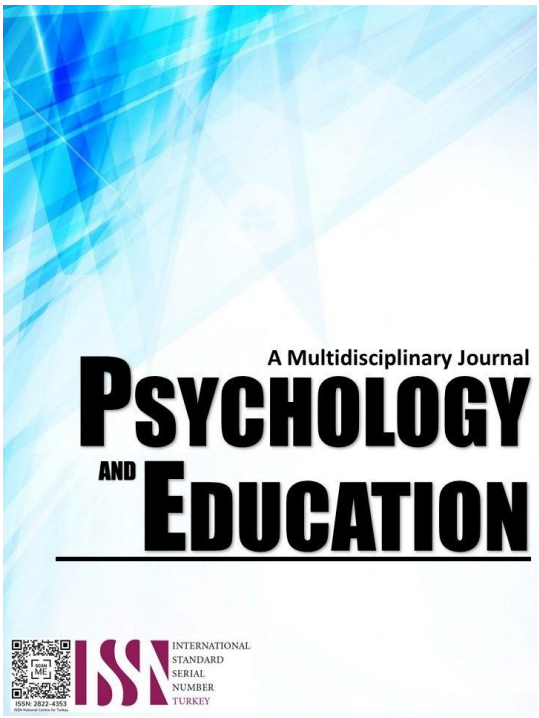
EFFECTS OF VARIOUS MATHEMATICS INTERVENTION TO THE LEARNERS' MOTIVATION AND NUMERACY SKILLS OF THE SECONDARY SCHOOL LEARNERS IN THE DIVISION OF LUCENA CITY



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Research Article

Effects of Various Mathematics Interventions to the Learners' Motivation and Numeracy Skills of the Secondary School Learners in the Division of Lucena City

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Abstract

This study explores the effects of various mathematics interventions on the motivation and numeracy skills of secondary learners in Lucena City. The researcher utilized a descriptive research design using the quantitative research approach. The study employs surveys to collect primary data from students and teachers. Additionally, secondary data on learners' numeracy levels and quarterly grades are analyzed to comprehensively assess the intervention's effect. The paired sample statistics showed an increase in mean scores from the first quarter ($M = 78.97$) to the second quarter ($M = 80.03$), suggesting measurable progress in numeracy proficiency. A strong positive correlation ($r = 0.885$, $p < .001$) between the first and second quarters confirmed the consistency of this improvement. Moreover, the paired-samples t-test indicated a statistically significant difference ($t = -4.84$, $p < .001$), demonstrating that the intervention program had a meaningful impact on learners' mathematics performance. Furthermore, the study reveals increased students' motivation and mathematics engagement, suggesting a positive correlation between structured intervention strategies and learner outcomes. The study concludes that well-designed and sustained mathematics interventions are essential in addressing learning gaps, improving numeracy proficiency, and fostering a positive learning environment. It recommends continuously refining intervention programs and incorporating data-driven strategies to ensure their effectiveness in enhancing academic performance and motivation in mathematics.

Keywords: *numeracy skills, motivation, intervention*

Introduction

Mathematics intervention is crucial in schools to strengthen students' numeracy skills—DepEd Order No. 55, s. The 2016 document, also known as the Policy Guidelines on the National Assessment of Student Learning for the K-12 Basic Education Program, emphasizes the need to support the development of foundational language, literacy, and numeracy skills. Likewise, DepEd Memorandum No. 117, s. 2005 highlights Strategic Intervention Materials (SIM), educational resources that the Department of Education endorsed to enhance student learning and academic performance. To promote effective learning in mathematics among elementary and high school students, DepEd has provided teachers with training and workshops on the development and utilization of these intervention materials.

Furthermore, DepEd Order No. 13, s. In 2023, the Adoption of the National Learning Recovery Program (NLRP) under the MATATAG: Bansang Makabata, Batang Makabansa initiative was implemented to enhance the department's learning recovery and continuity efforts, strengthen literacy and numeracy, and accelerate educational progress. However, as outlined in DepEd policies, students' numeracy achievement levels remain below proficiency despite these interventions—including the Early Language, Literacy, and Numeracy (ELLN) Program, NLRP, and SIM.

One of the key measures of a nation's educational success is the Programme for International Student Assessment (PISA), in which every 15-year-old student is administered a test for performance in science, arithmetic, and reading. The Philippines had the lowest average score of 353 among 78 countries participating in the 2018 PISA test. From this, one in five Filipino students had difficulty with math and could not achieve at least the minimum level of competence. Due to declining student performance, the education sector is now distressed. Moreover, the Philippines was still in the bottom 10 among 81 participating countries in reading, mathematics, and science based on the 2022 PISA rankings.

Mathematics modules in the Philippine education framework include well-selected subjects and pedagogy to enhance students' logical and mathematical thinking abilities, enabling them to comprehend key concepts. Despite this, the continued poor performance of students shows they cannot comprehend the subject (Guinocor et al., 2020). Continued failure by students to comprehend mathematical concepts is a cause for concern.

Several studies have compared various intervention methods with the hope of improving mathematical abilities, for example, remedial and enrichment activities (Magtolis, 2023), implementation of numeracy centers (Perez, 2023), playing card games (Sing et al., 2021), computer programs and one-on-one tutoring (Gahoy, 2024), peer tutoring systems (Alegre et al., 2018), and collaborative learning mechanisms (Roy, 2020). Educators develop these strategies with the end goal of improving students' mathematical abilities and learning. Additionally, it fosters children's emotional growth and boosts their confidence in academic performance because they believe their teachers are actively involved. Mathematics intervention programs aim to close the achievement gap and enhance student performance by providing more instruction, practice, and support to students who struggle with mathematical concepts and skills. However, the success of such programs depends on how they are implemented and how well teachers and students support them.

Education gives pupils the foundational abilities they need. Numeracy, writing, and reading are crucial, creating a solid basis for future academic success. Early learning challenges with fundamental math ideas can result in persistent learning challenges. Early exposure to mathematical ideas increases a student's likelihood of academic success. Kindergarteners who struggle with math tend to lag in subsequent years, according to research by Harris and Petersen (2019). Early mathematics intervention is necessary to lessen the number of students at risk. It will also help them enhance their problem-solving ability and apply it daily.

