



UTILIZATION OF MULTI-TIERED LESSONS IN TEACHING MATHEMATICS IN IMPROVING THE ACADEMIC PERFORMANCE OF GRADE 7 STUDENTS

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ABSTRACT

The study was conducted with the purpose of determining the effects of utilizing multi-tiered lessons in teaching Mathematics to improve the academic performance of Grade 7 students in Paso De Blas National High School. It was limited to two (2) sections of heterogeneous class. One group was taught using the traditional approach while one group was subjected to multi-tiered lessons.

The researcher adopted quasi- experimental with mixed approach method. For quantitative data, pretest and posttest questionnaire was used to test the effectiveness of the study. Qualitative data was also gathered using a survey questionnaire, this data was collected to support the result of quantitative data and to determine the experience of the participants under multi-tiered lessons.

The results of pretest and posttest of experimental group and control group showed that the utilization of multi-tiered lesson helped the learners to improve their mathematical academic performance.

The result of thematic analysis shown that students enjoys varied activities that are suited in their level. It was also found out that multi-tiered lessons helped students to learn the topics in their in-depth understanding.

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Keywords: *Mathematics Education, Academic Performance, differentiated instruction, scaffolding, Multi-tiered lessons*

INTRODUCTION

One of the most significant issues and concerns for educators is the quality of mathematics instruction and learning. Furthermore, Mathematics has always been perceived as the most difficult subject to learn and teach. Filipino students' performance in Mathematics is always low as compared to other subjects in the curricula from the national level down to school level (Callaman & Itaas, 2020)

Behind the low performance of students in mathematics, many factors considered to affect the students' mathematical performance such as students' lack of motivation, interest, and solid foundation. Teacher-factor is also pointed as one of the primary reasons in complexity in absorbing the lessons in Mathematics. With the continuous below the standard scores of students in international assessments, developing teacher's methodologies and pedagogies are necessary. When it comes to the delivery of the lesson, most of the teachers are using conventional method of teaching, wherein they directly instruct the students then after the discussion, seatwork will follow. This traditional method of teaching hinders the development of creativeness and critical thinking of the students since there is no deeper understanding and analyzing of lesson that took place, leading to a situation wherein students learn conceptually without meaningful learning. In this new MATATAG curriculum, the teachers' main objective in teaching Mathematics is to create a mathematically proficient and critical problem solver Filipino learners that could explore, appreciate and think critically. Thus, trying different methods to address the needs of the students should be done. Various pedagogies were employed to address the issues in mathematics education, teachers are constantly devising and implementing new strategies on how to improve their students' mathematics performance.

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One of the strategies that was introduced was differentiated instruction. In most of public schools, students are heterogenous, classrooms are filled with different types of learners, and there is a difficulty in accommodating all types of learners in discussion, teachers should modify the lesson to meet the needs of diverse learners.

According to Nagl (2023), differentiating instruction entails teaching the same topic to all students using a range of instructional methodologies, or it may require the teacher to provide lessons at differing levels of difficulty dependent on each student’s capabilities.

Differentiated instruction helps teachers to differentiate the lessons and activities, this strategy assists in reaching every student at their own level and increasing their chances of success. When the content is differentiated, every student is inspired to work on their own pace. In addition, differentiated instruction allows a motivates the students to participate and contribute to classroom activities, no students are left out of learning opportunities simply because the assignment and activities were based on their skills, talents, and interest.

The advantage of differentiated instruction as compared to traditional method is reflected on the research by Wilson (2021), stating that lecture is the least effective educational approach, with only 5 - 10% retention after 24 hours. Engaging the students in discussions, practicing after exposure to content, and teaching others are much more successful ways of ensuring learning retention.

Differentiated instruction is very familiar and yet, some teachers are not aware on how they can differentiate the instruction in their classes. There are different strategies to differentiate instruction these are: Though Menus, Rubrics, and Learning Style Inventories, Curriculum Compacting, through Independent Study and Learning Centers, Cubing and Lastly, Tiering Lessons/Multi-tiered Lessons.

In this study, the chosen type of differentiated instruction is the tiered lesson. In this instruction, the teacher have to tailor the instruction to meet individual needs of students. It is also about layering the lesson base on the learning readiness of the students. This strategy can be done by tiering the assignments, activities, assessment, learning materials and the lesson itself, also by knowing your students’ interest, readiness, and learning style.

