# DEMYSTIFYING Mastery Learning Strategy for Teaching Basic Calculus: An Explanatory APPROACH

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**ABSTRACT**

The objective of this undertaking was to examine the effect of mastery learning strategy in the academic achievement of the students in basic calculus. An explanatory sequential design of the mixed methods research was employed in this study which had purposively chosen Grade 11 STEM students in the private higher education institutions of Region XI taking basic calculus as participants, same participants were utilized for an in-depth interview and for focus group discussion. Using the mean gain, effect size, and t-test, the study revealed that the level of academic achievement of the participants after the intervention using mastery learning strategy were recorded as significant with low increase of achievement and high effect size level, indicative that improvement was seen and though low is still evident. The quantitative strand results were positively confirmed through the standpoints of the participants in the focus group discussions and in-depth interviews.

**KEYWORDS:** *Education academic achievement, mastery learning, basic calculus, mixed method, mathematics, stem students, Philippines*

## INTRODUCTION

Basic Calculus achievement is one of the growing problems in Senior High School especially for STEM strand students ever since the establishment of the K to 12 programs in year 2012-2013. Basic Calculus deals with the mathematical study of a continuous changes, provides frameworks for modelling systems, and predicts outputs (Berggren, 2018 cited by Casinillo & Aure, 2018). Students who are taking calculus classes nowadays, especially STEM students, encounter several problems (Yerizon, 2019). Just recently, a study on competency and proficiency of freshmen engineering students whose major

courses include Basic Calculus topics such as limit, continuity, derivative, and integrals showed an average to poor performance in the subject with a weighted mean value of 2.79 emphasizing the low student calculus achievement along with its related topic (Santos et al., 2022).

In the United States of year 2019, 12.7 percent of white graduating seniors and 3.7 percent of black seniors took an AP calculus examination and only two thirds and 40 percent, respectively, earned a passing grade of three or higher which is below the passing rate of 75 percent (Bressoud, 2020). This result demonstrates why students in the United States perceives achievement in calculus subject as difficult, and that expectations concerning failure in the subject are already discussed.

Similarly, in Indonesia, it was identified that students have difficulty in the main calculus materials, namely limit, derivative, and integral learning (Yerizon, 2019). A sufficiently large percentage of students displayed difficulties in limit function material of 75 percent, derivative material as 53 percent, and integral material as much as 75 percent. Each material exceeds the 50 percent difficulty level which explains why most of the senior high school students have low performance and achievement on basic calculus subject. Additionally, student's data concerning concepts mastery showed that 81.82 percent of the students in Indonesia experienced concept mastery difficulty in Derivatives, especially on the concepts such as determining the Derivative and value of a Derivative function (Wewe, 2020)

Moreover, a study conducted by Subia et al. (2020), in the Philippines, showed that the level of knowledge of the STEM students in Basic Calculus subject as measured by Blooms' taxonomy was average in remembering and understanding level, whereas in analyzing and evaluating, they measured below average. Furthermore, Auxtero and Callaman (2020), discovered that four consecutive batches of Grade 11 STEM students from Davao City performed poorly in examination that involve problem solving in Pre-Calculus in 2020 with almost 65 percent failure rate, and application of derivatives for the previous three batches showing 42, 54, and 46 percent failure rate, respectively. This indicates that the level of knowledge of the STEM students in Basic Calculus subject as measured by Bloom's taxonomy was below average to poor in analyzing and evaluating levels where according to Subia et al. (2020) measured only 40.52 and 23.21 percent, respectively. It was pointed out that their cognitive level in basic calculus did not meet the expected level which would likely

become a problem as they proceed to a higher part of the subject (Guskey, 2010).

Despite the importance of calculus in a wide range of disciplines, certain difficulties prevent students from learning it, which leads to unprecedented failure (Usman, 2012). The low-performance rate of students in calculus courses has been observed across different universities around the world (Agustin & Agustin, 2009). It has also been said that the difficulties of students in mastering conceptual and procedural knowledge due to improper use of learning strategies is what causes them to have difficulties in learning Basic Calculus (Mendezabal & Tindowen, 2018). Furthermore, it has been suggested that students might perform better in Basic Calculus if given a proper learning strategy such as Mastery Learning (Diseth & Kobbeltvedt, 2010).

Mastery Learning is evidently effective when used as a strategy for teaching and learning especially in improving student's proficiency and achievements in geometry, showing a significant effect on performance and retention (Adenji et al., 2018). It also shows positive significant relationship on the achievement in science, physics, chemistry, and other health-related fields (Damavandi & Kashani, 2010; Blessing & Olufunke, 2015; Cook et al., 2013).

Mastery Learning also shows a significant effect on the learning achievement and attitude towards mathematics of the students with a mean difference of 16.19 (Bhuyan & Devvi, 2013). Other studies also illustrated a significant relationship between Mastery Learning and students' academic achievement in mathematics subject (Yemi, 2018; Adenji et al., 2018; Shafie et al., 2010).