As international actions progress towards sustainable development, examining this research subject is crucial for assessing our performance on the global stage. One of the most critical objectives of the Sustainable Development Goals is addressing the world's various challenges by ensuring quality education. In 2022, former Education Secretary Leonor Magtolis Briones highlighted that students must be ready to become global citizens. Education must prioritize promoting global citizenship awareness as we commit to involvement, especially when facing educational obstacles. Therefore, the Department of Education strives to provide inclusive and equitable quality education, fostering lifelong learning opportunities for everyone.

Several studies have examined various Mathematics intervention programs to improve students' numeracy competencies. However, no study has quantified their impact on students' numeracy competencies and motivation, specifically in secondary schools in the Division of Lucena City. Furthermore, the division implemented a Mathematics intervention under Project 4B (Bawat Bata Bumasa at Bumibilang) with Republic Act No. 10533, or the Enhanced Basic Education Act of 2013, to address learning gaps. The act focuses on a flexible curriculum, wherein schools can adjust instructional strategies and develop localized instructional materials. Despite such efforts, most students still have a poor understanding of Mathematics, and the assessment results are still persistently low to average.

Given the scenario above, the researcher, a Mathematics teacher and subject coordinator for over 6 years, observed that the division's quarterly assessment results consistently show Mathematics trailing the bottom three subjects with the lowest MPS results, alongside English and Science, for the past years. Although interventions are made, some students perform below the desired level in the subject. This low performance is likely influenced by the extent of the intervention's implementation and other related factors. Therefore, the researcher believed that investigating the effects of various Mathematics intervention programs would be beneficial and could serve as a basis for enhancing school programs to improve learners' numeracy skills. The proposed intervention program framework of this study aims to identify effective strategies to enhance students' motivation and numeracy skills, leading to improved academic outcomes in Mathematics. By addressing ongoing challenges, the framework provides a structured, actionable approach for teachers, ensuring consistent evaluation and refinement of the most effective practices. Ultimately, it offers a model for improving mathematics instruction and student performance, creating a more engaging and supportive learning environment.

Research Questions

This study aimed to assess the effects of various Mathematics Interventions on the motivation and numeracy skills of secondary learners in the Division of Lucena City. Specifically, this study sought to answer the following questions.

1. What are the mathematics interventions implemented in the Secondary Schools in the Division of Lucena City?
2. What is the extent of implementation of the mathematics interventions in the Secondary Schools in the Division of Lucena City?
3. What is the level of numeracy skills of the learners in the Secondary Schools in the Division of Lucena City?
4. What is the level of motivation of the learners in the Secondary Schools in the Division of Lucena City in terms of:
    4.1. intrinsic value;
    4.2. self–regulation;
    4.3. self–efficacy;
    4.4. utility value; and
    4.5. test anxiety?
5. What is the effect of the implementation of the intervention on the numeracy skills and motivation of learners in the Secondary Schools in the Division of Lucena City?
6. What are the problems encountered, and strategies used during the implementation of the mathematics intervention in the secondary schools in the division of Lucena City?
7. What intervention program implementation framework can be proposed based on the findings of the study?

Literature Review

Mathematics education remains a significant area of concern in academic research, with numerous studies examining the factors affecting student performance, effective teaching strategies, and intervention programs. A common theme across the related literature is the persistent challenges in Mathematics education, particularly within the Philippine educational system. Despite the implementation of the K-12 curriculum, which aims to equip students with 21st-century skills, many students struggle with mathematical proficiency. According to Lagon (2023), traditional teaching approaches and even the integration of digital tools have failed to sustain student engagement, resulting in declining interest in Mathematics-related courses. Similarly, Villanueva et al. (2024) conducted a qualitative systematic study highlighting the country's Mathematics education deficiencies. Their findings align with international assessments such as PISA and TIMSS, which consistently place Filipino students at the bottom in terms of mathematical skills and problem-solving

abilities. The study emphasizes that one of the most pressing concerns is the misalignment between curriculum objectives, instructional methods, and assessment tools. While the K-12 curriculum intends to enhance learning outcomes, its effectiveness is hindered by inconsistent teaching practices and varying teacher competency levels. Therefore, the need for continuous professional development for educators is a crucial factor in improving student achievement in Mathematics.

Another parallel observed in the literature is the correlation between student engagement, motivation, and academic success. Widlund et al. (2022) explored how academic expectations influence students' interest in learning. They found that academic burnout increases as students' progress in secondary education, negatively affecting their engagement in Mathematics. This finding aligns with Beltran (2023), who examined various factors impacting the academic performance of Grade 10 learners in Mathematics. The study identified teaching strategies and communication skills as the most significant contributors to student achievement, particularly among low-performing learners. Interestingly, the research suggests that study habits, learning environments, and technological knowledge have a minimal influence on performance. This contradicts previous findings, such as those of Guinocor et al. (2020), who observed that students with strong study habits and discipline tend to perform better academically. These discrepancies suggest that while external factors such as teaching approaches play a vital role, intrinsic factors like motivation, mindset, and personal learning strategies contribute significantly to student success.

Further strengthening the argument on motivation, Comahig and Abuzo (2024) demonstrated that academic self-efficacy directly correlates with students' motivation to learn Mathematics. Their study also established that students' attitudes toward Mathematics influence their learning motivation. Similarly, Saadati and Celis (2023) developed an instrument to measure students' motivational beliefs, self-efficacy, and goal orientations in Mathematics. Their findings indicate that age and institutional differences contribute to variations in motivation, reinforcing the notion that student engagement is not solely dictated by curriculum design but also by individual psychological factors. Hassan Hossein et al. (2023) also support this perspective, highlighting that students with high motivation tend to respond positively to different teaching methods. Their research suggests that categorizing students based on motivation levels allows for more targeted interventions, further underscoring the importance of tailored learning approaches.

Given the challenges students face in Mathematics, several studies have proposed intervention strategies to improve student engagement and performance. Various instructional interventions have been explored, ranging from remediation programs to innovative teaching methods. Magtolis (2023) introduced Project Renrich: Remediation and Enrichment Activities, a program designed to enhance numeracy skills through tailored intervention materials. The study found that providing students with remedial and enrichment tools significantly improved their computation and analytical skills, with many participants achieving higher competency levels in post-assessments. Similarly, Perez (2023) investigated the use of numeracy station activities, incorporating interactive, colorful, and manipulative materials into the learning process. The findings revealed that these resources helped students develop independent learning skills while improving their numeracy abilities.