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A teacher can tiered the lesson based on content, process, and product of the students. A facilitated discussion at the end of each activity or inquiry reintegrates the learning, which allows all learners to contribute to the understanding of the class in the scope of the topic.

For this study, the tiering activities and instruction was based primarily on the depth of content and the process levels. This appeared to be a good fit for the demands of standard-based instruction, and more a content-focused education at the secondary level.

The competencies included in the Teacher’s Guide for Grade 7 Mathematics subject is vast; thus, considering the difficulty of most students in achieving these competencies, still, lessons must be equally interesting, engaging and fair in terms of students’ expectation and this could happen if teachers will employ the tiered lesson.

Moreover, the benefits of using this strategy are: 1.The use of tiered lessons allows students to develop required abilities at a learning rate that is better matched to their instructional level; 2. it supports learners with low skills and minimal prior knowledge in gaining meaningful academic growth; 3. it provides learners with high skills and above-average background knowledge the opportunity to go beyond the basics and lastly: 4. tiered lesson add depth, complexity, and universal connections to the content.

The researcher believes that this study will add to the body of knowledge in the discipline of Mathematics. Applying multi-tiered lessons could help the students to enhance their academic performance in mathematics in such a way that lessons are modified and scaffolded based on their in-depth learning level. Also, the standing of mathematical education could be improved by utilizing the multi-tiered lesson in teaching mathematics. The researcher believes that employing this strategy could empower teachers in teaching mathematics effectively.

The afore-mentioned benefits gave interest to the researcher to confirm these benefits, also to explore and validate the effectiveness of employing multi-tiered lesson as instructional strategy in improving the mathematical performance of Grade 7 students in Mathematics.

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MATERIALS AND METHODS

The researcher constructed and validated an instrument used as pre-assessment, pretest and posttest. Figure 3 presents the progression of test construction from planning to administration of instrument.



Figure 3. Process of Instrumentation and Validation

For the pre-experimental phase of the study, the researcher used a teacher-made pre-assessment tool as a basis in tiering the class. The test consisted of 9 open-ended questions covering various topics of Grade 7 Mathematics. The students who obtained a score from 0-4 was classified as Tier I (Beginners), those with a score of 5-8 was classified a Tier II (Intermediate Learners) and those with a score of 9-13 was categorized as Tier III (Advanced Learners).

A teacher-made test was also developed to serve as pre-test and posttest assessment tool during the experimental phase of the study. A Table of Specification was prepared to ensure that the required competencies were covered. The test is consisting of 50 multiple-choice questions covering the topics in Mathematics 7 that was discussed in fourth grading period. These. In addition, activities such as lesson plans, seat works, quizzes and assignments were checked by the school head since continuous monitoring of the progress of students is important in multi-tiered lesson.

These tests were validated by three internal and three external validators. After the validation of test instruments, the researcher revised the instruments based on the feedbacks, advices, and remarks of the experts in the field. The modified instruments were used for pilot testing, which involved 24 students. The result of the pilot testing was subjected to reliability

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test through Cronbach alpha coefficient. The calculated Cronbach's alpha value obtained was 0.8. This value indicates a good internal consistency among the items within each instrument. A Cronbach's coefficients of 0.7 or higher are generally considered acceptable and reliable for research instruments.

During the experimentation, the Master Teacher and Head Teacher used Classroom Observation Tool to observe the researcher and ensure the implementation of multi-tiered lesson. The said tool is currently being used in all public schools. Individual rating sheet was given for each observer and the ratings was summarized in inter-observer agreement form.

For the collection of the qualitative responses, the researcher developed survey questionnaires to assess the experiences and perspectives of the students in multi-tiered lesson. This survey questionnaire was transferred to google form and was sent to 10 participants in experimental group. This was also checked and validated by the experts to ensure the instrument measure what they intend to measure accurately.

The study adopted both quasi-experimental research design and mixed method approach. According to the work of Creswell and Plano (2018) the combination these two research designs can be very effective since it allows the researcher to take advantage of the qualities of both designs: the quasi-experimental design for investigating causal linkages and the mixed methods approach for offering a thorough grasp of the study subject. Quasi-experimental as mentioned by Trochim (2020), is one in which the researcher lacks full control over the assignment of participants to treatment conditions but is interested in assessing the causal effect of an intervention or treatment. This design is helpful in determining the effectiveness of multi-tiered lessons in improving the mathematical academic performance of grade 7 students.

