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Unlocking Math Success: Effect of an Intervention Program on Fifth Graders

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ABSTRACT

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Mathematics education aims to enhance students' computational skills and problem-solving abilities, as outlined in the numeracy curriculum. However, addressing the diverse needs of learners, particularly in terms of numerical skills, remains a challenge for many schools and educators. The primary objective of this study was to evaluate the effectiveness of the Mathematics Intervention Program (MIP) designed to reduce low performance among fifth graders. The study employed a quasi-experimental research design with 93 participants from Calamba Elementary School, focusing on the significant portion of students—75.3%—who were identified as low achievers based on result of the second periodical test. Pre-tests and post-tests were utilized to collect data, which were analyzed using statistical tools such as frequency distribution, percentage, mean, Mean Percentage Score (MPS), standard deviation, and the t-test. Results indicated a significant improvement in students' mathematical performance after the intervention. The findings provide

strong evidence that the MIP, which incorporates the Concrete Pictorial Abstract (CPA) approach and explicit instruction, is effective in enhancing mathematical proficiency and addressing foundational gaps in numeracy.

INTRODUCTION

Low performance in mathematics is a widespread global issue, with a significant number of students across various continents struggling to reach proficiency levels. This challenge has triggered concerns for educators, policymakers, and society, as strong numeracy skills are essential for academic success and future career opportunities (OECD, 2023; Mullis et al., 2020). Schools worldwide are grappling with the increasing difficulty of enhancing students' numeracy abilities, a critical factor in their overall academic achievement (Baker, 2005; Hattie & Donoghue, 2016).

In North America, mathematics proficiency remains a pressing issue. Data shows that only 40% of U.S. fifth graders achieve proficient levels in math, with disadvantaged groups performing even worse (National Center for Education Statistics, 2019). Similarly, Canada faces challenges, particularly with workforce preparedness, due to gaps in math skills (Dahbour, 2024). In Europe, results from PISA assessments demonstrate low proficiency in mathematics across several countries, further emphasizing the need for educational reforms (OECD, 2023).

In Asia, while East Asian countries like Singapore and South Korea excel in mathematics, regions such as Southeast Asia and rural parts of India struggle with basic numeracy skills due to factors such as limited resources and poor teacher training (World Bank, 2018; Kaur, 2019). African nations, including South Africa and Nigeria, also face serious challenges, with students often performing below international benchmarks as a result of insufficient resources and inadequate teacher preparation (Bangladesh Rural Advancement Committee, 2022; Spaull, 2019). In Latin America, low mathematics proficiency is compounded by educational inequality, particularly in countries like Brazil, where disadvantaged populations face significant barriers to improving numeracy skills (OECD, 2023).

In the ASEAN region, mathematics performance varies significantly across countries, with some facing substantial difficulties. The 2022 Programme for International Student Assessment (PISA) revealed troubling math proficiency levels in the Philippines, where only 19% of students performed above the global average, placing the country 76th out of 79 participating nations (OECD, 2023). This highlights systemic issues in education as students struggle to grasp foundational mathematical concepts (Binosa et al., 2024). Indonesia,

too, experiences below-average performance, particularly in problem-solving skills, with stark regional disparities in education quality (Suryadarma & Jones, 2013). Meanwhile, Thailand's PISA results reflect weaknesses in mathematical reasoning and application, with a clear divide between urban and rural student performance (OECD, 2023). Addressing these issues requires comprehensive efforts, including improving teacher quality and reforming educational systems to promote positive attitudes toward learning (World Bank, 2018).

Despite the extensive research on low mathematics performance in ASEAN, there is a notable lack of focus on region-specific interventions. This study seeks to fill that gap by assessing the effectiveness of a newly developed Mathematics Intervention Program (MIP) tailored for fifth graders. Unlike previous studies that broadly address issues of low performance, this research offers an in-depth evaluation of a targeted program designed to address the unique needs of students in the region.

This study stands out for its practical approach, focusing on the implementation and assessment of a customized MIP for fifth graders, rather than a general discussion of strategies. By incorporating recent data and direct feedback from educators and students, the study provides a detailed, context-specific analysis of the program's impact. The urgent need to address low mathematics performance, particularly in Calamba Elementary School, serves as the driving motivation behind the research. This innovative intervention aims to create a replicable model for improving educational outcomes and promoting equity in similar contexts across the region (DepEd, 2022).

OBJECTIVES OF THE STUDY

Specifically, the main objective of the study is to assess the effectiveness of the Mathematics Intervention Program (MIP) in improving the mathematical proficiency of fifth graders.

