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# THE MODERATING ROLE OF READING COMPREHENSION IN THE NEXUS BETWEEN PERCEIVED PROBLEM-SOLVING ABILITY AND MATHEMATICAL COMPETENCE AMONG HIGH SCHOOL STUDENTS

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**Abstract.** Reading comprehension plays a pivotal role in students' mathematical competence by enabling them to interpret problem statements, extract relevant information, and implement effective problem-solving strategies. This study investigated the moderating role of reading comprehension in the relationship between students perceived problem-solving ability and mathematical competence. A total of 300 Junior High School students from six public schools in the Division of Pampanga were selected using a stratified sampling technique. Findings indicated that students self- reported high levels of perceived problem-solving ability, reading comprehension, and mathematical competence. Regression analysis revealed that perceived problem-solving ability significantly predicted mathematical competence. Moreover, reading comprehension was found to moderate this relationship, strengthening the link between problem-solving perception and actual mathematical performance. These results suggest that reading comprehension is essential not only for understanding mathematical problems but also for actualizing students' problem-solving potential. The study recommends that educators incorporate reading strategies into mathematics instruction to enhance both literacy and numeracy, particularly for students with lower reading proficiency.

## Introduction

A significant number of students encounter difficulties with reading comprehension, which can negatively impact their academic development. These challenges often manifest as trouble recognizing words, linking ideas within a text, and grasping the central message. While some learners may accurately decode written words, they frequently struggle to understand the meaning behind the text. For example, when engaging with a passage, such students might overlook key details or fail to identify the author's main argument, hindering their ability to complete related assignments successfully.

Burns and Kidd (2020) describe reading comprehension as an active process where readers really engage with the text, thinking about what they are reading and making a sort of mental conversation between their understanding and what the author is saying. Morsy et al. (2020) see it as a mix of knowledge and thinking skills that help people understand written info. Basically, reading comprehension is a lively, reflective activity where readers put together the meaning by carefully interpreting the text.

Reading is a really important part of the school curriculum because it is the foundation for learning in all other subjects. When students struggle with reading, it can be tough for them to grasp key ideas and use what they have learned in different classes. So, just being able to sound out words is not enough; they also need to really understand what they are reading since the main goal is to make sense of the text. If students have trouble understanding what they read, it can hurt their performance across various subjects, showing how essential good comprehension skills are for overall success (Woolley, 2021). Teachers focus a lot on reading comprehension during lessons and assessments because it is closely linked to how well students do academically. Being able to understand reading material is often seen as a sign that meaningful learning has happened. García-Madruga et al. (2014) also highlight the connection between thinking skills, comprehension, and academic performance, pointing out how important cognitive processes are for understanding texts. Because of this, reading skills and school success are closely tied—most classroom tasks involve interpreting, analyzing, and using written information. When students have strong reading comprehension, they can respond more accurately, think critically, and come up with new ideas, which all help them grow and do well in school.

Afifah et al. (2020) did a study with fifth graders in the Kebumen Sub-district to see how reading skills relate to solving math problems. They found a pretty decent link between the two, with a correlation of $r = 0.587$, which suggests that kids who understand reading better generally also do better with math problems. They also discovered that reading comprehension accounted for about 25.8% of the differences in how well students could solve math problems. The study highlighted how important different language skills—like understanding word connections, common word pairs, and word structure—are for improving reading skills. Similarly, Akun (2022) looked at 49 studies from around the world with over 37,000 people involved. It found pretty clearly that reading skills and success in math go hand in hand. The study also highlighted that problem-solving skills play a big role here, meaning students who are better at reading usually also do better at solving math problems. Cruz et al. (2022) mentioned that there isn't enough research on other language factors that might influence understanding, so more studies are needed. Additionally, Amador (2022), in a paper published in the International Journal of Elementary Education, found that sixth graders with stronger reading skills tend to have a more positive attitude towards tackling word problems. Basically, good reading skills not only help with math but also make students more confident and motivated to solve problems.

