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Mastery learning strategy on general mathematics performance

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Abstract

This study aimed to determine the effectiveness of mastery learning strategy on general mathematics performance of Grade 11 Science, Technology, Engineering and Mathematics (STEM) students of Boracay National High School in the District of Malay during the School Year 2023- 2024. The pretest- posttest control group design using match paired subjects were utilized in this study. Twenty students were involved in this study where 10 students per group comprised the experimental and control groups. The control group was taught using the traditional way of teaching while the application of mastery learning strategy were used in the experimental group. The statistical tools used were the Frequency, Sum, Percentage, Mean and Standard Deviation for Descriptive Statistics, T- test for dependent samples, T- test for independent samples and Cohen's D for inferential statistics. Findings revealed that there was an improvement in the mean score of the control group but remains in the proficient level and those students taught with MLS got a higher mean score that made them to attain the high proficient level. There was a significant difference between the level of general mathematics performance of students.

Keywords: *mastery learning strategy, performance, post-test, pre-test, traditional teaching method*

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1. Introduction

The quality of mathematics education of each country in relation to other countries has been determined through international assessment. In fact, the Program results for International Students Assessment (PISA) is designed to assess students' preparedness for employment in future years, while the Trends International Mathematics and Science Survey (TIMSS) is a retrospective assessment whether learners have mastered what is taught. Filipino students ranked 77 out of 78 participating countries in PISA 2018 and 58 out of 58 participating countries in TIMSS 2019. In the latest ranking, the PISA 2022 result released December 5, 2023, almost no students in the Philippines were top performers in Mathematics, meaning that they attained level 6 in the PISA mathematics test. Based on the results, only 16% of Filipino students attained at least the basic or baseline level of proficiency in Mathematics subject. This means that 84% of Filipino students who took the test do not have sufficient mathematical skills compare to other countries (Chi, 2023). Consequently, Filipino educators were on quests to find ways to resolve the problems on mathematics achievement. The National Assessment Test (NAT) of the Department of Education (DepEd) is an internal students' assessment of the country aimed to monitor the level of students' mathematics, science and reading literacy. Scores of students prove the current state of education among the subjects tested; Mathematics was performed poorly by Filipino learners, consistent from 2004 to the present. This outcome proved that the latest results of PISA and TIMSS revealed that problem in Mathematics performance is still a problem. Ideally, if learners can improve their learning retention, the mastery of the topics could be improved. Thus, problems on mathematics performance could be resolved.

Each year, educators are still planning to implement new educational practices and instructional interventions that all promise to improve student learning. It can be difficult for school leaders to meet these challenges. Luckily, many methods include pieces of strategies combined to produce positive results. One framework that encompasses multiple research-supported strategies with a record of accomplishment of relevance over decades is the framework of Mastery Learning (Guskey, 2010; Adeniji et al., 2018; DeWeese & Randolph, 2011; Goksoy, 2018; Guskey, 2015). Mastery Learning is a program from Bloom that is widely used in school classroom across the United States as well as other countries (Hutcheson, 2015; Mavarech, 1985; Sood, 2013). According to Bloom, the motivation for the use of Mastery Learning comes from trying to reduce achievement gaps for students in average school classrooms (Udo et al., 2014;

Yildrian, 2006). From this context, this study intended to look if Mastery Learning Strategy can help Grade 11 Students of Boracay National High School have better performance in learning General Mathematics and can help improve their scores on quizzes, or any form of evaluation inside the classroom and even in regional of national level of assessment.

2. Literature Review

This study was anchored on the Mastery Learning Theory that focuses heavily on ensuring overall competence. Proficiency is ultimately the priority. As a result, the paradigm embraces a range of mechanisms designed to make sure that every learner is able to achieve the required level of competence (Winget & Persky, 2022; Gunawardena et al., 2024; Parker & Roumell, 2022). In most cases, mastery learning features a handful of key components. Along with having clear learning objectives, mastery thresholds are set to ensure competence. Established processes for showcasing mastery are part of the approach, along with well- defined assessment strategies for instructors. Since competence is a priority with mastery learning, customization is embraced as a way to make that possible (Zoller, 2019). The strategy aims to give learners enough space to adapt the experience in ways that ensure results (Clarity Consultants, 2022).