Other intervention programs have focused on gamified learning and technology-enhanced instruction. Singh et al. (2021) introduced Math Zap, a pedagogical tool designed to develop numeracy skills through mental computation exercises. The research found that this approach significantly improved students' proficiency in fractions, percentages, and decimals while fostering a positive attitude toward Mathematics. Additionally, Gahoy (2024) examined Project AIM (Abating Identified Mathematically Challenged Learners), which employed a range of strategies such as one-on-one tutoring, online resources, and after-school programs. The project focused on providing personalized support, tracking student progress, and using real-life applications to enhance mathematical understanding. The study reported a 67% reduction in the number of learners struggling with numeracy at Ternate Central Elementary School, demonstrating the effectiveness of targeted intervention.

Similarly, alternative teaching approaches such as experiential learning and collaborative strategies have been explored in Mathematics education. Alegre et al. (2018) and Roy and Verma (2020) examined the role of peer-assisted learning in Mathematics education. Their studies demonstrated that peer tutoring fosters academic and social skills, allowing students to participate actively in instruction and assessment. This aligns with the findings by Cagatan and Quirap (2024), who found a strong relationship between collaborative learning and academic achievement in primary school students. Their study emphasized that positive interdependence, shared responsibility, and motivational reinforcement contribute to students' academic success.

Despite the similarities among these studies, key differences arise in their conclusions about the most effective methods for improving Mathematics performance. While some researchers advocate for collaborative strategies and peer-mediated instruction, others emphasize the importance of individualized learning. For example, Bos et al. (2023) argue that intervention effectiveness depends on implementation quality and contextual relevance. Their study suggests that while intervention programs may yield short-term improvements, their long-term impact on student achievement remains uncertain. This highlights a gap in the literature regarding the sustainability of these interventions and their adaptability across different educational contexts.

Another notable difference in the research findings is the role of study habits and external influences. While Guinocor et al. (2020) found that study habits significantly impact academic performance, Beltran (2023) reported minimal effects of study habits and learning environments on Mathematics achievement. Additionally, Aguilar (2021) and Cuder et al. (2023) explored the effects of Mathematics anxiety on student performance, suggesting that students' self-perception and confidence in Mathematics play a crucial role in their learning outcomes. In contrast, Sukarya and Isnurani (2023) emphasized that teacher competence is the most influential factor in

numeracy development, underscoring the importance of instructional quality and pedagogical expertise. These differences indicate the need for further research to examine the interplay of personal, environmental, and instructional factors in shaping students' mathematical abilities.

Moreover, while several studies highlight the importance of teacher training and professional development, there is limited empirical evidence on how these factors directly impact student learning outcomes. Villanueva et al. (2024) and Sukarya and Isnurani (2023) acknowledge that teacher qualifications and continuous training are essential for improving Mathematics education. However, there is a lack of studies that comprehensively analyze the direct correlation between teacher efficacy and student achievement. Further research is needed to explore how professional development programs can be structured to enhance teaching effectiveness and student engagement in Mathematics.

Additionally, while technological interventions such as gamified learning (Singh et al., 2021) and digital instructional scaffolds (Lei & Xin, 2023) have been proposed as effective teaching strategies, their long-term impact on student performance remains uncertain. Studies like Isabelle (2020) and Deci and Ryan (2020) support the idea that gamification enhances student motivation, yet Bos et al. (2023) caution that the success of these interventions depends on proper implementation. This suggests further research on integrating technology in Mathematics education, particularly in understanding its effectiveness across different learner profiles.

To summarize, while numerous studies provide valuable insights into the challenges and interventions in Mathematics education, significant gaps remain in understanding the sustainability and long-term effects of various instructional strategies. Further research is needed to examine the complex interactions among student motivation, teacher efficacy, curriculum design, and intervention effectiveness. By addressing these gaps, future studies can contribute to developing more comprehensive and adaptive strategies that enhance Mathematics learning and improve student achievement.

Methodology

Research Design

The researcher employed a descriptive research approach within a quantitative research design. According to Williams (2007), descriptive research is a study methodology used to examine situations by identifying the characteristics of a particular event through observation. This design was considered most appropriate because it enables the systematic description of the effects of mathematics interventions without manipulating variables. Descriptive research is well-suited for identifying existing practices, implementation levels, and challenges, thereby providing an accurate picture of the intervention programs. A quantitative approach was used since the study focuses on measuring students' motivation and numeracy skills, which can be objectively assessed through surveys and tests. This ensures that the data gathered is measurable, comparable, and suitable for statistical analysis. Surveys and interviews with teachers and students were conducted to identify the interventions implemented, their extent and effectiveness, and the challenges encountered. In addition, students completed assessments to measure numeracy levels and questionnaires to evaluate motivation, both of which provided essential data for the study.

Respondents

The study's respondents include twenty (20) Grade 7 secondary school teachers and one hundred eighty-seven (187) Grade 7 learners involved in the intervention at secondary schools in the Division of Lucena City. A combination of stratified and purposive sampling was employed. Stratified random sampling was used to ensure fair representation of teachers and students across different schools. Purposive sampling was applied to specifically target Grade 7 teachers handling mathematics interventions, along with their corresponding students identified as non-numerate. Grade 7 teachers were chosen because intervention at this level is critical, as students transition from primary to secondary education, often exposing learning gaps in mathematics. The student respondents were those officially enrolled in intervention classes facilitated by the identified teacher-respondents. The non-numerate students were selected based on their performance in diagnostic assessments administered by their schools, which qualified them for inclusion in intervention programs. Demographically, all teacher respondents were licensed secondary school teachers with more than 3 years of teaching experience. They represented a mix of male and female students, reflecting the school's general population. This sampling procedure was designed to provide a balanced representation of both teachers and students, thereby strengthening the validity of the findings and allowing for replication in similar educational settings.

Instrument

A structured research instrument was developed and utilized to gather relevant data. The primary research instrument employed in this study consists of an adapted questionnaire, a questionnaire aided with an interview, a numeracy level test, and a data retrieval form.

For the first instrument, the researcher used the questionnaire adapted from Logan et al. (2021), titled "Validation of the Mathematics Motivation Questionnaire (MMQ) for secondary school students." This instrument will be used to assess students' motivation in mathematics.

The second instrument was a researcher-developed survey questionnaire, supported with interviews, designed to gather data on the mathematics interventions being implemented, their extent of application, their effectiveness, and the challenges encountered. This

instrument underwent a rigorous validation process. Draft questions were presented to experts in the field for validation, including a mathematics teacher, a language teacher, a master teacher, and a school head, for comments and suggestions. After editing the questions based on the recommendations and suggestions, the researcher presented a copy of the questions for final validation. A pilot test was conducted with a small group of respondents to refine unclear items and ensure reliability using Cronbach's alpha. This yielded a coefficient of 0.86, indicating a high level of internal consistency.