However, studies that are cited in the literature above mostly focused on correlations between the Mastery Learning strategy and the academic achievement of the students (Shafie et al., 2010), as well as the effect of Mastery Learning in the performance and retention in other variables (Adenji et al., 2018). The current study will adopt a mixed-method approach, in contrast to previous studies that used experimental and correlation methods. Furthermore, there aren't many studies that concentrate on STEM students' Basic Calculus accomplishment that use teaching methodologies like Mastery Learning that emphasize taking your time to grasp a concept or topic.

The researcher made the decision to carry out a study with the express purpose of enhancing students' mastery through the use of time allocation in

learning, corrective feedback, corrective exercises, and retesting. Furthermore, the administration and management of the school, particularly in the academic group, will have a new strategy for handling issues pertaining to students' academic performance thanks to the research provided by this study. The results of this study may be useful to the educational system as a guide when creating MELCs that concentrate on students' mastery through prioritizing learning duration over learning volume.

Most especially, the researcher aims to also present the content of this study to regional and national fora for a wider audience and effective dissemination. In the local area, the results of this study shall be presented to the private Grade 11 teachers during their Annual Academic Pre-planning and Curriculum Content Preparation. For national and international areas, the result of this study will be published in different journals and publication companies. The goal of this study is to provide teachers with more resources to help them prepare their teaching and learning strategies for mathematics lessons, particularly in basic calculus, and to support students' learning styles, which emphasize mastering a topic before going on to the next.

## Theoretical Lens

In every academic institution, the researcher agrees with the idea that teachers' strategies are among the most crucial factors in the achievement of the student and school objectives and that, as a result, their special qualities and experiences should be taken into consideration. Therefore, the researcher in this study believes that it is important to examine the role of teaching strategies such as mastery learning and its impact and effectiveness while considering student achievement.

As a pragmatist, the researcher strongly believed that the result of this undertaking shall address the existing problem by providing a concrete and reliable output such as an action plan for the sustainability and improvement of the variable being studied, in this case, the STEM students' Basic Calculus achievement. Moreover, the researcher of this undertaking is very much concerned with how the study will become a solution to the manifested application to problems. That is why, mixed methods were utilized in this study. Surely, the collection of data from the quantitative and qualitative phases will provide salient knowledge of the issue for the researcher.

This study is anchored on pragmatism. According to Saunders et al.

(2014), it is a research philosophy based on the epistemology that there is no single way to learn but many different ways of understanding because there are multiple realities. In mixed methods study, it enhances a more detailed understanding of research questions and results leading to a balanced conclusion on the challenges and opportunities of the research problem (Maswoswere, 2019).

To understand this research further, this study was anchored on the Mastery Learning Theory of Benjamin Samuel Bloom (1968). The Mastery Learning Theory dwell on the idea that most student can learn well and master subjects when teachers employ effective practices to construct a good learning environment (Lease, 2016). Positive school climate and a good learning environment are associated with positive child and youth development, effective risk prevention and health promotion, student learning, and academic achievement (Thapa et a., 2013). According to Bloom, students learning, and mastery is dependent on instruction and teachers' strategy in teaching, where individual differences of students must be taken into consideration.

Mastery Learning Theory can be used to analyze current practices in teaching and learning. For example, by making use of the learning time allocated, teachers were able to create a system that allowed them to test pupils, provide feedback, give corrections, and provide another test. Teachers can use this cycle as a way to give students excellent instruction, and as a result, students will grasp the material. In this way, learning a lesson well aids in the learner's ability to store and recall the knowledge until it is needed again.

Another theory was the Theory of Knowledge Acquisition of O'Dell and Grayson (1998). Knowledge acquisition according to O'Dell and Grayson (1998) can be expressed as the practices, processes, and tools used to move knowledge into a state where it is kept available for future use. With which a more knowledgeable adult helps a person, or a group perform a difficult task, capturing specified problem-solving instructions. Since, when someone continues to receive learning trials beyond the point of initial mastery, overlearning occurs.

In the study, students and teachers may, for example, use the idea of organizing the order of learning and information mastered to increase the possibility of storing that information deeply in their memory and to achieve long-term retention of information. A teacher may provide activities that target

pre-requisite knowledge, let the students master it using the Mastery Learning strategy then proceed to the next activity. Continue this cycle until students can retain and retrieve information after a period of the set interval.

## METHODS

### Research Design

The researcher of this study used a mixed method approach specifically the explanatory sequential design, particularly the Follow-up Explanation Model. Mixed methods research are those studies that include at least one quantitative strand and one qualitative strand which supplies a more complete comprehension of the research problem that of either quantitative or qualitative alone (Creswell & Plano, 2018). Further, it is used as the second method that is needed to improve the primary method. It enables researchers to answer questions with sufficient depth and breadth (Enosh, Tzafrir, & Stolovy, 2014). In the case of the study, qualitative data are needed to improve the findings of quantitative data. Also, this approach was used because the researcher wants to understand the standpoints of the STEM students employing the Mastery Learning strategy.

