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MATHEMATICS PROFICIENCY OF GRADE 10 JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This study was conducted to investigate the Level of Mathematics Proficiency among the Grade 10 Junior High School Students in one of the private schools in Bacolod City, Negros Occidental during the school year 2016-2017. This research employed a descriptive research design with 110 respondents selected through the stratified proportionate sampling. The validity of the test was established using the Lawshe's content validation method resulting in a content validity ratio value of 0.8. The reliability of the test was assessed using the Kuder Richardson 20, yielding a coefficient of 0.71, indicating a reasonably reliable instrument. Descriptive statistics such as Mean, Standard Deviation were used to analyze the responses. Additionally, the One-Way Analysis of Variance (ANOVA) and Tukey HSD for post-hoc test were utilized to identify any significant differences among groups. Results of the study revealed that the overall level of proficiency in the learning competencies of Grade 10 Junior High School students was "Satisfactory", interpreted as a "Moderate" level of proficiency. When analyzing specific areas, Algebra and Statistics and Probability turned out to be "Outstanding", indicating a "Very High" level of proficiency in these two areas. The study revealed significant differences between various pairs of competencies: Algebra and Geometry, Algebra and Trigonometry, Geometry and Statistics and Probability, Statistics and Probability and Trigonometry. Based on the results, the study proposed an action plan to address the identified areas for improvement that may benefit the students, teachers, administrators, and other members of the institution.

Keywords: Level of Proficiency, Learning Competencies, Junior High School Students, Descriptive Research, Action Plan, Bacolod City, Central Philippines

Introduction

Background of the Study

There are a number of reasons why one should study Mathematics. Several renowned authors and educators have emphasized the importance of Mathematics. Spooner (2013) highlights that Mathematics holds a high level of employability and contributes to a salary advantage, making it an essential skill in today's competitive job market.

McKellar (2015) underscores that students' mastery of mathematical concepts can lead to higher levels of academic performance and open doors to career paths they may not have previously considered.

The Mathematics curriculum, as Glatthorn (2012) suggests, can be seen as a pathway toward a conception of a fulfilling and successful life.

Despite the evident importance of Mathematics, many students face difficulties and challenges in mastering the learning competencies. For instance, a study conducted by the Mathematical Society of Japan reveals that students can often apply the standard mathematical formulas but struggle to explain the reasoning behind their solutions. This lack of in-depth mathematical skill is not confined to a single region, it extends even to students in science and engineering majors and those taking the university entrance examinations in Japan (Rotherham and Willingham, 2009). A similar trend is observed in Canada, where declining Math skills affect students' career choices (Kershaw, 2010).

The situation in the Philippines is equally concerning. In international assessments such as the Third International Mathematics and Science Study – Repeat (TIMSS-R), Filipino students have consistently ranked lower in Math and Science when compared to their counterparts in other countries. This reflects a nationwide issue that affects the country's global competitiveness (Gabriel, 2012). The challenges persist within the Philippines, as evidenced by the National Achievement Test (NAT) results, where students' average scores in Mathematics are far from satisfactory (Crisostomo, 2000).

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To address these concerns and improve Mathematics education, initiatives like the K to 12 Program have been introduced in the Philippines. However, the Department of Education reported that there is still room for improvement in achieving the desired learning outcomes (Fernandez, 2012).

Furthermore, the understanding of basic concepts and improving problem-solving amenity among the low achievements should be dealt with in the high school Mathematics curriculum. (Lim & Pyo, 2013). Also, the student must reach a predetermined level of mastery on one unit before they are allowed to progress to the next (Davis, 2014).

Recognizing these challenges and the need for a more focused approach to Mathematics education, the researcher, a dedicated Mathematics teacher, has undertaken this investigation. The primary goal is to assess the level of mastery of Mathematics curriculum learning competencies among the Grade 10 students in one of the private schools in Bacolod City, Negros Occidental. By understanding where students excel and identifying their areas of weakness in Algebra, Geometry, Statistics ad Probability, and Trigonometry, the researcher aims to tailor enrichment activities and intervention programs to meet the specific needs of the students. Moreover, the researcher seeks to explore practical ways for students to apply their knowledge and skills effectively and proposes an enhancement plan for the Mathematics area of the school. This research serves as a response to the urgent need for improving Mathematics education and aims to contribute to the success of students, both in their academic journey and their future endeavors in a rapidly changing world.

