Effectiveness of Mixed-Mode Assessment in Enhancing Students' Performance in Mathematics 9

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Abstract

In this study, a mixed method was employed to investigate how effectively the implementation of mixed-mode assessment may help increase students' success in taking their math test at Linga National High School in Pila, Laguna. An explanatory sequential mixed-method was employed as the design for this research since both qualitative and quantitative approaches to data gathering were included for this kind of study on student performance and perceptions. Two Grade 9 classes (sections) with very similar pre-test MPS scores were selected through purposeful sampling. The control group (section A) was tested using traditional testing procedures, and the experimental group (section B) was tested using mixed-mode assessments; section B's tests included both authentic and non-authentic tasks. The quantitative results were examined using means, standard deviations, and independent-sample t-tests. The qualitative findings from the focus-group discussions were also analyzed using thematic analysis.

Results indicated that both groups had comparable performance in the pre-assessment, with mean scores of 8.76 (MPS 29.29) for the traditional group and 9.24 (MPS 30.79) for the experimental group, suggesting a similar baseline understanding of Mathematics concepts. Following the intervention, the posttest mean for the traditional group was 17.49 with a standard deviation of 3.68 and the posttest mean for the mixed-mode group was 21.18 with a standard deviation of 3.51 Thus, the experimental group demonstrated an improvement in their performance. A statistical comparison of the means indicated a statistically significant difference at a p value <0.05 between the two groups, which provided support to reject the null hypothesis that there would be statistical differences in performance. Student evaluations indicated that the mixed-mode assessment was reliable, of high quality and valid. Therefore, the students felt the assessment method was appropriate, meaningful and relevant to their learning goals. Also, through a thematic analysis of students' reflections, it was determined that the use of mixed-mode assessment positively affected students' levels of engagement, motivation, conceptual understanding and confidence.

Therefore, the conclusion is that the mixed-mode assessment strategy was more effective than the traditional assessment strategy in promoting both student engagement and student performance in Mathematics 9. Based on these findings, recommendations include the implementation of mixed-mode assessment strategies into similar contexts, the inclusion of authentic tasks into traditional assessment methods, and teacher professional development regarding the implementation of mixed mode assessment.

Keywords: A*ssessment: Traditional: Mixed-mode: Mathematics*

1. Introduction

The function of assessment in education is to be an effective tool for teacher instructional improvement and student learning. An effective assessment can inform teacher instructional decisions, give students opportunities to assess their own learning and develop, and support students' overall academic achievement. Therefore, assessment should not only be viewed as a means of providing a grade, but as a way for teachers to use the results of assessments to plan future instruction.

There are two primary forms of assessment; non-authentic and authentic. Both are utilized by teachers to assess their students; however, each has its unique characteristics. Non-authentic assessments utilize the format of paper-and-pencil testing. Examples of non-authentic assessments include multiple choice, true/false, and matching tests. The focus of non-authentic assessments is on the correct answer rather than the reasoning behind the answer. Non-authentic assessments were historically used for broad-scale evaluations. On the other hand, authentic assessments are designed to mimic the real world. Authentic assessments allow students to apply their learning in meaningful ways. Examples of authentic assessments include; solving real world problems, conducting mini-investigations, building scale models, creating multimedia presentations, and performing tasks that require sequential steps to arrive at a solution and relate directly to real life.

Students are assessed based upon their final products and the methods they employed to achieve those products. Unlike traditional assessments which focus primarily on recalling knowledge, authentic assessments promote students to think creatively, critically, and apply what they have learned.

Although both authentic and non-authentic assessments have some merit, each has some significant drawbacks. Non-authentic assessments were criticized for reinforcing rote memorization and failing to measure higher-order cognitive abilities. Although authentic assessments are meaningful and engaging, they take up significant amounts of time and resources, and are often subjective when evaluated (Center for Innovative Teaching and Learning, 2025).

As a result of these limitations, many educators now support the concept of using a mixed-mode assessment. A mixed-mode assessment uses elements from both authentic and non-authentic assessments. By combining the merits of both assessment modes, a teacher is able to assess student learning in a more comprehensive manner. For example, a student may complete a weekly computerized math test (non-authentic), while simultaneously working on a group project that requires them to determine the measurements of angles and apply trigonometric ratios to solve a real-world problem (authentic). This form of assessment is beneficial because it provides teachers with a wider variety of ways to evaluate their students' learning and addresses both foundational knowledge and higher-order thinking.

The use of a mixed-mode assessment model was especially appropriate for assessing student learning in mathematics. This model supports students in developing computational fluency, while fostering an understanding of concepts and problem-solving in a real-world setting. This model was grounded in Constructivist Learning Theory, which emphasizes that students construct knowledge through direct experience in meaningful, contextual situations (McLeod, 2025). Through the use of mixed-mode assessments, students are provided with opportunities to demonstrate their understanding of the content through both standard formats and through real-world applications.

However, even with all of the effort of teachers, the challenge of improving learner performance in Mathematics 9 continues to persist. Teachers are using several key strategies to improve learner performance, including developing lesson plans and preparing activities. Additionally, performance indicators, such as the Mean Percentage Score (MPS), often reveal low mastery rates, particularly in higher-order thinking skills such as analysis and evaluation. Recent school-based data from Linga National High School in Pila, Laguna, indicated that 8 of every 10 students had the greatest difficulty with items that required greater comprehension and real-world application. These are areas in which authentic assessment can be transformational. However, non-authentic assessments continue to dominate the classroom and are often driven by factors of time, familiarity, and convenience when it comes to grading.

In light of the aforementioned difficulties and opportunities, this research looked into whether the implementation of mixed-mode assessment during the teaching of Mathematics 9 will make any significant difference in the academic achievement of the students. The objective of implementing this mode is not just to bring balance to the assessment process, but would also allow the students an opportunity to showcase their understanding of the subject matter. Although the literature supported the potential advantages of mixed assessment strategies, there was limited research focusing specifically on the implementation and effectiveness of such strategies in the area of junior high school mathematics, and specifically in the context of public schools in the Philippines.

1.1 Background of the Study

The study aimed to investigate the current state of assessment in terms of its impact on the improvement of student learning outcomes in Mathematics at Linga National High School. The assessment practice in the school has been repeatedly criticized by the results of previous assessment; thus, it is now time to review the present teaching practices. Traditional assessments are still widely used at most Grades 9 classes of the school. As such, written quizzes and long tests are still the dominant method for assessing the performance of learners. Despite the growing demand for learner-centered and real-world-based tasks, teachers do not see the practicality of using them due to the constraints of time, large class size, and inadequate training in preparing performance tasks.

However, educational institutions in various parts of the world have started to adopt different types of assessment, called mixed-mode assessment. Mixed-mode assessment allows for different kinds of assessment, depending on the needs of the learner. For example, Every Student Succeeds Act (ESSA) in the United States recommends the use of performance-based tasks along with standardized testing to determine both the foundational knowledge and the higher-order skills of students (Ayscue, et al., 2022). In addition, in Finland and Singapore, two countries whose students rank high in international assessments, their schools also use assessment models that combine project-based work, problem solving, and

reflective tasks along with written exams (Huang, 2024). The main goal of these assessment systems is to assess a wide variety of learning skills, including creativity, collaboration, and critical thinking.

On the other hand, some Philippine schools have already been experimenting with blended approaches to classroom assessment. With the advent of DepEd's 21st-century learning program, blended approaches to classroom assessment have become increasingly popular. Blended approaches to classroom assessment allow teachers to develop and implement a combination of performance tasks, digital portfolios, and collaborative projects in conjunction with the traditional paper-and-pencil tests (Gurat & De Gracia, 2016). Although blended approaches to classroom assessment have been tried in a number of schools throughout the country, very few schools have documented and evaluated their experiences in a systematic way. In particular, the blending of traditional and innovative forms of assessment in the field of secondary mathematics education has received little attention. As such, the study is designed to provide evidence of the effectiveness of blended approaches to classroom assessment in improving student learning outcomes in Mathematics.

At the end of December 2024, the school conducted a PISA Simulation through the Division of Laguna. In all, 81 out of a possible 280 Grade 9 students participated in the simulation. There was a total of 13 items included in the mathematics portion of the simulation. The mean score achieved by the participating students was 4.33. Translated into a Mean Percentage Score (MPS) of 33.31%, the data indicates that many students are struggling to understand and apply mathematical concepts, especially when faced with non-routine problems.

Furthermore, Republic Act No. 10533 (the Enhanced Basic Education Act of 2013) mandated a curriculum that was learner centered, inclusive and developmentally appropriate. In addition to providing factual information, it emphasizes that education should provide students with competencies relevant to life and work. The law supports the use of assessment methods that are integrative, contextualized and reflective of the demands of the real world. These assessment methods are in line with the principles of authentic assessment. As such, despite the nationally established standards and guidelines for teaching and assessing student learning, classroom practice in many schools, including Linga National High School, continue to utilize non-authentic assessment methods almost exclusively. It is a reflection of the reality teachers face of limited access to professional development programs on authentic task construction, constraints on time due to the pacing guide and the need to provide measurable grades. Although there are many positive claims about the power of authentic assessment to promote deeper learning, authentic assessments have only been used in the classroom setting because of these pragmatic issues. As an alternative way to overcome these issues, many have proposed the use of an "assessment model that balances both non-authentic and authentic assessments" referred to as "mixed mode assessment". Mixed mode assessment allows for efficient evaluation of the most basic level of knowledge acquisition while at the same time promoting students' problem-solving skills through the use of more authentic tasks.

The use of mixed mode assessment gives educators an avenue to develop students' competencies, especially in those subjects that require not just procedural competence but also conceptual understanding. Nevertheless, the power of mixed-mode assessment in improving student's learning outcomes is yet to be explored especially with respect to junior high school mathematics in Philippine public schools. Given the school's own challenges, and the national need to improve student mathematics achievement, it was crucial to investigate if the integrated approach could be a viable way to support student growth. Thus, the purpose of this study was to assess the impact of using mixed-mode assessment to improve the academic performance of grade nine learners in Mathematics at Linga National High School. This study provided educators with evidence-based insight into how combining both authentic and non-authentic assessment methods may lead to more meaningful learning and increased measurable performance.

1.2 Literature Review

Assessments are very important for measuring and developing knowledge of student learning. During recent years there has been an ongoing study by many researchers of different types of assessments and how they affect students' academic success. The following section will include a review of some selected studies that relate to the research being conducted in this study. Specifically, it will be reviewing: (1) students' performance with traditional assessments; (2) students' performance using mixed-mode assessments; (3) differences in students' performance with traditional versus mixed-mode assessments; and (4) how well mixed-mode assessments improve performance in mathematics.

Students' Performance under Traditional Assessment

Traditional forms of assessment, such as paper-and-pencil testing, have historically been employed in mathematics instruction. They are effective in determining an individual's ability to recall basic information and perform procedures; however, they are less successful in assessing an individual's higher-level thinking. A study conducted by Ilgaz and Afacan-

Adanir (2020), utilized both quantitative and qualitative research designs to examine the differences in assessment between the two. The researchers discovered that traditional forms of assessment focus primarily on recalling factual information. Thus, it is not possible for these forms of assessment to determine a learner's level of comprehension and problem-solving skills to their fullest extent. Therefore, there is a significant difference in the types of assessments that are being administered to students and the type of mathematical competency that is being assessed.

Similarly, a study was completed by Manlangit (2024) that compared the effects of utilizing traditional assessment methods versus utilizing rubric-based assessments on students' overall performance in mathematics. Students who were assessed using traditional methods, but were not provided with rubrics, performed less well than students who were assessed with rubric-based methods. The results of this study suggest that traditional assessment methods may not provide learners with the clarity or feedback that they require to increase their own level of understanding.