Reading comprehension is a fundamental cognitive ability that allows individuals to understand ideas, gather relevant information, and integrate knowledge meaningfully. This skill is especially vital in problem-solving, as it supports the application of learned concepts to real-world contexts, thereby transforming understanding into actionable outcomes. According to Harangus (2019), being able to effectively solve problems is a key indicator of a strong education system. Developing this competence enables students to use their comprehension skills across various academic disciplines, emphasizing the importance of in-depth understanding when facing diverse challenges. Problem-solving, being a multifaceted mental activity, includes recognizing issues, breaking them down into manageable parts, and devising appropriate strategies for resolution (Oliveri et al., 2017). Research also points to the value of

problem-solving in reaching academic and personal milestones (Mefoh et al., 2017), handling everyday problems (Sukariasih et al., 2020), and fostering critical thinking by shaping how learners structure and express their ideas (Fitriani et al., 2020).

In international evaluations like the Programme for International Student Assessment (PISA), the concept of problem-solving competence is characterized as the ability to address intricate, real-world, and interdisciplinary problems effectively. This skill involves the application of various cognitive processes, with a particular emphasis on reasoning, critical thinking, and logical analysis. Based on Jonassen (2021), this skill is not just about finding answers—it is also about understanding complex problems, analyzing the right information, and coming up with good strategies to solve them. It emphasizes the importance of higher-level thinking that helps people handle different and unpredictable situations, whether in school or everyday life. Building strong problem-solving skills is really key for keeping up with fast tech changes and our connected world, where you often need to pull together knowledge from different areas and think on your feet in new situations.

This assumes of domain-general skills and strategies that are applicable in a range of settings. Further, since problem solving competence is seen as a desirable educational goal, math and science educators have concentrated on helping students become competent in problem solving and reasoning in their respective fields (Kind, 2018; Kuo et al., 2018).

Problem-solving remains a critical focus in education, and it is highly dependent on foundational skills such as reading comprehension. Among the various cognitive abilities required, the relationship between understanding text and effectively solving problems is especially significant. Word problems often test not just numerical understanding but also reading proficiency, including vocabulary. Students frequently struggle—not due to a lack of math knowledge, but because they fail to comprehend the language of the problem. A typical issue involves difficulty in translating written scenarios into mathematical expressions. This highlights the importance of fully understanding a problem before solving it. Can (2020) emphasizes that enhancing reading skills is essential for navigating math word problems effectively. When students read well, they are better able to interpret contextual information and use it to guide their problem-solving strategies, allowing for more logical and organized solutions.

Pimperton and Nation (2020) looked into how students approach different math tasks, especially comparing word problems to just numerical calculations. They found that students' performance varied a lot depending on their reading skills. Basically, students who had a hard time with reading could often do simple calculations pretty well but struggled a lot more with word problems that required understanding and interpreting written language. This shows that being able to read well is really important for tackling math problems that involve language and more complex thinking. Other studies, like those by Fuchs et al. (2015) and Pape (2004), also support this idea, pointing out that strong reading skills are key for understanding the context and instructions in word problems. Overall, reading comprehension is seen as a big factor in how well students do in math, especially when they need to interpret text to find solutions. This just shows how important it is to include reading strategies in math lessons to help students tackle language-heavy problems more easily. According to Vilenius-Tuohimaa and colleagues (2018), strong reading skills are key to doing well in math, especially when

students need to understand written instructions or work through multiple steps. Overall, boosting reading skills can really help students handle tougher math problems, highlighting how closely linked literacy and math are in learning.