Statement of the Problem

The main purpose of the study is to determine the level of proficiency of the Grade 10 Junior High School (JHS) students in the learning competencies in Mathematics in one of the private schools in Bacolod City, Negros Occidental during the school year 2016 - 2017.

Specifically, it seeks to answer the following questions:

1. What is the level of proficiency of Grade 10 Junior High School students in Mathematics based on the learning competencies in the following areas:
   a. Algebra,
   b. Geometry,
   c. Statistics and Probability, and
   d. Trigonometry?
2. Is there a significant difference in the levels of proficiency in the learning competencies of Grade 10 Junior High School students in Mathematics when grouped and compared according to the areas used in the study?
3. What action plan can be proposed to enhance the level of proficiency of the students in Mathematics?

Hypothesis

Based on the statement of the problem, the hypothesis is advanced: There is no significant difference in the level of proficiency in the learning competencies of Grade 10 Junior High School students when grouped and compared according to the areas used in the study.

Theoretical Framework

The study is anchored on the K to 12 Basic Education Program Mathematics Curriculum of May 2012, which is supported by the updated version states that "Mathematics is one subject that pervades life at any age and in any circumstance. Thus, its value goes beyond the classroom and the school. Mathematics as a school subject, therefore, must be learned comprehensively and with much depth.

The twin goals of Mathematics in the basic education levels, K-12, are Critical thinking and problem solving". The use of appropriate tools is necessary for teaching Mathematics. These tools include manipulative, objectives, measuring devices, calculators and computers, smart phones and tablets, Personal Computers and the internet.
The study of Ozerem (2012), showed that the teaching and learning of Mathematics dominate the teacher-centered and textbook-oriented approaches. There is a minimal use of visualization tools. Context defined as the locale, situation, Filipino learners develop their critical thinking and expertise in solving mathematical problems. It refers to the beliefs, environment, language and culture that include traditions and practices, as well as the learner's prior knowledge and experiences.

The study draws on the definition of critical thinking proposed by Scriven and Paul (2008). It frames critical thinking as an intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

Mathematical problem solving is finding a way around a difficulty, around an obstacle, and finding a solution to a problem that is unknown. These two goals are to be achieved with organized and rigorous curriculum content, a well-defined set of high-level skills and processes, desirable values and attitudes, and appropriate tools, taking into account the different contexts of Filipino learners, decision-making; and applying and connecting. The following values and attitudes are to be honed as well: accuracy, creativity, objectivity, perseverance,

and productivity. We recognize that the use of appropriate tools is necessary in teaching Mathematics.

The framework is supported by the following underlying learning principles and theories: Experiential and Situated Learning, Reflective Learning, Constructivism, Cooperative Learning and Discovery and Inquiry-based Learning. The mathematics curriculum is grounded in these theories. Experiential Learning as advocated by David Kolb is learning that occurs by making sense of direct everyday experiences. Experiential Learning theory defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 2012).

Situated Learning, theorized by Lave and Wenger (2012), is learning in the same context in which concepts and theories are applied. Reflective Learning refers to learning that is facilitated by reflective thinking. It is not enough that learners encounter real-life situations. Deeper learning occurs when learners are able to think about their experiences and process these, allowing them the opportunity to make sense of and derive meaning from their experiences. Constructivism is the theory that argues that knowledge is constructed when the learner is able to draw ideas from his/her own experiences and connect them to new ideas. Cooperative Learning puts premium on active learning achieved by working with fellow learners as they all engage in a shared task. The mathematics curriculum allows for students to learn by asking relevant questions and discovering new ideas. Discovery Learning and Inquiry-based Learning support the idea that students learn when they make use of personal experiences to discover facts, relationships, and concepts. These approaches encourage active exploration and inquiry, which are essential components of effective mathematics education (Bruner, 2013).

All these make the foundation of the study become more robust, providing a comprehensive understanding of the principles and theories that underpin mathematics education and guiding the research in the context of the K to 12 program.

Conceptual Framework

The study was situated in one of the private schools in Bacolod City, Negros Occidental where Grade 10 students from the school year 2016-2017 were the primary respondents and whose Mathematics proficiency was assessed. The study evaluated the level of proficiency in Mathematics by focusing on the learning competencies covered from Grade 7 to Grade 10. These competencies encompass a range of mathematical concepts including Algebra, Geometry, Statistics and Probability, and Trigonometry.