A quasi-experimental study was conducted by Smolinsky, Marx, Olafsson, and Ma (2020) to compare the effectiveness of three different assessment methods in a calculus II class at a U.S. university. One section of the class was assessed using traditional paper-and-pen tests, a second section was assessed using computer-based tests, and the final section of the class was assessed using a combination of both methods. The methods used to assess the students ensured that there were no differences in the curriculum, homework, or instructor for each of the assessment methods. The results of the study indicated that the students who were assessed using traditional paper-and-pen methods scored slightly better than the other two groups of students, particularly for the more cognitively demanding problems. This indicates that traditional methods may promote more substantial conceptual processing. Additionally, the results of this study support the assumptions made in the current study regarding the value of traditional assessment methods in supporting performance in standard academic tasks when used appropriately.

Darling-Hammond, et al. (2020), in a study examining students' conceptual understanding of mathematics prior to an instructional intervention, found that students who were assessed using primarily traditional methods had minimal conceptual understanding. This finding reinforces the need for adopting more diverse and meaningful ways of assessments in helping reduce any gaps that may be present in deeper learning, especially mathematics. Darling-Hammond et al. (2020) also observe that any baseline assessments conducted always show bigger gaps in terms of deeper learning particularly mathematics which calls for any intervention. The above findings provide further proof that the low pretest scores observed in the current study were not just an isolated case, but a manifestation of the bigger problem in the system of mathematics learning. For this reason, a mixed mode of assessments became a strategy of choice.

In a study of students' performance on different assessment formats, McClelland and Cuevas (2022) investigated how sixth-grade students performed on paper-and-pencil tests (multiple-choice and short answer) versus computer-based tests. The study included a controlled sample design. The results of the study indicated that students consistently scored higher on paper-based assessments. This suggests that traditional assessments, if carefully constructed, will produce more accurate assessments of what students have learned, especially in areas of mathematics that include visual-spatial activities and sequential reasoning. The study highlights the significance of using traditional assessment formats to establish a baseline for students' performance.

In a study published by Thomas, Jong, Lau, and Lee (2018) the authors tested how well elementary students performed on both a computer-based version and a paper-based version of curriculum-based measurements for math. In total, there were 197 upper elementary students in the United States participating in the study. Thomas et. al. utilized "matched" probes for both problem solving and math fluency. They found that the students had significantly greater rates of accuracy and fluency when performing with paper-based versions of the assessments. These results confirm that traditional testing environments are more conducive to assisting with immediate recall of procedures and fluency which are essential skills for paper/pencil math exams. Therefore, the research from Thomas et. al. provides further evidence for using the same type of testing format in the control group to assess the performance of the mixed mode testing group.

The final body of literature referenced was a study conducted by Pandan and Lomibao (2022) on the assessment techniques being employed in online math classes during the COVID-19 pandemic. Utilizing a descriptive-correlation approach with 354 seventh grade students and their teachers; the researchers concluded that relying on paper and pencil assessment methods primarily based on multiple choice questions and computational drills resulted in reduced student engagement and lower levels of achievement in higher order thinking tasks. Additionally, the study highlighted that student that were only assessed through traditional methods did not have the opportunity to engage in problem solving within a more authentic or real-world context. The findings from Pandan and Lomibao's (2022) study also reinforce the importance of creating more meaningful assessments, such as those presented by a mixed mode method.

Overall, as supported by Ilgaz & Afacan-Adanir (2020), McClelland & Cuevas (2022), and Thomas et. al. (2018); it has been demonstrated that traditional assessments have proven to be successful for assessing basic recall and fluency in procedure-based assessments. Conversely, as noted by Manlangit (2024) and Pandan & Lomibao (2022); traditional testing methods have limitations in relation to providing the opportunity for students to develop higher level thinking, engagement, and real-world problem-solving skills. Collectively, the studies demonstrate an agreement in the fact that while traditional assessments can successfully measure the foundation of mathematical knowledge, they alone are inadequate; thus reinforcing the necessity for the development of more inclusive forms of assessments, such as mixed mode.

Students' Performance under Mixed-mode Assessment

Research has indicated that the use of a mixed mode assessment approach may provide a means of enhancing student learning outcomes. A study by Kandukoori et al. (2024) provided support for the benefits of using an assessment method that includes both digital and non-digital assessment strategies. In this study, students who were assessed using a combination of both digital and non-digital assessment strategies had significantly better results than students who were assessed using either solely digital or non-digital strategies, providing additional support for the use of a blended assessment model.

In addition to the benefits of using a blended assessment model, blended learning models (a model that incorporates both traditional and on-line learning strategies) have been found to have positive effects on student's mathematics performance. A study by Adjei et al. (2023) was designed to determine the effect of blended learning instruction (instruction that included a combination of face-to-face instruction and on-line instruction) on the academic performance of students enrolled in mathematics related courses. In total, 603 students attending the Catholic University of Ghana participated in this study. The results of the study indicated that students who received instruction using a blended learning model performed significantly better in their mathematics-related course(s) compared to students who received instruction using either a face-to-face model or an on-line model. The authors of this study concluded that blended learning is a viable option for the instruction of mathematics-related courses.

A quasi-experimental study entitled "The Impact of Blended Learning Model Using Authentic Tasks on Trigonometry Achievement" was conducted by Indrapangastuti et al. (2021) to investigate the relationship between blended learning (instruction that includes both face-to-face instruction and authentic task-based learning) and trigonometry achievement. A total of sixty secondary school students in Malaysia participated in this study. A pretest-posttest comparison of trigonometry achievement of the experimental group ($n = 30$) and the control group ($n = 30$) indicated that the trigonometry achievement of the experimental group was significantly greater than that of the control group ($p < .001$). This study illustrates the benefit of using a blended learning model when teaching trigonometry. Specifically, this study demonstrates how the inclusion of authentic tasks into the learning environment enhances the student's mastery of trigonometric concepts. Therefore, the results of this study are relevant to the development of a Mathematics 9 intervention plan based on a mixed mode assessment methodology.

A quasi-experimental study titled "Assessing the Effectiveness of Blended Learning Approach on Student Achievement in Mathematics" was conducted by Egara and Mosimege (2024) to assess the influence of blended learning on students' mathematics achievement. The participants of this study consisted of 120 students selected using a stratified random sampling technique. A quasi-experimental design was employed. The results of this study indicate that students exposed to blended learning strategies exhibited significant improvement in terms of mathematics achievement and retention rates compared to students in conventional learning settings. These results extend previous
evidence for the idea that combining different assessment methods enhances student achievement and performance.

Asaraik, Adjei and Opoku-Manu (2023) conducted a quantitative case study involving 603 students from the Catholic University of Ghana to compare the performance of students in face-to-face, on-line and blended instructional approaches. Paired sample t-tests were used to analyze the data. The results of this study indicated that students receiving blended instruction achieved significantly higher mean scores on mathematics-related tests than did students receiving face-to-face instruction. These findings validate your reasoning that combining different assessment formats will improve the quality of learning in mathematics courses.

A quasi-experimental study with 65 ninth-grade students in India examined the performance differences in mathematics of blended learning (traditional quizzes + authentic tasks) and traditional instruction only. Pre- and post-test comparisons of the experimental group (blended) demonstrated a statistically significant difference in favor of the experimental group compared to the control ($p < .05$). The authors affirmed your approach of combining both assessment

formats to obtain a better representation of a student's overall understanding.

Karjanto and Acelajado (2022) conducted a mixed-methods experiment with 55 college freshmen in College Algebra. The two formats tested were a traditional teaching format vs. a flipped classroom (active/ blended learning). The students in the flipped group scored significantly higher on the post-test ($p < .001$) and rated themselves as being more engaged and motivated. Feedback obtained from the qualitative component of the study illustrated that the mixed mode format encouraged self-directed learning, problem solving orientation and conceptual understanding. Similar to the constructivist aligned assessment strategies used in your study, the findings from Karjanto and Acelajado's study support the idea of using blended or mixed modes for assessing students.

Multiple studies cited above show that regardless of whether the format is called "mixed", "blended", "hybrid" etc., researchers consistently agree that the use of both traditional and innovative assessment formats leads to better Mathematics performance. For example, as stated by Kandukoori et al. (2024), Adjei et al. (2023), and Asaraik et al. (2023), students exposed to both formats had significantly higher scores than students exposed to only one type. Furthermore, the experimental findings from Indrapangastuti et al. (2021), Makkar and Sharma (2021), and Karjanto and Acelajado (2022) demonstrate significant post-test gains, increased student engagement and motivation, and enhanced conceptual understanding as a result of using a blended or mixed assessment model. Therefore, the studies referenced here are consistent in demonstrating that the use of mixed-mode assessments can provide a wealth of learning experiences and more complete measures of what students have learned; thus, they validate the method used in your Mathematics 9 Intervention Design.

Difference between Students' Performance under Traditional and Mixed-mode Assessment

Comparative studies have shown that when students are assessed with mixed mode approaches there is a positive impact on the performance of the student. Martinez-Garcia and Liu (2023) found that learners who were assessed using both paper-based and computer-based methods had significantly greater levels of engagement and academic performance than those who were assessed using traditional methods.

Furthermore, comparative studies have shown a positive impact on performance due to being assessed with mixed mode approaches. Zalmon et al (2024) found that learners who were assessed using both paper-based and computer-based methods had significantly greater levels of engagement and academic performance than those who were assessed using traditional methods.

Zhou, Zhou, and Machtmes (2024) investigated the impact of utilizing multiple assessment methods in mathematics instruction. Utilizing a quasi-experimental design, they determined that students who were assessed with different assessment methods than those traditionally assessed achieved significantly greater score levels. Their study indicated that combining different assessment methods will enhance both the conceptual knowledge of students as well as their academic performance.

Regmi et al (2024) also investigated the effect of a blended (mixed-mode) instructional approach in a medical nutrition course that utilized 110 undergraduate students in a blended format, and 93 students in a traditional format. Utilizing a mixed-method research design, Regmi et al (2024) measured the academic performance, engagement, and self-efficacy of the students in the blended format by assessing them through tests, interviews, and questionnaires. The quantitative analysis of the study utilizing t-tests and chi-square tests indicated that the students in the blended format performed significantly better than students in the traditional format, in terms of both performance and self-efficacy. Qualitatively, themes related to increased motivation and the perceived relevance of the course were identified in the study. As such, the study is aligned with the current study in that learner who utilize mixed-mode assessments report higher motivation and achieve better academic outcomes.

Chango et al (2024) also developed new multimodal data fusion techniques to assess final academic performance from various sources including online quiz logs, forum activity, and face-to-face class engagement in blended courses. Ensemble classification models were applied to data collected from first-year university students. The results indicate that engagement metrics across multiple modes significantly predict academic success, and that these engagement metrics perform better than traditional single source predictors. The study is relevant to the current study as it indicates how strong correlations exist between students' engagement in mixed-mode formats and their academic success.

Ng & Karjanto (2023) conducted an experiment comparing the effectiveness of a traditional lecture-based method versus an active learning (mixed-mode) format with real-world problem solving for mathematical economics students in

Malaysia. Of the 335 students involved in the study (189 in the treatment group, and 146 in the control group), the treatment group performed significantly better on post-intervention assessments, and achieved a very large effect size. Although the term "active learning" is not equivalent to "mixed-mode," this type of teaching methodology reflects a constructivist, student-centered approach similar to authentic assessment elements inherent in many mixed-mode formats, providing additional theoretical justification for the current study.