Furthermore, Can (2020) pointed out that language skills, especially reading comprehension, are pretty important for helping students get better at logical thinking and understanding math. To solve problems well, students need to understand both the language and numbers involved, and figure out what steps to take. The OECD runs a test called PISA every three years to check how 15-year-olds around the world are doing in reading, math, and science. Back in 2018, the Philippines was near the bottom of the list—79 out of 79 countries in reading—and scored way below the OECD average. That shows a lot of Filipino students still struggle with basic literacy. There was also a study on science reading skills among high schoolers, and it found that only about 7% really had it down, 49% were close, and 44% were still having a tough time. The 2022 PISA results showed a little improvement—Philippines moved up to 76th place out of 81 countries in reading, up from 79th in 2018—but they're still near the bottom overall in reading, math, and science. Beyond simple arithmetic, the capacity to tackle mathematical problems depends greatly on problem-solving skills. These skills, which allow students to convert abstract mathematical concepts into practical applications, are essential components of mathematical education. However, many students encounter difficulties that can sometimes hinder their problem-solving efforts. This is likely because mathematics extends beyond mere numbers (Frensch & Funke, 2019); it involves understanding the meaning of numbers and symbols, not just recognizing them.

Timmermans et al. (2017) mentioned that being good at solving word problems is really key to doing well in math. Singer and Strasser (2017) added that it is not just about crunching numbers; understanding and using language plays a big role too. For example, Greisen et al. (2021) discovered that students who struggle with understanding the language in instructions tend to do worse on math tests, and this is especially common among students from immigrant backgrounds. Plus, research shows that kids often find word problems tricky not because they don't understand the math itself, but because they have a hard time figuring out what the instructions are asking for — mainly because their language skills are still developing (Pape, 2004).

Murcia (2018) pointed out that solving math problems effectively usually needs both good reading skills and numerical thinking. Students with at least a decent grasp of the language usually get the problem better by catching clues from the context and using their background knowledge. In the Philippines, Silva and colleagues (2006) discovered that reading struggles and different learning styles really affect how students perform in math, showing how important reading comprehension is for understanding math problems. Plus, Trance (2013) studied students solving problems aloud and found that a common challenge was turning word problems into the right math formulas.

While numerous studies have explored the direct relationship between problem-solving ability and mathematical competence, limited research has examined how reading comprehension, a key cognitive-linguistic skill, moderates this relationship among junior high school students. These days, there is a lot of focus on how students' problem-solving skills connect to how well they do in math. As teachers and researchers look into what helps students

succeed in math, reading comprehension has come up as a pretty important factor. Since good reading skills are key for understanding math concepts, instructions, and problem statements, this study looks at how reading comprehension might influence the link between problem-solving abilities and math achievement. By exploring how problem-solving, reading skills, and math performance all interact, the research hopes to uncover ideas that can help improve teaching methods. The main goal is to give teachers evidence-based strategies to help students learn better and do well academically. Overall, this study emphasizes the importance of including reading comprehension in math education and adds to our understanding of how cognitive skills develop in different learning situations.

## 1. Conceptual/ Theoretical Framework

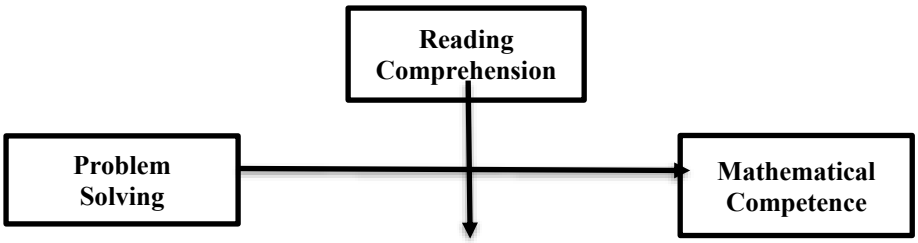


*Figure 1. The Proposed Model of Problem Solving Skills, Reading Comprehension, and Math Competence Relationships (Model 4 of Baron and Kenny, 1986) (Model 1 of Baron and Kenny, 1986)*