Education involves the process of the development and learning of the child on multiple dimensions, facilitated by the teacher, who is guided by a curriculum. Effective education is a process where the teacher, children and the schools involved and participated actively (Blinkoff et al., 2023; Bergmark & Westman, 2018; Parker et al., 2022; Darling-Hammond et al., 2019). An important restriction of education is that teachers cannot simply transmit knowledge to students, but students need to actively construct knowledge in their own minds. That is, they discover and transform information, check new information against old and revise rules when they do not longer apply. This constructivist view of learning considers the learner as an active agent in the process of knowledge acquisition (Richardson, 2015; Tam, 2000; Windschitl, 2013).

This study can also be related to Constructivist learning theory that has four basic characteristics which must be considered when implementing constructivist instructional strategies; knowledge will be shared between teachers and students; teachers and students will share authority; the teacher's role is one of a facilitator or guide; learning groups will consist of small numbers of heterogeneous students (Tam, 2000). In the constructivist classroom, the focus tends to shift from the teacher to the students. The classroom is no longer a place where the teacher pours knowledge into passive students, who wait like empty vessels to be filled (Bada, 2015). In

the constructivist model, the students are urged to be actively involved in their own process of learning. In traditional classroom, curriculum begins with the parts of a whole, it emphasizes basic skills (Boumova, 2008; Covill, 2011). Materials are primarily textbooks and workbooks, strict adherence to fixed curriculum is highly valued (Umida et al., 2020). As one of the identified factors, teacher's influence towards the learning of a student has a vital role in education (Bombaes, 2017). Teacher's factor contributes to the students' academic performance. Moreover, under this factor, other variables are taken identify the sub-factors that fall under teacher's influence are teacher motivation (Thoonen et al., 2011), punctuality of teachers (Sahito et al., 2016), learners' exercises (Min, 2008), teacher preparedness and teacher teaching aid (Siachifuwe, 2017).

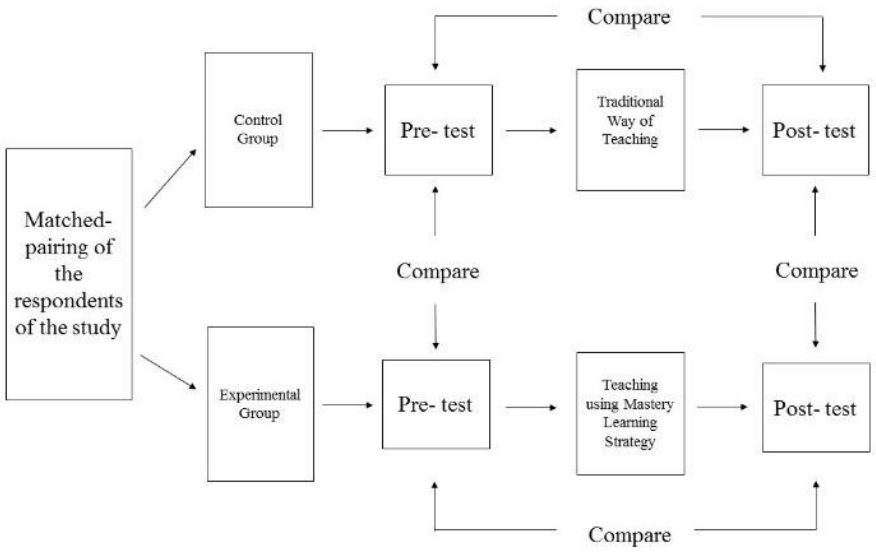
Mastery Learning Strategy works in psychological order of learning; learner proceeds from easy to difficult (Toheed et al., 2017). According to Bloom's Taxonomy of behavioral objectives, learner proceeds from lower to higher order of cognitive domain, i.e. from knowledge to comprehension and so on (Filgona et al., 2017). If lower order of cognitive domain is not mastered, this could deter a learner to proceed to the next higher order of cognitive domain (Bruno et al., 2007). Therefore, Bloom's (1968) mastery learning stress on ensuring that all learners should have a better understanding of the concepts taught before moving to the next level.

