathematics achievement.

> *Purpose and research questions*

The purpose of the study is to explore the effects of mastery learning strategy on pupil's mathematics achievement in Asante Akim North District. Specifically, the study sought answers to the following research questions:

1. What is the effect of mastery learning strategy on pupils' mathematics achievement?
2. What is the mathematics achievement of high and low ability pupils who have been exposed to mastery learning strategy?

> *Significance of the study*

The findings from the study would benefit many including ministry of education (MoE), national council for curriculum and assessment (NaCCA), Ghana education service (GES), mathematics teachers, pupils and future researchers. For instance, MoE in connection with the NaCCA would use the study as a guide to formulate new curriculum and refined the existing curriculum to aid in achieving Ghana's educational goals. The GES on the other hand would be encouraged by the findings to organize regular and effective workshop for employees on the use of mastery learning strategies (MLSs).

Also, mathematics teachers would be aware of the necessities of deploying MLS to foster mastery in the teaching and learning of mathematics and will adhere to the directives to achieve learning objectives. With this, pupils would be able to reach their utmost goal of gaining high mathematics achievement.

III. METHODS

> *Design*

The study adopted a type of experimental design called quasi-experimental pre-test post-test, non-equivalent control group design. Mertens (2010), quasi-experimental design is those that are "almost" true experimental designs, except that the participants are not randomly assigned to groups. The purpose behind my option for the design was that, in education numerous experimental situations happen where researchers need to use intact groups as in the case of this study (Creswell, 2012).

> *Target population and sampling*

The target population was 160 JHS pupils from two selected JHSs, with single stream in the district from Owerriman North Circuit. However, for the purpose of convenience and also to ensure a more detailed study of the elements involved, I used the JHS 2 pupils with sample size of 24 and 30 pupils respectively from the 2 schools. The study sample was selected from the population using the purposive sampling procedure. The class with 24 pupils was randomly selected for the experimental group and the class with 30 pupils occupying the control group.

> *Instrumentation*

A self-developed Mathematics Achievement Tests (MATs): Pre-test and Post-test were constructed from expert judge perspective. The tests were 4-option MCQ with each test having 30 items. The test-retest strategy was adopted for constructing test items for both pre-test and post-test. A pre-test was done to further refine the items using 10 pupils other than the respondents but of similar characteristics. An appropriate reliability index of .75 was obtained after cronbach alpha was computed.

> *Data collection procedure*

Formal permission was secured from appropriate authorities prior to the data collection exercise. I conducted the pre-test among both groups under the supervision of four trained invigilators. Respondents were also given the assurance of confidentiality and anonymity so pupils were coded as their identity was not requested. After the pre-test, treatment with MLS was given to the experimental group only while the control group was allow to study with the conservative technique. Post-test was conducted for both groups under a shuffled supervision of four trained invigilators to avoid halo effect.

> *Data processing and analysis procedure*

The data to answer the research questions were analyzed using descriptive statistics, specifically, means (M) and standard deviations (SD). At the end of the data collection, the test scores coded and keyed on SPSS version 26.0, for analysis and discussion. In the analysis, both groups were compared with the pre-test scores and the post-test separately to answer research question 1. Moreover, post-test scores of higher and low achievers were compared to answer research question 2.

IV. RESULTS

> *Research question 1: What is the effect of mastery learning strategy on pupils' mathematics achievement?*

This question sought to find out the effect of mastery learning strategy on pupils' mathematics achievement. Descriptive statistics were obtained from an analyzed pre-test and post test scores of both groups. Summary of the analysis are shown in Tables 1 and 2.

Group	N	Minimum	Maximum	Mean	Std. Deviation	Skewness
Experimental Group	24	1	5	2.79	1.103	.449
Control Group	30	2	7	3.57	1.251	.801
Valid N (listwise)	24					

Table 1:- *Results from Pre-Test*

Table 1 shows the results' analysis of pre-test for experimental and control groups. From the table, experimental group with n=24 had Mean=2.79, Std, Deviation=1.103, Min score=1 and Max score=5 while control group with n=30 had Mean=3.57, Std, Deviation=1.252, Min score=2 and Max score=7. It can be noted from Table 1 that, control group with (Mean=3.57, Std, Deviation=1.252, Min score=2 and Max score=7) performed better than experimental group with (Mean=2.79, Std, Deviation=1.103, Min score=1 and Max score=5) in the pre-test. However, considering the anticipated mean score=15 for the test, both performances were dire.

Group	N	Minimum	Maximum	Mean	Std. Deviation	Skewness
Experimental Group	24	14	30	20.71	4.554	.438
Control Group	30	2	15	6.07	2.791	1.008
Valid N (listwise)	24					

Table 2:- *Results from Post-Test*

Table 2 shows the results' analysis of post-test for experimental and control groups. From the table, experimental group with n=24 had Mean=20.71, Std, Deviation=4.554, Min score=14 and Max score=30 while control group with n=30 had Mean=6.07, Std, Deviation=2.791, Min score=2 and Max score=15. It can be inferred from Table 2 that, experimental group with (Mean=20.71, Std, Deviation=4.554, Min score=14 and Max score=30) performed significantly better than control group with (Mean=6.07, Std, Deviation=2.791, Min score=2 and Max score=15) in the post-test. However, considering the anticipated mean score=15 for the test and the results in Table 1, both performances had positive adjustment in the post-test with significant increase for the experimental group.

➢ *Research question 2: What is the mathematics achievement of high and low ability pupils who have been exposed to mastery learning strategy?*

This question sought to compare the mathematics achievement of high and low ability pupils who have been exposed to mastery learning strategy. Descriptive statistics were obtained from an analyzed post test scores of the experimental group. Summary of the analysis are shown in Tables 3 and 4.