Johnson and Christensen (2017) defined mixed method as an approach which involves collecting, analyzing, and integrating qualitative and quantitative data within a single study or program of inquiry to understand a research problem more completely than either approach

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alone. The use of mixed method approach allows the researcher to combine quantitative and qualitative data in order to provide a more complete understanding of the research problem.

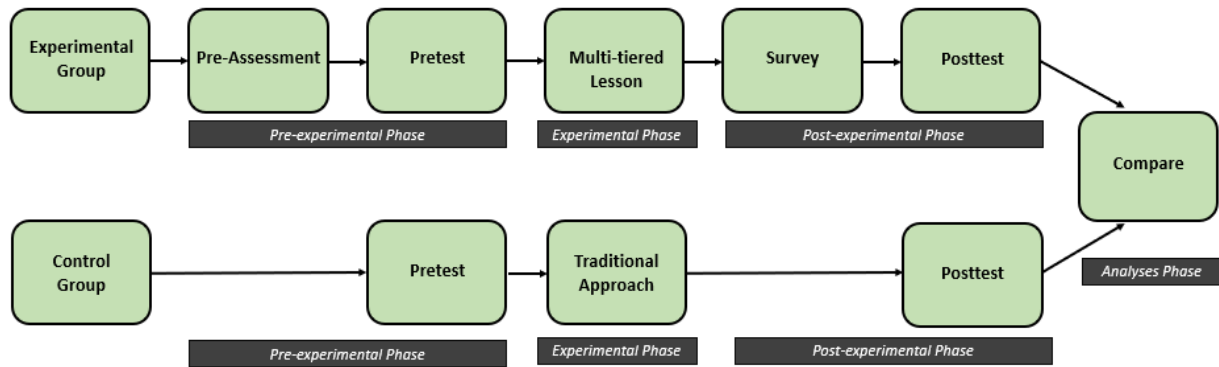


Figure 2. Quasi-mixed method design with two groups

For the quantitative approach, the study utilized a two-group experimental design which involves pre-testing, post-testing and assignment of control and experimental groups. The control group underwent traditional teaching method while the experimental group was exposed to multi-tiered instruction.

For the qualitative approach, the researcher administered survey questionnaire to 10 participants in experimental group to gather insights into their experiences and perceptions under the multi-tiered lesson.

The research design was consisted of four phases: pre-experimental phase, experimental phase, post-experimental phase and analyses phase. The pre-experimental includes the tiering designations or groupings of the students in experimental group which was based on their measured learning readiness using the pre-assessment tool. Also, in this phase, pretest was administered to both control and experimental group. During the experimental phase, the multi-tiered lessons and traditional instruction was implemented for four weeks. For the experimental group, the multi-tiered instruction, objectives and assessments were designed based on their tiered groups. The target objectives were

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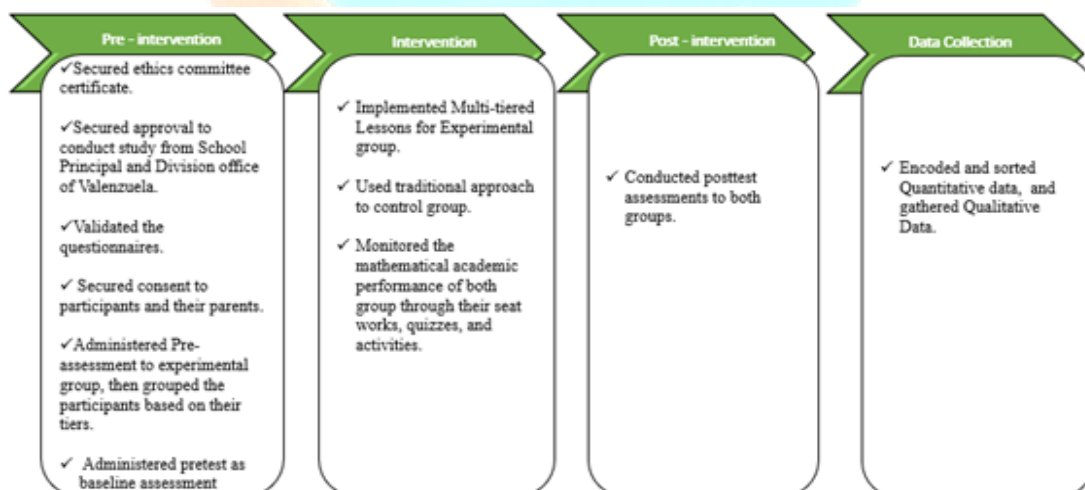
formulated in accordance to the Grade 7 Mathematics topics that was covered during fourth quarter and the for the assessment plan, worksheets, formative and summative assessments was used to monitor the students' mathematical performance.