Mastery Learning Strategy starts from clearly specifying what is to be learned and how it will be evaluated, then there will be group discussion or instruction to allow students learn at their own pace, then the teacher will give formative assessment to evaluate students' learning and provide on-going feedback to students (Hattie & Timperley, 2007; Baron, 2016; Curry et al., 2016; Park et al., 2020). Those students who scored 80% and above form the assessment will be given an enrichment activity and those students who scored below 80% will be given a remediation or corrective instruction and parallel assessment before proceeding to the next lesson.

Figure 1 shows the conceptual framework of the study. The subjects of the study were matched and paired; they were grouped either in the control or experimental group. The study conducted pre-test followed by an intervention or using Mastery Learning Strategy in teaching General Math for the experimental group and conventional way of teaching for the control group. The study administered a post-test to determine if there is a difference on students' performance.

Figure 1

A conceptual model showing the flow of the study



3. Methodology

The quasi- experimental method using the pre-test – post-test control group design with matched paired subjects was utilized in this study. Quasi-experimental research design involves the manipulation of independent variable to observe the effect on dependent variable. According to Harris (2020), quasi- experimental method used to evaluate interventions but that do not use randomization. Similar to randomized trials, quasi- experiments aim to demonstrate causality between an intervention and an outcome.

This study was conducted in Boracay National High School located at Balabag, Boracay Island of Malay in the province of Aklan, Philippines. The respondents of the study were the Grade 11 STEM students enrolled in School Year 2023-2024. These students have difficulties and challenges in retention that lead to their low performances in Mathematics subject. Some of their parent have no time to assist them in learning because of their work and some of them cannot understand the lesson in Senior High School, since they come from an old curriculum.

The sample size was based on the result of match pairing, composed of 40 students who were taken from 48 Grade 11 STEM Students. The selection was done by matching 20 students based on their average grade in Mathematics during Grade 10. The two groups were then randomly assigned either to the experimental or to the control group. This was done to give each group an equal chance of being selected to be in control or experimental group. A toss-coin was used for

this purpose. The STEM 1 class got the tail and was assigned as the control group while STEM 2 class got the head and was assigned as the experimental group.

A 50-item researcher-made test was used for the pre-test and post-test activities. The topics of the test were based on the competencies in the first quarter period which focus on Functions and their Graphs. The multiple choice type of instrument that was constructed by the researcher was subjected to validity and reliability tests. The same test was administered to the participants during the pre-test and the post-test to determine the effectiveness of Mastery Learning Strategy in improving students' performance in General Mathematics. After the conduct of content validity and reliability, there were 30 items left. Another set of Table of Specification (TOS) was prepared.

To establish the validity of the instrument, the researcher constructed a TOS. The researcher constructed the draft test with an initial of 50 items with TOS. It was submitted to a panel, this will be composed of a Research Adviser and two Senior High School Mathematics Teachers. Their comments and suggestions will serve as the basis for the inclusion and exclusion of test questions. After the revision, the draft test underwent a pilot test to 40 grade 11 STEM Students of Boracay National High School. Item analysis was done to decide the final set of questions to be included in the instrument. This was undertaken to determine the quality of problems, particularly the individual items. The result of item analysis revealed that out of 50 items, there were 34 items that were good, ten item that needed to be improved and six items were rejected. The 30 good items in accordance with the table of specifications comprised the instrument. To establish the reliability of the instrument, the researcher chose 30 students from other school. Difficulty Index and Discrimination Index was computed to identify whether the item were revised, retain and rejected. After Item Analysis, out of 50 items, there were 30 items retained.

The procedure used in gathering data was conducted in three stages or phases: pre-experimental phase, experimental phase and post- experimental phase.

