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Addressing Mathematical Competency Gaps through the Numera-Z Program: Improving Numeracy Skills amid Disruptive Learning Interests

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ABSTRACT

Mathematics education faces global challenges that affect numeracy learning based on the results from the Program for International Student Assessment (PISA) and Trends in Mathematics and Science Study (TIMSS), that many learners struggle to master basic skills essential for both academic and everyday tasks, as stated in the study of (Smith, 2020). In seeking innovative solutions, this study assessed the mathematical competency gaps and disruptive interests of learners at Palo 19 National High School. Also, evaluated the effectiveness and acceptability of the developed NumEra-Z Program, a computer-based numeracy intervention designed to enhance accuracy and speed in mathematical tasks. Grounded in Experiential Learning Theory and Constructivist principles, the program utilized the ADDIE instructional design model to facilitate the development and evaluation of NumEra-Z, addressing the gaps in numeracy skills. There were sixty-eight (68) learners from Grades 7 to 10 who participated in the study during the second quarter of School Year 2024-2025. The research identified the least-learned competencies, mostly with fractions, basic operations, and geometric representation. Through diagnostic assessments and surveys, the disruptive interests of the learners were moderately affected by excessive peer socialization, followed by a lack of interest in abstract concepts, and then by technology misuse. Pretest and posttest results showed improvements in numeracy accuracy and speed, while a survey assessed the program's acceptability in terms of relevance, organization, engagement, and overall effectiveness. Findings revealed significant improvements in learners' numeracy accuracy and speed following participation in the NumEra-Z Program. Additionally, a positive relationship was observed between program acceptability and numeracy skills. The study highlights the potential of learning interventions like the NumEra-Z Program to address persistent gaps in numeracy proficiency while fostering learner engagement.

Keywords: Mathematical Competency Gaps, Disruptive Interests, Numeracy Skills, Intervention Program

INTRODUCTION

Mathematics education faces global challenges that affect numeracy learning based on the results from the Program for International Student Assessment (PISA) and Trends in Mathematics and Science Study (TIMSS), that many learners struggle to master basic skills essential for both academic and everyday tasks, as stated in the study of (Smith, 2020). It reveals the consistent challenges in numeracy skills across different countries, particularly in the areas of numeracy accuracy and speed.

According to the Organization for Economic Cooperation and Development (OECD, 2019), the 2018 PISA assessment highlighted that, on average, 22% of 15-year-olds in countries did not reach the baseline level of proficiency in mathematics, which includes both accuracy and speed in calculations. These findings resonated in the TIMSS 2019 results, which showed that many learners struggle with basic numeracy tasks, particularly under time constraints. The TIMSS data also suggests that there is a significant gap between students who can accurately solve routine problems and those who can do so quickly, indicating a disparity between accuracy and speed in numeracy skills (Mullis et al., 2020).

Numeracy skills are fundamental for academic success and daily life, yet many Filipino students face significant challenges in developing both accuracy and speed in mathematics. As stated by the Department of Education

(DepEd, 2023) emphasizes numeracy as a critical component of the Matatag Curriculum, aiming to equip learners with the necessary mathematical competencies. Despite these efforts, national assessments indicate persistent gaps in numeracy proficiency, particularly in calculation accuracy and speed.

The results in the National Achievement Test (NAT) also reveal that a considerable percentage of Filipino learners perform below the expected level in mathematics (DepEd, 2022). Specifically, issues related to numeracy accuracy and speed are prevalent. According to a study by Reyes and Santos (2021), Filipino learners often struggle with accurate computation due to inadequate foundational skills and limited practice opportunities. Additionally, the pressure to complete mathematical tasks within allocated time frames contributes to reduced speed and increased errors, as highlighted by Cruz et al. (2020).

The motivation for this research began from a continual study of the numeracy challenges faced not just globally but also in national and local school settings. These challenges were reflected in consistently low according to the Summary Report of Proficiency Levels in Mathematics during the First Quarter Period of the S.Y 2024-2025, Mathematics gained the lowest scores across all the grade levels. Grade 7 with (80.48), Grade 8 with (81.73), Grade 9 with (85.52), and Grade 10 with (83.00). The General Percentage Average is (82.68) interpreted as (Satisfactory). The learners of Palo 19 National High School, despite the dedicated efforts of the mathematics teachers and the implementation of traditional instructional methods, continued to struggle with basic numeracy skills.

In seeking innovative solutions to enhance numeracy skills and increase student engagement, the researcher explored various educational technologies and teaching strategies. According to (Johnson, 2019), the rise of digital tools offers both opportunities and challenges in addressing diverse learning needs. Moreover, declining interest and engagement in learning mathematics further hinders learners' progress, emphasizing the need for adaptive interventions that influence modern technology, as stated by (Brown, 2021). This led to the consideration of computer-based learning, which has been gaining traction as an effective tool in education for its potential to make learning more interactive and enjoyable.

To address these challenges, the decision to develop the NumEra-Z Program is driven by the need to address the identified mathematical competency gaps and the disruptive interests of the learners. The program is designed to potentially improve both learners' accuracy and speed in numerical tasks. Furthermore, aligning the NumEra-Z Program with the existing curriculum ensures that the program supports the educational standards and learning objectives to enhance numeracy skills such as accuracy and speed in specific learning activities and exercises.

