Journal of Contemporary Educational Research, 2024, Volume 8, Issue 1
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Enhancing Proficiency in Quadratic Equations and Functions Through the MILAPlus Strategy

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Abstract: This study investigates the efficacy of the Mathematics Independent Learning Activity Practice and Play Unite Scheme (MILAPlus) as an instructional strategy to improve the proficiency levels of Grade 9 students in quadratic equations and functions through a study carried out at Quezon National High School. The research involved 116 Grade 9 students and utilized a quantitative approach, incorporating both pre-assessment and post-assessment measures. The research utilizes a quasi-experimental design, examining the academic performance of students before and after the introduction of MILAPlus. The pre-assessment establishes a baseline, and the subsequent post-assessment measures the impact of the instructional strategy. Statistical analyses, including *t*-tests, assess the significance of differences in mean scores and mean percentage scores, providing quantitative insights into the effectiveness of MILAPlus. Findings from the study revealed a statistically significant improvement in both mean scores and mean percentage scores after the utilization of MILAPlus, indicating enhanced proficiency in quadratic equations and functions. The Mean Proficiency Scores (MPS) also showed a substantial increase, demonstrating a marked improvement in overall proficiency levels among Grade 9 students. In light of the results, recommendations were given including the continued utilization of MILAPlus as an instructional strategy and aligning its development with prescribed learning competencies. Emphasizing the consistent adherence to policies and guidelines for MILAPlus implementation is suggested for sustaining positive effects on students' long-term performance in mathematics. This research contributes valuable insights into the practical application and effectiveness of MILAPlus within the context of Grade 9 mathematics education at Quezon National High School.

Keywords: Mathematics Independent Learning Activity Practice and Play Unite Scheme; Proficiency; Quadratic equations and functions

Online publication: January 20, 2024

1. Introduction

In the realm of mathematics education, proficiency in quadratic equations and functions is an essential competency that holds paramount importance. Quadratic equations and functions represent fundamental concepts in algebra with widespread applications across various disciplines, from physics to economics. As such, a solid understanding of quadratic functions is not merely an academic endeavor but a critical skill that empowers individuals to make informed decisions and solve real-world problems [1,2].

Nevertheless, there are often difficulties in the instruction and comprehension of quadratic equations and functions, with students frequently experiencing confusion and frustration in mastering this intricate mathematical subject, as evidenced by the results of the Programme for International Student Assessment (PISA) 2023. In the assessment administered to Grade 9 students, the Philippines ranked among the second lowest levels among participating countries. This research, titled "Enhancing Quadratic Equations and Functions Proficiency Through the MILAPlus Strategy," seeks to tackle these challenges by introducing and assessing a unique pedagogical approach called the Mathematics Independent Learning Activity Practice and Play Unite Scheme (MILAPlus) strategy. This method blends independent learning activities with playful elements, utilizing technology to enhance clarity and proficiency in quadratic functions among students.

Historically, traditional approaches to teaching quadratic functions have heavily relied on procedural instruction and abstract representations [2]. These approaches often leave students struggling to bridge the gap between the algebraic formalism of quadratic functions and their practical applications and relevance in the real world [3]. This disconnect between theory and application has contributed to students' frustration and lack of interest in the subject, creating a hindrance to effective learning [4]. In response to these challenges, this study takes inspiration from contemporary educational theories and research-based strategies [5].

The MILAPlus strategy integrates principles from constructivist learning (Piaget, 1950), cognitive load theory (Sweller, 1988), and the incorporation of technology (Kaput, 1992), offering a comprehensive and captivating approach to teaching quadratic equations and functions.

Constructivist learning theories propose that students actively build knowledge through experiences and interactions with their learning environment (Vygotsky, 1978). These theories emphasize the significance of involving students in meaningful problem-solving tasks and real-world applications to enhance their comprehension of mathematical concepts. In line with this philosophy, this study adopts a similar approach by integrating independent learning activities that prompt students to investigate quadratic functions through hands-on experiences and open-ended inquiries. These activities foster active engagement and critical thinking, which are integral aspects of mathematical proficiency [6].