The researcher also used the Numeracy Level test provided by the Division Office of Lucena City to identify the learners' level of numeracy skills. This assessment served as a standardized tool to identify learners' numeracy levels and ensured consistency across participating schools. Its use ensured that students were evaluated using an established division-wide measure of numeracy skills, lending credibility and comparability to the findings.

Finally, the researcher used a data retrieval form to collect secondary data from official school records. These records included students' academic performance for the first and second quarters. The form was designed to standardize the collection of data across schools and ensure accuracy. To verify completeness and reliability, the retrieved data were cross-checked against class records and certified by the respective school heads. This procedure ensured that the secondary data were both accurate and valid for use in the study.

Procedure

To collect the necessary data for the study, a series of steps was undertaken.

First, the researcher sought formal permission from the Schools Division Superintendent to conduct the research in selected secondary schools within the Division of Lucena City. Following this, letters were sent to the principals of the participating schools to obtain their consent for their institutions' involvement in the study.

Once approval was granted, the researcher explained the study's purpose and emphasized that the data gathered would be used exclusively for academic purposes, ensuring the authenticity, reliability, and integrity of all responses.

Data on the learners' numeracy levels were obtained through a standardized test administered by their respective Mathematics teachers. This test, adapted from the Division of Lucena City, consisted of 50 items designed to assess students' mathematical skills. Additionally, students in the intervention group completed a questionnaire to evaluate their motivation in Mathematics. This will be done at the start of the school year.

Teachers implemented mathematics interventions across the first and second quarters, while the researcher monitored fidelity through teacher logs, observations, and midline interviews. After the intervention, MMQ assessment was done and second-quarter grades were collected, supplemented by final teacher interviews and record verification. Pre- and post-data comparisons, along with teacher feedback, provided the basis for analyzing the effects of the interventions on students' motivation and numeracy skills.

Data Analysis

The study employed both descriptive and inferential statistical methods, using SPSS as the primary software for data analysis. Descriptive statistics, including frequency counts, percentages, mean, mode, and standard deviation, were used to summarize the data. Frequencies and percentages identified the common mathematics interventions implemented, while means and modes (based on 4-point Likert scales) determined the extent of implementation and highlighted the most common ratings. Students' numeracy test scores were classified into performance categories (non-numerate to above-average numerate) to describe their skill levels. Motivation in mathematics was analyzed through frequencies, means, and standard deviations across different dimensions (intrinsic value, self-regulation, self-efficacy, utility value, and test anxiety).

For inferential analysis, paired-samples t-tests were conducted to determine whether there were significant differences between students' first- and second-quarter grades. In contrast, correlation analysis examined the relationship between the mathematics interventions and students' academic performance. These tests provided evidence of the interventions' effects beyond simple descriptive summaries. Problems and challenges in implementation were analyzed using mean scores and frequencies from the 4-point Likert scale, and the strategies employed to address them were summarized using descriptive statistics.

Ethical Considerations

The researcher sought formal approval from the school head to conduct the study within the selected schools and secured permission from the Division Office as part of the necessary institutional clearances. Since the respondents were secondary learners, informed consent was obtained from both the students and their parents or legal guardians. Teachers also provided their consent for participation. Participation was strictly voluntary, and all respondents were given a clear explanation of the research objectives, procedures, and their rights as participants to ensure informed decision-making.

To uphold confidentiality and anonymity, all collected data was handled with the highest level of care. Identifying details of participants and schools were removed or coded to prevent disclosure of personal information. Only the researcher had access to the raw data, which was stored securely and used solely for academic purposes.

The study further ensured ethical integrity by adhering to principles of academic honesty, avoiding plagiarism through proper citation

of sources, and guaranteeing originality in data collection and analysis. Overall, all ethical protocols were strictly observed in compliance with research standards for studies involving human participants.

Results and Discussion

This section presents the findings according to the study's research questions.

Part I. Mathematics Interventions Implemented in the Division of Lucena City

Table 1. *Mathematics Interventions Implemented in the Division of Lucena City*

Mathematics Intervention	*S1*	*S2*	*S3*	*S4*	*S5*	*S6*	*S7*	*S8*	*S9*	*S10*	*S11*	*S12*	*S13*	*S14*	*S15*	*Frequency*	*Percentage*
1. One-on-one tutorial	✓	✓	✓	✓		✓	✓		✓	✓			✓		✓	10	66.7
2. Peer tutoring	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	13	86.7
3. Small Group Instruction	✓	✓	✓					✓		✓	✓					6	40.0
4. Use of Math Manipulatives	✓		✓	✓	✓	✓	✓			✓		✓	✓		✓	10	66.7
5. Interactive Technology and Software	✓		✓		✓		✓	✓	✓	✓			✓			8	53.3
6. Differentiated Instruction	✓		✓	✓		✓	✓	✓		✓					✓	8	53.3
7. Real-Life Applications	✓	✓	✓	✓			✓	✓		✓			✓		✓	9	60.0
8. Frequent Practice with Feedback	✓		✓						✓	✓						4	26.7
9. Parental Involvement	✓	✓	✓	✓			✓			✓			✓		✓	8	53.3
10. Focus on Mental Math	✓		✓	✓		✓		✓		✓	✓		✓		✓	9	60.0
Others	✓										✓	✓		✓		4	26.7

Legend: *S1–S15 – School 1–15; Frequency – Number of schools implementing the specific mathematics intervention*

Table 1 presents the various mathematics interventions implemented in secondary schools in the Division of Lucena City, along with the frequency and percentage of schools that use each intervention. According to the data, 86.7% of schools use peer tutoring, making it the most often used intervention. In support of this, Alegre et al. (2019) highlighted that peer tutoring interactions positively impact learners' mathematical achievement. The peer tutors act as evaluators of learning, helping the learners improve their skills.

About 66.7% employed one-on-one tutorials and math manipulatives, highlighting their effectiveness in providing personalized learning experiences and concrete representations of mathematical concepts. Real-life applications and a focus on mental math each account for 60%, highlighting the importance of connecting mathematical skills to real-life situations and consistently practicing fundamental skills mentally to enhance understanding of concepts.