Finally, a meta-analysis of blended learning studies across several countries was completed by Inal & Korkmaz (2023). The researchers evaluated the performance, attitude, achievement, and engagement of students in blended/mixed-mode formats. The results of the meta-analysis indicated that blended/mixed-mode formats produced significantly better achievement and engagement than traditional formats. Participants in blended/mixed-mode formats reported improved motivation, self-efficacy, and attitudes toward the material. Moreover, participants in the blended/mixed-mode formats demonstrated noticeable increases in test scores. Collectively, these findings provide additional evidence supporting the author's assertion that mixed-mode assessments can produce better academic performance and learner engagement in mathematics education.

In total, across the reviewed literature and studies, the authors consistently found that mixed-mode approaches result in greater academic performance than traditional assessments alone, as evidenced by Martinez-Garcia and Liu (2023), Zalmon et al. (2024), and reinforced by Regmi et al. (2024) where the blended group outperformed the traditional group in both achievement and self-efficacy. Similarly, Chango et al. (2024) , Ng & Karjanto (2023) , and the meta-analysis of Inal & Korkmaz (2023) all demonstrated that learners are more engaged, motivated, and significantly perform better on post-tests in mixed-mode or active-learning environments than in purely traditional formats. None of the reviewed studies directly conflicted with one another; rather, they collectively support the conclusion that mixed-mode assessments consistently result in superior academic performance and engagement levels, which provides further support for the use of this approach in the current study.

Effectiveness of Mixed Mode-Assessment in Enhancing Students' Performance in Mathematics

In this context in the Philippines, research conducted by Dimatacot and Parangat (2022) examined the implementation of cooperative learning strategies related to mixed mode assessment principles. Junior high school students achieved substantially higher math test scores. Research by Dimatacot and Parangat (2022) also highlighted that if well implemented, students will have a better opportunity to develop a strong conceptual foundation for their math learning.

Research by Mulana et al (2021) used performance assessments, and are key components of mixed mode assessment strategies to measure students' math learning achievements. Students who completed performance-based assessments demonstrated greater achievement than students completing traditional assessments. Thus, incorporating performance type tasks into a mixed mode assessment framework can be an effective way to help students develop their math knowledge and skills.

Research conducted by Ukobizaba, Nizeyimana, & Mukuka (2021) found that the combination of authentic assessments and traditional assessments produced significant increases in the problem-solving abilities and participation of students in mathematics classrooms. The study found that students performed better when assessments encouraged both conceptual knowledge and practical applications.

Using a quasi-experimental design, Dimatacot and Parangat (2022) investigated the impact of cooperative learning—a strategy that is very similar to mixed-mode assessment—on junior high school mathematics performance in the Philippines. The study included grade 9 and 10 students from Bamban National High School, Zambales. Pre- and post-tests were administered and t-tests and Pearson correlation analysis were conducted. The results revealed a significant increase in post-test scores, demonstrating that cooperative learning significantly improved students' performance in mathematics (Dimatacot & Parangat, 2022). This is in line with your goal of determining how mixed mode assessment, including cooperative strategies, can enhance academic performance.

Mulana et al. (2021) conducted a random control experiment using 144 tenth-grade science students in the Buleleng province of Indonesia to study the effect of performance evaluation versus conventional evaluation on learning achievement. These researchers used 2 × 2 design and took cognitive styles into consideration. Data analysis was done using univariate analysis of covariance using SPSS. This study revealed that students with performance tasks did significantly well than the students taking traditional tests. It is also notable that the performance of the students differed depending on their cognitive styles. The field-independent students performed better, indicating the interaction between the

test methods and students (Mulana et al.,2021). The results support your intention to add authenticity to the assessment within a mixed-mode format in order to improve students' mathematics achievement.

Papama, Makeleni, & Masha (2022) compared the effectiveness of cooperative (mixed-mode) and traditional instructional approaches in improving the mathematics performance of ninth-grade learners in South Africa. The quasi-experimental design involved comparing the achievement of matched groups of students receiving either control or experimental treatments. A two-sample t-test confirmed that the cooperative instruction yielded a statistically significant increase in student performance ($t = 12.0146$, $p < .05$) over traditional instructional methods. Your assumption that active and collaborative assessment methods will generate better outcomes in mathematics learning is supported by these results (Papama et al., 2022).

Finally, Zales (2022) assessed a collaborative learning strategy called Perpend, Pair, and Partake or 3Ps for ninth-grade mathematics in the Philippines. Using a quantitative experimental design, researcher-made tests (KR-20 reliability = 0.90) were administered before and after the intervention. The treatment group demonstrated a significant improvement in achievement ($t = 4.137$, $p = 0.000$) compared to the control group, demonstrating the effectiveness of collaborative and less lecture-oriented approaches (Zales, 2022). The research supports Constructivist Learning Theory and demonstrates the utility of adding authentic and collaborative activities to assessment methods.

The reviewed literature and studies demonstrate that the incorporation of authentic, cooperative, and performance-based assessments into assessment formats has been consistently shown to result in substantially higher mathematics achievement than traditional assessment methods (Dimatacot and Parangat, 2022; Papama et al., 2022; and Zales, 2022). Additionally, Mulana et al. (2021) showed that performance assessments, a critical aspect of a mixed-mode assessment approach, resulted in better outcomes, and therefore support the idea that blended assessment approaches promote conceptual understanding and proficiency. Contradictions did not exist amongst the authors. Instead, the authors' findings uniformly support the concept of mixed-mode assessment as a more effective, student-centered model of assessment that fosters deeper learning and increased performance in mathematics.

Synthesis

Research over the past few years shows that evaluations (assessments) based on the traditional model of measuring how much you remember are inadequate in assessing your ability to think critically about problems. Assessments of mixed mode, utilizing both authentic and traditional assessments, have been shown to dramatically enhance learner performance and engagement. Students assessed using mixed mode assessments tend to perform better than students who were only assessed using traditional assessments. Similarly, we have seen significant improvement in junior high school mathematics performance as a result of incorporating cooperative and realistic assessment tasks at the local level. Overall, research suggests that mixed mode assessments may provide an improved method of balancing and enhancing academic performance in mathematics.

Despite the growing body of literature on alternative and mixed-mode assessment strategies, a clear empirical gap remains in the context of junior high school Mathematics, particularly within Philippine public secondary schools. Previous studies have concentrated either on traditional evaluation techniques or performance-oriented ones, without adequate investigation into the relative efficacy of using both methodologies in a unified instructional system. In addition, whereas earlier studies have confirmed the usefulness of mixed mode techniques in improving engagement and performance, there has been inadequate investigation into the impact of these techniques on quantitative academic results and qualitative perception of the students.

Moreover, very few empirical pieces of work have adopted a quasi-experimental research design coupled with thematic analysis, thus addressing the needs for measurable learning improvement as well as experiences of the learner. This implies that there is a need for an exploration of the existing gap both in terms of the context and methodology. This study will therefore attempt to fill this gap by comparing traditional and mixed-mode modes of assessment as well as the experience of learners.

1.3 Theoretical Framework

The research process was guided by the concepts of the Constructivist Learning Theory. According to this theory, individuals construct their knowledge through experience, reflection, and interaction with their environment. According to Shah and Kumar (2019), "Constructivism views students as active participants in the learning process, not just as passive receivers of information." For students to learn authentically, they need to engage with tasks that challenge their thinking,

are relevant to the context of daily living, and enable them to make sense of the concepts being studied using prior knowledge and exploration.

Within the framework of constructivist learning, assessment was seen as much more than simply a measure of how much knowledge students had acquired. Assessment was seen as a means to facilitate and support student learning. In order for classrooms to be able to offer students the opportunity to learn in a way consistent with constructivist learning, teachers' assessments must be aligned with the instruction that students receive. Furthermore, assessments should focus on the demonstration of understanding rather than the rote memorization of content. Authentic assessments (i.e., projects, problem-solving activities, performance-based assessments) are typically preferred because they represent real-world problems and require students to think at the highest level. Non-authentic assessments (e.g., quizzes and multiple-choice tests) do have a role in education in that they can provide a baseline of students' foundational knowledge; however, these may not adequately assess students' comprehension of a particular concept or topic. When used together (mixed-mode assessment), authentic and non-authentic assessments can provide a more complete picture of what students know.

Figure 1. The Constructivist Learning Theory

A Constructivist Learning Theory lens is best suited to guide this integration. The theory asserts that the greatest student gains are achieved with an array of process-based and task-based assignments that provide opportunities for students to demonstrate their learning in multiple ways. As such, the assessment processes for learners at the Mathematics 9 level (i.e., applying concepts, analyzing patterns, solving real world problems), need to assess beyond recall; they need to be designed to facilitate students constructing knowledge through both structured and open ended tasks.

Research conducted by Gezer et al. (2021) also supports this position. They found, in their study of math classrooms, that the combination of formative (authentic) and summative (non-authentic) assessments, improved the performance of all students, but particularly low achieving students. Thus, this research lends further credence to the notion that mixed mode assessments based on constructivist principles will produce more equitable and productive learning outcomes for students. Therefore, Constructivist Learning Theory will serve as the singular theoretical basis for this study, providing a rationale for the incorporation of authentic and non-authentic assessment methods into the design of the study, as well as a body of literature to examine how mixed mode assessment will lead to increased academic achievement for grade 9 students in Math by facilitating relevant, meaningful, active, and contextualized learning.

The theoretical framework in this study does not only act as the background for reference, but it becomes the guiding tool in the process of choosing variables, designing the research, and interpreting the findings. The principles of the constructivist approach to learning and assessment were used to develop the mixed-mode assessment tasks, which put an accent on active construction of knowledge and real-life application of the acquired skills, as well as constant provision of feedback. Consequently, the theoretical assumptions became the basis for forming the independent variable (the type of assessment) and its impact on the dependent one (academic performance of students). Besides, the use of qualitative data,

such as student perceptions, was based on the assumption that the process of learning involves not only cognition but experience as well.

1.4 Conceptual Framework

This study examines the impact of a mixed-mode assessment method on improving student achievement in Mathematics 9. In addition to this, it will examine the association between the two variables of the study: assessment methods (the independent variable) and student performance (the dependent variable).

Two methods of assessment were applied during the study. A traditional assessment method and a mixed-mode assessment method; the latter is a combination of an authentic and a non-authentic assessment method. An example of an authentic assessment would be a task that requires the student to solve problems that are representative of real world issues. Examples of authentic tasks are math journaling, group presentations, and real life problem solving. On the other hand, examples of non-authentic assessment methods are quizzes and multiple-choice tests.

A conceptual model that demonstrates the assessment methods (traditional and mixed mode) as the independent variable affecting the two main aspects of the study, i.e. student performance and student perception. The first pathway, named "Direct Influence", demonstrates how the assessment method directly impacts student performance. Student performance was evaluated using pretest and post-test scores. This relationship implies that the study attempts to identify if there are changes in assessment practices that result in improved academic outcomes.

The second pathway, called "Perceived Effectiveness" links the assessment method to student perception. Student perception was collected using qualitative research methods (focus groups). This also reflects the study's intent to collect data about how students view, experience, and assess the assessment process. Specifically, their views on the use of a mixed-mode assessment method that incorporates both authentic tasks (i.e. real world problem solving, performance tasks) and non-authentic tasks (i.e. quizzes, multiple-choice tests). The information they provide can explain why or support the numerical findings.