Cognitive load theory, formulated by Sweller (1988), offers guidance on designing instructional methods that accommodate the constraints of working memory. Educators can assist students in handling the intricacies of quadratic functions by minimizing cognitive load through well-structured and scaffolded instruction (Paas *et al.*, 2003). The MILAPlus strategy incorporates these principles by thoughtfully organizing learning activities and allowing students to progressively develop their comprehension of quadratic functions. The objective is to prevent cognitive overload and improve the retention and application of knowledge.

Incorporating technology into the MILAPlus strategy is in harmony with the changing dynamics of education. Technology has revolutionized how students engage with and comprehend mathematical concepts [5]. Our research utilizes educational software, simulations, and interactive tools to present visual and dynamic depictions of quadratic functions in discussions. These digital resources render abstract concepts more concrete and provide instant feedback, allowing students to explore and experiment with quadratic functions (Ruthven and Hennessy, 2002).

The MILAPlus strategy emphasizes independent learning activities, providing students with the authority to guide their learning process. This methodology is in line with the principles of self-regulated learning (Zimmerman, 2002). Students are prompted to establish goals, track their progress, and contemplate their learning encounters. This metacognitive dimension of the strategy cultivates increased autonomy and self-efficacy in mathematical learning [7]. Additionally, the strategy includes a built-in mechanism that encourages students to actively write, read, and comprehend lessons to the best of their ability, promoting dynamic learning.

Moreover, the incorporation of playful elements in the MILAPlus strategy is influenced by the concept of gamification (Deterding *et al.*, 2011). Techniques from gamification, including rewards, challenges, and interactive simulations, are fused to craft an immersive and stimulating learning atmosphere [8]. This method seeks to amplify students' inherent motivation and enjoyment of mathematics, recognizing factors influencing proficiency [9].

With the myriad of instructional strategies in teaching Mathematics, many of which were unable to support students to succeed on more challenging assessments that demand substantial and higher mathematical skills. The mathematics teacher's pedagogical knowledge, management skills, and classroom instructions must be reviewed and re-aligned to research-based teaching methods.

The MILAPlus instructional strategy was conceived by the researcher, drawing inspiration from the Dynamic Learning Program (DLP) developed by the Bernido couple of CVIF, Jagna Bohol. According to Bernidos, a teacher must teach students to "learn how to learn" independently. Through this personal statement from the Ramon Magsaysay awardees in Education year 2010, the researcher inserted the strongest feature of the Dynamic Learning Program which is the use of dynamic learning activity sheets, and convinced that "It takes a giant leap of faith for a teacher to believe that students can learn the material on their own." United with this ideology and believing that MILAPlus instructional strategy will contribute to the success of the students, the researcher has employed this teaching practice for almost three years at Quezon National High School and even investigated its effectiveness in action research titled "The Use of Mathematics Independent Learning Activity (MILA) in the Improvement of Selected Grade 8 Students' Performance in Mathematics" presented in the Division of Quezon Research Plenum 4.0 in 2015 spearheaded by Schools Division of Quezon in partnership with Teacher Researcher Association of Quezon (TRAQ), a renowned research organization in Quezon Province [10].

Given the circumstances, the development of the MILAPlus instructional strategy was initiated. With the provided context, the researcher aimed to examine the impact of these instructional approaches on teaching quality within the area, potentially contributing to its enhancement. This research aimed to explore the impact of the MILAPlus strategy on improving students' proficiency in quadratic functions. By integrating constructivist principles, cognitive load theory, technology, independent learning activities, and playful elements, the MILAPlus strategy presented a comprehensive and innovative approach to tackling persistent challenges in the teaching and learning of quadratic functions [10].

2. Literature review

2.1. Independent learning

In advocating for the DLP, Bernido (2018) underscores that independent learning strategies should not be misconstrued as providing students unrestricted freedom. According to Bernido, a regulated and guided approach is essential, where students aim to comprehend the material independently while adhering to structured activities provided by the teacher. He argues that this process-induced learning in mathematics instruction surpasses the conventional teacher-induced approach, offering a more effective and superior method for classroom education.

The Bernido couple further emphasizes that the underlying principle for independent learning to be effective is the "Learning by Doing" principle. Students work on activity sheets without prior lectures to develop critical thinking skills, and the protocol of copying everything enhances retention.