About 53.3% of schools use interactive technology and software, differentiated instruction, and parental involvement, emphasizing the role of diverse teaching strategies, interactive activities, and ICT in catering to varied learning needs. Only 40% of schools utilize small group instruction, suggesting that while collaborative learning is encouraged, it is not as widely adopted as peer tutoring.

This finding supports Isabelle (2020), who stated that gamified learning makes educational activities interactive and enjoyable. By utilizing gamified experiential learning, educators can design strategies that capture students' interest, making them more eager to participate and take on new challenges. However, Deci and Ryan (2020) emphasize that while students may show enthusiasm for gamified learning, they must also develop mastery and competency to achieve meaningful academic progress.

Overall, the data suggest that schools in Lucena City employ a mix of traditional and modern instructional strategies to improve numeracy skills and learner motivation, with peer-assisted and application-based learning being the most favored approaches.

Part II. Extent of Implementation of Mathematics Interventions

Table 2 presents the extent of implementation of mathematics interventions in secondary schools within the Division of Lucena City. Results were analyzed using both mean scores and modal values, providing a clearer picture of the consistency and intensity of implementation across schools.

The findings show that Peer Tutoring (M = 3.45, Mode = 4), Small Group Instruction (M = 3.30, Mode = 4), Interactive Technology and Software (M = 3.40, Mode = 4), and Parental Involvement (M = 3.35, Mode = 4) emerged as the most strongly implemented

interventions. The modal value of 4 indicates that the majority of respondents consistently rated these strategies as fully implemented. This demonstrates that collaborative learning, digital integration, and parental support are widely embraced practices in the Division.

Table 2. *Extent of Implementation of Mathematics Interventions in the Division of Lucena City*

Mathematics Intervention	*Frequency*				*Modal Value*	*Mean*	*Verbal Interpretation*
	4	*3*	*2*	*1*			
1. One-on-one tutorial	2	5	13	0	2	2.45	FrI
2. Peer tutoring	11	7	2	0	4	3.45	FI
3. Small Group Instruction	9	8	3	0	4	3.30	FI
4. Use of Math Manipulatives	3	14	1	2	3	2.90	WI
5. Interactive Technology and Software	10	8	2	0	4	3.40	FI
6. Differentiated Instruction	1	14	4	1	3	2.75	WI
7. Real-Life Applications	3	13	4	0	3	2.95	WI
8. Frequent Practice with Feedback	3	14	3	0	3	3.00	WI
9. Parental Involvement	11	5	4	0	4	3.35	FI
10. Focus on Mental Math	3	11	5	1	3	2.80	WI
Others	1	10	9	0	3	2.60	WI

Legend: *4 – 3.26–4.00, Fully Implemented (FI); 3 – 2.51–3.25, Well Implemented (WI); 2 – 1.76–2.50, Fairly Implemented (FrI); 1 – 1.00–1.75, Poorly Implemented (PI)*

Supporting this, Berson and Lorente (2020) emphasized that peer tutoring benefits both tutors and tutees, fostering mastery, self-confidence, and teamwork. Similarly, the use of technology also aligns with Awidi and Klutsey (2024), who found that interactive software enhances confidence, engagement, and mathematics achievement. Parental involvement, backed by Avci and Ozgenel (2024), is consistently associated with stronger motivation and academic outcomes.

Meanwhile, several interventions were rated as well implemented, with a modal value of 3. These include the Use of Math Manipulatives (M = 2.90, Mode = 3), Differentiated Instruction (M = 2.75, Mode = 3), Real-Life Applications (M = 2.95, Mode = 3), Frequent Practice with Feedback (M = 3.00, Mode = 3), Focus on Mental Math (M = 2.80, Mode = 3), and other strategies (M = 2.60, Mode = 3). A mode of 3 indicates that most respondents perceived these interventions as being applied regularly, though not always consistently. Research supports the effectiveness of these approaches when consistently practiced—for example, as demonstrated by Angco and Angco. (2024) concluded that manipulatives improve confidence, motivation, and mathematical skills. Insorio and Libranda (2024) reported that differentiated instruction enhances engagement by addressing diverse learner needs, while feedback is one of the most powerful tools for improving learning (Wisniewski et al, 2020). These results suggest that while these strategies are generally practiced, there is variability in how strongly and consistently they are implemented across schools.

Part III. Level of Numeracy Skills and Motivation of Learners in the Division of Lucena City

Table 3. *Distribution of Learners' Numeracy Level Test Results Across Schools*

School	*Above Average Numerate (45-50)*	*Average Numerate (38-44)*	*Emergent (18-37)*	*Non-Numerate (0-17)*	*Total*
S1	3	17	312	18	350
S2	0	0	45	10	55
S3	0	11	67	7	85
S4	0	47	414	7	468
S5	1	4	47	14	66
S6	0	18	91	10	119
S7	0	0	65	7	72
S8	0	0	43	10	53
S9	0	7	51	9	67
S10	3	33	684	41	761
S11	0	23	390	15	428
S12	3	4	86	10	103
S13	5	5	87	8	105
S14	0	9	13	10	32
S15	1	11	42	11	65
Total	16	189	2437	187	2829
%	0.57	6.68	86.14	6.61	100.00

Table 3 presents the distribution of learners' numeracy level test results across 15 participating schools. The classification of learners into four categories: Above Average Numerate (45–50), Average Numerate (38–44), Emergent (18–37), and Non-Numerate (0–17), which was based on the numeracy level scale adapted from the Division of Lucena City that is used widely across the division.

Out of a total of 2,829 learners, only 16 learners (0.57%) were classified as Above Average Numerate, while 189 learners (6.68%) were identified as Average Numerate. The most significant proportion, 2,437 learners (86.16%), belonged to the Emergent category, indicating that most students are still developing but have not yet attained proficiency in numeracy.

Crucially, 187 learners (6.61%) were identified as non-numerate, falling within the 0–17 score range. They are considered the respondents of the study and serve as the focus of further analysis. These students demonstrate very limited or no mastery of fundamental numeracy skills. Therefore, they struggle with basic mathematical concepts and operations, which may hinder their ability to perform even fundamental arithmetic tasks. The lack of numeracy skills can significantly affect students' academic performance, particularly in subjects that require quantitative reasoning, problem-solving, and logical thinking.