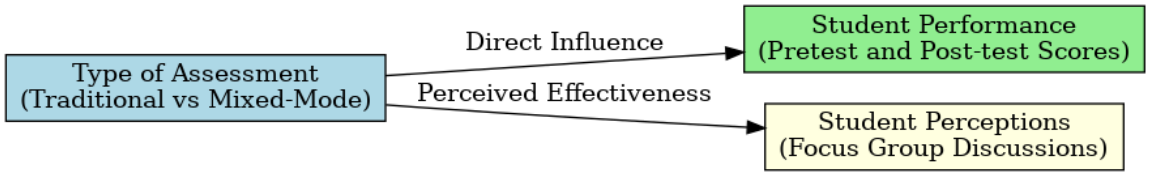

Figure 2. The Research Paradigm

Both results are important to each other as Constructivist Learning Theory, upon which this research is based, indicates that the construction of knowledge is through the experience of the learner. The model therefore demonstrates that mixed-mode assessment is not solely for improving grades but for changing how students interact with mathematics problems, how students view issues of equity and clarity, and how students create knowledge from various methods of assessing their abilities. Therefore, this conceptual model illustrates how the independent variable (type of assessment), will affect both measurable student performance and the perception of the assessment's effectiveness. This enables the study to provide an all-encompassing review of the application of mixed-mode assessment in Mathematics 9.

1.5 Statement of the Problem

This study aims to investigate the effectiveness of mixed-mode assessment in enhancing students' performance in Mathematics 9.

Specifically, it aims to answer the following questions:

1. What is the mean level of performance of the students from the traditional and experimental groups during the pre-assessment?
2. What is the students' performance during the post-assessment in Mathematics under the traditional assessment group?
3. What is the students' performance during the post-assessment in Mathematics 9 under the experimental assessment group?

4. Is there a significant difference between the students' performance in Mathematics 9 under the traditional and experimental assessment group?
5. How does the mixed-mode assessment enhance the performance of students in Mathematics 9 and to what extent do the experiences and challenges they encountered contributed to the outcomes?
6. What recommendations can be made to improve the effectiveness of the mixed-mode of assessment in enhancing students' performance and skills in Mathematics 9?

1.6 Hypothesis of the Study

The researcher posited the following hypothesis and tested using 0.05 level of significance:
H_o: There is no significant difference between the students' performance in Mathematics 9 under the traditional and experimental assessment group.

1.7 Significance of the Study

This study is intended to assess the impact of using a combination of mixed-mode assessment techniques in order to enhance the students' performances in Mathematics 9. The outcome of the study is expected to contribute significantly to each of the following groups.

For Students, the study will contribute to students by providing assessment practices which are considered to be more appealing to students; are relevant to their lives and support different types of learning. With the implementation of a variety of modes of assessment (e.g., traditional testing vs. problem solving) students should have the opportunity to demonstrate what they know through their demonstration of problem-solving skills. As such, students should be motivated to learn and perform well academically, and develop a deeper understanding of the mathematical concepts they are studying.

For Grade 9 Mathematics Teachers, Mathematics teachers will understand how their students view the effectiveness of the methods used in assessing student learning. As such, the results of this study will assist teachers in refining their assessment practices to combine the most appropriate mix of authentic and non-authentic assessment tasks to create an assessment environment that supports students' learning processes. Further, the study may provide guidance to teachers in aligning their assessment practices with curriculum standards and their students' needs.

For School Heads, School administrators will see the value in this study as it demonstrates how assessment practices affect student learning. As such, the results of the study may provide direction for instructional supervision, resource allocation and school- based training to improve the quality of assessment practices at the school site. Further, the study may provide a basis for schools to develop and implement assessment practices that are effective across all grade levels.

For Mathematics Education Supervisors, Education supervisors may utilize the findings of this study to evaluate and enhance current assessment practices within their jurisdiction. As such, the study provides empirical data regarding the benefits of utilizing multiple assessment strategies. Education supervisors may utilize the study to develop policies or training modules to support educators to adopt best practices in assessment at the classroom level.

For Researchers, Future researchers will benefit from this study as a source of information to develop additional research projects in the area of mathematics education and assessment. As such, the study contributes to the body of literature on mixed-mode assessment and provides a framework for conducting similar studies at other grade levels, in other subject areas, or in other educational settings.

1.8 Scope and Limitations of the Study

The study was conducted at Linga National High School, located in Barangay Linga, Pila, during the last quarter of the 2025-2026 School Year. The purpose of this study is to examine whether a combination of different modes of assessment will improve the academic performance of ninth-grade students studying mathematics, particularly those who are studying the concept of trigonometric ratios. The sessions took place over a period of four weeks. The assessment was aligned to the "Most Essential Learning Competencies" (MELCs), which are the learning standards set by the Department of Education.

All 238 ninth-grade students enrolled in six classes were initially administered a pre-test measuring students' understanding of trigonometric ratios. The researcher then compared the average scores of each class and selected two classes with relatively equivalent average scores. The researcher randomly selected 80 students from these two classes; the first class was designated as the control group and would continue to use the traditional assessment methods; the second class was assigned to the experimental group and would receive a combination of traditional and innovative (authentic) assessment methods.

Because of constraints related to scheduling, coordinating teachers, and the typical classroom structure which tends to favor either the traditional approach or some type of blended approach, there is no third group which would have been assessed solely using an authentic assessment method. The pilot test also demonstrated that the school's teachers were unable to consistently implement authentic assessment methods throughout the entire grading period. Therefore, the mixed-mode assessment strategy was considered a more practical and applicable assessment strategy for this study.

Five students from the experimental group were selected to participate in the qualitative aspect of the study. They were selected based upon their regular attendance, high level of participation, and the ability to express themselves clearly. These five students participated in a focus group discussion (FGD) where they discussed their perceptions of the validity, reliability, and overall quality of the mixed-mode assessment strategy. The FGD provided additional context to the quantitative findings and provided a student-centered perspective on the effectiveness of the mixed-mode assessment strategy.

This study only included two of the six ninth-grade classes. Those classes were selected because of their similar pre-test scores. The study also only examined the effectiveness of the mixed-mode assessment strategy in relation to one specific mathematics topic - trigonometric ratios - within one academic quarter. Other variables that could potentially influence the outcomes of the study were outside of the researcher's control. Such variables include prior knowledge of the students, the instruction and methodology employed by the teacher, the motivation and enthusiasm of the students, and external sources of support.

In addition to the variables mentioned above, the study did not attempt to control for all variables that can affect student achievement. Examples of such variables include the motivation and enthusiasm of the students, the amount of support students receive at home, and how well students retain information over extended periods of time. On the other hand, in order to maintain the internal validity of the research, both the control and experimental groups were taught by the same teacher using the same teaching resources, competencies, and timing. The only differentiating factor among the two groups was the assessment technique used. This approach tried to identify whether the use of the assessment technique had an impact on the academic performance of the learners. Such limitations have been identified and can be considered in further studies.

1.9 Definition of Terms

The following terms were given operational definitions based on how they were used in this research, in order to ensure coherence and clarity:

Authentic Assessment. Within this study, an authentic assessment is one that includes performance-based assessments which are designed to mirror a student's use of mathematical concepts within a real-world application. Authentic assessments can take many different formats (problem solving, project based, journal reflections, etc.) and allow for students to demonstrate how well they think critically, reason, and understand the underlying concepts of mathematics versus simply being able to memorize.

Experimental Group. Within this study, the Experimental Group represents the group of Grade 9 students who were provided with a mixed mode assessment strategy. This strategy included both authentic assessments (performance-based assessments, real life problem solving), and non-authentic assessments (written quizzes, multiple choice tests). The Academic Performance of these students was compared to those who did not receive the mixed mode assessment in order to assess its impact on learning.

Mixed-Mode Assessment. Within this study, Mixed-Mode Assessment refers to the combination of authentic and non-authentic assessment strategies. Real life, performance-based assessments are combined with traditional written test formats to provide a comprehensive assessment of students' knowledge and abilities.

Non-Authentic Assessment. In this study, Non-Authentic Assessment refers to traditional assessment formats. Examples include paper and pencil tests, multiple choice items, and computational quizzes. Students' factual knowledge, procedural fluency, and ability to recall and/or apply basic mathematical procedures are assessed using non-authentic assessments.

Student Performance. Student Performance, as used within this study, is a representation of the academic achievement of Grade 9 students in the area of mathematics. Students' pre-test and post-test scores were collected prior to and subsequent to the implementation of the Mixed-Mode Assessment in order to measure their level of performance.

Traditional Group. Within this study, the Traditional Group represents the group of Grade 9 students who received non-authentic assessment formats. Paper and pencil testing, quizzes, and objective type examinations were used to measure the academic performance of this group. This group served as a comparison to the group receiving the Mixed-Mode Assessment.

2. Methodology

2.1 Research Design

A mixed-methods approach has been taken to address this problem, using an explanatory sequential design. The sequential design is an example of a mixed-methods design. In this type of design, both quantitative and qualitative data are collected and analyzed. An example of a sequential design is the "mixed-methods" design. In this type of design, first, the quantitative data are collected and analyzed. Then, the qualitative data are collected and analyzed. Finally, the findings are compared. A mixed-methods approach allows the researcher to collect both quantitative and qualitative data. An example of a sequential design is the "explanatory sequential design." In this type of design, the quantitative data are analyzed before the qualitative data are collected and analyzed. The findings of the analysis of the quantitative data are then used to develop the framework for the analysis of the qualitative data. In addition, the findings of the qualitative data may be used to explain why the quantitative data were as they were. The explanatory sequential design was chosen because it provides a way to use both quantitative and qualitative data to provide a deeper understanding of the research problem.

According to George (2025), mixed-methods research uses elements of both quantitative research and qualitative research. George (2023)also states that by using elements of both types of research, a researcher is able to gain a more complete picture than if he/she had conducted a single-type-of-data study. That is, a researcher who uses a mix of both types of data, will be better able to understand his/her research problem than one who conducts either only a quantitative study or only a qualitative study.

2.2 Population and Sampling

This study took place at Linga National High School, Pila, Laguna, Philippines in the fourth quarter of SY 2025-2026. There were 238 total grade nine students registered as part of the six sections, each of which is heterogeneous and composed of equal numbers of students distributed based on academic grades.

The researcher used Purposive Sampling, a non-probability sampling technique where participants are selected based upon specific characteristics or criteria relevant to the study (Nikolopoulou, 2023) for the Quantitative Component. The researcher selected two Grade Nine classes (Sections A & B) whose Pretest Mean Percentages Scores (MPS) were similar to one another and therefore, the two groups were academically comparable before receiving the intervention. Section A (the Control Group) received traditional (non-authentic) assessment strategies while Section B (the Experimental Group) received a Mixed-Mode Assessment Strategy that combined both Authentic and Non-Authentic Strategies. This created a Two-Group Quasi-Experimental Design that allowed the researcher to compare the Academic Performance of the two groups using Pretest and Posttest Data.

For the Qualitative Component, the researcher used Purposive Sampling to select Five Students from the Experimental Group to provide Deeper Reflections about their Experiences with the Mixed-Mode Assessment. The Criteria for Selection of these Students were: (1) Consistent Attendance During the Intervention Period, (2) Willingness to Participate in Interviews/Guided Reflection, (3) Clear Communication Skills, and (4) Varied Academic Performance

Levels. The Insights provided by the students through their Feedback supplemented the Quantitative Data collected and provided Student-Centered Insights regarding how the Students Experienced/Received the Different Assessment Strategies Used.

The Ethical Rationale for selecting the Participants using Purposive Sampling was to Ensure that the Study Groups were Equitable/Fair and Comparable, which would Strengthen the Internal Validity of the Research Findings. Since the Groups were Selected Based on Pre-Existing Academic Performance (Pretest MPS), the likelihood of Observed Differences in the Post Test Results being due to the Intervention (Mixed Mode Assessment) Rather than Due to Previous Academic Differences Between the Groups was Enhanced.