Experimental Group	Levene's Test		t-test for Equality of Means			
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	4.665	.042	7.586	22	.000	7.583
Equal variances not assumed			7.586	17.157	.000	7.583

Table 3:- *T-test for Equality of Means for Results from Post Test of Experimental Group*

Table 3 reports equality of means of high ability and low ability pupils from the experimental group in the post-test. From the table, Levene's test of equal variances assumption was violated with $\rho = .042 < \alpha = .05$ indicating that, equal variances not assumed. From the Levene's test, t-test for equality of means of high ability and low ability pupils from the experimental group in the post-test ($t=2, 22$) shows difference with $\rho = .000 < \alpha = .05$. The H_0 was rejected because the t-test reported was statically significant.

Experimental Group	N	Minimum	Maximum	Mean	Std. Deviation	Std. Error Mean
High Ability	12	21	30	24.50	3.030	.875
Low Ability	12	14	19	16.92	1.676	.484

Table 4:- *Group Statistics of Results from Post Test of Experimental Group*

Table 4 reports the group statistics of the high ability and the low ability pupils from the experimental group in the post-test after it was reported in Table 3 that, there was substantial transformation in means of the two ability groups. From the table, pupils with high ability had Mean=24.50, Std, Deviation=3.030, Min score=21 and Max score=30 while pupils with low ability had Mean=16.92, Std, Deviation=1.676, Min score=14 and Max score=19. It can be inferred from Table 4 that, pupils with high ability with (Mean=24.50, Std, Deviation=3.030, Min score=21 and Max score=30) performed significantly better than pupils with low ability with (Mean=16.92, Std, Deviation=1.676, Min score=14 and Max score=19) in the post-test.

V. DISCUSSION OF FINDINGS

Results analyzed in Table 1 and Table 2 answer research question 1 which sought to find out the effect of mastery learning strategy on pupils' mathematics achievement. From Table 1, it was revealed that, control group with (Mean=3.57, Std, Deviation=1.252, Min score=2 and Max score=7) performed better than experimental group with (Mean=2.79, Std, Deviation=1.103, Min score=1 and Max score=5) in the pre-test. However, considering the expected mean score=15 for the test, both performances were horrible. After the treatment with MLS on experimental group, Table 2 find out that, experimental group with (Mean=20.71, Std, Deviation=4.554, Min score=14 and Max score=30) performed significantly better

than control group with (Mean=6.07, Std, Deviation=2.791, Min score=2 and Max score=15) in the post-test. However, considering the anticipated mean score=15 for the test and the results in Table 1, both performances had positive adjustment in the post-test though, the experimental group had a significant increase and positive result because of the positive effect of the MLS and the results from the control group still dire. The findings are in agreement with the finding of Mayanchi, Anya, & Kainuwa (2017) who reported in their study that, there was an improvement in the experimental groups who were treated by MLS as compare to the control group. Similarly, Wachanga & Gamba (2004) who asserted in a study with general objective as "effects of using MLS on secondary school students' achievement in Chemistry" that, MLS enables learners to learn chemistry as well as other related-subjects like mathematics enhanced than using the consistent instructional technique.

Results analyzed in Table 3 and Table 4 answer research question 2 which sought to compare the mathematics achievement of high and low ability pupils who have been exposed to mastery learning strategy. From Table 3, it was noted that, there is a significant difference in means of high ability and low ability pupils from the experimental group in the post-test from the test of equality of means ($t=2, 22$) with $\rho = .000 < \alpha = .05$. It was further clarify in Table 4 that, pupils with high ability with (Mean=24.50, Std, Deviation=3.030, Min score=21 and Max score=30) performed significantly better than pupils with low ability with (Mean=16.92, Std, Deviation=1.676, Min score=14 and Max score=19) after both were exposed to treatment with MLS. The findings confirm with the finding of Ihendinihu (2013) who declared that students who are taught through the use of MLS teaching method achieved statistically substantial greater scores in the achievement test not merely for the upper group learners however for the lower group learners. However, the finding contradicts the assertion of McCane, Ott, Meek, & Robins (2017) who found out that the Mastery learning strategy model has a noteworthy encouraging influence on student learning, especially for lower group learners.

VI. CONCLUSIONS AND RECOMMENDATIONS

Considering the findings of this study, it has been concluded that MLS has constructive effects on pupils' mathematics achievement. Also, the study can conclude that pupils who are taught with MLS differ in terms of ability and that pupils with high ability excel more than pupils with low ability. I therefore recommend base on the findings that, NaCCA through MoE should adjust the curriculum and ensure to plan instructions with MLS. Again, GES should provide TLRs to support teaching and learning with MLS. Lastly, mathematics teachers should embrace MLS in their instructions in order assist pupils gain mastery in content to aid achievement of learning objectives which in a long term will play vital role in the development of the nation.

LIMITATIONS

Nachmias & Nachmias (2009) defined limitations as potential issues that could interrupt the study's progress. Since this study aimed at finding out the effect of mastery learning strategy (MLS) on pupils' mathematics achievement, accurate information from respondents may not be obtained since they would want to protect the integrity of their schools. This may falsify the findings of the study. Again, the information collected on the availability of computers in association to the number of pupils could give a fabricated impression since some computers could be old-fashioned. The researcher requested to test some computers to verify if they are functional. The study was confronted with drawbacks of which they were tackled not to discredit the findings. However, necessary measures like orientation for stimulate respondents' interest, were considered to mitigate the possible influence on the study's findings to discredit the validity and reliability of findings.

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