The ultimate goal of the research was to propose an action plan. This action plan aimed to address the identified proficiency levels and challenges in the mentioned mathematical areas. It was designed to benefit not only the Grade 10 students but also other members of the educational institution.

The schematic diagram below represented the relationships between the study variables. It demonstrated that the assessment of students' proficiency in Mathematics, as well as the identification of significant differences among the areas of Algebra, Geometry, Statistics and Probability, and Trigonometry, served as the foundation for the development of the proposed action plan. This action plan was intended to provide tailored support to students and contribute to the overall improvement of Mathematics education within the school.

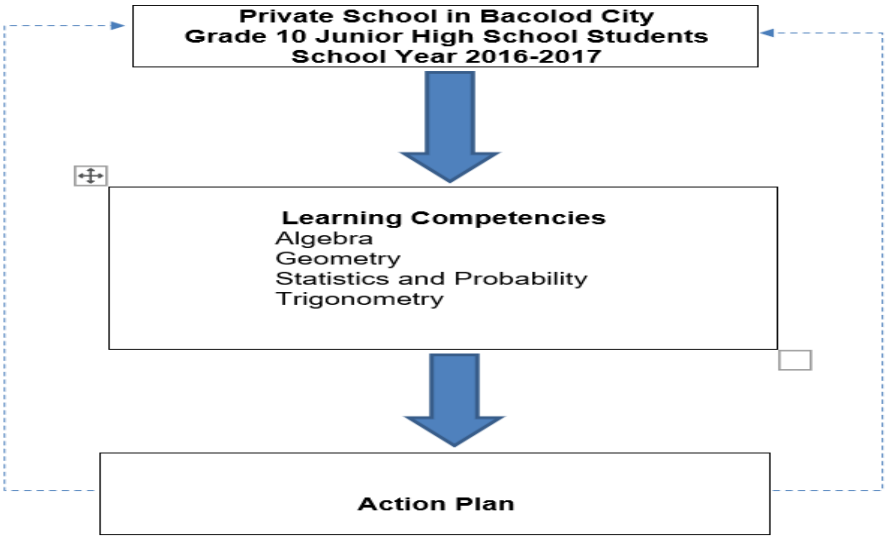

Figure 1: Schematic Diagram of the Framework of the Study

Methodology

Research Design

The choice of a descriptive research design was based on the need to thoroughly understand and establish the foundational learning competencies before addressing more complex mathematical tasks. This design allows for a comprehensive examination of the existing proficiency levels.

Descriptive research, as defined by Camorin (2016), is a research type that involves describing a situation or a particular state of affairs in terms of specified aspects or factors. It is concerned with providing a clear picture of the current conditions related to the study.

In line with the objectives of descriptive research, the study sought to capture a range of data related to the students' mathematical proficiency. This included not only their overall proficiency levels but also specific characteristics and factors that contribute to their performance.

The primary goal of this descriptive research design was to gather factual, accurate, and systematic data related to the students' learning competencies in mathematics. This data might take the form of averages, frequencies, and various statistical calculations to provide a comprehensive overview.

The study narrowed down its focus to four distinct areas within mathematics: Algebra, Geometry, Statistics and Probability, and Trigonometry. These areas were examined individually to gain a deep understanding of students' proficiency levels in each.

The descriptive research design adopted for this study was chosen for its suitability in providing an in-depth description of the learning competencies of Grade 10 students in mathematics. It aimed to offer a comprehensive view of the students' current mathematical proficiency in the specified areas, which would serve as a foundation for further research and the development of an action plan.

Respondents of the Study

The respondents of the study were the 110 Grade 10 junior high school students in one of the private schools in Bacolod City, Negros Occidental who were officially enrolled for the school year 2016 - 2017.

Table 1: Profile of the Respondents

(n = 110)

Section	Population	Sample	Percentage
10 – A	38	28	25%
10 – B	38	28	25%
10 – C	39	28	26%
10 – D	37	26	24%
TOTAL	152	110	100%

Table 1 presents the respondents of the study. Out of the 152 Grade 10 students, 110 are considered as respondents. Among them are the 28 Grade 10 students from Sections A, B and C resulting to 25% of the total number of respondents for the first two sections and 26% for the third. The fourth section which is the Grade 10 - D has 26 respondents and this represents the 24% of the respondents in the study.