Finally, the researcher ensured fairness by making sure that students who were not selected for the Experimental Group were not disadvantaged. The Control Group continued to receive the standard, DepEd-aligned curriculum and the traditional assessment methods that are regularly used in the school. The Experimental Group and Control Group received instruction from the same teacher using the same content and time allocations. The researcher simply added an alternative assessment strategy to what the teacher normally does; therefore, no student lost instructional opportunities or evaluation opportunities.

2.3 Respondents of the Study

The participants of the study comprised 75 Grade 9 students from two classes that had almost the same Mean Percentage Score (MPS) in the pre-test. This involved Section A as the control group where the traditional method of assessment was used, and Section B as the experimental group where the mixed-mode assessment was conducted.

The participants' selection process was based on certain inclusion criteria. First, only students officially enrolled in Grade 9 during the 2025–2026 school year at Linga National High School were considered. Second, the two sections were chosen based on their comparable pre-test MPS results to ensure equivalence between the control and experimental groups. Third, only students who were officially enrolled and actively attending classes in the selected sections were included.

Additionally, participation required both student assent and parental or guardian consent. Lastly, only students with regular attendance throughout the intervention period were deemed eligible to ensure that they had sufficient exposure to the respective assessment methods.

Pre-test Results of Grade 9 Students
The table below showed the number of students who took the test and the results of each Mean Percentile Score.

Table 1*: Pre-test Mean Percentile Score Results*

SECTIONS	TOTAL	Pre-test MPS Results
DEL PILAR	41	33.50
RIZAL	38	39.15
BONIFACIO	40	36.15
LUNA	38	30.79
JACINTO	37	29.29
AGUINALDO	40	33.25

Table 1 shows that Rizal had an MPS of 39.15, while Luna had 38 respondents and Jacinto had 37, yielding MPS results of 30.79 and 29.29, respectively. The results demonstrate that all Grade 9students lacked definite knowledge of the test's material, resulting in a low MPS.

Table 2: *Distribution of Respondents by Gender and Group*

Gender	Jacinto Traditional Group	Luna Mixed-Mode Group	Total	Percentage
Male	19	19	38	**51.67**
Female	18	19	37	**49.33**
Total	**37**	**38**	**75**	**100.00**

Table 2 shows the two sections with the lowest MPS, Jacinto as the Traditional Group and Luna as the Experimental Group or Mixed-Mode Group.

The table indicates an equal number of males and females in both Jacinto and Luna sections. Section Jacinto, or the Traditional Group, had 19 males and 18 females, for a total of 37 out of 75 or 51.67 percent of total respondents, whereas section Luna, or the Mixed-mode Group, had 19 males and 19 females, for a total of 38 or 49.33 percent. This symmetry maximizes statistical power, making it much easier to find out whether the Mixed Mode Assessment genuinely outperformed the Traditional method rather than the findings being a product of chance.

2.4 Participants of the Study

A qualitative part of this research was conducted using a sample of five grade 9 students who were members of the experimental group (Mixed-mode Assessment) and who were selected based upon their performance level, communication skills, attendance and their willingness to be involved in the research. The goal of this qualitative part of the research was to gain a deeper understanding of what these students thought about the reliability, quality, and validity of the mixed mode assessment approach that they had been exposed to.

Below is a short description of the five students who participated in this aspect of the research:

1. Student 1 was an exceptionally strong student who achieved scores greater than 90% in both the pre-test and post-tests. He was selected as one of the participants in order to explore what strong students think about the mixed mode assessment strategy and whether or not it challenges and engages them.
2. Student 2 was a mid-level performer who generally scored at or near the mean for all assessments. She was selected because of her regular attendance, average academic performance and her potential to represent the typical student experience and how the assessment strategies impacted her own learning process.
3. Student 3 was a poor performing student whose post test results did not show a great deal of improvement over those of the pre-test. He was selected as a participant for this aspect of the research because of his open and reflective nature. Understanding how the mixed mode assessment impacts those students who are likely to require additional support was of interest in this research.
4. Student 4 was a student who regularly participated in class discussions and expressed herself verbally very well. While Student 4's academic performance was average, she was selected because of her ability to communicate her ideas clearly and effectively. This ability to express her ideas was viewed as important in developing the qualitative analysis for this research.
5. Student 5 was a student who exhibited large improvements in scores from the pre-test to post-test. Student 5's perspective was viewed as particularly relevant in exploring how the mixed mode assessment may have positively impacted the learning of students who were struggling.

Research Instruments

Three main data collection tools were employed during this investigation: an Academic Performance Test - Pre-test & Post-test, and a Semi-Structured Interview Guide.

Academic Performance Test - Pre-test & Post-test

Table 3: *Interpretation of Mastery Level for a 30-item Test*

Score (out of 30)	Percentage Range	Mastery Level	Interpretation
28.80 – 30.00	96–100%	Mastered	Students demonstrated complete understanding of the competency.
25.80 – 28.50	86–95%	Closely Approximating Mastery	Students showed high understanding but with minor errors.
19.80 – 25.50	66–85%	Moving Towards Mastery	Students showed developing understanding of the competency.
10.50 – 19.50	35–65%	Average Mastery	Students demonstrated partial understanding but need improvement.
2.25 – 10.20	15–34%	Low Mastery	Students showed limited understanding of the competency.
1.5 – 4.20	5–14%	Very Low Mastery	Students showed very minimal understanding.
0 – 1.20	0–4%	Absolutely No Mastery	Students did not demonstrate understanding of the competency.

To evaluate how well grade nine mathematics students could perform academically in their mathematics course, a 30-question test was constructed and given to all grade-nine students. The test contained questions that represented a variety of question formats which measured cognitive levels at recall, comprehension, application, and analysis. Each format was specifically aligned with the department's standards for the six trigonometric ratios. A pre-test version of the test was administered prior to intervention. After completion of the intervention a post-test was administered.

Pilot Testing and Reliability Analysis

A pilot test was conducted among Grade 9 students with similar characteristics to the actual respondents but not included in the study to avoid data contamination. The purpose of the pilot testing was to determine the internal consistency of the 30-item pre-test instrument. The selected students' demographic characteristics (age, grade level, and curriculum) were very close to the target population; however, they were not included in the study so as to prevent the introduction of extraneous variables into the collected data.

Table 4: *Kuder–Richardson (KR-20) Reliability Coefficient of the 30-Item Pre-test*

Instrument	Number of Items	KR-20 Coefficient	Interpretation
Pre-test (Trigonometric Ratios)	30	0.87	Highly Reliable

The reliability of the test was evaluated and analysed through the use of the Kuder-Richardson Formula 20 (KR-20), which is appropriate for dichotomously scored items. The computed KR-20 coefficient of 0.87 indicates that the test instrument has high internal consistency, making it suitable for measuring students' performance in Mathematics 9.

On the other hand, the researcher used Cronbach's Alpha reliability analysis to assess the internal consistency of the survey instrument. Cronbach's Alpha is considered an appropriate measure for Likert type scales and has been widely applied to evaluate the extent to which all of the items on a given scale measure the same construct. As stated by Frost (2024), Cronbach's Alpha coefficient of .70 or higher indicates acceptable reliability. Therefore, the researchers only provided those dimensions that met or exceeded this reliability threshold to the actual participants.

Table 5: *Cronbach's Alpha Reliability Coefficients of the Survey Questionnaire*

Dimension	Number of Items	Cronbach's Alpha	Interpretation
Reliability	5	0.88	Highly Reliable
Quality	5	0.91	Highly Reliable
Validity	5	0.86	Highly Reliable
Overall Instrument	15	**0.90**	**Highly Reliable**

The findings showed that the entire survey instrument had high reliability. All of the alpha values for each dimension exceeded the minimum threshold, and therefore the instrument was both statistically reliable, as well as suitable to utilize within the data collection phase of this study.

The test was reviewed and validated by three Master Teachers from public secondary schools to ensure content validity, relevance, and clarity. Their feedback was used to revise test items prior to final administration. Student scores was interpreted using the DepEd Mean Percentage Score (MPS) scale adopted from DepEd memorandum No. 160, s.2012.

Interview Guide (Qualitative Component)

A semi-structured interview guide was utilized to obtain reflective thoughts from five purposefully selected students in the experimental group for the qualitative component of the study. The questions were written to encourage open discussion and honest feedback on their experiences with the mixed-mode assessment technique. The statements were translated into Tagalog to make them easier for student-respondent to understand.

These are the guide questions that were provided:

1. In what ways is the Mixed-mode Assessment effective in improving your performance in illustrating the six trigonometric ratios?
2. In what ways is the Mixed-mode Assessment effective in improving your performance in determining the six trigonometric ratios of special triangles?
3. In what ways is the Mixed-mode Assessment effective in improving your performance in solving real-life problems through the use of trigonometric ratios?
4. Which aspects of the assessment help improve your performance the most? the least? Why?
5. Were there aspects of the assessment that you found confusing or difficult or even unfair? Please explain.
6. Was the assessment process aligned with your learning from the class? Why?

The feedback and responses received from these students were used to substantiate and elaborate on the results obtained through the quantitative research, thus offering a deeper insight into the efficiency of mixed-mode assessment methods.

2.5 Data Gathering Procedures

The study followed a systematic procedure to ensure accuracy, reliability, and adherence to ethical standards in data collection. After receiving formal ethics approval from the Institutional Ethics Review Committee, the researcher secured permission from Dr. Editha M. Atendido, Schools Division Superintendent of the Schools Division Office (SDO) Laguna; Rissa S. Viterbo, School Head of Linga National High School; and Dr. Gisela I. Pingad, Public Schools District Supervisor of the Pila Sub-Office.

Table 6: *Gantt Chart of Data Gathering and Mixed-Mode Assessment Implementation*

Activities	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Securing Permissions & Approval	✔					
Orientation & Consent/Assent	✔					
Pretest Administration	✔	✔				
Implementation of Traditional Assessment		✔	✔	✔	✔	
Implementation of Mixed-Mode Assessment		✔	✔	✔	✔	
Monitoring & Data Recording		✔	✔	✔	✔	✔
Posttest Administration						✔
Conduct of Interview (FGD)						✔
Data Analysis						✔

After receiving permission, orientation was provided to the Grade 9 students before gathering any data. At this point, the researcher made it clear to the student-articipant what the study entailed, including its objective and expected outcomes. Consent forms were completed by the parents of the students before the experiment took place.

In order to maintain confidentiality, all answers provided by students were coded anonymously (such as S1, S2, FGD-P1). The code key was accessible only to the researcher and was saved separately in an encrypted file that did not contain the actual data. Descriptions that could be used to identify students were stripped from the final report.

Data collection took place on a scheduled timeline towards the end of School Year 2025-2026. Pilot testing of the instruments used in the research took place in Week 1 among the students sharing similar characteristics to those that were not part of the actual study to ensure reliability of results. In Week 2, the 30-item pre-test on trigonometric ratios was administered to establish the baseline performance of the participants.

During the Intervention Phase from Week 2 through 5, the control group underwent assessment through traditional means while the experimental group had exposure to mixed mode assessment which involves the use of authentic and non-authentic activities. There were standardized procedures used in each of the two groups, such as similar instructions, same classroom setting, and equivalent time spent.

The post-test was carried out in Week 6 for both the experimental and control group using the same test used in the pre-test in order to determine whether there were any changes in the knowledge of the participants. Similarly, in Week 6, a focus group discussion (FGD) was done among five participants in the experimental group.