The foundational principle of "Learning by Doing," rooted in experiential learning theory, is a cornerstone in education, emphasizing the significance of active involvement and hands-on participation. According to this

principle, individuals learn more effectively when engaged in real-world tasks and problem-solving, as opposed to passively receiving information through traditional didactic methods. Recently, there has been a renewed interest in this pedagogical approach, with educators and researchers recognizing its potential to enhance learning outcomes and foster a deeper understanding.

The "Learning by Doing" principle aligns closely with constructivist learning theories advocated by Vygotsky (1978) and Piaget (1950). Constructivism posits that learners actively construct knowledge through interactions with their environment and meaningful activities. In educational settings, applying this principle encourages educators to design learning experiences that promote active engagement, critical thinking, and reflection, emphasizing not only the acquisition of knowledge but also its practical application.

This method seeks to enhance students' comprehension and memory of the material through hands-on learning opportunities. In summary, the "Learning by Doing" principle forms a foundational framework for educational practices emphasizing active engagement, experiential learning, and the practical application of knowledge. Its conformity to constructivist theories and versatility in different learning settings render it a valuable pedagogical approach, assisting educators in enhancing student learning outcomes and cultivating a deep comprehension of the subject matter. As education advances, the efficacy of the "Learning by Doing" principle endures as a powerful means to craft meaningful learning experiences.

The "Learning by Doing" principle shares several key similarities with the MILAPlus strategy proposed in this study. Both approaches prioritize active engagement, experiential learning, and practical application of knowledge as essential components of effective learning.

Both the "Learning by Doing" principle and the MILAPlus strategy underscore the significance of active participation in learning. The study integrates the MILAPlus approach, involving independent learning activities that encourage students to actively engage with quadratic functions through practical experiences. Likewise, "Learning by Doing" stresses that individuals learn more effectively when actively immersed in real-world tasks and problem-solving, aligning with the hands-on methodology of the MILAPlus strategy.

Secondly, both methods emphasize applying knowledge in practical and real-world contexts. The MILAPlus strategy employs technology and interactive tools to provide dynamic, real-world illustrations of quadratic functions, allowing students to experiment and apply their knowledge. Likewise, the "Learning by Doing" principle contends that effective learning takes place within meaningful and practical situations, reinforcing the importance of applying knowledge in authentic scenarios.

Moreover, both the MILAPlus strategy and the "Learning by Doing" principle share the objective of cultivating a profound understanding of the subject matter. The research seeks to improve the proficiency of Grade 9 students in quadratic functions, prioritizing not just knowledge acquisition but also comprehension and application. Similarly, "Learning by Doing" emphasizes that experiential learning leads to a more profound understanding and retention of information, which aligns with the desired learning outcomes of the MILAPlus strategy.

However, it is worth noting that while there are significant similarities between the two approaches, the MILAPlus strategy is specifically tailored to quadratic functions instruction and integrates elements such as gamification and independent learning activities. In contrast, "Learning by Doing" is a broader educational principle that can be applied across various subjects and contexts. Nonetheless, both approaches champion active, experiential learning as a means to enhance learning outcomes and deepen understanding, making them complementary in the pursuit of effective mathematics education.

The "Learning by Doing" principle and the MILAPlus strategy share common principles related to active engagement, practical application, and a deeper understanding of the learning process. These similarities

highlight the alignment of the MILAPlus strategy with well-established pedagogical principles, reinforcing its potential effectiveness in enhancing quadratic function proficiency among Grade 9 students.

2.2. Quadratic equation and function proficiency

Quadratic equations and functions, a foundational aspect of algebra, carry significant weight in mathematics education due to their broad applications in science, engineering, economics, and everyday situations. Proficiency in comprehending and working with quadratic equations and functions is not only essential for academic achievement but also for cultivating problem-solving skills and mathematical literacy [11]. In this discourse, people delve into the importance of proficiency in quadratic functions, the challenges associated with it, and the strategies aimed at its enhancement.

A robust understanding of quadratic equations and functions is imperative because these functions represent numerous real-world phenomena. Whether modeling the trajectory of a projectile, understanding the shape of a parabolic reflector, or analyzing financial aspects of business such as cost and revenue, quadratic functions are ubiquitous [2]. Consequently, students excelling in quadratic functions are better equipped to analyze and resolve problems across diverse domains.