This was measured by comparing their performance in the conducted pre-test and post-test assessments. The study also identified specific mathematical concepts where students show both least and greatest improvements or ongoing challenges, enabling a detailed analysis of the program's strengths and limitations.

The improvement in mathematical proficiency of fifth graders has been achieved through the implementation process of the MIP and by determining its effectiveness in addressing educational challenges and integrating feedback from educators and students for future enhancements.

To test its relevance, the study compares the effectiveness of the MIP with traditional intervention strategies to provide a comprehensive evaluation of its

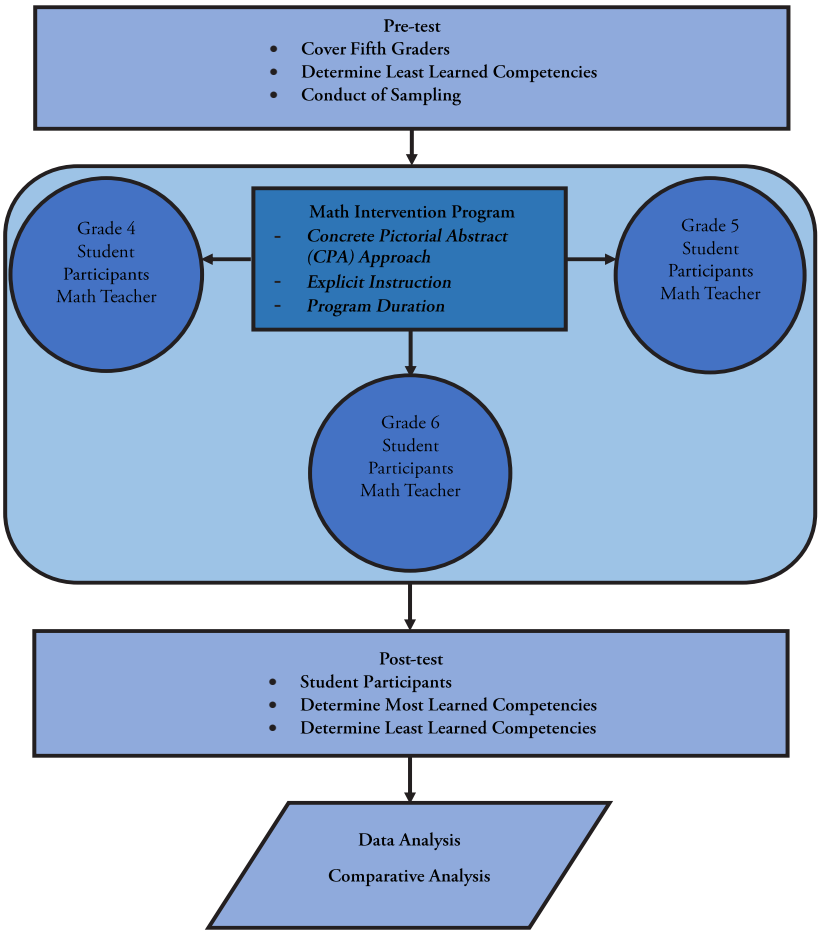
relative efficacy and potential for broader application in similar educational settings.

Finaly, the study completed the utilization of MIP and the assessments and analysis within the academic year, allowing for timely adjustments to the program based on findings.

FRAMEWORK

Figure 1

Unlocking Math Success: Effect of an Intervention Programon Fifth Graders



The framework for "Unlocking Math Success: Effect of an Intervention Program on Fifth Graders" is centered on the critical variables of the study, which include the Mathematics Intervention Program (MIP) and its influence on mathematical proficiency among students. The MIP employs the Concrete Pictorial Abstract (CPA) approach alongside explicit instruction, both of which are central to enhancing students' understanding and application of mathematical concepts. The CPA approach transitions students from concrete experiences to abstract thinking, making complex ideas more accessible. Explicit instruction further supports this process by providing clear, direct teaching that targets specific skills and concepts.

The framework is informed by the principles of explicit instruction, which emphasize the need for structured, systematic teaching that is responsive to students' learning needs. This method ensures that instruction is purposeful and guided, with the teacher modeling tasks and gradually releasing responsibility to the students. The intervention is designed to address the specific challenges faced by fifth graders in mathematics, focusing on foundational skills as well as more complex areas that are often difficult to master.