Data-Gathering Instrument

The researcher-made test was carefully designed to align with the Grade 7 to Grade 10 learning competencies outlined by the Department of Education (DepEd) for the K to 12 Basic Education Program. This alignment ensured that the test was relevant to the educational standards and goals of the curriculum involving the four areas: Algebra, Geometry, Statistics and Probability, and Trigonometry.

The validation of the test was a crucial step to ensure its quality and appropriateness. Ten jurors, including experts from various private and public schools, participated in the validation process. They assessed the test for suitability, dependability, and credibility as a measurement instrument.

The content validity of the test was assessed following the Lawshe's (1972) content validation method. The calculation of the Content Validity Ratio (CVR) resulted in a value of 0.8. This high CVR score indicated that the general content of the test was essential for assessing the intended learning competencies.

The survey instrument comprised 52 multiple-choice questions, distributed across the four specified areas: 12 items for Algebra, 13 items for Geometry, 17 items for Statistics and Probability, and 10 items for Trigonometry. This distribution ensured that each area was adequately represented in the assessment.

Before administering the test to the main respondents, it underwent a pilot- testing phase with 30 selected Grade 10 students from the same school. This step allowed for the identification of any

potential issues, ambiguities, or difficulties in the test. The pilot testing helped ensure that the instrument was clear and comprehensible to the students.

To evaluate the reliability of the test, the Kuder Richardson 20 (KR21) was used, resulting in a reliability coefficient of 0.71. This coefficient indicated that the test was considered "consistent" and "reliable". It attested to the stability and repeatability of the test, suggesting that it measured what it intended to measure consistently.

The test was administered to students given 1 hour and 10 minutes to complete the 52 questions. Adequate time allocation ensured that students had sufficient time to respond to each item without feeling rushed.

Statistical Tools

To analyse the data the numerical code using the guided manual and with the Statistical Package for Social Sciences or the SPSS was utilized. Below are the statistical tools to be used in this study.

For problem number 1, to determine the level of proficiency according to the learning competencies of Grade 10 Junior High School students in Math in the areas of Algebra, Geometry, Statistics and Probability, and Trigonometry, the mean, which was one of the measures of central tendency, and the standard deviation were used.

The following interpretation guides are:

Mean Score Range	Verbal Interpretation
90 - 100	Outstanding
85 - 89	Very Satisfactory
80 - 84	Satisfactory
75 - 79	Fairly Satisfactory
74 Below	Did Not Meet Expectations

For problem number 2, to determine whether or not there is a significant difference in the level of learning competencies of Grade 10 junior high school students when grouped and compared according to the four areas in the study, the one-way analysis of variance (ANOVA) was used.

Results

In this part, the researcher presents the data that were gathered in tabular form, and analyzed and interpreted them on the basis of the statement of the problem. This is the order followed in the presentation.

Table 2: Level of Proficiency According to the Learning Competencies of Grade 10 Junior High School Students in Mathematics in the Four Areas

Subject Areas	Mean Scores	SD	Verbal Interpretation
Algebra	91	9	Outstanding
Geometry	74	13	Did Not Meet Expectations
Statistics & Probability	93	7	Outstanding
Trigonometry	76	13	Fairly Satisfactory
Over-all Mean	84	6	Satisfactory

Table 2 shows that the mean scores of the Grade 10 students are 91 in Algebra, 74 in Geometry, 93 in Statistics and Probability, 76 in Trigonometry, and 84 as an over-all mean result. The results determined the levels of proficiency of the students in the different learning competencies in the four areas specified in the study. Their proficiency levels were outstanding in Algebra and in Probability and Statistics, Fairly Satisfactory in Trigonometry, and Did Not Meet Expectations in Geometry. The over-all result showed further that the level of proficiency of Grade 10 students was satisfactory. With regards to the results of the standard deviation, Algebra scores resulted to 9, Geometry to 13, Statistics and Probability to 7, Trigonometry to 13, and an over-all standard deviation of 6.

The results revealed that the highest level of proficiency of Grade 10 students was in Statistics and Probability and the lowest was in Geometry. The standard deviation column presents that Geometry and Trigonometry have the same scores which are both higher compared to the other two areas which were Algebra and Statistics and Probability. These confirmed to us that scores of the students in Geometry and Trigonometry were more scattered than the scores they had in Algebra and Statistics and Probability.