METHODOLOGY

Research Design

This study used a descriptive-correlational design to assess the mathematical competency gaps and disruptive interests among learners of Palo 19 National High School, and to evaluate the effectiveness and acceptability of the developed NumEra-Z Program in enhancing numeracy skills. A quantitative method of research was employed to compare the results of the pretests and posttests to determine whether there is a significant difference in the performance of the learners after the implementation of the NumEra-Z Program. Also, a survey questionnaire was conducted to assess the acceptability of the NumEra-Z Program as perceived by the learners' overall experiences.

Research Locale

The study was conducted at Palo 19 National High School situated in the rural municipality of Tampakan, Division of South Cotabato, Region XII. According to the Philippine Statistics Authority (PSA, 2024), the age group with the highest population of the Barangay is 10 to 19, with 262 individuals (24.94%). The school primarily serves sixty-eight (68) students from Grade 7 to 10 from low-income farming communities and is considered the smallest Secondary School in the Municipality of Tampakan. According to the Proficiency Level Report 2023-2024, the school's performance in mathematics is the lowest subject area with a general average of (82.75) Satisfactory. Thus, considering this institution serves a diverse group of learners and offers a favorable environment for evaluating educational interventions such as the NumEra-Z Program in enhancing numeracy skills and engaging the learners in math classes.

Research Participants

This research used a purposive sampling technique to select the sixty-eight (68) learners from Grades 7 to 10 at Palo 19 National High School in Tampakan, South Cotabato. The sampling technique targets all learners enrolled in the numeracy program during the Second Quarter grading period of the School Year 2024-2025. According to the (DepEd Order No. 13, 2023), the National Mathematics Program under the Matatag curriculum is part of DepEd's National Learning Recovery Program. This focuses on enhancing students' numeracy and mathematics skills at all grade levels. This program supports interventions such as the NumEra-Z Program to address students' specific learning needs and improve their performance in mathematics. According to the summary report in the DepEd Learners Information System (LIS, 2024), the participants' age ranges from 12 to 16 years old, including Forty-four (44) male and Twenty-four (24) female learners. Learners within this age range typically transition into more advanced mathematical concepts, making it a critical period for developing numeracy skills, as considered by (Piaget, 1972).

Research Instrument

The validity and reliability of the research instruments used in this study were established through a thorough process to ensure the accuracy and consistency of the collected data. The study employed an adapted standardized test and a self-developed survey questionnaire, requiring a thorough discussion of their construction, validation, and reliability testing procedures.

This study gathered the First Quarter test scores of Grades 7 to 10 of the learners to identify the least learned mathematical competencies gaps and reviewed the basic foundational skills of each learning competency. Then, a standardized test questionnaire was adapted from the Rapid Mathematics Assessment (RMA) tool used by (DepEd, 2016) to assess the numeracy level of the learners, and the basic foundational skills required in learning mathematics include fractions, missing numbers in patterns, basic operations, and geometric representation. Content validation from curriculum experts and evaluators ensures the alignment of the learning competencies and the basic foundational skills in math, ensuring that each item reflects the essential skills.

The disruptive interests of the learners were assessed using a self-developed survey questionnaire that collected data according to the following factors. Excessive peer socialization, a lack of interest in abstract concepts, and technology misuse were identified as significant factors affecting learner engagement, as stated in a study on classroom management by (Barkley, 2010). The instrument underwent content validation by a panel of five experts in mathematics education and educational research to ensure that the instrument serves as a reliable basis for developing learners' intervention activities.

The adapted version of the (RMA) tool from the DepEd served as a pretest/posttest assessment of the numeracy skills of the learners, which is widely used in Philippine schools. It is a twenty (20) item short-answer questionnaire. This instrument was modified to align with the specific learning competencies targeted and the appropriateness for the age group. Moreover, learners' numeracy skills in terms of accuracy were categorized as Non-numerate, Basic-numerate, Moderately numerate, and Highly numerate. And learners' numeracy skills in terms of speed were categorized as Slow, Fast, Moderately Fast, and Very Fast. In the context of short-answer questions, approximately one to two minutes per question, depending on the difficulty and the nature of the material, according to Fischel's principles. This allows learners to organize their thoughts and respond concisely without feeling rushed. Furthermore, the acceptability of the NumEra-Z Program as perceived by the learners was collected using a developed survey questionnaire that measured the following criteria: relevance, organization, engagement level, and the learners' overall experience. The questionnaire was assessed and validated by five educational research experts.

Data Gathering Procedure

This study secured permission from the Dean of the Graduate School of Sultan Kudarat State University.

According to (Creswell, 2014), obtaining approval from the institution where the researcher ensures that the study is aligned with the university's standards for research integrity and ethical conduct. Then, send a formal request to the Office of the Schools Division Superintendent and the Office of the School Principal of Palo 19 National High School. As per DepEd Order No. 16, s. 2017, research studies conducted within DepEd schools must obtain permission from the Schools Division Office to ensure that the research aligns with educational goals and does not disrupt the learning environment, access to the learners, and school resources. After getting approval, informed consent was obtained from both the learners and their guardians.

Next, a pretest was administered to all sixty-eight (68) learners from Grades 7 to 10 to assess the learners' baseline numeracy skills, specifically focusing on accuracy and speed in performing basic mathematical tasks, conducted in their classrooms under the supervision of the researcher to maintain a consistent testing environment.