Evaluation of the performance of the mixed-mode assessment was done through quantitative and qualitative means. The quantitative evaluation involved mean score calculations and group comparisons. Thematic analysis was employed for the qualitative evaluation of the students' perception regarding engagement, understanding, fairness, and learning.

In the course of analysing the data, objectivity was achieved by using empirical data and systematic coding of the responses. Bracketing was used to reduce personal biases while results were shown in aggregate form to ensure that objectivity was maintained. The research followed well-defined methodologies and ethics for gathering and analysing data.

Delineation of Assessment Procedures

In order to maintain clear procedures in the study's implementation, a clear distinction was established between the traditional assessment and mixed-mode assessment approaches.

The control group was assessed through traditional techniques that involved mainly pen-and-paper test centered on recall, computation, and objective questions based on the MELCs of the DepEd. The use of traditional assessment techniques was centered more on individual performance and summative assessment with little application of real-world tasks. On the other hand, the experimental group was subjected to both traditional and authentic assessment techniques.

These involved written test, task-based testing, problem solving, group work, and application of concepts in real life situations involving trigonometry.

In terms of procedures, both groups were given the same instructional material and allotted the same amount of time, along with the same goals for the learning process. What was varied here is the way the assessment was conducted, which made the assessment process the independent variable in the research design.

2.6 Data Analysis

For this research study, quantitative and qualitative data analysis methods have been used to fulfill the demands of the mixed methodology of research. The data acquired from pre-test and post-test and qualitative interviews has been analyzed using the appropriate statistical and thematic analysis techniques to effectively answer the research questions posed in the study.

Frequency and Percentage

The frequencies and percentages employed in organizing the data and describing its basic features like demographics of the participants. Frequency involves the use of counts to indicate the number of students falling into certain classes, such as gender and score intervals, while percentages involve proportional representation out of 100. It is important in ensuring that data is made comparable and easily readable, especially in cases where the total number of subjects may not be an exact figure. Through these descriptive statistical measures, it will be easy to show how 75 participants are distributed.

Mean

The mean is a method of describing the center of the distribution of the students' scores in both the pretest and posttest in both the control group (traditional assessment) and the experimental group (mixed-mode assessment). The mean provides a clear description of how well the students performed prior to the session and after the session. In addition, the comparison of the mean score will help determine if any improvement in academic performance occurred due to the type of assessment used.

Standard Deviation

The Standard Deviation measures the degree of variation or dispersion of the students' scores from the mean. The Standard Deviation helps determine the degree of consistency of the performance of the students within each group. When the Standard Deviation is small, it indicates that the students' scores are close together. However, when the Standard Deviation is large, it can indicate that there is a great deal of variation in performance and may be indicative of either the ineffectiveness or lack of equity of the assessment methods.

Independent Samples T-Test

An Independent Samples T-Test is used to determine if the mean difference between the two groups (control and experimental) is statistically significant. The T-Test is an inferential statistical method that tests the hypothesis that the mean improvement in academic performance of the students who took the mixed-mode assessment is significantly different from those who took the traditional assessment. The T-Test can be used to determine if the observed differences in performance are due to the assessment intervention or occur randomly.

While mean and standard deviation were used to describe the central tendency and variability of student performance, these measures alone are insufficient to determine whether observed differences are statistically significant. Therefore, an independent samples t-test was employed to compare the posttest performance of the traditional and mixed-mode assessment groups. The inferential statistical test permits the conclusion to be drawn that the variation between the group mean values is significant. The application of the t-test enhances the research analysis because it enables hypothesis testing at the 0.05 level of significance.

Thematic Analysis

The researcher interviewed five chosen students. After collecting the qualitative data, the researcher used thematic analysis to identify patterns or themes that are seen from the results of the interviewees. Thematic analysis is a method that used a coding process through the following three specific positions: First is Coder 1, which is the researcher itself. He performed the coding process which included recording and classifying each answer to get the raw themes. Coders 2 and 3 are the master teachers at secondary school in Pila, Sub-office, Doctor Aileen D. Calaramo and Doctor Roann C. Oliva who did exactly the same process as coder 1. They created themes as results of their process due to closeness of respondents' answers. Using more than one encoder helped the researcher make qualitative results stronger and more effective.

Ethical Considerations

In conducting this study, the researcher was aware of the various established ethical principles inherent in educational research. In particular, the researcher was concerned about respect for persons, beneficence, non-maleficence, and justice. Because the respondents were Grade 9 students (minors), and the researcher was also the classroom teacher, the researcher had to take additional precautions to avoid any perceived risk, power imbalance and/or violation of the rights and well-being of the participants.

In order to provide complete transparency and obtain informed consent from the participants and their parents/guardians, the researcher provided a Participant Information Sheet to each participant and their parent/guardian. The Participant Information Sheet explained the purpose of the study; what would happen during the study; and how the data would be used. The data would be used for the purpose of completing the thesis submission; reporting the study to the institution; and potentially publishing the results of the study in an academic journal.

Data Collection Methods and Recording Protocols

Audio recording of FGDs was done with explicit consent of the participants. All of the audio recordings are stored as encrypted digital files on a password protected laptop and as backup on an encrypted external storage drive that is only accessible to the researcher. According to the data retention policy, these recordings will be deleted using secure data-wipe software after five years.

Voluntary Participation and Researcher–Teacher Relationship of Power

The researcher ensured that all participants in this study participated voluntarily and that all participants knew they could withdraw from the study at any time without fear of reprisal or negative effects on their academic standing. The researcher specifically told all potential participants that participating in the study, or not participating in the study, would have no effect on their grades, academic standing or future teacher evaluations.

Informed Consent and Assent

The researcher recognized the potential for a power relationship between teachers and students during this study. Therefore, the researcher took measures to minimize the potential for coercion or obligation to participate. Parents or guardians of the students were provided clear information that students' choice to participate in the study or not, would not negatively impact students' grades, academic standing, class treatment, or teacher evaluation. The researcher received consent and assent from students outside of grading and instructional activities. Additionally, students were assured that they could withdraw from the study at any time without penalty or negative consequences.

Admitting to the Potential for Minimal Risk and Withdrawal

Although the researchers believed the assessment tasks and FGDs were low-risk and not intrusive, the researcher acknowledged that there could be some risk associated with the study. For example, participants may experience some temporary performance anxiety or psychological discomfort. To address these potential risks, the researcher informed participants at the beginning of each session, that if they needed to stop the study temporarily or withdraw from it at any point, they could do so. They were further assured that their grade or academic standing would not suffer due to withdrawal. Guidance support was also available to those who might need it.

Confidentiality, Privacy, and Anonymity

This study fully adhered to the Data Privacy Act of 2012 (Republic Act No. 10173), and followed the core principles of the act throughout the entire research process. Purpose limitation was achieved in the study by collecting only the data required to meet the goals outlined in the approved research proposal. Any unnecessary data was not collected; therefore, the data collected will not be used for any purpose other than academic research and institutional reporting.

Data Minimization was accomplished through the reduction in the amount of personal data collected. The least amount of data needed to answer the research questions was collected, which consisted of students' test scores and perception. There was also a specified retention period for storing all the research data. The data will be securely kept for five years after the completion of the study. At the end of the five-year retention period, there will be a proper destruction process that entails the permanent deletion of all digital data using proper means and shredding of hard copies.

Anonymity was maintained by replacing students' names with alphanumeric identifiers (S1, S2, FGD-P1). Also, in the presentation of the qualitative results, no identifying descriptions were presented. Examples include, but are not limited to, specific academic ranks, unique personal characteristics, or distinguishing classroom behaviors. When necessary, quotes from participants were paraphrased to maintain anonymity. This prevented participants from being identified based upon contextual cues in the small sample size.

Data Storage and Data Protection Measures (Expanded)

All data collected in this study was collected, stored, and managed in a manner to provide complete confidentiality and protection of the data. All digital files, including students' test scores, survey responses, and interview transcripts were stored in a password protected laptop, and copied onto an encrypted external storage device that was only accessible to the researcher. All hard copy materials, including consent forms and test instruments were stored in a locked filing cabinet within the researcher's office. No third parties had access to the raw data. The data was retained for a period of five years after the completion of the study. At the end of the five-year retention period, all electronic files will be permanently deleted using secure deletion methods. Hard copy materials will be shredded to prevent data reconstruction.

In addition to anonymizing the students' data via alphanumeric codes (i.e., S1, S2, FGD-P1), as opposed to naming the students, no identifiable descriptors of the students' academic performances, personal characteristics, or classroom behaviour was included in the qualitative analysis of the data. Due to the classroom environment of this study and the relatively small number of participants, further precautions were taken to ensure that the individual participants could not be deduced through contextual information. As needed, qualitative excerpts were paraphrased, and quotes were chosen to reflect commonalities among participants versus each participant's unique experience. The quantitative results of the study were analysed at an aggregate level to avoid identifying individual student performance from the data presented.

Data Protection Principles Applied to the Study

The researcher applied the principles of data protection throughout the study. One such principle is the purpose limitation. For example, all of the data collected in the study was utilized specifically for the purposes stated in the research proposal. The secondary utilization of such information will need a separate consent procedure. Another aspect of data protection is known as data minimization. This means that the researcher only collected those data which were necessary to answer the research questions.

Ethical Approach toward Students with Learning Gaps

Those students identified as having learning gaps were handled ethically and not merely considered data points. The process of ethical intervention was put into place in order to give assistance to those students scoring “Did Not Meet Expectations” (below 19 points) on the pre/post test. Supplemental learning materials and simplified activity sheets were developed to address foundational gaps in Trigonometric Ratios. Additionally, these supplemental instructional materials were integrated into the curriculum so that all participants in the study, regardless of the group they belonged to, would receive the necessary academic support to meet the Most Essential Learning Competencies (MELC). Finally, the researcher collaborated with the subject teacher to ensure that remedial instruction was completed discreetly during regular class hours or through existing school-based tutoring programs to minimize any potential social stigma related to low academic achievement.

Conflicting Roles of Researcher and Teacher

Because the researcher was simultaneously the teacher of both the control and experimental groups, a conflict-of-interest protocol was implemented to protect the integrity of the study. To remove the potential for grade bias, the researcher used a standardized answer key to check all of the pre-test and post-test results. Additionally, to validate the performance task results for the mixed-mode group, the researcher used pre-validated rubrics that were reviewed by Master Teachers. To ensure the integrity of the qualitative component of the study, the researcher did not facilitate the focus group discussions (FGD); instead, a neutral co-teacher or research assistant facilitated the FGD to ensure that students felt safe providing honest feedback regarding the assessment process without the fear of academic consequences. Finally, to ensure equitable instructional delivery, both groups received the same lesson content, time allocations, and instructional materials. The only variable was the assessment method. These measures were implemented to remove the researcher's pedagogical roles from the investigation to protect the validity of the findings and the ethical treatment of the students.

Transparency and Fairness in Selecting Participants for FGD

The selection of the five students for the FGD was intentionally made using criteria such as consistent attendance and active participation. The purpose of the FGD was to collect rich, articulated qualitative data; therefore, the selection of students for the FGD was not intended to result in preferential treatment or academic bias. All students, regardless of whether they were selected for the FGD, were assessed using the same standardized rubrics and objective testing instruments. It was clearly communicated to the students that those students not selected for the FGD were not excluded based on poor performance or lack of ability. Rather, the small sample size was a function of the qualitative research methodology used to allow for in-depth discussions. To ensure that all students were able to provide input about the assessment process, all students in both the experimental and control groups were given an equal opportunity to provide feedback through the researcher-made perception questionnaire. Student participation in the FGD was completely voluntary, and there were no consequences for refusing to participate in the FGD or failing to be selected for the FGD.