Results of the study affirmed by Mata & others (2012), showed that in general, students had positive attitudes towards mathematics and their attitudes as they further progressed in school.

Results of the study confirmed by Opitz & others (2016), averred the empirical studies have consistently shown moderate achievement in mathematics in the junior high school could often be traced to deficit in the understanding of certain basic mathematical concepts taught in primary schools.

Table 3: Comparative Statistics in the Level of Proficiency in the Learning Competencies of Grade 10 Junior High School Students When Grouped and Compared According to the Areas Used in the Study

Indicator	df	Mean Square	Critical f	Computed p-value	Sig. @ 0.05
Between Groups	436	10521.264	94.962	0.000	Significant
Within Groups	439	110.794			

Statistics in table 3 reveals the value 0 .000 is "lower" than 0 .05. This means that there was a significant difference in the level of proficiency of learning competencies of Grade 10 Junior High School students when grouped and compared according to the areas used in the study. Considering this result, the hypothesis of the study was "rejected".

Table 3a: Comparative Statistics in the Level of Proficiency in the Learning Competencies of Grade 10 Junior High School Students When Taken Altogether

Specific Area	Other Areas	p-value	Sig. @ 0.05
Algebra	Geometry	.000	Significant
	Statistics & Probability	.804	Not Significant
	Trigonometry	.000	Significant
Geometry	Algebra	.000	Significant
	Statistics & Probability	.000	Significant
	Trigonometry	.479	Not Significant
Statistics & Probability	Algebra	.804	Not Significant
	Geometry	.000	Significant
	Trigonometry	.000	Significant
Trigonometry	Algebra	.000	Significant
	Geometry	.479	Not Significant
	Statistics & Probability	.000	Significant

*Significant at 0.05 level

The table provides the different areas used in the study with their corresponding significant levels for multiple comparisons. The table reveals that there was a significant difference in the levels of proficiency of the learning competencies of Grade 10 Junior High School students when grouped and compared as: Algebra and Geometry; Algebra and Trigonometry; Geometry and Statistics & Probability; Statistics & Probability and Trigonometry. On the other hand, results showed that there was no significant difference in the levels of proficiency of the learning competencies of the students when grouped and compared as: Algebra and Statistics & Probability; Geometry and Trigonometry. The discussion of these results could refer to the relevant research findings of Torbeyns, Obersteiner & Verschaffel (2012) and Siegler & others (2011), which related number sense and fractions mastery to overall mathematics achievement which reinforced the importance of addressing disparities in proficiency.

Moreover, Capate and Lapinid (2015), said that looking into the least mastered contents of the Grade 8 students according to the results of their Mathematics Achievement Test (MAT), the number of least-mastered and most-mastered contents for the three areas was of equal degree. Overall, 50% of the materials were most-mastered (got a 60% and above correct response) while the remaining 50% were least-mastered (got lower than 60% correct response). When analyzed per area, Patterns and Algebra had the most number of least-mastered contents, with 11 out of 17 (64.71%) contents falling below the mastery level. Better learning achievements through the conventional practice of instruction (Kapur, 2014).

The results of the students in Geometry affected this mathematical concept. A lot of trainings was needed to develop skills in problem - solving (Gloria, 2015).

Summary of Findings

The investigation focused on assessing the Level of Proficiency in Learning Competencies among Grade 10 Junior High School students in Mathematics at a private school in Bacolod City, Negros Occidental during the School Year 2016-2017. The study aimed to specifically gauge proficiency in Algebra, Geometry, Statistics and Probability, and Trigonometry.

The research utilized a descriptive design, employing statistical tools such as mean, standard deviation, and one-way analysis of variance for data analysis. The analytical approach encompassed both descriptive and comparative procedures.

Results indicated that, overall, students demonstrated "Outstanding" proficiency levels in Algebra and Statistics & Probability. This outcome was attributed to the recent introduction of these topics during the school year, with the highest proficiency observed in Statistics & Probability, likely due to intensive study during the fourth quarter.

However, students exhibited a "Fairly Satisfactory" proficiency level in Trigonometry and fell short of expectations in Geometry. This disparity was linked to the challenges students faced in applying previously learned concepts from the previous school year. The findings suggested a need for focused interventions and teaching strategies to enhance understanding and application of mathematical concepts, particularly in Geometry and Trigonometry.