Afterwards, the learners underwent the NumEra-Z Program, which integrates the in-class learning scaffold activities and computer-based learning activities into their numeracy program over the Second Quarter grading period of the School Year 2024-2025. After the intervention period, a posttest identical to the pretest was administered to the same group of learners to measure any changes in their numeracy skills, and a survey questionnaire was administered to assess their perception and express their levels of acceptability with the statements about the NumEra-Z Program. After collecting all the data for analysis, the researcher discussed the implications of the findings in relation to existing literature.

Ethical Considerations

This research study followed ethical guidelines approved by the Office of the Schools Division Superintendent. Both the learners and their guardians provided informed consent, and confidentiality was maintained in compliance with international research ethics standards and participants' understanding.

RESULTS AND DISCUSSION

Mathematical Competency Gaps Across Grade Levels

Table 1. Least Learned Mathematical Competencies in the First Quarter Performance of Grade 7 Learners

Mathematical Competency	Mean	Mastery (%)
Relationship between angle pairs	48.5	32
Solve problems on percentage increase/decrease	50.2	35
Solve money problems with percentages	47.8	30
Perform operations on rational numbers	49.1	34

As seen in Table 1, the Grade 7 learners exhibited the lowest performance in solving money problems involving percentages (M=47.8, 30%) and describing angle pair relationships (M=48.5, 32%). This suggests that the learners struggle with applying mathematical concepts to real-world contexts involving percentages and financial literacy. These findings align with Singh et al. (2016), learners often struggle with percentage-related problems due to difficulties in proportional reasoning and real-life application, which are essential for financial literacy. Similarly, research by Reys et. al. (2019) highlights that understanding percentages requires a strong grasp of fractions and decimals, concepts that many learners find challenging. The difficulty in understanding the relationship between angle pairs also indicates a need to strengthen foundational geometric concepts, as emphasized by Van de Walle et.al. (2018) that difficulties in geometry, particularly in understanding angle pair relationships, stem from a weak foundation in spatial reasoning and visualization skills.

The findings of this study align with these previous works, indicating the necessity of targeted interventions to reinforce conceptual understanding and enhance problem-solving abilities in both financial mathematics and geometry.

Table 2. Least Learned Mathematical Competencies in the First Quarter Performance of Grade 8 Learners

Mathematical Competency	Mean	Mastery (%)
Solving problems on polynomial factors	46.9	28
Finding the equations of a line	48.3	31
Illustrate systems of linear equations	47.5	29

Table 2 presents the mean gained score and the percentage mastery of Grade 8 learners for each mathematical competency in the First Quarter which demonstrated the lowest mastery in solving problems involving factors of polynomials (M=46.9, 28%), followed by illustrating systems of linear equations (M=47.5, 29%), then finding equations of a line (M=48.3, 31%). These results suggest that Grade 8 learners find algebraic concepts, particularly those involving polynomials and linear equations, difficult to grasp. This indicates that learners need structured scaffolding strategies to bridge their conceptual gaps in algebra and coordinate geometry. To address these challenges, implementing structured scaffolding strategies has been shown to be effective. Arifin et al. (2020) demonstrated that scaffolding, such as providing written equations and step-by-step guidance, can bridge gaps in students' problem-solving abilities. Additionally, Aikhuele (2020) explored scaffolding strategies in a remedial mathematics course and found that activating prior knowledge, using manipulatives, visuals, teacher modeling, and technology integration can enhance students' understanding of algebraic concepts.

Table 3. Least Learned Mathematical Competencies in the First Quarter Performance of Grade 9 Learners

Mathematical Competency	Mean	Mastery (%)
Solve quadratic equations	45.6	26%
Solve problems with quadratic inequalities	47.1	27%
Transform quadratic functions	46.8	27%

The data above presents the mean gained score and the percentage mastery of Grade 9 learners for each mathematical competency in the First Quarter. The Grade 9 learners showed the lowest mastery in solving quadratic equations (M=45.6, 26%), followed by transforming quadratic functions (M=46.8, 27% and solving problems with quadratic inequalities (M=47.1, 27%). Quadratic functions, inequalities, and transformations require a strong foundation in fractions, geometric representation, and algebraic operations that involve spatial reasoning and visualization skills. These results support Rogers' (1987) Experiential Theory, which emphasizes the role of interactive tools, such as gamified learning experiences in reinforcing abstract mathematical concepts. The integration of computer-based activities in the NumEra-Z Program aims to address these learning gaps through visual and interactive approaches.

Table 4. Least Learned Mathematical Competencies in the First Quarter Performance of Grade 10 Learners

Mathematical Competency	Mean	Mastery (%)
Solving problems involving sequences	47.9	30%
Prove remainder, factor, and rational root theorem	45.2	25%
Factor polynomials	46.7	26%

Table 4 presents the mean gained score and the percentage mastery of Grade learners for each mathematical competency in the First Quarter. The Grade 10 learners exhibited the lowest performance in proving the remainder, factor, and rational root theorems (M=45.2. 25%), followed by factoring polynomials (M=46.7, 26%), then solving problems involving sequences (M=47.9, 30%). These competencies require an understanding

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of algebraic structures and number patterns. According to Dewey & Piaget's Constructivist Theory, learners perform better when they can manipulate abstract concepts in a dynamic environment. Thus, providing interactive problem-solving tasks and digital tools will enhance their ability to grasp complex mathematical principles.