An explanatory sequential design according to Edmonds and Kennedy (2017) is often used when the researcher is interested in following up the quantitative results with qualitative data. Thus, its purpose was to utilize the qualitative data to strongly and furtherly explained the partial quantitative results which involved collecting data through pre-test and post-test in the first phase, analyzing it, and following up with qualitative interviews that clarified the conducted pre-post examination, although, these approaches' results were analyzed separately.

Additionally, in accordance with the use of explanatory sequential design, a Follow-up Explanation Model was used in this study. Follow-up Explanation Model is a model in which the qualitative inquiry will be used as a follow-up strategy in explaining the quantitative findings (Maforah & Leburu-Masigo, 2018). Moreover, the researcher used the follow-up explanation model since the quantitative strand is given precedence over the qualitative strand and the results from the quantitative design was used to develop a semi-structured interview questions for qualitative data collection (Salihu & Kawi, 2021).

In the quantitative phase, pre-test and post-test method were used in the

study. To get the level of effectiveness of an intervention, the researcher got the difference in the mean scores of the participants from the pre-test and post-test. In this study, the design was used to get the results on the impact of Mastery Learning on the Basic Calculus achievement of STEM students. With this, statistical tools were utilized to determine the relationship among variables.

While the qualitative phase, a phenomenological approach was used by the researcher specifically the Phenomenological analysis guide by Colaizzi (1987). A phenomenological approach is a form of qualitative inquiry that emphasizes experiential, lived aspects of a particular construct. It is experienced at the time that it occurs rather than what is thought about the experience, or the meaning ascribed to it subsequently (Nelson, 2021). The results were analyzed through thematic analysis to further explain the quantitative findings based on the perspective, understanding, and feelings of the participants. The results from the quantitative phase were link to the formulated themes in the qualitative phase to determine how the data of the quantitative phase corroborated with the findings in the qualitative phase.

This method was the best fit since the researcher of this undertaking wanted to follow up the quantitative data with qualitative data to find out the significant influence and relationship of Mastery Learning strategy to the Basic Calculus achievement of the STEM students.

**Place of the Study**

The research was conducted in a private non-sectarian school in Davao City, specifically in Tugbok District. The school is one of the K to 12 delivering institutions that offers four (4) Senior High School strands namely, STEM, ABM, HUMSS, and ICT.

The researcher of the study chose this place because of two reasons: First, the researcher is currently employed at the said school as a subject teacher which gives the advantage of ease of access to the respondents of the study as well as the students' academic record. As part of this community, the researcher wanted to know and understand the experience and academic situation of private school students when it regards their academic achievement. In this way, the researcher was able to provide significant insights on how to improve and sustain the academic achievement of STEM students, especially in Basic Calculus.

Second, the school itself has low Basic Calculus achievement as

evidenced in the achievement scores of the students in the previous final exam result in 2019 which showed a poor achievement rating which is an alarming achievement and performance result, especially for those who are in the administrative position. For this very reason, the researcher selected this place of study since there is a need for an intervention in the academic achievement of the students.

**Research Participants**

The researcher chose participants for both the quantitative and qualitative in terms of data collection for the data to be congregated and associated easily. For this reason, when there will be different participants in both approaches, it will give great confusion in comparing the results since the participants and respondents of the study have distinct characteristics (Creswell, 2006).

In the quantitative phase, the participants were the 49 STEM strand students who was part of the group that took the pre-test and post-test before and after employing the mastery learning strategy in the preliminary phase of the study. The research participants of this study were selected using the purposive sampling design where the intact population of Grade 11 STEM students in the selected school which are already assembled as a group or section before the conduct of the study was examined. Thus, to achieve homogeneity, the following criteria was set: each participant is a STEM strand student taking Basic Calculus classes in the second semester of the year 2022-2023.

In the qualitative phase, there are 17 participants who participated in the study. There are ten participants who was invited by the researcher for the in-depth interview (IDI), specifically the five highest scorer and five lowest scorer participants who underwent the intervention since their experiences as the top and lowest scorers gave validation on the effectivity and impact of mastery learning Strategy and another seven members for the focus group discussion (FGD) who are categorized as the middle scorers out of those who underwent the intervention. It was noted that the participants in the IDI will no longer participate in the FGD and thus, there would be another set of participants for FGD. These students were selected since they underwent mastery learning strategy and thus, it was appropriate for a phenomenology study to utilize the experiences and standpoints of the respondents mentioned above. The findings were used to define the evolving themes that furtherly explains the outcomes during the quantitative phase of the study.