The third phase is post-experimental phase which includes the administration of posttest for both control and experimental group, and conduct of survey of 10 students under the treatment group. Lastly, the analyses phase focused on the statistical analysis of the students' mathematical performance in their pre-test and posttest.

To augment the quantitative findings of the study, qualitative data was collected and analyzed. Qualitative data consists of open-ended information that the researcher usually gathers through interviews, focus groups and observations. The qualitative method that was utilized in the study aimed to document the experiences of the students who was exposed to multi-tiered instruction since it is not directly observed from the experimentation. The qualitative responses were expected to provide baseline assessment of multi-tiered lessons based on the perspectives and experiences of the research participants.

Data Gathering Procedure

Figure 4 below shows the flowchart of data gathering procedures done by the researcher.



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Prior to conduct of the study, the researcher secured the ethics committee certificate to guarantee that all participants involved in this study are aware of the terms of approval and which documents have been approved.

A letter of request was forwarded to the school Principal and Division Office to seek permission for the conduct of the study and administration of assessment tests to the selected research participants. Upon the approval, the researcher conducted the study based on the action plan.

To ensure that the research was performed in a courteous, transparent, and responsible manner, while preserving the rights, autonomy, and welfare of the student-participants of the study, a consent was given to students and parents of participants.

The researcher then administered the pre-assessment test to experimental group. After tiering the class, the researcher administered the pretest to both the control and experimental group. The two modes of instruction were conducted in the entire fourth grading period or for a total of 4 weeks. After the Grade 7 Math lessons were completed, the two groups took the posttest assessment.

At the end of the experimentation, 10 participants in experimental group was surveyed to evaluate their learning experiences after exposure to tiered lessons.

Statistical Treatment of Data

The statistical treatment of data is crucial in a research. It provides as the foundation for data analysis, converting raw data into useful insights that either support or disprove research ideas. The rigorous application of statistical methodologies assures that the research findings are legitimate, reliable and accurate, hence increasing the study's overall credibility (Kern et.al., 2019)

For this study, descriptive and inferential methods were used in the analysis of the quantitative data collected from the performance assessment tests. The initial phase of

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statistical treatment involves descriptive statistics. Descriptive statics provide a preliminary assessment of the data, clear and brief description of the data, paving the way for more complex analysis (Flick, 2020). Frequencies, means and standard deviations was computed to summarize and describe the pretest and posttest scores. Independent samples t-test was used in this study to compare the pretest scores of control and experimental group, this statistical treatment assures that the two groups have equal level of ability in terms of mathematical academic performance. Independent sample t-test is a parametric test which is used to compare the means of two independent populations. The researcher employed this statistical tool to evaluate whether there were significant differences between the control and experimental groups' posttest results.

Additionally, paired t-test was utilized to test the hypothesized differences between the pre-test and posttest scores. The paired t-test is used to compare two population averages in which observations from one sample can be paired with observations from the other (statisticssolutions.com). Cohen's effect size formula complements with the result of paired t-test in this study. It measures the magnitude of the difference between two means in terms of standard deviation units, it is also vital in the context of paired t-test. While paired t-test indicates whether the difference between the paired means is statistically significant, Cohen's d provides a measure of the size of this difference (Lakens, 2019).

Collected quantitative data was encoded using Microsoft Excel. The SPSS (Statistical Package for the Social Science), an advanced statistical software was employed to facilitate these processes. This tool provides a variety of statistical functions and graphical presentations, allowing researchers to conduct comprehensive studies and efficiently illustrate their findings (Field, & Miles, 2019).

Data from the survey questions was summarized and the underlying thematic structure was derived.

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RESULTS AND DISCUSSION

Test Scores of the Grade 7 Student-participants

The table below shows the descriptive statistics of pretest administered to both control and experimental group.

Table 2.

Descriptive Statistics for the Pretest Scores

Group	N	Lowest	Highest	Mean	SD
Control	40	2	21	14.13	5.06
Experimental	40	4	20	14.10	4.58

Table 2 shows the pretest scores of the control and experimental groups of the study. As can be seen on the table, the mean score of the control group was 14.13 with a standard deviation of 5.06 while experimental group has a mean score of 14.10 with a standard deviation of 4.58. The descriptive statistics of pretest revealed that the mean difference of the two groups were 0.03 and that of control group has a greater mean score compared to experimental group. It has the same result with the study conducted by Bellinger (2023) which aimed to explore the impact of multi-tiered instruction on mathematical achievement specifically in urban school setting. It was found out that multi-tiered lessons promoted equitable learning opportunities and contributed to higher academic performance in mathematics among urban students.