To address the persistent challenges in these foundational mathematical skills, particularly in fractions and geometric representation, the NumEra-Z Program designed a scaffolded activities that start with simpler concepts and gradually increase in complexity, which helped students build confidence and understanding. Also, Interactive group work learning activities where learners work together to solve problems through peer discussion and support. Another one is computer-based activities, incorporating interactive online tools and simulations that can engage learners to practice skills independently, which include virtual manipulatives for geometric representations or interactive quizzes that reinforce basic operations.

Learners' Disruptive Interests

Table 5: Learners' Disruptive Interest in Mathematics Classes in Excessive Peer Socialization

Statement	Mean	SD	Interpretation
I talk to my classmates during lessons, even when it is not allowed.	2.56	0.80	Often
Group activities with my friends distract me from completing individual tasks.	2.50	0.87	Sometimes
I feel more focused when sitting away from my close friends.	2.91	0.97	Often
My performance decreases when I am seated next to classmates I usually chat with.	2.59	0.83	Often
I enjoy chatting with my peers during class more than paying attention to the lesson.	2.06	0.96	Sometimes
I tend to share unrelated topics with classmates while the teacher is explaining the lesson.	2.34	0.96	Sometimes
I prefer to work with friends on activities, even when individual work is assigned.	2.74	0.92	Often
I get involved in off-topic discussions during class time.	2.65	0.84	Often
My classmates ask me questions unrelated to the lesson, which distracts me.	2.91	0.91	Often
. I struggle to concentrate in class when seated near my friends.	2.68	0.91	Often
Overall Mean	2.59	0.90	Often

Table 5 reveals insights into learners' disruptive interest in mathematics classes, particularly concerning excessive peer socialization. The overall (M=2.59, SD=0.90) indicates that learners frequently display the impact of peer interactions on their focus and performance during lessons. This suggests that social dynamics play a significant role in the learning environment. Learners often feel more focused when seated away from friends (M=2.91, SD=0.97), prefer working with friends even when individual tasks are assigned (2.74), and frequently engage in off-topic discussions during class (M=2.65, SD=0.84). Additionally, students reported that their classmates often distract them with unrelated questions (M=2.91, SD=0.91) and that they struggle to concentrate when seated near friends (M=2.68, SD=0.91). These findings emphasize the dual nature of peer relationships in educational settings while collaboration can foster engagement, it may also lead to distractions that hinder academic performance (Wentzel, 2010; Ryan & Patrick, 2001).

Conversely, items 2, 5, and 6 received a rating of “sometimes”, indicating that learners do not feel significantly distracted by group activities or they prefer chatting overpaying attention to lessons. Excessive socialization is acknowledged as a concern, but learners may also recognize the value of structured group work and the importance of maintaining focus during lessons.

To address these findings effectively, NumEra-Z Program implemented strategies that balance collaborative learning with individual accountability. For instance, incorporating structured group activities with clear expectations can help mitigate distractions while fostering peer interaction, as supported by (Johnson & Johnson, 2014). Additionally, seating arrangements could be strategically planned to minimize disruptions while still allowing for social engagement during appropriate times.

Table 6: Percentage of Learners’ Disruptive Interest in Mathematics Classes in Lack of Interest in Abstract Concepts

Statement	Mean	SD	Interpretation
I have difficulty understanding lessons that involve abstract ideas or theories.	2.66	0.64	Often
I lose interest when the lesson requires me to think about hypothetical situations.	2.34	0.77	Sometimes
I prefer subjects that are concrete and easy to relate to daily life.	3.25	0.80	Often
I struggle to stay engaged in math lessons that involve abstract problem-solving.	2.50	0.95	Sometimes
I find it hard to concentrate when the topic doesn’t have clear, real-world applications.	2.78	0.81	Often
I enjoy lessons more when they involve practical examples rather than theories.	3.37	0.69	Always
I lose focus during class discussions of abstract concepts.	2.34	0.75	Sometimes
I am more motivated by hands-on activities than abstract thinking tasks.	2.88	0.86	Often
I find theoretical explanations difficult to follow and understand.	2.50	0.66	Sometimes
. I get bored when teachers explain ideas that seem too complicated or unrelated to real life.	2.35	0.91	Sometimes
Overall Mean	2.70	0.78	Often

Table 6 sheds light on learners' views regarding disruptive interests in mathematics classes, particularly concerning their lack of interest in abstract concepts. The overall (M=2.70, SD=0.78) indicates that the learners frequently display a lack of abstract ideas that disrupt their engagement in mathematics class. Several statements received notable “often”, particularly items 3 and 6, which emphasize a preference for concrete subjects and practical examples (M=3.25, SD=0.80), learners express a clear disposition towards topics that are relatable to their daily lives. Furthermore, the consistent (M=3.37, SD=0.69) enjoyment of lessons that involve practical examples rather than theories underscores the importance of real-world applications in maintaining learners’ interest, as supported by (Brusilovsky & Millán, 2018) that contextualizing abstract concepts through relatable examples can enhance learner engagement and understanding.

Conversely, items 2, 7, 9, and 10 received a rating of “sometimes”, indicating that learners do not universally find abstract concepts uninteresting, some learners reported losing interest in hypothetical situations or finding theoretical explanations challenging, others indicated they do not often lose focus during discussions of abstract concepts or get bored with complex ideas, while there is a general tendency to prefer concrete applications, there are also learners who can engage with abstract concepts under certain conditions.