Conclusion

From the foregoing results, the following conclusions were drawn:

The study indicated that the overall proficiency level of Grade 10 Junior High School students in Mathematics was "satisfactory." This suggested that there was room for improvement in the learning competencies of the students.

The students demonstrated "Outstanding" proficiency in Algebra and Statistics & Probability. This exceptional performance might be attributed to their recent study of these subjects during the school year, particularly in the fourth quarter. The students had a strong grasp of these concepts, which led to their high proficiency levels.

In contrast, the students achieved only a "Fairly Satisfactory" level of proficiency in Trigonometry, and they "Did Not Meet Expectations" in Geometry. These results suggested that the students faced difficulties when applying concepts they learned in the previous academic year. It appeared that they struggled to retain and effectively apply these previously learned mathematical principles.

The study found significant differences in proficiency levels when comparing different subject areas. Specifically, significant differences existed between: Algebra and Geometry, Algebra and Trigonometry, Geometry and Statistics and Probability, and Statistics and Probability and Trigonometry. This indicated that students displayed varying degrees of proficiency across these subjects. It is important to investigate the reasons for these differences and implement targeted interventions to address areas where students have been struggling.

Notably, there were no significant differences observed in proficiency levels between Algebra and Statistics & Probability and between Geometry and Trigonometry. These findings suggested that students might face similar challenges in retaining and applying previously learned concepts in these subject pairs. Identifying the specific difficulties or patterns in these areas could inform targeted teaching strategies.

The study also revealed that some students struggled with retaining past lessons and making errors related to signs and exponents in their final answers during the tests. Additionally, a number of students had difficulty analyzing word problems in the given items. This information highlighted the specific areas where students needed additional support and emphasized the importance of continuous practice and improvement in mathematical skills.

Recommendations

In the light of the findings and conclusions arrived at by the researcher, the following are recommended:

The curriculum planner and developer may conduct a comprehensive review of the curriculum in the light of the K-12 standards. This review may consider the implications of these standards, which define what students should know and be able to do in mathematics. It may aim to create a more integrated and coherent curriculum framework that ensures students' development and mastery of mathematical competencies across the different subjects.

The school administrators may take the study's results into account and conduct a thorough assessment of students' mathematical learning abilities, particularly in relation to their competencies. This assessment may be used to track and ensure the development of competencies in alignment with the curriculum. This includes verifying whether these competencies are adequately developed in the lessons.

The Learning Area Coordinators may play a crucial role in monitoring the progress of teachers in terms of their proficiency in teaching Mathematics. They may encourage innovation in teaching approaches for Algebra, Geometry, Statistics and Probability, and Trigonometry, as outlined in the curriculum guide. Providing support and professional development to teachers may help them adapt to new teaching methodologies and strategies.

To address the identified issues of students forgetting past lessons and making mistakes with signs and exponents, the school may offer math remedial classes and consultation hours. Additionally, intensifying peer-tutoring activities during classes and Math Club time may provide students with peer support and opportunities for collaborative learning. Teachers may also review the content of their mastery tests to ensure they align with the curriculum.

Mathematics teachers may be equipped with the necessary skills and knowledge to implement a spiral approach or progression in their teaching. They may employ various teaching strategies and innovations to effectively impart knowledge and skills related to the specified competencies in the mathematics curricular program. Continuous professional development may help teachers stay updated on the best practices in teaching mathematics.

Fostering student motivation and appreciation for mathematics is crucial. Teachers may inspire students to focus on and appreciate mathematics as a valuable life skill. Emphasize the importance of critical thinking and good decision-making in everyday life, both within and beyond the school setting. Teachers may also help students understand the practical applications of mathematics in their lifelong learning journey.

The students may be actively engaged with the topics discussed in mathematics. They may be encouraged to practice problem-solving and critical analysis regularly. They may be provided with opportunities for hands-on learning, real-world applications, and practical exercises that help students retain and apply their mathematical knowledge effectively.

For future researchers, it is recommended to consider variables not addressed in this investigation, such as teaching methodologies, classroom resources, and socio-economic factors. Additionally, replication of this study in elementary education, both in public and private academic institutions, may provide valuable insights into the effectiveness of mathematics education at an earlier stage.

Conflict of Interest

The authors declare no conflict of interest in the conduct of this research.

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