Figure 1 illustrates the conceptual framework that underpins this research. It draws inspiration from the model introduced by Bergqvist and Österholm (2010), which explores the relationship between reading and mathematical problem-solving. Unlike traditional linear models that treat reading and problem-solving as separate phases, this framework highlights their interdependent nature. It emphasizes the reciprocal relationship between cognitive elements (such as mental representations) and behavioral actions. Notably, it incorporates a cyclical perspective, proposing that behavioral outcomes can influence cognitive processes just as cognitive functions inform behavior. The model merges two foundational theories: Kintsch's (1998) framework on mental representation and Lithner's (2008) theory concerning the behavioral aspects of task-solving. In this study, the framework positions students' self-perceived problem-solving ability as the independent (predictor) variable, reading comprehension as the moderating factor, and mathematical competence as the dependent (outcome) variable.

**Objectives**

To describe the levels of students' perceived problem-solving skills, reading comprehension, and mathematical competence.

To determine the significant effect of students` perceived problem-solving ability to their mathematical competence

To investigate whether students` reading comprehension significantly moderates the relationship between perceived problem-solving ability and mathematical competence.

## 2. Methods

### 3.1. Research Design.

The researcher used a quantitative research approach specifically Complex Correlational Design. A complex correlational design is a research approach that examines the relationships among multiple variables simultaneously, often involving both quantitative and categorical data. Unlike simple correlational studies that focus on the relationship between two variables, complex correlational designs assess how several variables interrelate, providing a more comprehensive understanding of the data (Jhiangani et al., 2015). As Cohen et al. (2003) put it, this approach checks both how closely connected two things are and if one can actually predict the other. In this case, the team wanted to see if students' own views on their problem-solving skills could help predict how well they do in math, and they also looked at whether reading comprehension influences this relationship.

### 3.2. Respondents

A total of 300 junior high school students were carefully selected from six different schools within the Pampanga division. To achieve a balanced and representative sample, the selection process involved choosing two schools from each of the three designated size categories—small, medium, and large—thus ensuring that each category was adequately represented. The overall sample size was determined through a rigorous statistical process known as a power analysis. In conducting this analysis, the researchers set a significance level ($\alpha$) of 0.05, which indicates a 5% risk of committing a Type I error, and aimed for a statistical power ($1 - \beta$) of 0.80, meaning there was an 80% chance of detecting a true effect if one existed. The guidelines outlined by Pilot and Hungler (1999) were followed to ensure the appropriateness of this calculation. For the effect size, the researcher adopted a value of 0.15, which is based on Cohen's $f^2$—a standardized measure commonly used in social sciences research to quantify the magnitude of differences or effects. To ensure that the sample accurately reflected the actual student populations of each school, the researchers employed a proportional stratified sampling technique. This method involved dividing the population into strata based on the schools, then selecting students proportionally from each stratum to maintain the demographic and size characteristics of the overall population within each school.

### 3.3. Instruments

**Scale for Problem Solving Skills in Mathematics.** To assess students' mathematical problem-solving skills, the researchers used a self-report questionnaire developed by Uysal (2007). This instrument comprises 28 items rated on a five-point Likert scale, ranging from 1 ("never") to 5 ("always"). It is organized into three key dimensions: "Effort invested in solving problems" (11 items), "Self-confidence in problem-solving abilities" (9 items), and "Problem-solving strategies or procedures used" (8 items). This instrument has a content validity index (CVI) = 1.00 and reliability coefficient of 0.93.

**Reading Comprehension in Mathematics Inventory.** This is a self-created 30-item instrument designed to assess students' reading comprehension of math word problems. Scores were treated using Phil- IRI scale with adjectival ratings of frustration (58% and below) , instructional (59-79%) , and independent (80-100%). The instrument passed the validity and reliability tests achieving a CVI of 1.00 and KR 20 = 0.87.