Moreover, proficiency in quadratic equations and functions nurtures mathematical fluency and critical thinking. It requires students to grasp intricate concepts such as vertex form, discriminants, and the characteristics of roots. Proficient students can manipulate quadratic equations and graph parabolas, and apply them to solve a range of mathematical and practical problems. This proficiency extends beyond algebra; it lays the foundation for advanced mathematics and calculus, where quadratic functions play a fundamental role [1].

To overcome these challenges and enhance mastery of quadratic functions, educators have explored various methods. An especially effective strategy involves integrating technology and interactive tools. Educational software and graphing calculators empower students to visualize and manipulate quadratic functions, transforming abstract ideas into more tangible forms (Kaput, 1992). Furthermore, technology offers prompt feedback, enabling students to delve into and experiment with quadratic functions (Ruthven and Hennessy, 2002).

In summary, achieving proficiency in quadratic functions is crucial for mathematical literacy and effective problem-solving. Despite the common difficulties faced by students in mastering this subject, educators can enhance understanding by incorporating technology, interactive tools, and active learning strategies, thereby equipping students with vital mathematical skills applicable in both academic and real-world contexts.

Teaching quadratic functions in mathematics education has long been acknowledged as a challenging task, with students often grappling to grasp the abstract concepts and problem-solving techniques associated with the topic [6]. To address this difficulty and improve clarity for students, researchers have explored various themes within mathematics education. This literature review focuses on three key themes: pedagogical approaches, technology integration, and curriculum development, each providing valuable insights to establish a research-based approach to teaching quadratic functions.

2.3. Pedagogical approaches

A central focus in the literature revolves around the exploration of innovative pedagogical approaches for teaching quadratic equations and functions. Studies in this field have underscored the effectiveness of inquiry-based learning, problem-based learning, and cooperative learning approaches [1]. For instance, inquiry-based learning encourages students to delve into quadratic concepts through hands-on investigations and open-ended questions, fostering active engagement and critical thinking [9]. Problem-based learning centers on real-

world problems involving quadratic functions, providing students with meaningful contexts for learning and problem-solving [4]. Cooperative learning strategies encourage collaboration among students, enabling them to collectively discuss and solve quadratic problems, thereby enhancing their understanding of the subject [12].

Cognitive load theory, applied to pedagogy, recommends aligning instructional methods with the limitations of working memory. This involves reducing cognitive load through well-structured and scaffolded instruction to manage the complexity of quadratic functions [9].

The integration of technology in mathematics education emerges as a transformative theme. Computer-based simulations and dynamic graphing software, including virtual manipulatives and graphing calculators, provide visual and interactive representations, rendering abstract concepts of quadratic functions more tangible [5,8]. These tools not only enhance engagement but also offer immediate feedback for self-assessment and correction [9].

The increasing popularity of online learning platforms and educational apps in teaching quadratic functions introduces personalized learning, adaptive assessments, and data-driven insights [5,8,10]. Effectively integrating technology enables educators to establish a dynamic learning environment catering to various learning styles and fostering a profound understanding of quadratic functions.

Additionally, it is crucial to develop formative and summative assessments tailored to quadratic functions to gauge student progress and identify areas of confusion [13]. The literature emphasizes the importance of assessments that go beyond rote memorization, focusing on promoting conceptual understanding and problem-solving skills. Curriculum development research guides the creation of these assessments, ensuring alignment with the research-based teaching strategies and pedagogical approaches discussed earlier [4,13].

In short, resolving confusion in teaching quadratic equations demands a multidimensional approach, encompassing innovative pedagogy, technology integration, and evidence-based curriculum development. Synthesizing these elements enables educators to create comprehensive methods for enhancing students' understanding of quadratic functions.

3. Research methodology

3.1. Research objectives

The objectives of this study were to assess how the MILAPlus instructional strategy impacts the proficiency of ninth-grade students in quadratic equations and functions. Specifically, the study aimed to:

(1) Assess the proficiency levels of Grade 9 students in quadratic equations and functions before the implementation of the MILAPlus strategy.
(2) Determine if there is a significant difference in the proficiency of Grade 9 students in quadratic equations and functions before and after the utilization of the MILAPlus strategy.
(3) Identify potential enhancements to refine the MILAPlus instructional strategy based on the study results for further effectiveness.

3.2. Hypothesis

H_o: There is no notable distinction observed in the proficiency levels of Grade 9 students before and after applying the MILAPlus strategy, as indicated by the pre-test and post-test results.