The identification of 187 learners as non-numerate highlights a critical challenge in Mathematics education, as these students demonstrate very limited or no mastery of fundamental numeracy skills. Addressing this issue requires a comprehensive approach that involves targeted interventions, enhanced teacher training, curriculum adjustments, and strengthened parental support. Without immediate and sustained efforts, students' long-term academic success and their real-world mathematical proficiency may be at risk.

In support of this, Tout et al. (2020) emphasized that numeracy is a vital ability that children should be able to apply across various contexts, while Peng and Kievit (2020) noted that numeracy skills are essential not only for academic achievement but also for everyday life. Thus, the failure to develop foundational numeracy skills, as indicated by the large proportion of learners in the Emergent and Non-Numerate categories in this study, may lead to greater learning difficulties and more significant educational setbacks in the future.

Part IV. Student's Motivation during the Implementation of the Mathematics Intervention

Table 4. *Students' Motivation in Mathematics during the Implementation of the Mathematics Intervention*

	Motivation	*Mean*	*Verbal Interpretation*
1	Intrinsic Value	3.28	High Interest in Math
2	Self–Regulation	3.33	Strong Self-Regulation
3	Self–Efficacy	3.24	Moderate Confidence
4	Utility Value	3.24	Very Useful
5	Test Anxiety	3.01	High Anxiety
	Grand Mean	3.22	Moderately Motivated

Legend: *4 – 3.26–4.00, Highly Motivated; 3 – 2.51–3.25, Moderately Motivated; 2 – 1.76–2.50, Less Motivated; 1 – 1.00–1.75, Poorly Motivated*

Table 4 provides an overview of students' motivation in mathematics during the implementation of a mathematics intervention. The data reveal that overall, students showed moderate motivation toward mathematics, as indicated by the grand mean of 3.22, which falls within the "Moderately Motivated" range. This suggests that while students displayed a certain level of interest and engagement with the subject, their motivation could be further enhanced. Specifically, Intrinsic Value emerged as the highest motivating factor, with a mean score of 3.28, categorized as "Highly Motivated."

This indicates that students have a relatively high level of interest in mathematics and find the subject inherently valuable. This aligns with Schunk et al.'s (2020) research, which highlights the critical role of intrinsic motivation in sustaining engagement and academic success.

Another key factor was Self-Regulation, which received a mean of 3.33 and was also categorized as "Highly Motivated." This suggests that students demonstrated strong self-regulation skills, as they were able to set goals, monitor their progress, and adapt their strategies. This is consistent with Zimmerman (2020), who emphasizes that self-regulation is crucial for effective learning, particularly in subjects such as mathematics, where sustained effort and adaptability are essential.

However, while Intrinsic Value and Self-Regulation scores were high, Self-Efficacy and Test Anxiety showed room for improvement. Self-efficacy, which reflects students' confidence in their ability to succeed in mathematics, had a mean of 3.24, falling in the "Moderately Motivated" range. This suggests that students have moderate confidence in their mathematical abilities, a result in line with research by Schunk and Dibenedetto (2020), which demonstrates that students' beliefs in their capabilities are fundamental to their motivation and persistence. Although students showed some confidence, their assessment confidence was a concern, with a mean score of 3.01, indicating "High Anxiety."

This result indicates that students experience a level of anxiety when faced with math assessments, a finding supported by Putwain et al. (2020), who argue that test anxiety can undermine students' performance and motivation, especially in subjects perceived as challenging like mathematics.

Overall, the findings suggest that while students in this study displayed strong interest in mathematics and good self-regulation skills, their lack of confidence in their abilities and the anxiety they experience during assessments could be limiting their motivation. These results align with studies by Linnenbrink and Pintrich (2021), which emphasize that motivation is not only about interest but also about self-belief and emotional responses to academic challenges.

Furthermore, the findings echo the work of Cuder et al. (2023), who highlight that addressing test anxiety and boosting students' self-efficacy are essential to improving overall motivation and academic success in mathematics. To improve students' motivation and performance, future interventions should focus on strengthening their self-confidence and providing strategies to manage test anxiety, ensuring that students feel both capable and less intimidated by assessments. This holistic approach to motivation will help students not only stay engaged with the subject but also persist through challenges and develop the necessary skills for success in mathematics.

Part V. Effect of the Implementation of the Mathematics Intervention on the Numeracy Skills and Motivation of Learners

Table 5. *Frequency and Percentage Distribution of Learners' Academic Performance for the First and Second Quarters*

Learners' Academic Performance	*1st Quarter*		*2nd Quarter*	
	f	*%*	*f*	*%*
Outstanding (90-100)	0	0.00	1	0.53
Very Satisfactory (85-89)	9	4.81	25	13.37
Satisfactory (80-84)	69	36.90	70	37.43
Fairly Satisfactory (75-79)	109	58.29	91	48.66
Did not Meet Expectation (74 and below)	0	0.00	0	0.00
Total	187	100.00	187	100.00

Table 5 shows the distribution of learners' academic performance for the first and second quarters. In the first quarter, most learners (58.29%) were rated as Fairly Satisfactory (75–79), followed by 36.90% in the Satisfactory (80–84) category. Only 4.81% achieved a Very Satisfactory (85–89) rating, and none reached the Outstanding level. Significantly, no learner fell under Did Not Meet Expectation.

In the second quarter, there was a noticeable improvement. The Very Satisfactory group increased to 13.37%, and one learner (0.53%) achieved an Outstanding rating. Meanwhile, the Fairly Satisfactory group decreased to 48.66%, indicating that some learners moved to higher performance levels. The number of learners in the Satisfactory category also slightly increased.

These results suggest a positive trend in academic performance, with more learners achieving higher grades in the second quarter. The absence of failing grades in both quarters highlights the overall academic progress of the group.

Table 6. *Paired Sample Statistics on the First and Second Quarter Grades of Learners under Mathematics Intervention*

Paired Samples Statistics					
		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
Pair 1	1st Quarter	78.965	20	2.0579	.4602
	2nd Quarter	80.025	20	2.0206	.4518

Table 6 presents the Paired Samples Statistics, which compares student performance in Mathematics between the first and second quarters. The mean score for the first quarter is 78.965, while the mean for the second quarter is 80.025, indicating a slight improvement in numeracy skills after implementing a mathematics intervention program. The sample size (N = 20) remains consistent for both quarters, meaning the same students were assessed in both periods.