The mean pretest scores were compared between the control and experimental groups to confirm that they were equal before the start of the intervention. In order to identify the appropriate statistical treatment, a normality test is run in the data. The results of the normality test indicate that the data are normally distributed. Hence, a parametric test is appropriate to use. An independent-samples t-test is run in the data to compare the test scores between the control and experimental groups using the IBM SPSS. An independent

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Samples t-test is a statistical method used to determine whether there are significant differences in the means of two independent groups. When applied to pretest scores in a control and experimental group, this test determines whether any observed differences in means between these groups is likely due to chance or reflects a true difference due to the experimental treatment. This test assumes that the data from both groups are normally distributed and have similar variances (Gravetter et al., 2016).

Independent Samples t-test of the Pretest Scores between the Control and Experimental Groups

Table 3.

Independent Samples t-test of the Pretest Scores between the Control and Experimental Groups

Group	Tcal	df	P
Control	0.023	78	0.982
Experimental			

In table 3, an independent sample t-test was used. This tool compares the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. This tool is widely used in research specifically, intervention researches. In fact, this tool was used by Rushton (2018). On his study entitled "Teaching and Learning Mathematics through Error Analysis". This study used independent samples t-tests to compare pretest scores between the control and treatment groups before implementing an error analysis intervention. The results showed no significant difference in pretest scores, establishing baseline equivalence between groups before analyzing the effects of the intervention on mathematical achievement. Same result is evident on Table 3 of the researcher.

Table 3 shows that the p-value associated with the $t(78) = .023$ is .982 which is greater than .05 ($p > .05$) indicating that they are not statistically different. Accordingly, no

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significant differences were found between the mean scores of the control and the experimental groups before the utilization of Multi - tiered lesson. The groups are said to be equivalent at the beginning of the study. These results indicate that the students from the control and experimental groups possessed similar set of skills and equal amount of knowledge on the topics covered in this study. Moreover, this means that the students are of the same level prior to the conduct of the experiment. Additionally, this further strengthens the acceptability of the two groups who participated in this experiment.

Descriptive Statistics for the Posttest Scores

Table 4

Descriptive Statistics for the Posttest Scores

Group	N	Lowest	Highest	Mean	Median	SD
Control	40	8	41	25.83	27.00	8.07
Experimental	40	10	43	28.98	28.00	8.28

Table 4 describes the statistics of the result of post test administered to both groups. They served as the main data of the study to determine the effectiveness of multi-tiered lesson as an instructional strategy in improving the mathematical performance of grade 7 students. As can be gleaned in the table the mean score of the experimental is higher than that of control group. It can be said that the utilization of multi-tiered lesson paved way for a higher mean score of the experimental group.

As showed in the Table 4, there is a low standard deviation of the control group using the traditional instructional approach on Mathematics with 8.07. It indicates that the scores of the students are spread closely to the mean with the value of exactly 27 which is notably lower than the experimental group. The utilization of multi-tiered lesson in Mathematics 7 resulted to a higher standard deviation of 8.28 which directed to the conclusion that the scores of students in the experimental group were widely dispersed from the mean score of 28.98.

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The control group has a mean score of 25.83 which is lower compared to the mean score of 28.98 of experimental group. The mean score difference of the two group was 3.15, which shows that students exposed to multi-tiered lesson scored higher and performs better in Mathematics as compared to control group.

Lewis'(2019) study also indicated that students in the experimental group, who received multi-tiered instruction, performed significantly better on the posttest compared to those in the traditional instruction.

In contrary, the results of study conducted by Silva, et. al (2020) revealed that though intervention group showed improvements in engagement and understanding, there is no significant difference in the posttest score from those in control group.

Difference between the Pretest and Posttest Scores

The pretest and posttest scores are compared to test the hypothesis. To determine the appropriate statistical treatment, the differences in scores are subjected to a normality test using the IBM SPSS. Results show that the data are normally distributed. Hence, Paired-samples t-test is appropriate. The summary of the IBM SPSS output is shown in table 5

Table 5.