3.3. Research methods

The researcher evaluated the significant influence of the MILAPlus strategy on the proficiency of ninth-grade students in the Math 9 Quadratic Equation and Function lesson. Employing a quasi-experimental research design, the study aimed to assess the effectiveness of teaching strategies grounded in research. This section

explores the applied research methods and their implications within the context of the study.

3.4. Research design

This study employed a quasi-experimental design for practical reasons. Firstly, this design allowed for the assessment of the impact of research-based teaching strategies in a real educational setting without resorting to random assignment. Randomly assigning students to different teaching methods poses challenges and may not always be feasible due to ethical and logistical concerns [14,15].

Instead, the researcher compared existing classes that implemented the strategies, facilitating a more naturalistic examination of the effects of the intervention. To assess the impact of the research-based teaching strategies, particularly the MILAPlus instructional strategy, pre- and post-testing measures were utilized. Before the intervention, baseline assessments were administered to both the intervention and comparison groups to establish a starting point for comparison. Subsequently, after implementing the teaching strategies, a post-test was conducted to measure the outcomes and changes in students' understanding of quadratic functions [2,13].

The quasi-experimental research design allowed an investigation into the effectiveness of research-based teaching strategies within a practical educational context. Although it comes with inherent limitations such as potential selection bias, careful matching, data collection, and statistical analysis were employed to mitigate these issues and provide valuable insights for enhancing the teaching of quadratic functions [16].

3.5. Respondents and sampling

The research encompassed the entire supervisory population of the researcher, comprising 123 Grade 9 students. From the total student body across four sections for the academic year 2023–2024, the inclusion criteria consisted of students who underwent the pre-test; students who finished the post-test; students exposed to the MILAPlus instructional strategy during the quadratic equations and functions discussion; and students actively participating in the assigned MILA throughout the entire lesson.

The survey participants were identified using the non-probability purposive sampling technique. Out of the initial 123 students (n = 123), only 116 students (n = 116) met and qualified for the inclusion criteria.

The sample size adhered to the recommended number for the study, and the respondents were students from four heterogeneous sections, namely Special Program for Foreign Language - Korean Lily and Tulip, Special Program for Journalism - Gryffindor, and one BEP Grade 9 Canna Lily. The researcher had confidence that the results of the study would be advantageous for learners in enhancing the quality of mathematics instruction.

3.6. Research instrument

The researcher utilized a validated instrument developed by ten mathematics teachers, all teaching the same curriculum and subjects. This instrument consisted of 30 test questions, a collaborative effort among mathematics teachers, subsequently reviewed and validated by two master teachers and the department head. The 30-item test, aligned with the Most Essential Learning Competencies (MELCs) for Mathematics 9 in Quarter 1, served as the primary data source to assess proficiency levels before and after implementing MILAPLus. The test underwent test-retest validity and reliability checks, yielding a Cronbach alpha value of 0.884 based on a pilot test conducted with 85 students from STE and BEP, who were not the actual study respondents. Additionally, eight researcher-made and validated MILA sheets were integrated into the instructional strategy for the quarter as an essential component.

3.7. Data collection

The researcher secured consent from the School Principal, Mathematics Department Heads, and participating students at Quezon National High School. Following the administration of the pre-test, the final list of respondents was established for coordination with authorities. The data collection process involved meticulous administration and retrieval of instruments, with confidentiality maintained through a coding platform. Subsequent data analysis allowed ample time for exploration and discussion.

Furthermore, the researcher utilized the school's Mean Percentage Score template, tabulated numerical data, and employed the ZipGrade application for accurate checking and data backup. A variety of instruments, including tests, assessments, observations, and qualitative insights from interviews and social media posts, contributed to comprehensive data collection. Statistical analysis, including *t*-tests and Cronbach's alpha, was employed to assess differences in pre- and post-test scores, enhancing internal validity.

The use of statistical analysis, specifically *t*-tests for dependent samples, aimed to evaluate differences in pre- and post-test scores between the intervention and comparison groups, enhancing internal validity by controlling for initial group differences. The test underwent reliability and validity testing, achieving a high Cronbach's alpha of 0.884 in a pilot test involving 85 students from STE and BEP, indicating strong internal consistency. Despite the quasi-experimental design providing valuable insights into the effectiveness of the teaching strategy, it is essential to acknowledge inherent limitations.