Pre-experimental phase. The researcher first secured the permission of the Division Senior Education and Program Specialist in the Division of Aklan and School Principal to utilize students' grade as one of the bases for matched pairing for the conduct of the study, Parental consent was also secured form the parents of the students, the content of the consent was explained to the respondents assuring that their confidentiality and identity will be protected. Then, the researcher

prepared the instrument to be used for the pre-test and post-test. The researcher also prepared the materials and tasks needed for the conduct of the study.

Experimental stage. After their consent was secured, the data gathering instrument was administered to the control and experimental group in the pre- test to determine their performance before the intervention. The researcher conducted the lesson from Monday to Thursday for two weeks for the two groups. The control group was taught using the traditional method while the experimental group was taught using the Mastery Learning Strategy. The control group followed the 1:15- 2:15 schedule while the experimental group followed the 3:15- 4:15 schedule. During this stage, all the classes in the two groups were treated just like ordinary class days. Activities used for experimental and control groups are shown in table 1.

Table 1

Activities used for mastery learning strategy and traditional way of teaching

Competency	Activities for Mastery Learning Strategy	Activities for Traditional Way of Teaching
Competency 1	Presentation, Oral Recitation, Pair Activity, Quiz, Enrichment Activity- Group Work, Corrective Instruction, Parallel Assessment	Lecture, Discussion, Quiz
Competency 2	Discussion, Problem Solving, Use of Task Cards, Re-teaching of the Lesson, Giving of Quiz	Discussion, Problem Solving, Oral Recitation, Quiz
Competency 3	Presentations, Group Activity, Quiz, Individual Work for Enrichment, Giving Another Examples, Assessment	Lecture, Board Work, Activity, Quiz
Competency 4	Discussion, Word Problems, Crating Financial Plan, Corrective Instructions, Parallel Quiz	Lecture, Problem Solving, Group Activity, Quiz
Competency 5	Lesson Discussion, Games, Oral Recitation, Problem Solving, Enrichment Activity, Re- teaching of the steps Discussion, Mathinik Challenge, Word Problems, Quiz,	Discussion, Oral Recitation, Word Problems, Quiz
Competency 6	Pair Activity, Corrective Instruction, Parallel Assessment	Simple Recall, Lecture, Board Activity, Quiz
Competency 7	Discussion, Use of Activity Sheets, Game, Corrective Instruction, Giving of Parallel Assessment	Lecture, Solving, Pair Activity, Quiz
Competency 8	Discussion, Graphing, Table Completion, Group Activity, Quiz, Re- teaching of Steps, Parallel Assessment	Discussion, Graph and Table Presentation, Quiz
Competency 9	Slide presentation, Matching Activity, Giving Another set of Examples, Quizzes	Lecture, Use of Activity Sheets, Quiz

These activities were for two-week competencies found in the curriculum guide of General Mathematics. For the traditional way of teaching, the researcher followed the exact two-week time frame while for the Mastery Learning Strategy, it took five weeks to finished all the competencies.

***Post-experimental stage*.** At the end of the intervention period, the test given in the post test was parallel to the pre-test. However, it was scrambled, reworded and re-arranged. The test was given to determine the performance of the respondents in General Mathematics subject. The researcher administered the test, and the participants took the post- test. Test papers were checked and scores were tallied, computer- processed, analyzed and interpreted.

To analyze the data obtained, frequency, sum, percentage, mean, standard deviation for descriptive statistics, T-test for Dependent and Independent Samples and Cohen's D for Inferential Statistics were used. All statistical analysis was set at 5% level. Data were processed using the Statistical Package for the Social Sciences (SPSS) software. The decision to reject or confirm the hypothesis will be based on the computed p- value. If the p- value is less than or equal to the 5% level then the hypothesis was rejected, and if the p- value is greater than the 5% level then the hypothesis was confirmed.

The researcher took into consideration ethical issues while conducting the study, such as informed consent of the parents and confidentiality of the results. Permission of the parents to allow their children to participate in the study was sought by the researcher through a letter. They were asked to sign a letter which included the information about the nature and objectives of the study. The parents and learners were also informed that their participation even during the experimental stage. They were assured about the confidentiality of their children's participation in the study. The researcher ensured that the participants would not be harmed physically or psychologically.