The standard deviation values (2.0579 for the first quarter and 2.0206 for the second quarter) suggest that the dispersion of scores around the mean is relatively small, indicating that student performance was consistent across both quarters. The standard error of the mean (0.4602 in the first quarter and 0.4518 in the second quarter) indicates that the sample mean is a reliable estimate of the overall population mean. This data suggests that the intervention contributed to an improvement in students' numeracy skills.

To support this, Layug et al. (2021) highlighted that the range of strategies is moderately to highly effective in bridging the gaps between struggling students in Mathematics. Thus, identifying areas for improvement that support students' accomplishments is important in meeting their needs. (Bos et al., 2023)

Table 7. *Paired Sample t-Test Result on the First and Second Quarterly Grades of Learners under Mathematics Intervention*

Paired Samples Test									
		Paired Differences					*t*	*df*	*p-value*
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*				
					Lower	*Upper*			
Pair 1	1st Quarter & 2nd Quarter	-1.0600	.9800	.2191	-1.5187	-.6013	-4.837	19	.000

Table 7 presents the Paired Samples t-test results comparing the first and second-quarter grades of learners who participated in the mathematics intervention. The mean difference between the two quarters is -1.0600, indicating a slight improvement in student scores from the first quarter to the second. The standard deviation (0.9800) and standard error mean (0.2191) suggest that scores across students vary relatively slightly.

The t-value (-4.837) represents the computed t-statistic, which measures the magnitude of the difference between the two sets of scores relative to their variability. With a degree of freedom (df) of 19 and a significance value (p-value) of .000, the test result is statistically significant at $p < 0.05$. This means that the improvement in scores is unlikely due to random chance, suggesting that the mathematics intervention had a meaningful impact on student performance. Overall, the statistically significant results indicate that the mathematics intervention successfully enhanced students' academic performance in numeracy. Future studies may explore additional factors such as motivation, learning strategies, and classroom engagement to further understand the broader impact of intervention programs on student achievement.

Table 8. *Practical Significance of Intervention on the Academic Performance in Mathematics of the Students under Intervention*

Paired Samples Correlations			
		N	*Correlation*
Pair 1	1st Quarter & 2nd Quarter	20	.885

Table 8 presents the paired sample correlations between learners' first and second-quarter grades under the mathematics intervention. The correlation coefficient is 0.885, indicating a strong positive relationship between the two sets of scores. This means that students who performed well in the first quarter tended to maintain their performance in the second quarter, and those with lower scores in the first quarter had similar trends in the next period.

This high correlation implies that the intervention had a consistent and stable impact on students' performance, reinforcing the idea that their improvement in numeracy skills was not due to random factors but was likely influenced by the Mathematics intervention. This could mean the intervention reinforced existing mathematical skills, helping students retain and build upon their knowledge. Therefore, the Mathematics intervention was effective in maintaining and slightly improving student performance.

These findings align with studies that emphasize the importance of structured mathematics interventions. For instance, Hill et al. (2023) found that evaluating targeted interventions significantly aids program implementers in helping students reach their full potential.

Part VI. Problems Encountered and Strategies Used during the Implementation of the Mathematics Intervention

Table 9. *Problems Encountered during the Implementation of Mathematics Intervention*

Problems Encountered	*I-1*	*I-2*	*I-3*	*I-4*	*I-5*	*I-6*	*I-7*	*I-8*	*I-9*	*I-10*	*I-11*	*Composite Mean*	*VI*
	Mean												
1. Insufficient Resources/ Funding Issues	2.05	2.95	3.7	3.05	2.7	2.35	1.4	2.15	1.9	1.75	1.6	2.33	SE
2. Time Constraints	2.95	3.35	2.8	3.5	3.2	3.5	2.9	3.45	2.65	2.75	2.85	3.08	OE
3. Inadequate Parental Involvement	2.4	2.1	1.85	2.05	2.25	1.95	1.65	1.5	2.6	1.6	1.4	1.94	SE
4. Overburdened Teachers	2.75	2.65	2.55	2.7	2.2	1.9	1.45	2.25	1.7	1.3	1.25	2.06	SE
Grand Mean	2.54	2.76	2.73	2.83	2.59	2.43	1.85	2.34	2.21	1.85	1.78	2.35	SE

Legend: *4 – 3.26–4.00, Always Encountered (AE); 3 – 2.51–3.25, Often Encountered (OE); 2 – 1.76–2.50, Sometimes Encountered (SE); 1 – 1.00–1.75, Rarely Encountered (RE); I-1–I-15 – Intervention 1 to 15*

Table 9 presents the problems encountered during the implementation of mathematics intervention programs, which were categorized into four main areas: insufficient resources and funding issues, time constraints, inadequate parental involvement, and overburdened teachers. The table analyzes these problems across various interventions, including one-on-one tutorials, peer tutoring, small group instruction, the use of math manipulatives, interactive technology, differentiated instruction, real-life applications, frequent practice with feedback, parental involvement, and mental math. The mean, composite mean, and grand mean provide insights into how frequently these challenges were encountered and offer an overall assessment of the difficulties faced in implementing these interventions.

The mean scores for each problem area reveal how often the problems were encountered across different interventions. Time constraints emerged as the most significant challenge, with a mean of 3.08, categorized as "Often Encountered" (OE). This indicates that the limited time available for various interventions, particularly those requiring sustained engagement, such as peer tutoring and differentiated instruction, was a recurring issue. Teachers and students alike struggled to find sufficient time for these strategies, which are crucial for individualized support and practical learning. Time constraints were seen as a significant barrier that hindered the full implementation of these interventions.

In addition to time constraints, insufficient resources and overburdened teachers were frequently cited as significant challenges, with means of 2.33 and 2.06, respectively, placing these problems in the "Sometimes Encountered" (SE) category. The issue of insufficient resources, particularly the lack of materials such as math manipulatives and technology, was another barrier that limited the success of interventions. The lack of adequate funding to procure necessary materials prevented teachers from effectively utilizing tools that could have enhanced student engagement and learning. Similarly, overburdened teachers faced difficulties in balancing their teaching responsibilities with the additional workload required to implement these interventions. As a result, many teachers found themselves unable to provide the necessary individualized attention, further compounding the challenges of effective intervention delivery.

Inadequate parental involvement also emerged as a challenge, with a mean of 1.94, placing it in the "Sometimes Encountered" (SE) range. This suggests that while parental involvement was identified as important for the success of interventions such as real-life applications and mental math, it was not consistently achieved. Many interventions requiring family participation struggled due to limited parental engagement. This could be attributed to a lack of structured programs to actively involve parents or insufficient efforts by schools to encourage family support. The need for greater parental involvement is crucial, as research has shown that active family

engagement can significantly improve student outcomes and motivation.