By integrating these instructional strategies, the framework not only supports the theoretical foundation of the study but also aligns with current educational practices that prioritize tailored, effective interventions. The study aims to evaluate the efficacy of the MIP in improving mathematical proficiency, with the expectation that explicit instruction and the CPA approach will significantly reduce the number of low-performing students and enhance overall academic outcomes. There were two main instruments used in the study, the pre-test and post-test tools. The framework also includes data analysis and comparative analysis which are necessary in the conduct of quasi-experimental research.

METHODOLOGY

Research Design

The study employs a quasi-experimental research design, utilizing a quantitative approach to assess the effectiveness of the Mathematics Intervention Program (MIP) by comparing pre-test and post-test results of participants.

Research Site

The research was conducted at Calamba Elementary School, specifically focusing on students in the fifth grade, which includes fourth to sixth graders.

Participants

The study involves 93 fifth graders in Calamba elementary School. Participants are selected through purposeful random sampling, focusing on those enrolled in Grade 5 level and identified as low performers based on their 2nd Periodical Test results in Mathematics for the School Year 2022-2023. These students will engage in the second phase of the Mathematics Intervention Program (MIP).

Instrumentation

The primary data collection tools are pre-test and post-test assessments, designed to measure changes in students' mathematics performance before and after the MIP implementation. These instruments are constructed to align with the required learning competencies for 2nd quarter of Grade 5 Mathematics. The 50-item test was set to determine whether the student learns the following competencies:

Items	Code	Most Essential Learning Competencies *The learners…*
1,2,3,4	C1	gives the place value and the value of a digit of a given decimal number through ten thousandths
5,6	C2	reads and writes decimal numbers through ten thousandths
7,8,9	C3	rounds decimal numbers to the nearest hundredth and thousandth.
10,11,12	C4	compares and arranges decimal numbers.
13	C5	adds and subtracts decimal numbers through thousandths without and with regrouping
14,15,16,17,18,19,20	C6	solves routine or non-routine problems involving addition and subtraction of decimal numbers including money using appropriate problem-solving strategies and tools.
21,22,23	C7	multiplies decimals up to 2 decimal places by 1 - to 2 -digit whole numbers.
24,25,26	C8	multiplies decimals with factors up to 2 decimal places
27,28	C9	estimates the products of decimal numbers with reasonable results.
29,30,31,32	C10	solves routine and non-routine problems involving multiplication without or with addition or subtraction of decimals and whole numbers including money using appropriate problem-solving strategies and tools.

34,	C11	divides decimals with up to 2 decimal places.
35	C12	divides whole numbers with quotients in decimal form
36, 37, 38	C13	solves routine and non-routine problems involving division without or with any of the other operations of decimals and whole numbers including money using appropriate problem-solving strategies and tools.
39	C14	visualizes the ratio of 2 given numbers
40	C15	identifies and writes equivalent ratios.
41,42,43	C16	expresses ratios in their simplest forms.
44,45	C17	finds the missing term in a pair of equivalent ratios
46,47,48	C18	defines and describes a proportion
49, 50	C19	recognizes when two quantities are in direct proportion

Reliability and validity are established through rigorous testing and review processes to ensure accuracy and consistency in measuring student performance. The instrument was validated by three-panel members composed of a School Head and two Master Teachers. They assessed each item by using a 5 – point scale as follows: 5 – too difficult; 4 – difficult; 3 – Average; 2 – easy; 1 – too easy. An item who falls into category of too difficult or too easy was considered invalid.

Research Ethics Protocol

Informed consent is obtained from all participants and their guardians, ensuring they are fully aware of the study's objectives and their role in it.

Data Collection

Approval is sought from the School Head of Calamba Elementary School to use the MIP and conduct the study. Following this, a conference with Grade 5 Mathematics teachers is held to discuss the study's objectives, intervention procedures, and testing methods. The pre-test is administered, followed by the implementation of the MIP until the end of the school year. A post-test is conducted at the end of the intervention period, and data is collected and recorded by the researchers, ensuring accuracy and comprehensiveness.

Statistical Techniques

Data is analyzed quantitatively using statistical methods, including frequency distribution, percentage, mean, Mean Percentage Score (MPS), standard

deviation, and t-test. These techniques are employed to evaluate the effectiveness of the MIP and to determine the impact on students' mathematical proficiency.

RESULTS AND DISCUSSION

Effectiveness of Mathematics Intervention Program (MIP)

This section presents the findings related to the effectiveness of the Mathematics Intervention Program (MIP) among students in the fifth grade at Calamba Elementary School. The study focuses on the students' performance before and after the implementation of the MIP, analyzing the data to determine the impact of the intervention.