To address these findings effectively, NumEra-Z Program considered integrating more hands-on activities and real-world applications into the lessons to cater to learners' preferences for concrete learning experiences. Additionally, project-based learning or the use of manipulatives can help bridge the gap between abstract theories and practical understanding (Hattie, 2009).

Table 7: Percentage of Learners' Disruptive Interest in Mathematics Classes in Technology Misuse

Statement	Mean	SD	Interpretation
I use my phone during class for purposes unrelated to the lesson.	1.71	0.74	Never
I spend more time playing games or watching videos than reviewing or doing homework after class.	2.50	0.81	Sometimes
I usually prefer online entertainment over studying or doing academic tasks after school.	2.46	0.78	Sometimes
I spend a lot of time on my phone or computer on non-educational activities, which reduces my time for studying.	2.49	0.80	Sometimes
I use my tablet/laptop/computer for non-academic activities in online learning sessions.	2.45	0.76	Sometimes
I find myself browsing unrelated websites during lectures.	1.73	0.83	Never
I am more engaged when technology is present in the classroom.	3.21	0.79	Often
My focus is affected when I use technology, even if it's allowed for educational purposes.	2.42	0.89	Sometimes
I use gadgets for entertainment during class time.	1.74	0.73	Never
. I delay completing my homework or assignments because I am engaged in online activities (e.g., social media, gaming).	2.85	0.96	Often
Overall Mean	2.36	0.81	Sometimes

Table 7 provides an insightful analysis of learners' views regarding disruptive interests in mathematics classes, specifically focusing on technology misuse. The overall (M=2.36, SD=0.81) indicates that the learners occasionally show that they do not perceive technology misuse as a significant issue in their learning environment. Notably, the first statement, "I use my phone during class for purposes unrelated to the lesson," received (M=1.71, SD=0.74) "never", reinforcing the notion that learners are aware of the importance of staying focused during class. Moreover, some learners do not have a personal phone/tablet that they can use during the lecture.

While most responses lean towards "sometimes", there are specific areas where learners express concern about the impact of technology on their academic engagement. In statements 7 and 10 received a rating of "often", indicating that they feel more engaged when technology is present in the classroom (M=3.21, SD=0.79) and delaying homework completion due to online activities like social media and online gaming (M=2.85, SD=0.96) suggests that some learners recognize a potential conflict between their academic responsibilities and their engagement with technology. Interestingly, other statements related to technology misuse, such as spending time on non-educational activities (M=2.49, SD=0.80) or browsing unrelated websites during lectures (M=1.73, SD=0.83), received "sometimes", indicating that learners do not frequently engage in these disruptive behaviors,

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while learners enjoy using technology but generally mindful of its appropriate use within an educational context.

To address these findings effectively, NumEra-z Program leverages technology to enhance engagement while also setting clear expectations for its use in the classroom, as supported by (Hattie, 2009) that structured activities that integrate technology for educational purposes can help maintain learners' focus. Additionally, promoting digital literacy and self-regulation strategies can empower learners to balance their academic tasks with their interest in technology.

Table 8: Summary of Learners' Disruptive Interest in Mathematics Classes (Pretest)

Factors	Mean	SD	Interpretation
Excessive Peer Socialization	2.59	0.90	Often
Lack of Interest in Abstract Concepts	2.70	0.78	Often
Technology Misuse	2.36	0.81	Sometimes
Overall Mean	2.55	0.83	Often

The data summarized in Table 8 provides a comprehensive overview of learners' disruptive interests in mathematics classes, reflecting their perceptions of various factors influencing their engagement and focus during lessons. The overall (M=2.55, SD=0.83) indicates a general agreement among respondents regarding the presence of disruptive interests in their learning environment. These findings highlight the need for targeted teaching-learning strategies that address learners' disruptive interests through enhanced engagement by fostering collaborative learning environments that balance peer interaction with individual accountability, incorporating real-world applications to make abstract concepts more relatable, and utilizing technology as an educational tool rather than a distraction.

Table 9: Level of Numeracy Accuracy among Mathematics Learners (Pretest)

Grade Level	Mean	SD	Interpretation
7	9.71	4.58	Basic Numerate
8	11.00	4.02	Basic Numerate
9	10.90	4.15	Basic Numerate
10	10.46	3.36	Basic Numerate
Overall Mean	10.52	4.13	Basic Numerate

Table 9 illustrates the level of numeracy accuracy among mathematics learners across grades 7 to 10, with an overall (M=10.52, SD=4.13), indicating that learners are classified as "Basic Numerate". This classification suggests that while learners possess a fundamental understanding of numeracy concepts, they frequently make errors, highlighting a critical area for improvement. All grade levels fall within the "Basic Numerate" category, indicating that students across the board struggle with numeracy accuracy, this suggests that learners may benefit from targeted interventions aimed at enhancing their numeracy skills.

To address these challenges, NumEra-Z Program considered implementing differentiated instruction strategies that focus on building numeracy fluency through practice and reinforcement, hands-on activities, real-world applications, and formative assessments can help identify specific areas where learners struggle, as supported by (Hattie, 2009).