The core goal of the purposive sampling technique is to focus on a particular characteristic of a population which enabled the researcher to answer the research questions. It was a choice, the purpose of which varies depending on the type of purposive sampling technique that is used (Creswell, 2003).

**Data Analysis**

The results of the study were interpreted using descriptive statistical tools such as mean, standard deviation, and Effect size. The mean was used to describe the level of achievement of the participants. Standard deviation was used to calculate the amount of dispersion of the data values. A high standard deviation means that the data is spread out on a wider range of values while a low standard deviation means that the data is closer to the mean value. A T-test was also used to compare the means of the pre-test and the post-test and to check whether there is a significant difference. Lastly, the Effect Size was used to determine the effect of the intervention on the scores using the Pre-test and Post-test results.

The data in the qualitative phase were analyzed through thematic analysis. Caulfield (2019) emphasized that thematic analysis refers to identifying, analyzing, and interpreting patterns of meaning within qualitative data. On the other hand, an in-depth interview will offer a chance to capture rich, descriptive data about people's behaviors, attitudes, and perceptions, and unfold complex processes (Williams, 2019). These can be used as a standalone research method or as part of a multi-method design, depending on the needs of the research. According to Creswell (2003), in doing the thematic analysis, the researcher needed to follow the identified six steps in the process.

First, the data for analysis were organized and prepared through transcribing interviews, optimally scanning materials, and categorizing each visual material among others. Second, reading or looking at all the data in order to gain a general sense of the information and to secure the opportunity to reflect on its overall meaning. Third, was the coding of the data. In this case, the researcher organized the collected data by categorizing the images and text and then labeling the categories with a term. In the fourth step, the coding process was utilized to come up with a description of the people, setting, or categories/themes for analysis.

The step was essential as it helped to design detailed descriptions for

different forms of research initiatives. Fifth, this step mandated the researcher to advance the way themes and descriptions are represented in the qualitative narrative. For example, a researcher may opt to use a narrative passage to confer the outcomes of the analysis. Lastly, is making an interpretation of the findings or the results. This phase required a researcher to ask him or herself about the lessons gained.

## RESULTS

### Pre-test Mean Scores of the Participants

**Table 1**
*Pre-test Mean Scores of the Participants*

| Topics | Mean | Percent of correct answer | SD | Description | Interpretation |
|---|---|---|---|---|---|
| *Slope of the Tangent Line* | 4.08 | 27.21 | 2.21 | Low | Fairly Satisfactory |
| *Derivative of Algebraic Function* | 6.55 | 38.54 | 2.55 | Low | Fairly Satisfactory |
| *Differentiation Rules* | 5.12 | 28.46 | 2.39 | Low | Fairly Satisfactory |
| ***Pre-test*** | **15.65** | **31.31%** | **5.14** | **Low Achievement** | **Fairly Satisfactory** |

Table 1 presents the mean score of the participants during the pre-test which obtained 15.65 with a standard deviation of 5.14 and is described as low achievement based on the 31.31 percent of correct answers in basic calculus. The table also presents the individual mean score and corresponding percent of correct answers of the participants in the different topics during the pre-test. The result shows that, the topic on the slope of the tangent line, derivative of algebraic function, and differentiation rules, got a mean score of 4.08, SD = 2.21; 6.55, SD = 2.55; 5.12, SD = 2.39, respectively with corresponding 27.21, 38.54, and 28.46 percent of correct answer which was all described as low achievement.

Based on the data obtained, the findings revealed that the mean score of

the learners during the pretest was described as low level, with a disperse standard deviation from the mean. This denotes that the academic achievement of the learners before the intervention is fairly satisfactory. It is notable that before the intervention, the learners have a low level of achievement in Basic Calculus. This result is supported with the study conducted by Mendezabal and Tindowen (2018), where out of the 25 item exam in differential calculus, most students' scores range from 6-10 and got a mean score of 8.27 which stated that students usually have difficulty on the pretest resulting to low mean score achievement and fairly satisfactory performance before the conduct of the study. Additionally, Nunez et. al. (2023) affirmed that the scores of the students both in the comparison and experimental group only obtained 5.60 and 5.60 respectively, which was categorized under low level during their pre-test indicating that students had a lack of knowledge regarding the lesson before the conduct of the study and had low level of performance. Moreover, the study confirms the result of Tan and Ambasa (2022), when they found out that the scores of the students in the pretest has a very low performance and was categorized under deficient level.