Ethical Safeguards for Vulnerable Learners

Following the principles of Justice and Beneficence, the study established various safeguards for minor populations, especially those who may have been identified as having special education needs and/or coming from marginalized social groups. In order to avoid feelings of frustration or inadequacy, the "mixed-mode" tasks - specifically, the complex, real-world problem-solving activities - were developed using the principles of Universal Design for Learning (UDL) and therefore used multiple methods of instruction; and, when possible, incorporated scaffolding (e.g., templates with fewer elements than typical templates, or visual aids) to support bridging the gap of baseline skill level among students.

Post-Study Knowledge Sharing and Beneficence

The researcher also committed to sharing the potential benefits of the mixed-mode approach with the control group post-study. The Post-Study Enrichment Phase for the control group will include a series of transition sessions that introduce students to the same types of authentic tasks (e.g. real world problem solving activities and math journaling) that the experimental group used. This way, the researcher can ensure that no student is disadvantaged based on group assignment, and that all participants will have equal access to the most effective approaches to instruction and assessment that the study identifies

3. Results And Discussions

3.1 What is the mean level of performance of the students from the traditional and mixed-mode group of assessment?

A pre-test was conducted for all participants before implementing the interventions to assess how well grade 9 students were performing on mathematics items using both traditional and mixed-mode assessments. The pre-test established a point of reference for comparing student's prior knowledge and skills across the two groups before either group received their respective types of assessments. Table 5 presents the mean performance of Grade 9 Students during their pre-test.

Table 7: *The Mean Performance Level of Grade 9 Students in Mathematics During Pre-test*

Group	*Score Interval*	*Frequency*	*Mastery Level*	*Mn and SD*
Traditional	11 – 19	15	Average Mastery	Mn: 8.76 SD: 4.49
	5 – 10	16	Low Mastery	
	2 – 4	2	Very Low Mastery	
	0 – 1	4	Absolutely No Mastery	
Mixed-Mode	11 – 19	11	Average Mastery	Mn: 9.24 SD: 4.47
	5 – 10	21	Low Mastery	
	2 – 4	5	Very Low Mastery	
	0 – 1	1	Absolutely No Mastery	

The table shows that sixteen students under the traditional assessment demonstrated low mastery, with scores ranging from 5 to 10. On the other hand, two students exhibited very low mastery, with scores between 2 and 4. The group had a mean score of 8. 76 and a standard deviation of 4.49. Under the mixed-mode assessment, twenty-one students demonstrated low mastery, with the scores ranging from 5 to 10, while one student showed absolutely no mastery, with a score between 0 and 1. Overall, the mixed-mode group obtained a mean of 9.24 and a standard deviation of 4.4.7.

The results of this study are consistent with the conclusions drawn by Darling-Hammond, et al. (2020), who concluded that when students are assessed using primarily traditional methods, they generally show limited understanding of concepts before receiving instructional interventions, supporting the need to use more diverse, and meaningful methods for assessing students. Darling-Hammond et al. (2020), also pointed out that the results of baseline assessments in their studies consistently revealed the presence of gaps in deeper learning in areas such as mathematics, requiring targeted instructional strategies to remedy.

Under the traditional group, the responses of the three students interviewed further support this finding. They shared that they found the test difficult because they were not yet familiar with the topics and had limited prior knowledge. One student mentioned difficulty understanding the questions, while another expressed uncertainty in answering due to lack of confidence. The third student indicated that the format of the test made it hard to explain. These findings are consistent with existing literature on how students usually have gaps in their background knowledge in relation to new mathematical concepts, especially those requiring analytical thinking and problem-solving skills (e.g., Haara et al., 2020).

The majority of students may have achieved low mastery and absolutely no mastery on the mixed-mode assessment during the pre-test because they had not yet been properly exposed to the course content. Because this was done before formal instruction, students' prior knowledge may have been limited, resulting in overall poor performance and no mastery.

The comments of the three students interviewed help to explain this finding. They said that they struggled since they did not yet understand the topic. One student noted guessing certain answers, and another stated that they were confused how to approach certain tasks. The third student stated that they lacked prior information to perform successfully.

Darling-Hammond et al. (2020) further supported the assumptions of the present study regarding the nature of low scores on the pretests. Darling-Hammond et al. (2020) assumed that low scores on the pretests were common, rather than being caused by individual student deficiencies or lack of effort. The present study, therefore, positioned the mixed-mode assessment as a strategic intervention designed to assist in improving student achievement.

3.2 What is the students' performance during the post-assessment in Mathematics 9 under traditional mode of assessment?

Table 8: *Pos-test Performance during the Post-Assessment in Mathematics 9 under the Traditional Assessment Group*

Score Interval	Frequency	Mastery Level	Mn and SD
20 – 25	12	Moving Toward Mastery	Mn: 17.49 SD: 3.69
11 – 19	25	Average Mastery	

From the table, it can be gleaned that twenty-five of the Grade 9 students under the traditional assessments got an average mastery with a score interval of 11 to 19. On the other hand, twelve students got a moving toward mastery level with a score between 20 to 25, In totality, the Grade 9 students under traditional assessment got a mean of 17.49 with a standard deviation of 3.69.

The result is supported by the studies conducted by Skedsmo & Huber (2024) stating that traditional assessment practices limit student's ability to obtain Deeper Learning due to inadequate Formative Feedback and minimal Application Opportunities.

3.3 What is the students' performance during the post-assessment in Mathematics 9 under the mixed-mode assessment?

The table below shows the result of the post-test, frequency, mastery level, mean and the standard deviation under the mixed-mode assessment group.

Table 9: *Post-test Performance of Grade 9 Students during the Post-Assessment in Mathematics 9 under Mixed-Mode Assessment Group*

Score Interval	Frequency	Mastery Level	Mn and SD
26 – 28	7	Closely Approximating Mastery	
20 – 25	19	Moving Toward Mastery	Mn: 21.18 SD: 3.51
11 – 19	12	Average Mastery	

According to table 9, nineteen of the Grade 9 students under the mixed-mode assessment achieved the moving toward mastery with a score interval of 20 to 25. While the seven students got a closely approximating mastery level with a score between 26 to 28. In totality, the Grade 9 students under the mixed-mode assessment got a mean of 21.18 with a standard deviation of 3.51.

Vlachopoulos & Makri (2024) point out that authentic assessments provide additional value in terms of providing deeper learning experiences for students. They state that when students are required to solve real world problems, they are developing skills to think at higher levels of mastery.

Although the number of students under the closely approximating mastery level was smaller than those in the moving toward mastery category, it provides evidence that students developed skills to perform at nearly the same level as those that achieved mastery because they became more engaged in the learning experience and/or received the opportunity to engage in more active learning. As stated by Zhan, Boud, & Du (2025), authentic assessments create environments where students are more likely to be successful in achieving their potential and are more likely to be able to utilize higher-order thinking.

3.4 Is there a significance difference between the students' performance in Mathematics 9under the traditional and mixed-mode assessment group?

To determine whether there is a significant difference in the performance of students under traditional and mixed-mode assessment, an independent sample t-test was conducted. The results are presented in Table 8.

Table 10: *Difference in Post-Test Performance Between Traditional and Mixed-Mode Assessment Groups*

Group	Mean	SD	t-value	P val	Decision	Interpretation
Traditional	17.49	3.69	4.32	±0.000	Reject H_0	There is significant difference
Mixed-Mode	21.18	3.51				

From table 10, it can be observed that the mean of the Grade 9 students under the mixed mode of assessment was higher than the students under the traditional assessment with a mean of 21.18 and 17.49 respectively. Also, the group was more consistent since the variability of the performance of the Grade 9 students under the Mixed-Mode Assessment was lower than the traditional with a SD of 3.51 and 3.69 respectively.

The computed t-value of 4.32 with a corresponding p value of ±0.000 which is less than 0.05, it shows there is a statistically significant difference between the two groups. Therefore, the null hypothesis ("there are no differences in the academic achievement of students receiving traditional assessments vs. students receiving mixed mode assessments") was rejected. Although a significant difference was observed ($p < .05$), the study did not compute effect size measures such as Cohen's d, which could provide a clearer understanding of the magnitude of the difference. Future studies are encouraged to include effect size analysis to better determine the practical significance of the findings.

Overall, these findings indicate that using a variety of assessment types (both authentic and non-authentic) leads to greater student learning and improvement over using only one type of assessment. This result corresponds with Quinlan, Sellei, and Fiorucci (2024) finding that authentic assessment provides students with improved ability to apply knowledge and increase their performance academically. As noted by Xiong et al., (2025), when assessment models include several formats, the reliability and stability of students' performance outcomes will be enhanced.

Since we found that there is a statistically significant difference between the two modes of assessment, we know that the mode of assessment utilized does significantly affect students' achievement in academics. Therefore, the study's findings indicate that the mixed-mode assessment strategy is more effective than the traditional assessment strategy in increasing students' success in mathematics. In conclusion, these findings show that developing diverse and learner-centered assessment strategies will enhance both performance and comprehension in Mathematics.

Enumerated Findings

Based on the data gathered and analysed, the following findings were obtained:

1. The mean pre-test performance of the Grade 9 students under the Traditional Assessment Group was 8.76 (SD = 4.49), while the Mixed-Mode Assessment Group obtained a mean of 9.24 (SD = 4.47). Both groups were generally at the Low Mastery level, with some students falling under Very Low Mastery and Absolutely No Mastery.
2. In the post-test, the Traditional Assessment Group obtained a mean score of 17.49 (SD = 3.69), which corresponds to the Average Mastery level, with most students falling within the score interval of 11–19.
3. In the post-test, the Mixed-Mode Assessment Group obtained a mean score of 21.18 (SD = 3.51), which corresponds to the Moving Toward Mastery level, with some students reaching Closely Approximating Mastery.
4. There was a statistically significant difference between the post-test performance of the Traditional and Mixed-Mode Assessment Groups ($p < 0.05$), with the Mixed-Mode Assessment Group obtaining a higher mean score.

3.5 How does the mixed-mode assessment enhance the performance of students in Mathematics 9 and to what extent do the experiences and challenges they encountered contributed to the outcomes?

To assess how well the mixed-mode test worked, the researcher conducted a focus group session with five students who had been randomly selected for the mixed-mode group. During this FGD, participants responded verbally while those facilitating the session recorded and transcribed the sessions. Researchers then identified key words or phrases in these transcripts and assigned them into categories called "themes." Four primary themes emerged from the research: (1) Student Engagement & Motivation; (2) Student Understanding & Application; (3) Assessments' Fairness, Reliability, and Validity; and (4) Learner Gains. All of the themes found in the above qualitative analysis supported all quantitative analysis that is shown in the prior tables.

Student Engagement & Motivation

Participants stated that the variety of types of questions and formats in which they were asked to respond to on the mixed-mode test created an environment of greater student engagement and motivation for learning mathematics. Participants stated that the inclusion of performance-based items and problem-solving type questions made classes more engaging and interactive than traditional forms of testing. Increased participation by students resulted in sustained interest in class activities and participation in other learning experiences. Thus, based on participant statements, it appears that increased engagement resulted in enhanced student achievement. As evidenced by the results in Table 8, students in the mixed-mode format scored significantly higher ($p < .05$) than did students in the control format.

Student Understanding & Application

The second area of concern to emerge from the data included both improved conceptual understanding and application of mathematical concepts to everyday life. Students stated that mixed-mode testing forced them to think critically about mathematical concepts rather than just recalling them. These results are similar to those found in Table 7. In this table, we see that a significantly larger number of students assessed at either Moving Toward Mastery or Closely Approximating Mastery than did students in the control group. Therefore, it would appear that when students have opportunities to practice applying their knowledge, there will be both greater learning and improved performance.