Paired-samples t-test Comparing the Performance of the Participants before (Pre-test) and after (Posttest) the use of multi-tiered lesson

Group	T	Df	P	Interpretation	
Control					
Post - Pretest Scores					
	12.483	39	0.000	Highly Significant	1.97

Experimental

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Post - Pretest Scores

14.165	39	0.000	Highly Significant	2.24
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The data is analyzed using a paired samples t-test to compare the participants' pretest and posttest results. The results show that the calculated t for both the control and experimental groups are highly significant as the p-values are both less than .01 ($p < .01$). It means that there was a significant increase in the scores of the control group from pre-test (mean = 14.13) to post-test (mean = 25.83), $t(39) = 12.483$, $p < .01$, and the increase was very large based on Cohen's effect size formula ($d = 1.97$) with the mean increase of 11.70 points. Meanwhile, for the experimental group there was a significant increase in the scores of the from pre-test (mean = 14.10) to post-test (mean = 28.98), $t(39) = 14.165$, $p < .01$, and the increase was huge based on Cohen's effect size formula ($d = 2.24$) with the mean increase of 14.88 points. It can be noted the mean increase in the scores of the experimental higher than the mean increase of the scores of the control group.

Learning Experiences of the Students after Exposure to Multi-Tiered Lessons

To support the result of quantitative data analysis, the researcher conducted thematic analysis of the collected qualitative data. Gaining insights into students' experiences is essential in enhancing the academic performance of the students.

The succeeding discussion pertains to the thematic analysis based on the guide questions provided by the researcher during the survey process. In general, there were four (4) themes that were derived from the responses of the participants in the study.

Theme 1: Enhanced Understanding

All of the participants expressed an improvement in their understanding of the subject matter due to multi-tiered lessons. This suggest that personalized and tiered instruction can assist clarify concept and deepen understanding. Some of them stated that:

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- “ Lumalim po ang pagkakaintindi ko sa lesson” (informant 1)
- “ Mas naiintindihan ko na po ang lesson ni Mam, saka parang dumali” (informant 2)
- “ Ma’am’s approach helped me to undertand each lesson deeper.Thank You!” (informant 6)

Theme 2: Impactful Experiences

Based on their responses, specific experiences such as group activities, one-on-one sessions and individualized feedback, were identified as effective. This emphasizes the value of tailored and practical learning experiences in improving comprehension. Here’s some of their response:

- “ Yung group activity po, kasi po natutulungan kami ng mga kaklase.” (informant 3)
- “Yung one-on-one sessions po malaking tulong sa akin. Mahina po kasi talaga ako sa math □”(informant 1)
- “Yung mga personalized feedback po, malaking bagay sa learning ko” (informant 8)

Theme 3: Increased Engagement and Motivation

Students claimed higher engagement and motivation as a result of the interactive and personalized nature of multi-tiered lessons. This theme asserts that personalized learning approaches can increase student interest and motivation.

- “Mas engaged po ako kasi ang daming activities na sakto sa kaya ko.” (informant 5)
- “I'm more motivated to learn because the lessons are designed to fit my needs” (informant 10)
- “ I'm more engaged in my studies because your lessons are more interactive” (informant 9)

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Theme 4: Challenges and Benefits of Multi-tiered Lessons

While students appreciated the individualized feedbacks and diverse activities, they also noted challenges such as feeling overwhelmed and managing time across multiple tiers. These highlights the importance of balanced instructional design which takes into account students' workload and support needs. Stated challenges are:

"I enjoy the lessons, but sometimes it feels like there is too much to manage" (informant 8)

"I appreciate the different activities, although managing all the tasks is challenging" (informant 7)

"Yung mga task maganda po kasi nakaka-focus ako at nakakasabay, pero minsan nakakapagod dahil sa dami" (informant 3)

Conclusion

Based on the aforementioned findings of the study, the following conclusions were articulated and formulated.

1. There was no significant difference between the pretest scores of control and experimental groups. Also, both groups were at the scale of low mastery and were at the same level of mathematical academic performance before the study was conducted.
2. In comparison of scores from pretest to posttest, both groups have high significant increase in their scores however, increase of scores of participants in experimental group is higher than that of control group. Thus, the null hypothesis is rejected and it infers that there is a significant difference between the mean scores of the pretest and posttest of the control and experimental groups after the use of the intervention.
3. It was evidently shown in the data that the group where multi-tiered lesson was subjected performs better than the group taught using the conventional approach.

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4. The result of the study implies that the use of multi-tiered lesson in teaching improves the mathematical academic performance of Grade 7 students.

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