**Post-test Mean Scores of the Participants**

**Table 2**
*Post-test Mean Scores of the Participants*

| Topics | Mean | Percent of correct answer | SD | Description | Interpretation |
|---|---|---|---|---|---|
| *Slope of the Tangent Line* | 6.27 | 41.77 | 3.04 | Moderate | Satisfactory |
| *Derivative of Algebraic Function* | 10.92 | 64.23 | 3.39 | High | Very Satisfactory |
| *Differentiation Rules* | 8.76 | 48.64 | 2.97 | Moderate | Satisfactory |
| ***Post-test*** | **25.94** | **51.88%** | **7.77** | **Moderate Achievement** | **Satisfactory** |

Table 2 presents the mean score of the participants during the post-test which is 25.94 with a standard deviation of 7.77 and is described as moderate achievement based on the 51.88 percent of correct answers in basic calculus. The

table also presents the individual mean score and corresponding percent of correct answers of the participants in the different topics during the post-test. The result shows that, the topic on the slope of the tangent line, derivative of algebraic function, and differentiation rules, got a mean score of 6.27, SD = 3.04; 10.92, SD = 3.39; 8.76, SD = 2.97, respectively with corresponding 41.77 moderate level, 64.23 high level, and 48.64 moderate level percent of correct answers.

The findings on the posttest revealed that the learners got a mean score described as moderate level, and a disperse standard deviation from the mean. This denotes that the academic achievement of the learners after the intervention is satisfactory. It is notable that after the intervention, the learners, although still have a moderate level of achievement in Basic Calculus, have made an increase in their scores from the pre-test which signifies that the strategy employed during the intervention have helped the learners improve their scores.

The result conforms to the study of Nunez et. al. (2023) where after the intervention using enhancing mastery, the students were able to acquire a mean value of 12.78 and 12.96 for the comparison and experimental group respectively, indicating a higher achievement level especially for the experimental group. Additionally, Khansila (2022) affirmed that after using mastery learning approach, the students were able to improve their post-test results from the previous 50.30 to 74.38 mean score achievement which was describe as high post-test achievement. Moreover, the result confirms the assumption of Latimier et. al (2019), when they mentioned that post testing effect is significantly larger than that of pretesting.

**Significance of the Difference in the Pre-test and Post-test Mean Scores of the Participants**

**Table 3**
*Significance of the Difference in the Pre-test and Post-test Mean Scores of the Participants*

| | t | p-value | Remarks |
|---|---|---|---|
| Pre-test<br>Post-test | 9.266 | .000 | Significant |

| | | |
|---|---|---|
| Effect Size (Cohen's D) | 1.10 | Large |

***Significant at 0.05 level of significance*
*Cohen's d: Very small (0.01), Small (0.20)*
*Medium (0.50), Large (0.80), Very large (1.20), Huge (2.0)*

Table 3 presents the computation of the value to test the significant difference in the pre-test and the post-test achievement of the participants. The result indicated a significant difference between the mean scores of the pretest and the posttest. Additionally, the t-value of 9.266 and a p-value of .000 which was less than the set p-value of 0.05 level of significance indicate that there is a significant difference in the pretest and posttest performance of the participants.

The difference between the pre-test and post-test mean scores of the participants was tested under an alpha 0.05 significance level. The p-value of .000 presented in table 3 is less than 0.05, implying that there is a significant difference between the participants' pre-test and post-test mean scores in Basic Calculus, specifically in Slope of the tangent Line, Derivative of algebraic function, and Differentiation rules. Further, this demonstrates that the post-test achievement of the participants was significantly higher than their pre-test achievement.

The finding is consistent with the results of the study of Nwoke et al., (2014) which shows that Mastery learning strategy had a significant effect between the achievement scores of the student with p-value less than 0.05 as compared to conventional teaching. Additionally, Adenji et al., (2018) indicated that Mastery learning is evidently effective when used as a strategy for teaching and learning especially in improving proficiency and achievement. Furthermore, the results coincide with the study of Arhin (2020) where after the conduct of the treatment with Mastery learning strategy, the experimental group performed significantly better than that of the control group.

**Extent of Mastery Learning Enhancement on Students' Achievement in Basic Calculus**

**Table 4**
*Extent of Mastery Learning enhancement on students' achievement in Basic Calculus*

| | Mean | Mean Gain | % Inc. | Remarks |
|---|---|---|---|---|

| Topic | (Pre-test) | (Post-test) | | % | |
|---|---|---|---|---|---|
| *Slope of the Tangent Line* | 4.08 | 6.27 | 2.19 | 4.38 | Very Low |
| *Derivative of Algebraic Function* | 6.55 | 10.92 | 4.37 | 8.74 | Very Low |
| *Differentiation Rules* | 5.12 | 8.76 | 3.64 | 7.28 | Very Low |
| ***Total*** | ***15.65*** | ***25.94*** | ***10.29*** | ***20.57*** | ***Low*** |

Table 4 presents individual and overall mean gain and the percent of increase from the participants' pre-test and post-test exam. The mean of the participants from the pre-test categorized on the topics about the slope of the tangent line, derivative of algebraic function, and differentiation rules, got a mean gain of 2.19 (4.38% increase), 4.37 (8.74% increase), and 3.64 (7.28% increase), respectively, which was all described as very low level increase in each individual topic. However, the overall mean gain during the post-test was 15.65 which corresponds to a 20.57% increase and was interpreted as low level increase in the achievement in basic calculus after the conduct of the study.