Assessments' Fairness, Reliability & Validity

Students believed that the mixed-mode test was fair, consistent, and related to what they had learned during the lessons. Furthermore, they felt that the directions for each item were clearly defined and reflected what they had learned. Additionally, students thought that being able to complete the same assessment in multiple formats provided a more accurate representation of their knowledge and lessened possible biases that could occur if only one format was available. These perceptions support the results in Table 8. The mixed-mode format produced lower variability (i.e., smaller SD) than did the control format. Lower variability indicates a more consistent assessment result and therefore provides evidence for reliability in assessing different populations of students.

Learner Gains

Finally, students reported gains in both their performance and confidence in their ability to learn mathematics. Students acknowledged that their ability to successfully solve problems and understand mathematical concepts grew over time. They attributed this growth to receiving feedback on their work and having opportunities to revise incorrect answers. These beliefs regarding learner gains are supported by the quantitative results in Tables 7 & 8. Specifically, both the average scores (Table 8) and shifts toward higher mastery levels (Table 7) show that the mixed-mode format supported both improved academic performance and long-term learning.

3.6 Convergence of the Quantitative and Qualitative Analysis

This process analysed how well the statistical data concerning the performance of students matches the themes that were produced through the interviews. In particular, the comparison will connect students' competence levels with their opinions on engagement, comprehension, equity, and learning.

Table 11: *Convergence of Post-test and the results of the Interview of Grade 9 Students Under Traditional and Mixed-Mode Assessment*

Group	Score Interval	Frequency	Mastery Level	Themes
Traditional Mn: 17.49 SD: 3.69	20 – 25	12	Moving Toward Mastery	1. Engagement and Motivation 2. Understanding and Application 3. Assessment Fairness, Reliability, and Validity 4. Perceived Learning Gains
	11 – 19	25	Average Mastery	
Mixed-Mode Mn: 21.18 SD: 3.51	26 – 28	7	Closely Approximating Mastery	
	20 – 25	19	Moving Toward Mastery	

From the table above, there are twenty-five students who were assessed using the Traditional method of assessment who attained mastery level with a range of 11 – 19 scores, whereas there are twelve other students who attained the level of moving towards mastery level with a range of 20-25 scores. Overall, the students have a mean score of 17.49 with a standard deviation of 3.69.

The seeming inconsistency between the low levels of mastery seen during the pre-test and the better results seen during the post-test seems to imply that the learners had no prior knowledge of the basics of trigonometry. But the fact that there is improvement in the mixed mode group after the implementation of the intervention means that the intervention could have helped improve the learning process gradually.

As stated by Arumugham et al. (2025), the traditional assessment emphasizes memorization and standardized assessment, which might limit the conceptual understanding of students and lead to clustering of students within the moderate range of performance spectrum. There might be a few reasons for the better achievement of some students compared to others. Some reasons can include disparities in existing knowledge, preparation, and provision of extra enrichment opportunities. According to Van Geel et al. (2023), if the teachers do not employ varied instructional strategies or offer constant informal feedback about the performance of students, the underperforming students would stop achieving any academic success in intermediate levels and would never attain mastery.

Moreover, according to Wiggins (2019), due to the high degree of dependence of traditional tests on selected response forms of questioning, students' possibilities to show their comprehension and application of the learned mathematical concepts are significantly limited. Hence, it could be concluded that traditional evaluation practices by themselves are not enough to foster higher levels of mastery among students.

Despite these flaws and limitations, it is important to emphasize that traditional assessments still provide a structured measure of students' procedural knowledge and foundational skills, which are essential components of Mathematics learning.

Conversely, the performance of the Grade 9 students through the Mixed-Mode assessment points out a remarkable transition towards mastering the subject, with seven learners scoring Closely Approximating Mastery (26-28) and nineteen learners having scored Moving Toward Mastery (20-25). Such high performance has been seen in the mean score of the group which stands at 21.18, showing the fact that students gain more when different types of tests are carried out to help them display their learning experience. Furthermore, the respondents noted that diversity in assessment formats motivated them to learn better as they could use multiple problem-solving strategies instead of only taking written examinations. The

respondents explained that using different techniques to solve problems made learning more appealing, and doing step-by-step activities along with working together with classmates boosted their self-confidence.

Moreover, students felt that they understood and applied mathematical concepts more effectively, observing that using mathematical lessons such as trigonometry in real-world applications improved their understanding of these concepts. Students also perceived that doing hands-on activities and problem-solving was a quicker way of learning than just memorizing formulas. Regarding assessment, the participants found it important to note that there was clarity in the instructions given and the balanced evaluation involved as it tested not only their knowledge but also their ability to solve problems. This made them feel that the test was fair, hence making them want to participate more. According to Miller & Manderfeld (2021), diverse assessments improve understanding by applying knowledge.

Furthermore, students in the Mixed-Mode group showed higher consistency in their performance as indicated by a lower standard deviation (3.51) than that of the traditional method. This implies that through using the mixed-mode strategy, it was easier to minimize the variability that might be caused by differences in learning methods and levels among learners. This observation is supported by Goyibova et al. (2025) in that diversification enhances reliability. Additionally, students observed noticeable improvement over time, expressing that seeing their progress encouraged them to keep trying and reduced their fear of making mistakes, thereby creating a positive feedback loop that reinforced learning.

The convergence of the findings from both quantitative and qualitative approaches proves congruity between the actual outcomes of performance and personal experience of students. While in the quantitative findings the mean scores were higher, and variance lower in the mixed mode group, it is clear from the qualitative findings why that happened – due to higher involvement of students, better comprehension of concepts, and more justified assessment. Such combination implies that the observed positive change in performance may be affected not only by the assessment approach, but also by motivational factors.

Nevertheless, in spite of the fact that these changes were related to good academic achievements, the existence of students in the “Moving Towards Mastery” category is an example that confirms the claim of Levy-Feldman (2025) that individual characteristics and readiness play an important role in achieving complete mastery. Therefore, high mean scores, low variance, and similar qualitative evaluation of engagement, understanding, assessment fairness, and academic achievements point to the fact that mixed mode assessment may become a beneficial tool in improving students’ performance in Mathematics 9. However, these findings should be interpreted with caution, as the results indicate association rather than definitive causation.

Discussion

Despite the fact that the findings from the research suggest statistically significant differences between the traditional and mixed-mode test groups, it is important to interpret the results with caution. Statistically significant differences do not always mean practical or educational significance. The mixed-mode test group received a higher mean score; however, the level of improvement also needs to be taken into account within the context of class time limitations and different student preparedness levels.

Moreover, there could be other reasons behind the difference in results. For example, the higher engagement in the experiment group may not be explained by the assessment type alone but also by the novelty effect and/or increased motivation of students from using new teaching techniques. Likewise, the smaller variance in the mixed-mode group could also be associated with the structure provided to the students.

Furthermore, although the assumptions of normality and homogeneity of variance used in the statistical tests have been taken into consideration, they might still limit the study due to the small size and non-random nature of the samples. Hence, even if there is evidence that mixed-mode assessment is linked to better performance, any claims about causality need to be made with caution.

3.7 What recommendations can be made to improve the effectiveness of the mixed-mode of assessment in enhancing students’ performance and skills in Mathematics 9?

Based on the findings of the study, the following recommendations may be made:

1. Teachers are advised to adopt mixed-mode assessment techniques since the results show higher mean scores and better engagement of students when subjected to multiple assessment techniques.

2. The school can develop professional development programs that focus on authentic assessment and mixed modes of assessment since the study reveals an increase in the performance of students due to the use of these techniques.
3. The assessment models can be designed in a way that traditional and performance tasks are used in order to assess procedural and conceptual knowledge respectively.
4. Students should be encouraged to participate in the various forms of assessment in order to improve their performance.
5. As some of the students had lower mastery levels in the study, the adoption of mixed-mode assessment would require scaffolding, remediation, and differentiation.
6. Future research work would need larger sample sizes, longer intervention periods, and effect size in order to strengthen the findings of the present study.
7. A mixed-mode assessment model could be developed and piloted.

4. Findings

This study investigated the effectiveness of mixed-mode assessment in enhancing the performance of Grade 9 students in Mathematics. Based on the findings from the study, the following were established:

1. The two groups had similar performance during the pre-test with mean scores being within the Low Mastery category, implying low level of prior knowledge regarding the concepts of trigonometry.
2. Performance in the Traditional Assessment Group moved to the Average Mastery category in the post-test indicating some improvement in the performance of the students.
3. The Mixed Mode Assessment Group performed better than the other group during the post-test having attained Moving Toward Mastery category, with several students attaining Closely Approximating Mastery.
4. There was a significant difference between the post-test performances of the two groups.

5. Conclusions

The main objective of this research was to assess the effect of both traditional and blended mode assessment tools on the academic performance of ninth graders in Math. The second objective of this study was to determine the perspective of the ninth graders towards the application of a blended mode assessment tool. The findings of the study have been obtained using the data that has been analysed. This excerpt outlines the conclusion obtained from the study regarding each objective.

1. Both groups were comparable in terms of their pre-test scores, which means that the students had about the same level of previous knowledge before the intervention.
2. Moderate gains were observed with the application of Traditional Assessment, but the gains were not enough to push most students above the average mastery level.
3. Higher gains were observed when Mixed-Mode Assessment was used.
4. Since there is a significant difference between the two groups, it means that Mixed-Mode Assessment is more effective than Traditional Assessment in terms of increasing and enhancing students' performance in Mathematics 9, hence the rejection of the null hypothesis.

Despite the above results, there are certain limitations with this study, and these include:

1. The study involved only two classes (80 students) from one secondary school, which is a public institution.
2. The duration of the intervention used in the study was only four weeks.
3. The study has only considered Trigonometric Ratios, and this cannot be representative of all Mathematics topics.
4. Purposive sampling has been used, and this can lead to selection bias.
5. There could have been other external influences that were not controlled during the research.

6. Recommendations

`The recommendations for improvement of math learning and assessment practices (and future educational research) are drawn from the results and conclusions derived from this study.

1. The math teachers are advised to adopt the mixed-mode assessments in order to increase the academic performance and mastery of concepts.
2. The teachers could use both the conventional and authentic assessments in order to have an overall evaluation of the learning process.
3. The schools could offer training and workshops for the teachers on how to design and implement the mixed-mode assessments.
4. The intervention programs could be developed for those students who will continue performing poorly in order to help them get to a higher level of mastery.
5. The curriculum developers may think of implementing the mixed-mode assessments in their framework to promote the achievement.
6. Future researchers are encouraged to conduct similar studies using larger sample sizes, longer intervention periods, and different mathematical topics to validate and extend the findings of this study.
7. Future studies may also address the limitations of this research by incorporating random sampling techniques, longitudinal designs, and additional variables such as student motivation and learning styles to obtain more comprehensive results.

Acknowledgements

I express my profound gratitude to my adviser, Dr. Alvin S. Serrano, for his invaluable mentorship, patience, and unwavering support throughout this research. His dedication and expertise served as a constant source of inspiration. I am equally indebted to Dr. Courtney Love Jacinto for her steadfast guidance and for graciously addressing my numerous queries until the successful completion of this process.

I also recognize my own resilience, determination, and hard work in overcoming the challenges encountered along the way. Above all, I offer my highest praise and deepest gratitude to God Almighty. His grace, wisdom, and boundless blessings sustained me through every stage of this journey, making this significant milestone possible. To Him be all the glory and honour.

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