Table 10: Level of Numeracy Speed among Mathematics Learners (Pretest)

Grade Level	Mean (minutes)	SD	Interpretation
7	35.27	7.91	Slow
8	27.61	8.09	Fast
9	36.76	7.12	Slow
10	27.04	7.19	Fast
Overall Mean	31.67	7.58	Moderately Slow

Table 10 provides insights into the level of numeracy speed among mathematics learners across grades 7 to 10. The overall (M=31.67, SD=7.58) categorizes learners as "Moderately Slow" in completing numeracy tasks. While some learners can work through problems at a reasonable pace, there remains a significant portion of learners who struggle with speed.

Grade 7 and Grade 9 learners are classified as "Slow" (M=35.27, SD=7.91) and (M=36.76, SD=7.12), respectively. Learners take longer than expected to complete numeracy tasks, which may indicate difficulties in processing or applying mathematical concepts efficiently. In contrast, Grade 8 and Grade 10 learners are classified as "Fast", (M=27.61, SD=8.09) and (M=27.04, SD=7.19), respectively. Learners in these grades can perform problem-solving tasks at a good pace, indicating a higher level of numeracy fluency. The differences in numeracy speed across grade levels highlight the need for targeted interventions to support slower learners, particularly those in Grades 7 and 9.

To address these challenges, NumEra-Z Program implemented strategies such as timed practice sessions, where learners are encouraged to solve problems within a set timeframe, thereby improving their speed and efficiency. Additionally, (Hattie, 2009) stated that incorporating engaging activities that promote quick thinking, such as math games or competitions, can motivate slower learners to enhance their pace while reinforcing their understanding of numeracy concepts

Table 11: Learners' Acceptability of the NumEra-Z Program in terms of Relevance

Indicators	Mean	SD	Interpretation
The NumEra-Z Program has helped me improve my least learned numeracy skills.	3.18	0.54	Acceptable
The lessons provided by the NumEra-Z Program are in line with the learning objectives for every session.	3.47	0.50	Highly Acceptable
The NumEra-Z Program has made it easier for me to solve mathematical problems.	2.96	0.50	Acceptable
The NumEra-Z Program has enhanced my understanding of the application of key mathematical concepts to real-life.	2.90	0.49	Acceptable
I believe that the NumEra-Z Program is an essential part of my math education.	3.41	0.55	Highly Acceptable
Overall Mean	3.18	0.57	Acceptable

The overall (M=3.18, SD=0.57) indicates that, on average, learners generally accepted that the program is relevant to their learning objectives. Specific indicators within the table reveal varying degrees of acceptability, like "the lessons provided by the NumEra-Z Program are in line with the learning objectives for every session" (M=3.47, SD=0.50), interpreted as "Highly Acceptable", suggests that learners find the content of the program closely aligned with their academic requirements, which is crucial for maintaining engagement and motivation (Brusilovsky & Millán, 2018). However, some indicators, such as "the NumEra-Z Program has enhanced my understanding of key mathematical concepts" (M=2.90, SD=0.49), suggests that while learners appreciate the program's relevance, how the NumEra-Z Program was designed to address their specific mathematical competency gaps and their preferred learning styles, there may be areas for improvement on how concepts are conveyed or reinforced, like scheduling group sessions according to their numeracy levels so that teachers can focus on administering the differentiated activities provided.

Table 12: Learners' Acceptability of the NumEra-Z Program in terms of Organization

Indicators	Mean	SD	Interpretation
1. The instructions in the NumEra-Z Program are easy to follow.	3.10	0.58	Acceptable
2. I find the NumEra-Z Program easy to use without needing much assistance.	2.72	0.64	Acceptable
3. The layout and design of the NumEra-Z Program make it user-friendly.	3.28	0.57	Acceptable
4. I can quickly find the information or tools I need within the NumEra-Z Program.	3.18	0.73	Acceptable
5. The NumEra-Z Program provides clear instructions on how to complete each task.	3.35	0.54	Highly Acceptable
Overall Mean	3.13	0.65	Acceptable

The overall (M=3.13, SD=0.65) indicates that learners generally view the organization of the program positively. However, the relatively higher standard deviation suggests that there is more variability in learners' opinions regarding the program's organization compared to other factors.

Among the specific indicators, the statement "the instructions in the NumEra-Z Program are easy to follow" (M=3.10, SD=0.58), and "the layout and design of the NumEra-Z Program make it user-friendly" (M=3.28, SD=0.57) interpreted as "Acceptable". This indicates that most learners find the instructions clear, which is essential for effective learning (Hattie, 2009). Conversely, the statement "I find the NumEra-Z Program easy to use without needing much assistance" (M=2.72, SD=0.64) suggests that learners generally agree with this statement, there may still be some challenges that require assistance. This finding points to further refinement of the program to enhance its usability and reduce reliance on external help, like providing more opportunities for learners to be exposed and oriented to using laptops/computers or exploring more available educational software that is familiar to the learners' use. Additionally, the statement, "the NumEra-Z Program provides clear instructions on how to complete each task," achieved a (M=3.35, SD=0.54), interpreted as "Highly Acceptable". This suggests that learners appreciate clear instructions for guidance in every session, which is crucial for their ability to navigate tasks effectively and build confidence in their skills (Brusilovsky & Millán, 2018).