The findings on the pre-test and post-test revealed that during the post-test, the participants gained an increase from their previous mean scores in each specific topic. It was found that all topics had a mean gain and percent of increase on the achievement of the participants was categorized under very low level. Overall, the mean gained after the intervention on mastery learning strategy was interpreted as low level of achievement. This implies that from the pre-test scores of the participants, they were able to obtain an increased in their scores during their post-test.

This finding is consistent with the result obtained by Nunez et. al. (2023), where they found out that using enhancing mastery approach, students were able to acquire mean gain of 7.348 and a huge effect size of 2.464 which indicates that the intervention had a huge impact on the students' achievement in basic calculus. Moreover, the findings of this study confirm the result of the study by Bhuyan and Devvi (2013) where the experimental group exposed to Mastery learning strategy were able to obtained a mean value of 17.66 compared to the control or conventional method with 1.47 giving a mean difference of 16.19. Which is indicative that Mastery learning allows learner to gain higher achievement when compared to the conventional method.

**Profile of the Participants**

**Table 5**
*Profile of the Participants*

| No. | Participant Code | Age | Grade Level | Study Group |
|---|---|---|---|---|
| 1 | Buggy | 17 | 11 | IDI |
| 2 | Boa Hancock | 17 | 11 | IDI |
| 3 | Shanks | 18 | 11 | IDI |
| 4 | Nami | 17 | 11 | IDI |
| 5 | Robin | 17 | 11 | IDI |
| 6 | Ussop | 19 | 11 | IDI |
| 7 | Linlin | 18 | 11 | IDI |
| 8 | Vivi | 17 | 11 | IDI |
| 9 | Atlas | 18 | 11 | IDI |
| 10 | Zoro | 17 | 11 | IDI |
| 11 | Mr. 3 | 18 | 11 | FGD |
| 12 | Frankie | 18 | 11 | FGD |
| 13 | Shiratori | 18 | 11 | FGD |
| 14 | Luffy | 17 | 11 | FGD |
| 15 | Mihawk | 17 | 11 | FGD |
| 16 | Jinbei | 17 | 11 | FGD |
| 17 | Nojiko | 18 | 11 | FGD |

Presented in Table 5 is the profile of the participants in the in-depth interview and focus group discussion. There were 10 informants for the IDI which were chosen from the same participants during the quantitative phase. Specifically, these informants were the top five (5) highest and the top five (5) lowest scorers during the post-test exam since their experiences as the top and lowest scorers gave validation on the effectivity and impact of the strategy. Followed by 7 participants for the FGD. The participants on the FGD are chosen from the middle scorers during the post-test since they are neither the top scorers nor the lowest.

The 17 participants comprise of ten for the in-depth interview and seven for the focus group discussion. The participants include the Grade 11 students of section Kerith of private higher education institutions who had been enrolled in

the STEM strand and are taking Basic Calculus subject. Moreover, as gleaned from the table, the participants' identity was replaced with code names inspired from the anime characters of One Piece since students are equated with the adventurous character in the series who have been facing continuous challenges.

***Standpoints of the Participants on the Significance of the Difference of the Pre-Test and Post-Test Scores***

**Table 6**
*Standpoints of the Participants on the Significance of the Difference of the Pre-Test and Post-Test Scores of the Participants*

| Difference | Essential Themes | Typical Reasons |
|---|---|---|
| Pre-Test and Post-Test Scores<br><br>Significant<br><br>t = -9.266<br>df = 48<br>p-value = .000 | Confirmed significant difference between the pre-test and post-test scores | Assessments conducted before moving to the next topic.<br><br>Students were given opportunity to change their score.<br><br>Students gain self-esteem and self-confidence in solving problems in calculus.<br><br>Students strive to do better because they do not want to be left by the group.<br><br>Students are comfortable discussing with their classmates. |

Presented in Table 6 are the typical reasons and explanations of the issues and the emerging themes from the specific items on the pretest and posttest. Several themes were drawn out from the in-depth interview and focus group discussion, which derived from the responses on the third research question on the significant difference between the pre-test and the post-test mean scores of the participants. The participants were asked about their stance and insights regarding the quantitative results on specific items of the variables.

Additionally, they were asked to explain and give examples on what specific items have made a difference in their mean scores.

Confirmed significant difference between the pre-test and post-test scores. This theme underscores how the strategy improved the participants' scores significantly. Some of the participants pointed out that the assessments conducted before moving to the next lessons and the eagerness to not be left behind are the driving factors for the differences between the pretest and posttest scores. The remarks of the following participants fostering the approaches and strategies they have encountered supported the foregoing observations.