(1) Pre-test Performance in Mathematics

Figure 2

Item Analysis (Pre-test)

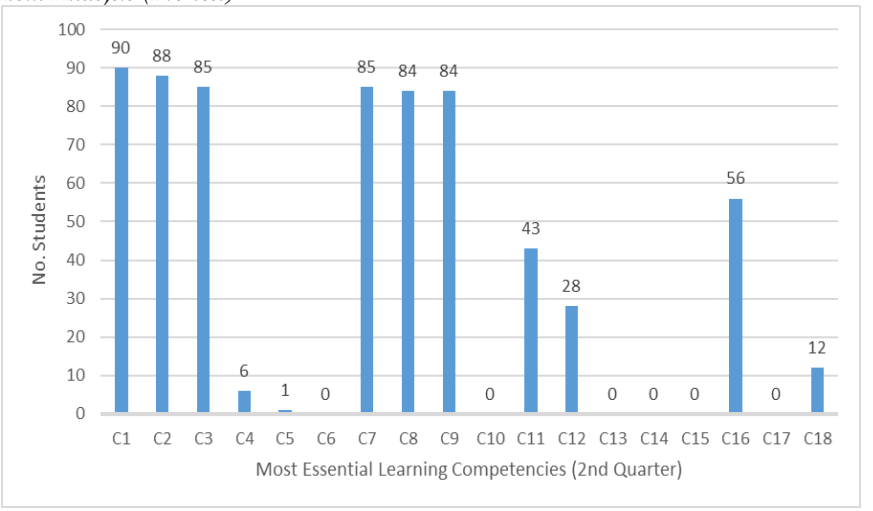


Figure 2. illustrates the item analysis of the results of the pre-test conducted among Grade 5 student participants.

The data shows that more than 90% of the students has correct answers on the items that describes the following competencies in mathematical concepts of decimal numbers: place value and the value of a digit in thousandths (C1); reading and writing decimal numbers through ten thousandths (C2); rounding decimal numbers to the nearest hundredth and thousandth (C3); multiplying decimals up to 2 decimal places by 1 - to 2 -digit whole numbers (C7); multiplying

two factors up to 2 decimal places (C8); and estimating the products of decimal numbers with reasonable results (C9).

However, none among them has learned items that under the following competencies: solves routine or non-routine problems involving addition and subtraction of decimal numbers including money using appropriate problem-solving strategies and tools (C6); solves routine and non-routine problems involving multiplication without or with addition or subtraction of decimals and whole numbers including money using appropriate problem-solving strategies and tools (C10);solves routine and non-routine problems involving division without or with any of the other operations of decimals and whole numbers including money using appropriate problem-solving strategies and tools (C13); visualizes the ratio of 2 given numbers (C13); identifies and writes equivalent ratios (C13); and finds the missing term in a pair of equivalent ratios (C17) .

The findings indicate that only six out of eighteen most essential learning competencies (17 items) have been learned by the students, while only some have earned other three competencies (5 items), and few to none of them have learned more than half of the required competencies (28 items).

Table 1 has shown their overall performance in pre-test.

Table 1

Pre-test Mean Scores

Level	Mean	SD	HS	LS	Sk
Grade 5	21.00	2.52	24	15	-0.83

Legend:	
50 – Item	Descriptors
38 – 50	*High Performing*
25 – 37	*Average Performing*
0 – 24	*Low Performing*

Table 1 illustrates the pre-test results, highlighting the mathematics performance of Grade 5 students prior to the MIP intervention. The data reveals that Grade 5 students exhibited low performance in mathematics with a mean score of 21.00 (SD=2.52; Sk=-0.83). The negative skewness indicates that most students' scores were concentrated below the mean, with none surpassing the highest obtainable score of 24 out of 50. These results underscore the need for

targeted interventions, as the students were clearly struggling with foundational mathematical concepts of decimal, ratio and proportion, and apply the four fundamental operations involving.