3.8. Data analysis

The statistical approach for interpreting data involved utilizing the Mean Percentage Score (MPS) to ascertain proficiency levels. The MPS, derived by averaging the percentage scores from the pre-test and post-test, was categorized into qualitative levels (Beginning, Developing, Approaching Proficiency, Proficient, and Advanced). These categories were aligned with the standards adopted by the researcher and followed DepEd Order No. 31, s. 2012.

To assess the significant difference in proficiency levels before and after implementing the MILAPlus strategy, the paired sample *t*-test was employed, considering the approximately normal distribution of data. The null hypothesis (H_o) suggested that there is no notable difference between the means of the correlated groups. To assess this hypothesis, the paired sample *t*-test formula was employed, providing valuable insights into the efficacy of MILAPlus in improving proficiency in quadratic equations and functions.

3.9. Ethical considerations

Ethical considerations were paramount throughout the study. The researcher ensured that all participants, including students, teachers, and schools, provided informed consent to participate. Similarly, measures were taken to address any potential harm or risks associated with the intervention and to conduct the study ethically and responsibly.

In the instruction of quadratic equations and functions, as with any mathematical concept, educators had to observe ethical principles to establish a fair and inclusive learning atmosphere. This involved promoting academic integrity by discouraging plagiarism and cheating, respecting diverse learning styles and backgrounds, and nurturing a supportive classroom culture that ensured equal opportunities for all students to excel. Moreover, the researcher prioritized data privacy and security when utilizing technology for teaching quadratic equations, ensuring the confidential handling of students' personal information and academic records in compliance with applicable laws and regulations.

By adhering to these ethical considerations, the researcher aimed to foster a supportive and morally upright learning environment conducive to both academic excellence and ethical conduct for students. The researcher

was wholly dedicated to upholding this research mandate and accepted exclusive responsibility for the study's outcomes and implications.

4. Results and discussion

The presentation, interpretation, and analysis of the said data were arranged under the questions posited as the objectives of the study. **Table 1** illustrates the proficiency levels of Grade 9 students both before and after the implementation of MILAPlus instructions. The evaluation uses the Mean Proficiency Score (MPS), with the standard deviation (SD) indicating the variability in scores.

Table 1. Proficiency levels of Grade 9 students before and after the utilization of the MILAPlus strategy

	MPS	SD	Proficiency level
Pre-test	28.06	2.44	Developing
Post-test	51.15	3.65	Approaching Proficiency

Before introducing MILAPlus, the table shows a mean proficiency score (MPS) of 28.06, with a standard deviation (SD) of 2.44, placing the proficiency level in the "Developing" category. This suggests that students were in the process of developing proficiency but had not yet reached a satisfactory level of mastery. Following the application of MILAPlus instructions, there was a noteworthy advancement in proficiency levels. The Mean Proficiency Score (MPS) rose substantially to 51.15, accompanied by an increase in the standard deviation to 3.65. The MPS of 51.15 now falls within the "Approaching Proficiency" range, signifying substantial progress by the students and their proximity to attaining a satisfactory level of proficiency in the subject. The findings in **Table 1** demonstrate a significant improvement in the proficiency levels of Grade 9 students after incorporating MILAPlus instructions.

The positive change observed in the MPS, transitioning from the "Developing" phase to "Approaching Proficiency," indicates that the introduction of MILAPlus instructions has had a constructive impact on the academic accomplishments of the students. This strategy seems to have played a significant role in enhancing their understanding and proficiency in the subject matter.

The standard deviation plays a crucial role in gauging the extent of spread or diversity in the scores. The increase in standard deviation after the adoption of MILAPlus instructions may signify increased variability in proficiency levels among students. This variance could stem from individual differences in how students respond to the new instructional approach, with some demonstrating more pronounced improvements than others.

To sum up, the outcomes in **Table 1** imply the efficacy of the MILAPlus strategy in enhancing Grade 9 students' proficiency levels, as evidenced by the significant MPS increase from the "Developing" stage to "Approaching Proficiency." The standard deviation provides additional insights into the range of student responses to the instructional strategy.