> *Ano po kanang, kunwari naa moy ihatag sa amoa nga activities sir tapos dili namo siya ma pasar, ... hatagan napod mi ug bag-o hangtod sa maabot na namo ang passing score. (Nami_IDI#4)*
>
> *Hmmm ah, kanang mga like past quizzes nato and then mga repeated assessment, remedials, because of that kanang naka help siya para ma better akoang understanding sa Basic Calculus. (Robin_IDI#5)*
>
> *During kanang mag solve bitaw ug problems sir kanang diba is ... kanang tabang jud kaayo siya sa akoa para mahibal-a namo ang kanang way sa pag-solve jud sir and also kanang ma-master jud nako siya. (Frankie_FGD#2)*
>
> *Sa akoa sir is kanang, pareha anang repeated assessment and kanang mag ask sa mga peers, siyempre sa sugod sir di man jud ka maka-kabisado pa kaayo, so, as time goes on sir ... ma-master namo. (Shiratori_FGD#3)*

***Standpoints of the Participants on the Mean gain from the mean of the Pretest and the mean of the Post-test scores***

**Table 7**
*Standpoints of the Participants on the mean gain from the mean of the pretest scores and the mean of the posttest scores*

| Level | Essential Themes | Typical Reasons |
|---|---|---|

| | | |
|---|---|---|
| Mean of the Pre-Test scores = 15.65<br>Mean of the Post-Test scores = 25.94<br><br>Mean Gain = 10.286 | Confirmed mean gain scores | Remedials and repeated assessments conducted.<br><br>Less intimidating for the students.<br><br>Group activities and peer tutoring.<br><br>Tutorial discussions |

Presented in table 7 are the explanations of the issues and the emerging themes from the specific items on the pretest and posttest. Several themes were drawn out from the in-depth interview and focus group discussion, which derived from the responses on the fifth research question on the participant's standpoints on the mean of the pretest and the mean of the posttest. The participants were asked about their stance and insights regarding the quantitative results on specific items of the variables. Additionally, they were asked to explain and rationalize their standpoints on the issues probed.

**Confirmed mean gain scores.** An indicator that Mastery Learning strategy is manifested depends generally on how students were prepared before taking their posttest exam. This can be gleaned from the responses of the participants who stressed out that some methods in Mastery Learning strategy have helped them acquire knowledge and eventually gain an increased in their scores. The declarations of these participants who eagerly shared their experiences validated the result.

> *Mag agree ako sir kay ang pretest wala jud ko kabalo sa mga lessons so pataka lang ko, pagka post-test kay since kabalo naman ko nakatuon ko sa lessons and sa strategy nakakuha kog taas na score. (Luffy_FGD#14)*

> *Kasi in the past po kasi we have sa atung learning strategy remedials and then repeated assessments and because of that na-improve akuang mga scores. (Robin_IDI#5)*

> *Because maybe sir kay pretest is like gina kuan pa amuang learning kay wala paman mi kabalo sa lesson and sa mga uban,*

*posttest is murag kabalo naman mi unsaon, gi tudluan nami murag gi balik-balik na ... (Vivi_IDI/8)*

During the conduct of the pre-test and the post-test on the quantitative part, the participants were able to make a difference on the scores and acquire an increase on their mean scores. Upon the conduct of the interviews on the IDI and FGD participants, they were able to confirm the mean gained.

**Connecting-Merging.** As can be gleaned from the utterances of the participants on the mean gain score achieved during the post-test which was described as moderate-level achievement. This was manifested when the learners professed that they were able to improve their skills and knowledge from their post-test using the methods involve in the strategy employed during the intervention, they were able to master the contents and moved on to the next lesson after passing the assessments. Moreover, they expressed that the strategy helped them become motivated, comfortable, and it allows them to gain self-confidence. Hence, a theme: Confirmed mean gain scores emerged.

This result conforms to the findings of Pyzdrowski et al., (2013), where they stated that learners with a comfortable and creative environment may improve student attitude towards learning and developed a positive outcome on their performances. Additionally, Guskey (2010) affirmed that students must achieve a specified level of content knowledge prior to progressing to the next unit of instruction through one or more trials.

Moreover, the result confirms the findings of Alsalhi et. al. (2021) where they mentioned that through the use of differentiated instructions, students are able achieve higher mean level of 16.86 than that of traditional teaching which is only 11.50.