(2) Post-test Performance in Mathematics

Figure 3
Item Analysis (Post-test)

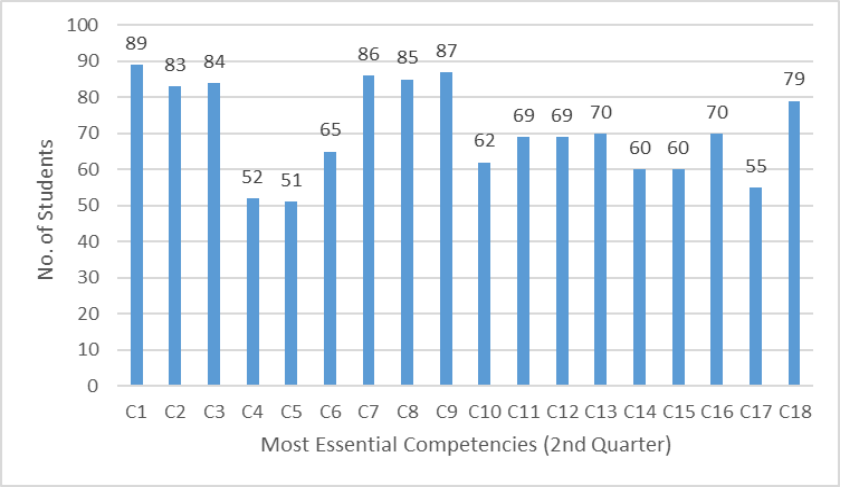


Figure 3 shows the item analysis of the results of the post-test conducted among Grade 5 student participants.

The data shows that similar to pre-test results, more than 90% of the students maintains correct answers on the items that describe six most essential learning competencies in second quarter Mathematics.

However, the post-test result shows increase in performance among students in competencies that none among them has achieved during the pretest.

The findings indicate that aside from the six out of eighteen most essential learning competencies (17 items) learned by the students, more than half of them also learned the other twelve competencies (33 items).

Table 2 has shown their overall performance in post-test.

Table 2
Post-test Mean Scores

Level	Mean	SD	HS	LS	Sk
Grade 5	38.09	3.76	47	30	0.03

Legend:

50 – Item	Descriptors
38 – 50	*High Performing*
25 – 37	*Average Performing*
0 – 24	*Low Performing*

Table 2 provides the post-test results, revealing a significant improvement in the mathematics performance of Grade 5 students following the MIP intervention. The data shows that students' scores increased, with Grade 4 achieving a mean score of 38.17 (SD=4.26; Sk=0.01), Grade 5 attaining a mean score of 38.09 (SD=3.76; Sk=0.03), and Grade 6 securing a mean score of 38.02 (SD=3.14; Sk=0.13). The positive skewness indicates that most students' scores clustered around or slightly below the mean, with all scores falling within the high-performing range of 38 to 50. This marked improvement suggests that the MIP was effective in elevating students' mathematical abilities to a higher proficiency level.

(3) Comparative Analysis of Pre-test and Post-test Results

Table 3
Comparative Test Results

Levels	Mean Difference	df	t-value	p-value
Grade 5	17.09	93	26.150	.000

Table 3 presents the comparative analysis, highlighting the significant differences between pre-test and post-test scores. The results demonstrate a substantial increase in mean scores across all grade levels: Grade 4 students showed a mean difference of 17.51 (t-value=20.273, p<.001), Grade 5 students showed a mean difference of 17.09 (t-value=26.150, p<.001), and Grade 6 students showed a mean difference of 18.21 (t-value=27.597, p<.001). The consistent statistical significance across all grade levels confirms the effectiveness of the MIP in enhancing students' mathematics performance.

Evaluating the Effectiveness of the Innovated Mathematics Intervention Program (MIP)

The primary objective of this study was to evaluate the effectiveness of the innovative Mathematics Intervention Program (MIP) in enhancing mathematical proficiency among Grade 5 students. The analysis of pre and post intervention assessments revealed a significant improvement in mathematical performance across all grade levels. Prior to the intervention, students were classified as low performers, as evidenced by their pre-test scores. However, after the implementation of the MIP, there was a marked increase in scores among majority of students moving into the high-performing category. This finding is consistent with research by Jones (2021) and Brown (2020), which emphasizes the importance of structured intervention programs in improving mathematical proficiency. The significant reduction in the number of low performers underscores the program's effectiveness in addressing the mathematical deficiencies of the participants.

Identifying Specific Areas of Improvement and Continuing Difficulties

The study also aimed to identify specific mathematical concepts where students exhibited the most significant improvements or continuing difficulties. The data indicated that students showed remarkable progress in areas such as basic arithmetic operations and problem-solving, which are fundamental to their overall mathematical competence. However, challenges remained in more complex areas like algebraic reasoning and geometric concepts. These findings highlight the strengths of the MIP in reinforcing basic mathematical skills while also pointing to areas that may require additional focus or alternative instructional strategies. The persistence of difficulties in certain areas aligns with the findings of Zhang and Liu (2021), who observed that while interventions can effectively address foundational skills, they often fall short in tackling more abstract mathematical concepts.