4. Findings and Discussion

The level General Mathematics performance of students in the pre- test in the control and experimental group is shown in table 2.

In the control group, the data revealed that 10 or 50.00% of the respondents were proficient, 8 or 40.00% were low proficient, and 2 or 10.00% were very low proficient. The mean percentage score was 12.05 with standard deviation of 4.16 which meant that the respondents General Mathematics performance was proficient. On the other hand, in the experimental group there were 8 or 40.00% were proficient, 10 or 50.00% were low proficient and 2 or 10% were very low

proficient. The mean percentage score was 11.7 with standard deviation of 3.91 which meant that the respondents General Mathematics performance was low proficient.

Table 2
Level of general mathematic performance of grade 11 students in pre-test

Level of General Mathematics Proficiency	Mastery Learning Strategy		Traditional Way of Teaching	
	f	%	f	%
Proficient (12.01-18.00)	8	40	10	50
Low Proficient (6.01-12.00)	10	50	8	40
Very Low Proficient (0.00-6.00)	2	10	2	10
Total	20	100	20	100
Mean Score	**11.7**		**12.05**	
Description	**Low Proficient**		**Proficient**	
SD	**3.91**		**4.16**	

Table 3 shows the level of General Mathematics performance of Grade 11 STEM students in post-test using traditional way of teaching and mastery learning strategy.

Table 3
Level of general mathematics performance of grade 11 students in post-test

Level of General Mathematics Proficiency	Mastery Learning Strategy		Traditional Way of Teaching	
	f	%	f	%
Advanced (24.01-30.00)	3	15	0	0
Highly Proficient (18.01-24.00)	12	60	4	20
Proficient (12.01-18.00)	5	25	8	40
Low Proficient (6.01-12.00)	0	0	8	40
Total	**20**	**100**	**20**	**100**
Mean Score	**20.15**		**14.7**	
Description	**Highly Proficient**		**Proficient**	
SD	**3.62**		**3.92**	

In the traditional way of teaching, there were 4 or 20.00% highly proficient, 8 or 40.00% proficient and 8 or 40.00% low proficient. The mean percentage score was 14.7% with standard deviation of 3.92 which meant that the respondents performance using the traditional way of teaching was proficient. In experimental group, the data revealed that 3 or 15.00% were advanced, 12 or 60.00% were highly proficient and 5 or 25% were very proficient. The mean percentage score was 20.15 with 3.62 standard deviation which meant that the respondents General

Mathematics performance after the intervention was highly proficient. This shows that the level of performance by the group in post-test to Mastery Learning Strategy increases.

Table 4 highlights the mean Gain of students in General Mathematics in post-test using Mastery Learning Teaching strategy and traditional way of teaching. The pre-test mean of students in experimental group was 11.7 and the post-test mean was 20.15, the mean gain was 8.45 which is higher than the control group. Students in traditional way of teaching got a pre-test mean of 12.05 and post-test mean of 14.7 with the mean gain of 2.65.

Table 4

Mean gain in the general mathematics performance of grade 11 students in post- test

Group	Pretest Mean	Posttest Mean	Mean Gain
Mastery Learning Teaching Strategy	11.7	20.15	8.45
Traditional Way of Teaching	12.05	14.7	2.65

Table 5 shows the significant difference on the level of General Mathematics performance between the control and experimental group in pre-test. Result shows that there is no significant difference on the level of General Mathematics performance in pre-test using Mastery Learning Teaching strategy and traditional way of teaching ($t(38)= 0.274$, $p=0.785$). This means that both of the group have difficulty in learning General Mathematics subject.

Table 5

Significant difference on the level of general mathematic performance in pre-test

Group	Mean	df	t- value	p value
Mastery Learning Teaching Strategy	11.7	38	0.274^{ns}	0.785
Traditional Way of Teaching	12.05			

Note: $^{ns}p>0.05$, not significant

Table 6 reveals the significant difference between the two groups after the intervention. It shows a significant difference the level of General Mathematic performance in post-test using Mastery Learning Teaching strategy and traditional way of teaching ($t(38)=-4.569$, $p=0.000$). This shows that the intervention is an effective tool in teaching General Mathematics because students have better performance in the post-test.