**Joint Display of Quantitative and Qualitative Results**

**Table 8**
*Joint Display of Quantitative and Qualitative Results*

| Research Area | Quantitative Results | Qualitative Results | Nature of Integration |
|---|---|---|---|
| Pre-Test and | Mean of the | Participants confirmed | |

| | | | |
|---|---|---|---|
| Post-Test Scores | Pre-Test scores = 15.65<br>Mean of the Post-Test scores = 25.94<br><br>Mean Gain = 10.286 | the mean gain score. Based on the IDI and FGD, it could be gathered that the general assertions confirm the mean gain score. (Refer to Table 6) | Connecting -Merging |
| Significance of the Difference of the Pre-Test and Post-Test Scores | Pre-Test and Post-Test Scores<br><br>Significant<br><br>t = -9.266<br>df = 48<br>p-value = .000 | Participants confirmed the significant difference of the pre-test and post-test scores. Based on the IDI and FGD, it could be gathered that the general assertions confirm the significant difference. (Refer to Table 7) | Connecting -Merging |

Presented in Table 8 is the merging results from the quantitative and qualitative data of the participants before, during, and after the intervention. Including the in-depth interview and focus group discussion merging result. In the table presented below, it was shown that using the connecting – merging nature of integration, the quantitative result was confirmed true by the qualitative results. Three participants from the IDI and FGD groups namely; Vivi, Mihawk, and Jinbei, mentioned some features of Mastery Learning strategy that asserts the confirmation of the quantitative results.

> *Remedial sir, because ang remedial sir kay sometimes man jud kay walay time kay kulang sa time so remedial is like naga pataas sa atung time na masabtan jud nato ang lesson niya pag abot sa repeated ... (Vivi_IDI#8)*

> *Parehas pod repeated assessment kasi ano siya, trial and error man diba sir kanang mag-solve ka hangtod sa pinaka-last pero pag mali, usab napod ka, mag sige kag usab-usab para ma-master najud nimo siya ... (Mihawk_FGD#5)*

> *For me sir combination sa peer tutorial and repeated assessment, because after man sa lecture niya dili kaayo siya klaro saimoha pwede ka mangutana sa imuhang peers. Sa repeated assessment is usab-usabon nimo ... (Jinbei_FGD#6)*

Going through the data, the result revealed that using the connecting – merging nature of integration, the mean gain and significance difference quantitative result was confirmed true by the qualitative result. Additionally, some participants from the IDI and FGD groups mentioned some features of Mastery learning strategy such as; remedials or remediation, repeated assessment, and peer tutorials, that asserts the confirmation of the quantitative results. This means that due to many aspects of Mastery learning strategy employed during the intervention, the participants were able to perform well and made a significant difference in their posttest scores.

The result conforms to the study conducted by Guskey (2010) and Ihendinihu (2013) which implies that mastery learning uses differentiated and individualized instruction, progress monitoring, formative assessment, feedback, corrective procedures, and instructional alignment to minimize achievement gaps and increase achievement. Additionally, Morgen (2013) affirmed that Mastery learning indicate positive outcomes for the students especially in the areas such as achievement and mastery. Furthermore, the findings are also found to be parallel on the study conducted by Adeniji et. Al., (2018) where they concluded that Mastery learning strategy improves student's performance and is effective in influencing students' different scoring levels to achieve equally in a given task.

## CONCLUSION

High academic achievement is a driving force that encourages schools, teachers, and even students to employ strategies that would ensure success. In fact, good learning strategies with high level of learning development capabilities develop learners not only academically, but holistically as they are able to improve retention capabilities and emotional readiness in various activities. Undeniably, effective strategies can develop learner's motivation, focus, and may even lead to retention and mastery. With this kind of aspects that learning strategies had demonstrated, consequently, mastery learning strategy poses a great impact on students' achievement. The succeeding annotations are the conclusions extricated from the research findings. Based on the descriptive findings, it can be concluded that before the use of mastery learning strategy, the

learners had a low level of academic achievement which is evident from the mean score of 15.65 and the percent of correct answer which is 31%. While after the intervention, the learners were able to acquire a mean score of 25.94 which is an increase from the previous mean score and with percent of correct answers equivalent to 52%, was interpreted as moderate level. This denotes that mastery learning strategy have helped the learners improve their academic achievement as evident from their 10.286 mean gain score, a 21% increase from the previous percentage of correct answers during the pre-test and is interpreted as low level increase. It can be gleaned as well that a significant difference is evident with p-value of .000 in the mean of the pretest and posttest of the learners, thus, implying that mastery learning strategy helped make a significant difference in the academic achievement of the learners. On the issues of the quantitative findings that need clarifications on the pretest – posttest significance among the quantitative data and on the resulting analysis of the qualitative data, revealed a theme result of a confirmed significant difference between the scores. In terms of the mean gain score and extent, it was found to be significant and resulted to a confirmed mean gain score specifically on the topics such as derivative of algebraic functions, slope of the tangent line, and differentiation rules. For the standpoints of the participants on the mean of the pretest and posttest scores, it can be concluded that one theme was drawn out from the responses in the in-depth interview and focus group discussion which confirmed the quantitative result. Lastly, on the corroboration of the qualitative and the quantitative result, a connecting-merging nature of integration help confirmed the quantitative result.

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