Table 13: Learners' Acceptability of the NumEra-Z Program in terms of Engagement Level

Indicators	Mean	SD	Interpretation
1. The activities in the NumEra-Z Program keep me interested in learning math.	3.25	0.44	Acceptable

2. I am motivated to complete the tasks provided by the NumEra-Z Program.	3.26	0.44	Acceptable
3. The NumEra-Z Program encourages me to practice math more often.	3.28	0.51	Acceptable
4. The interactive elements of the NumEra-Z Program make learning enjoyable.	3.18	0.42	Acceptable
5. I feel more engaged in math class because of the NumEra-Z Program.	3.26	0.44	Acceptable
Overall Mean	3.25	0.45	Acceptable

The overall (M=3.25, SD=0.45) indicates a strong positive response, suggesting that learners generally feel engaged and actively involved in the program. Specific indicators within the table reveal that learners find the activities in the NumEra-Z Program effective in maintaining their interest in learning math, the statement "the activities in the NumEra-Z Program keep me interested in learning math" (M=3.25, SD=0.44). Similarly, the statement "I am motivated to complete the tasks provided by the NumEra-Z Program" (M=3.26, SD=0.44), indicating that learners feel motivated to engage with the program's content. The statement "the interactive elements of the NumEra-Z Program make learning enjoyable" (M=3.18, SD=0.42) suggests that incorporating interactive features into educational programs can significantly enhance learner engagement and enjoyment, as supported by (Brusilovsky & Millán, 2018). Additionally, learners expressed acceptability with the statement "the NumEra-Z Program encourages me to practice math more often" (M=3.28, SD=0.51), reinforcing the program's effectiveness in promoting consistent practice and skill development.

Moreover, the NumEra-Z Program provided group-based tasks to ensure social interaction without compromising distractions, then individual tasks as a learning scaffold to ensure independence in their numeracy skills. In addition, the game-based and computer-based learning challenged the learners with a competitive setting, which drives them to engage more and to improve in every session.

Table 14: Learners' Acceptability of the NumEra-Z Program in terms of Overall Package

Indicators	Mean	SD	Interpretation
1. I enjoyed the variety of activities and exercises the program offered.	3.24	0.43	Acceptable
2. I felt the pace of the program was appropriate for my skill level.	3.26	0.44	Acceptable
3. I would recommend the NumEra-Z Program to other students.	3.15	0.53	Acceptable
4. I feel that the NumEra-Z Program has positively impacted my math performance.	3.22	0.42	Acceptable
5. I am pleased with my experience using the NumEra-Z Program.	3.19	0.40	Acceptable
Overall Mean	3.21	0.44	Acceptable

The overall (M=3.21, SD=0.44) indicates that learners generally agree with the program's quality and effectiveness and share similar positive views about its overall package. Specific indicators reveal positive perceptions among learners, the statement "I enjoyed the variety of activities and exercises that the program offered" (M=3.24, SD=0.43), indicating that the program's success in incorporating interactive group work, peer support, and computer-based activities is vital in reinforcing challenging mathematical concepts. Similarly, the statement "I feel the pace of the program was appropriate for my skill level" (M=3.26, SD=0.44) reflects that the scaffolded structure of the NumEra-Z Program was effective in addressing diverse numeracy levels, particularly with non-numerate and basic-numerate learners. The statement, "I feel that the NumEra-Z Program has positively impacted my math performance" (M=3.22, SD=0.42) suggests that learners perceive concrete benefits from their engagement with the NumEra-Z program as an effective learning tool (Hattie, 2009).

Additionally, the statement "I would recommend the NumEra-Z Program to other students" (M=3.15, SD=0.53) further indicates that learners are likely to advocate for its use among their peers. This reflects the NumEra-Z Program's game-based nature that meets learners' motivational aspect of learning mathematics.

Table 15: Summary of Learners' Acceptability of the NumEra-Z Program

Factors	Mean	SD	Interpretation
Relevance	3.18	0.57	Acceptable
Organization	3.13	0.65	Acceptable
Engagement Level	3.25	0.45	Acceptable
Overall Package	3.21	0.44	Acceptable
Overall Mean	3.19	0.53	Acceptable

The overall (M=3.19, SD=0.53) indicates that learners generally agree with the program's acceptability. Breaking down the individual factors reveals that Relevance (M=3.18, SD = 0.57), suggesting that students find the program appropriate to their learning needs. Since the NumEra-Z program was designed based on personal factors such as learners' disruptive interests, the researcher adapted learning activities and educational computer games to fit learners' needs. This aligns with findings from educational research that emphasize the importance of aligning instructional materials with students' expectations to enhance engagement and motivation (Brusilovsky & Millán, 2018).

The Organization factor (M=3.13, SD=0.65), indicating that while learners view the program's structure positively, there is slightly more variability in their opinions compared to other factors. This suggests improvement to how content is organized and presented to ensure consistency in user experience, which was observed during the computer-based sessions. At first, the learners found it challenging to explore programs like the interface of GeoGebra without requiring assistance. Further use and exploration of available educational software gradually enhanced its usability and reduced reliance. Nevertheless, the program facilitated a scaffolding learning strategy and tools to organize the learning objectives in every session, linking to the organization of learning.

The Engagement Level (M=3.25, SD=0.45) reflects strong agreement among learners that the program effectively maintains their interest and motivation in mathematics, as the NumEra-Z Program emphasizes that conventional technology-enhanced learning combined with a game-based learning environment is more interesting and improves motivation to learners, which was observed during the group-based discussion and computer-based activities, learners tend to participate well when their peer assisted them and encouraged them to ask questions. This finding is crucial, as engagement is a significant predictor of academic success and can lead to improved learning outcomes (Hattie, 2009).