Table 6

Significant difference the level of general mathematic performance in post-test

Group	Mean	df	t- value	p value
Mastery Learning Teaching Strategy	20.15	38	-4.569**	0.000
Traditional Way of Teaching	14.70			

Note: *p>0.05, significant
**p>0.01, highly significant

Table 7 shows the result on the level of students' performance in pre-test and post-test using traditional method of teaching. There is a significant difference between the level of General Mathematic performance of Grade 11 students in pre-test and post-test using traditional way of teaching (t(19)=-10.878, p=0.000). Traditional way of teaching is also effective because the level of students' performance in General Mathematics increased.

Table 7

Significant difference between the level of general mathematic performance using traditional way of teaching

Exposure	Mean	df	t- value	p value
Before	12.05	19	-10.878**	0.000
After	14.7			

Note: *p>0.05, significant
**p>0.01, highly significant

Table 8 reflects the performance level of students in experimental group in pre-test and post-test. There is a significant difference between the level of General Mathematic performance of Grade 11 students in pre- test and post- test using Mastery Learning Teaching Strategy (t(19)=-23.54, p=0.000).

Table 8

Significant difference between the level of general mathematic performance using mastery learning teaching strategy

Exposure	Mean	df	t- value	p value
Before	11.70	19	-23.544**	0.000
After	120.15			

Note: *p>0.05, significant
**p>0.01, highly significant

Table 9

Effect size of the use of mastery learning strategy on general mathematics performance

Exposure	Mean	n	SD	D	Description
Before	11.7	20	3.91	2.23	Large
After	20.15	20	3.65		

Note: <0.2 small effect, 0.50 medium effect,> 0.8- large effect

Table 9 shows the effect size of the use of Mastery Learning Strategy on General Mathematics performance. The effect size of the use of Mastery Learning Strategy on General Mathematics performance is large (D=2. 23). It implies that the Mastery Learning Strategy has a strong and meaningful effect on improving mathematics performance in a way that is highly noticeable and important.

5. Conclusion

The General Mathematics performance in the pre-test of Grade 11- STEM students in the control group was proficient while experimental group was least proficient. However, there was an improvement in the mean score of control variable who were taught using traditional way of teaching but still remains in the proficient level and those who were taught with Mastery Learning Strategy or the experimental group improved their mean score that made them to attain the high proficient level from least proficient level. There was significant difference between the level of General Mathematics performance of Grade 11 STEM students in pre-test and post-test using both the traditional way of teaching and Mastery Learning Teaching strategy. However, the effect size of the use of Mastery Learning Strategy on General Mathematics performance is large, a strong and meaningful effect on improving Mathematics performance.

Mastery Learning Strategy can increase achievement. Since achievement is important in the student learning process, Mathematics teachers should be encouraged to use this strategy. Using Bloom's Mastery Learning Strategy has a positive effect on students' academic achievement and retention in Mathematics subjects compared to the traditional way of teaching alone. Hence, students may adopt the Mastery Learning Strategy by answering several quizzes and engage in corrective instruction to become aware and learn from their mistakes in Mathematics. They should strive for mastery and not just learn something just to get through the class. On the other hand, teachers should be persuaded to use the Mastery Learning Strategy by providing different activities

suited for fast and slow learners in teaching Mathematics as it is more effective and useful as compared to Traditional Learning Approach. Similarly, school administrators should provide necessary trainings on teaching methodologies such as Bloom's Mastery Learning Strategy to ensure effective and successful instructional process. This could also be added on LAC sessions of teachers. Meanwhile, DepEd personnel and curriculum makers should lessen the competencies to be taught by the teachers and remove those who have already taught in early year level in order for the teacher to have enough time in teaching new lesson without rushing to finished other competencies and to ensure the students' mastery. They must also provide seminars to teachers that focus on the teaching strategies applicable for fast and slow learners inside the classroom.

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