Similar to Merle's (2019) study, the enhanced proficiency of students following the implementation of a specific MILA instructional strategy, as depicted in the table, can be attributed to various factors. Interactive online modules create a dynamic and participatory learning experience, incorporating multimedia, simulations, and interactive activities to enhance engagement. The strategy allows tailoring instructions to individual learning styles and paces through online modules, offering personalized feedback and adaptive learning features.

Interactive elements facilitate active learning, prompting students to explore and apply concepts actively. This hands-on approach aids in solidifying understanding of quadratic equations and functions. Immediate feedback on students' responses is crucial, enabling prompt identification and correction of mistakes, reinforcing correct concepts, and minimizing misconceptions.

In addition, accessibility can accommodate diverse learning styles and preferences, making it easier for students to engage with the content. A positive and immersive learning atmosphere plays a role in fostering motivation and concentration when tackling intricate subjects such as quadratic equations and functions. This can be associated with a collaborative learning approach [12] which differs from the current study's emphasis on an independent learning strategy. The independent approach involves a structured mechanism of reading, writing, and comprehending the lesson before engaging in discussions, as outlined in Merle's study (2019).

Table 2 presents the results of a *t*-test conducted to identify a significant difference in the proficiency levels of Grade 9 students in quadratic equations and functions before and after the implementation of the MILAPlus instructional approach.

Table 2. *T*-test for assessing significant proficiency differences in Grade 9 students regarding quadratic equations and functions

Variables compared	Mean	df	Computed *t*-value	Decision	Impression at 0.05 level
Pre-test (before the utilization of MILAPlus)	8.48	115	18.657	Reject H_o	Significant
Post-test (after the utilization of MILAPlus)	15.41				

The table indicates that the calculated *t*-value, which is 18.657, led to the rejection of the null hypothesis (H_o) at a significance level of 0.05. This rejection indicates a substantial improvement in the proficiency levels of the selected Grade 9 students in the topics of quadratic equations and functions, attributed to the adoption of the MILAPlus.

Before the implementation of MILAPlus, the average score stood at 8.48, and following the adoption of MILAPlus in instructing quadratic equations and functions, there was a significant increase to 15.41. These subjects cover diverse elements, including techniques for solving quadratic equations like square root extraction, factoring, completing the square, and utilizing quadratic formulas. Furthermore, the quadratic function component entails addressing word problems that incorporate concepts related to quadratic functions.

Many, if not all, students find mathematics both fascinating and challenging. Researchers generally agree that there is no singular or definitive approach for teachers to maximize learning outcomes. As a teacher-researcher advocating this perspective, the study observed an improvement in student proficiency through the application of the adapted teaching strategy MILAPlus. This systematic approach, integrated into the educational process, serves as a straightforward and cost-effective intervention. Despite its simplicity, MILAPlus effectively enhances learning opportunities, nurturing the development of three critical meta-cognitive skills: writing, reading, and independently comprehending and solving complex problems [10].

5. Conclusion

The study underscored the efficacy of MILAPlus in enhancing proficiency in quadratic equations and functions. Through a thorough statistical analysis involving Mean Percentage Score and paired sample *t*-test, the impact of MILAPlus on student learning outcomes became evident.

The findings presented earlier in this study led to several key conclusions. Firstly, the MILAPlus

contributed to a substantial increase in mean scores and mean percentage scores associated with quadratic equations and functions. This was supported by pre-test and post-test results from a selected group of Grade 9 students before and after the implementation of MILAPlus.

Secondly, Grade 9 students demonstrated a significant improvement in their proficiency levels in mathematics, reflected in the notable difference in their MPS.

Lastly, MILAPlus emerged as an effective strategy for elevating the proficiency of Grade 9 students in understanding quadratic equations and functions. The conclusion section delves into the implications of these findings for future educational practices.

6. Recommendations

In light of the study's outcomes, the following suggestions are put forth:

(1) The teacher-researcher may employ MILAPlus as an instructional strategy when teaching intricate mathematical concepts in Grade 9.

(2) To optimize the effectiveness of MILAPlus, it is suggested that the design and implementation closely align with the prescribed learning competencies.

(3) To ensure a sustained, positive impact on their long-term performance in mathematics, learners are encouraged to consistently adhere to the established policies and guidelines governing the implementation of the MILAPlus strategy.

Disclosure statement

The author declares no conflict of interest.

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