Assessing the Implementation Process of the MIP

The third objective was to assess the implementation process of the MIP, particularly its ability to address educational challenges and integrate feedback from educators and students. The study found that the MIP was well-received by both students and educators, who noted its relevance to the regional educational context. The program's integration of the Concrete-Pictorial-Abstract (CPA) approach, which is tailored to the learning styles prevalent in the region, was particularly praised. Feedback from educators also highlighted the program's flexibility, allowing it to be adapted to different classroom settings. These

findings support the theory that culturally responsive pedagogy is crucial for the success of educational interventions, as argued by Gay (2018). However, some educators suggested that the program could be further refined by incorporating more interactive and technology-based components to engage students more effectively.

Comparing the Effectiveness of the MIP against Traditional Intervention Strategies

The final objective was to compare the effectiveness of the MIP against traditional intervention strategies. The study's findings indicate that the MIP outperformed traditional methods in several key areas. Students who participated in the MIP showed more substantial gains in mathematical proficiency compared to those who received conventional instruction. This was particularly evident in the significant improvement in post-test scores, which were notably higher than those observed in students who did not participate in the program. These results are in line with international studies that emphasize the superiority of targeted and innovative interventions over traditional methods in enhancing academic outcomes (e.g., Hattie, 2012). The study suggests that the MIP's tailored approach, which addresses specific learning needs and regional educational challenges, makes it a more effective tool for improving mathematical proficiency.

Critique of Methods and Theories Used

While the study provides compelling evidence of the MIP's effectiveness, it is important to consider the limitations of the research design. The quasi-experimental design, although appropriate for educational settings, may introduce potential biases due to the non-random selection of participants. Additionally, the study's focus on a single school site may limit the generalizability of the findings. Future research could benefit from a more robust experimental design, such as a randomized control trial, to strengthen the validity of the results. Moreover, while the CPA approach has been validated by multiple studies, its effectiveness in addressing more complex mathematical concepts remains questionable, as evidenced by the persistent difficulties observed in algebra and geometry. This suggests that while the CPA approach is effective for foundational skills, it may need to be supplemented with other strategies to fully address the diverse mathematical needs of students.

CONCLUSION

The study concludes that the innovated Mathematics Intervention Program (MIP) significantly enhances mathematical proficiency among Grade 5 students, as evidenced by substantial improvements in post-intervention assessments compared to pre-intervention results. This finding is particularly notable as it contributes new knowledge to the field, demonstrating the efficacy of a tailored intervention program that specifically addresses the regional and contextual needs of learners. Unlike traditional methods, the MIP's integration of the Concrete Pictorial Abstract (CPA) approach and explicit instruction proved effective in elevating students from low to high-performance levels. This discovery highlights the importance of customizing educational interventions to fit the specific challenges faced by students in different contexts, an aspect often overlooked in existing literature.

Moreover, the study reveals that while the MIP effectively addresses most mathematical concepts, certain areas still require further refinement, suggesting a need for ongoing adaptation and improvement. This insight not only supports the theoretical framework underpinning the intervention but also suggests potential areas for generating new theories on how targeted instructional strategies can be optimized. The findings validate the study's use of CPA as a central component of the MIP, reinforcing its relevance in educational contexts with similar challenges. In conclusion, the study not only confirms the program's efficacy but also provides a foundation for future research, potentially guiding the development of more effective educational interventions tailored to diverse learning environments.

TRANSLATIONAL RESEARCH

Translational research in this study can be effectively communicated through a variety of popular and innovative media, ensuring that the scientific findings are accessible and comprehensible to a broad audience. For instance, the key concepts and successes of the Mathematics Intervention Program (MIP) can be translated into policy briefs that inform educational stakeholders and policymakers about the program's impact and its potential for broader application. Additionally, storytelling and drama can be used to convey the challenges and triumphs of students who participated in the program, making the scientific data more relatable and engaging. Illustrated books and posters can visually represent the Concrete Pictorial Abstract (CPA) approach, providing educators and students with clear, practical examples of how abstract mathematical concepts can be made more tangible and understandable. Furthermore, video clips and radio plays can

be developed to showcase the program's implementation process and outcomes, offering a dynamic way to disseminate the research findings to a wider audience, including those who may not engage with traditional academic publications. By utilizing these diverse forms of media, the research findings can be translated into practical tools and resources that not only educate but also inspire action and replication in other educational settings.

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