Finally, the Overall Package (M=3.21, SD=0.44) indicates that learners are satisfied with the comprehensive offerings of the NumEra-Z Program. In the implementation of the program, it was important that the teacher was creative and solicited ongoing feedback from learners that helped refine and adapt the integrated learning activities and computer software that was used based on their experiences and needed learning objectives. This resulted in improved learning instructions for the next session activities, while most learners are observed to be enjoying, and they are challenged to improve better in the next session activities.

Table 16: Paired Sample t-Test in Numeracy Accuracy

Test	Mean	SD	t-Stat	Sig
Pre	10.46	4.16	-16.05	0.000
Post	13.93	3.90		

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The pre-test for numeracy accuracy (M=10.46, SD=4.16) increased to a post-test (M=13.93, SD=3.90), with a t-statistic of (-16.05), where ($p < 0.05$) indicates a highly significant difference between pre- and post-test scores, confirming that the program effectively enhanced learners' numeracy accuracy. These findings align with educational research by (Hattie, 2009; National Mathematics Advisory Panel, 2008), emphasizing the importance of targeted interventions in improving foundational math skills, which incorporate structured practice, feedback, and conceptual clarity—key components of effective numeracy instruction—are known to yield measurable improvements in student outcomes

Table 17: Paired Sample t-Test in Numeracy Speed

Test	Mean (minutes)	SD	t-Stat	Sig
Pre	32.56	8.58	8.25	0.000
Post	25.96	7.05		

The pre-test for numeracy speed (M=32.56, SD=8.58) decreased to a post-test (M=25.96, SD=7.05), with a t-statistic of (8.25), where ($p < 0.05$) indicates a statistically significant difference between the pre- and post-test scores, this suggests that the program effectively enhanced learners' speed in completing numeracy tasks. These findings align with existing research by (Hattie, 2009; National Mathematics Advisory Panel, 2008), which targeted instructional programs in fostering both speed and accuracy in mathematics must focus on strategies that enhance computational fluency and problem-solving efficiency, such programs can lead to meaningful gains in students' overall mathematical performance.

Table 18: Correlational Analysis between Learners' Acceptability of the NumEra-Z Program and Numeracy Skills (Posttest)

Variables			r	Sig	Interpretation
Learners' Acceptability	vs	Accuracy	0.82	0.000	Strong Positive Correlation
		Speed	-0.70	0.000	Moderate Negative Correlation

** Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation coefficient ($r=0.82$, $p < 0.05$) between learners' acceptability of the program and numeracy accuracy (posttest) was found to be a strong positive correlation, suggesting that learners who demonstrated higher posttest accuracy in numeracy tasks were more likely to view the program favorably, possibly due to perceived competence and alignment of the program's challenges with their skill levels. Such findings align with Bandura's (1997) theory of self-efficacy, where success in tasks reinforces confidence and positive perceptions of educational interventions.

Conversely, the Pearson correlation coefficient ($r=-0.70$, $p < 0.05$) between the program acceptability and numeracy speed (posttest) was observed to be a moderate negative correlation, indicating that learners who completed tasks more quickly or improved speed and reported higher acceptability of the program. This inverse relationship may reflect reduced cognitive load or frustration when tasks are completed efficiently, enhancing learners' satisfaction with the program's design and usability, as supported by (Sweller, 2011).

These results underscore the dual impact of the NumEra-Z Program, improving accuracy fosters confidence, while enhancing speed reduces task-related stress, both of which contribute to higher acceptability. The findings emphasize the importance of balancing skill development (accuracy) and efficiency (speed) in educational tools to maximize learner engagement and satisfaction, as stated by (Hattie, 2009; Deci & Ryan, 2000).

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CONCLUSION

Based on the findings, the mathematical competency gaps and the pretest results among Grade 7 to 10 identified specific mathematical areas of weakness that include numeracy skills in fractions, basic operations, and geometric representations.

In terms of learners' disruptive interests, engagement in mathematics classes was moderately affected by excessive peer socialization, followed by a lack of interest in abstract concepts, and then by technology misuse. The program was focused on addressing the mathematical competency gaps while fostering a more engaging learning environment, balancing social interactions with other activities, making abstract concepts more relatable with specific aspects of technology engagement that warrant attention while minimizing potential distractions.

The numeracy accuracy of the learners before the intervention was consistently at a Basic – Numerate level across all grade levels, while numeracy speed varied. After participating in the NumEra-Z Program, the posttest results show a statistically significant improvement that was observed in both numeracy accuracy.

Learners' acceptability of the NumEra-Z Program was generally positive, with favorable perceptions of relevance, organization, engagement level, and overall package. Therefore, the ADDIE model (Gagné, 1977) ensures a systematic approach towards instructional design in the development of the NumEra-Z Program.

Correlation analysis revealed a strong positive correlation between numeracy accuracy and learner acceptability, indicating that learners who perceived the program as more acceptable tended to demonstrate greater improvement in accuracy. However, a moderate to strong negative correlation was found between numeracy speed and acceptability, suggesting that while the program improved speed, some learners may have perceived it differently. Therefore, while the NumEra-Z Program demonstrates potential benefits, ongoing evaluation and adaptation are necessary to ensure its sustained success and broader applicability in addressing the mathematical competency gaps and disruptive interests of the learners.

Conflict of Interests

The authors declared no conflict of interest.

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