The composite mean provides a broader view of how frequently these challenges were encountered across all interventions. The composite mean for time constraints was the highest at 3.08, reinforcing the notion that time limitations were the most significant barrier faced during intervention implementation. Insufficient resources and overburdened teachers were also challenges that were "often encountered" or "sometimes encountered," with composite means of 2.33 and 2.06, respectively. These results indicate that issues like resource shortages and teacher workload were significant, but they were not as consistent as time constraints. The composite mean for parental involvement was 1.94, showing that although parental engagement was important, it was not consistently present across the interventions.

The grand mean, which averages the composite means of all the problem areas, was 2.35, indicating that the overall challenges encountered during the implementation of mathematics interventions were of moderate frequency. This places the overall challenges in the "Sometimes Encountered" (SE) category. While time constraints were the most frequently encountered challenge, issues of insufficient resources, overburdened teachers, and inadequate parental involvement were also important but not as consistently encountered across all interventions. The grand mean suggests that while these problems posed significant barriers to intervention success, they were not universal across all interventions, and some strategies may have been less affected than others.

These findings are consistent with previous research on the implementation of educational interventions. For instance, Garcia and Weiss (2019) highlighted the negative impact of teacher workload on the quality of intervention programs, noting that excessive non-teaching responsibilities limit teachers' ability to provide the individualized support necessary for student success. Similarly, Utami (2022) emphasized the importance of parental engagement, showing that students whose parents are actively involved in their education tend to perform better academically. In this study, the lack of consistent parental involvement in interventions that required family participation likely contributed to the challenges faced.

In conclusion, the analysis of the mean, composite mean, and grand mean reveals that time constraints, insufficient resources, and overburdened teachers were the most significant barriers to the effective implementation of mathematics intervention programs. These challenges were encountered frequently across multiple interventions, especially those requiring sustained student engagement and the use of specialized materials. The grand mean of 2.35 places these challenges in the "Sometimes Encountered" (SE) category, suggesting that while these issues were significant, they were not insurmountable. Addressing these barriers through increased funding for resources, reducing teacher workload, and improving parental involvement programs could enhance the effectiveness of future mathematics interventions. By tackling these challenges, it is possible to improve the overall success of mathematics interventions and contribute to better student learning outcomes.

Table 10. *Strategies used to Address the Problems Encountered during the Implementation of Mathematics Intervention*

Problems Encountered	*Strategies used to Address the Problem*	*Frequency*	*Percentage*
1. Insufficient Resources/ Funding Issues	-Game Based Activities /alternative for ICT	2	10.00
2. Time Constraints	-Giving of additional enrichment activities and follow up at home	7	35.00
	-Additional time (30 minutes) after class	5	25.00
	-Proper scheduling and monitoring	2	10.00
	-Compress lesson to accommodate bigger issues on interventions	1	5.00
3. Inadequate Parental Involvement	-Consistent encouragement and reminders/ Reward system	3	15.00
4. Overburdened Teachers			
	Total	20	100.00

Table 10 presents the strategies used to address various problems encountered during the implementation of a mathematics intervention. The data includes the frequency and percentage of responses for each strategy.

The most commonly encountered problem was time constraints, which were addressed through several strategies. The most frequently used strategy was providing additional enrichment activities and follow-up at home (7 responses or 35%). This was followed by providing additional time (30 minutes) after class, with five responses (25%) indicating that many implementers recognized the need for more instructional time to deliver interventions effectively. Other strategies for addressing time constraints included proper scheduling and monitoring (10%) and compressing lessons (5%).

Inadequate parental involvement was also a significant issue, addressed by consistent encouragement and reminders, including the use of a reward system (3 responses or 15%). This suggests that fostering family engagement was viewed as an important factor in supporting students' mathematics learning.

Insufficient resources or funding issues were addressed through game-based activities or ICT alternatives, with two responses (10%) demonstrating creativity in overcoming financial limitations by integrating low-cost, engaging methods.

The least addressed issue in the table is overburdened teachers, for which no specific strategy is listed. This implies that this concern

may still lack structured interventions or was less frequently mentioned in this context.

Overall, the table highlights that time constraints are the most pressing challenge in implementing mathematics interventions, and a variety of strategies are being employed to mitigate their impact. The results underscore the need for adequate time allocation, parental involvement, and resource support to ensure successful program delivery.

Conclusions

Based on the findings, the following conclusions were drawn:

The study concluded that secondary schools in the Division of Lucena City implement a range of mathematics interventions designed to address learners' diverse needs. Peer tutoring, one-on-one tutorials, and the use of manipulatives are identified as the most commonly employed strategies. These interventions were found to be generally well to fully implemented, reflecting a strong emphasis on collaborative and group-oriented learning approaches. Findings further revealed that while the majority of students exhibited improvement in numeracy skills, a small proportion (6.61%) remained in the non-numerate category. Learners demonstrated a moderate level of motivation in mathematics, with self-regulation and intrinsic value emerging as key factors (overall mean = 3.22). Statistical analysis confirmed a significant increase in academic performance from the first to the second quarter, affirming the effectiveness of the intervention programs. Nevertheless, several challenges were encountered, including inadequate resources, time constraints, limited parental involvement, and heavy teacher workload. To address these, teachers implemented various strategies such as enrichment activities, extended instructional time, and motivational initiatives. Consequently, an intervention framework was formulated to further improve students' numeracy skills and motivation through structured, engaging, and learner-centered mathematics instruction.

Considering the conclusions drawn from the study, the following recommendations are hereby proposed:

Teachers are encouraged to strengthen the use of effective Mathematics interventions, such as peer tutoring, small group instruction, and the integration of digital learning tools, to enhance students' numeracy and motivation further. They may also provide enrichment and follow-up activities to support non-numerate learners, incorporating engaging, hands-on approaches such as using Mathematics manipulatives and game-based learning. School administrators are advised to allocate sufficient resources, schedule regular intervention sessions, and establish partnerships with local government units and private organizations to address funding constraints and ensure sustainability. Moreover, they may provide continuous professional development programs to equip teachers with innovative, technology-based, and research-informed instructional strategies. Finally, future researchers are encouraged to conduct comparative or longitudinal studies on various mathematics intervention models to examine their long-term effects on learners' numeracy skills and motivation across different educational contexts.

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