**Mathematical Competence Scale.** It is a questionnaire consisting of 30 items that intend to measure the mathematical competence of students aligned with the math word problems given

to them to measure their reading comprehension level. The instrument passed the validity and reliability tests achieving a CVI of 1.00 and KR 20 = 0.82.

### 3.4. Data Collection and Analysis

Data were collected through online survey questionnaire forms and examinations after securing all the permits to the Education Program Supervisor of Mathematics and Superintendent of Department of Education Division of Pampanga. Data were all tabulated and processed using Microsoft Excel and treated using Warp – PLS version 8.0. Descriptive, Regression, and Moderation Analyses were utilized in this study.

## RESULTS AND DISCUSSIONS

### 1. Respondents` Level of Perceived Problem-Solving Ability, Reading Comprehension, and Mathematical Competence

**Table 1**

*Descriptive Analysis of the Students` Level of Perceived Problem-Solving Ability, Reading Comprehension, and Mathematical Competence*

| Mathematical Constructs | M | SD | Level |
|---|---|---|---|
| Perceived Problem-Solving Ability | 4.02 | 0.87 | High |
| Reading Comprehension | 81.03 | 0.64 | Independent |
| Mathematical Competence | 25.70 | 2.03 | High |

Table 1 provides an overview of the descriptive statistics related to students' perceived problem-solving skills, reading comprehension, and mathematical performance. The data suggest that students generally feel quite confident in their problem-solving abilities, with a mean score of 4.02 (SD = 0.87), and demonstrate solid achievement in mathematics, with a mean of 25.70 (SD = 2.03). These skills are fundamental for handling complex tasks and applying mathematical concepts in real-life contexts—an important aspect of 21st-century learning (Rahman, 2019). According to Kilpatrick et al. (2001), students who perform well in mathematics often show strengths in conceptual understanding, procedural accuracy, strategic thinking, logical reasoning, and tend to have a positive attitude toward the subject. Furthermore, based on their Phil-IRI scores, students achieved an average reading comprehension rate of 81.03%, which corresponds to the "independent" level as defined by the Department of Education's Philippine Informal Reading Inventory (DepEd, 2010). This level indicates that learners are capable of understanding texts on their own, utilizing prior knowledge with minimal instructional support. As the highest proficiency level in reading, the independent level suggests that students are prepared for more advanced academic work. Overall, these results indicate that students demonstrate strong cognitive skills across problem-solving, literacy, and mathematics domains.

### 2. Test of Significant Effect of Students` Perceived Problem-Solving Ability to their Mathematical Competence

**Table2:** Results of the Hypotheses Testing *(Direct Effects)*

| Hypotheses | *β* | *p* | *SE* | $F^2$ | *Decision* |
|---|---|---|---|---|---|
| **Direct effects** | | | | | |
| $H_1$. Perceived Problem-Solving Ability□ Math Competence | 0.230 | 0.015 | 0.050 | 0.049 | Accepted |

The findings of the study suggest a statistically significant and positive association between students' self-perceived problem-solving abilities and their mathematical performance (β = 0.230, p < .05). Basically, students who believe more in their problem-solving skills usually do better in math. The positive beta shows that when students feel more confident about solving problems, their math performance tends to improve. Effective problem-solving skills help students to address complex mathematical challenges, select appropriate strategies, and reach accurate solutions (Dayaganon et al., 2022). These skills promote a flexible and adaptable approach to learning mathematics, thereby enhancing both understanding and practical application. Also, working on problem-solving activities helps boost critical thinking and logical skills, which are key for understanding more advanced math concepts. Building these skills can make students more confident when tackling tough academic challenges and help them apply what they've learned in different situations. This lines up with what Firmansyah et al. (2024) found, showing that students' confidence in their problem-solving skills is closely linked to how well they do in math. Similarly, Chytrý et al. (2020) emphasized that mathematical proficiency depends significantly on the capacity to employ strategies and effectively apply knowledge. Moreover, Toraman et al. (2020) supported the idea that academic performance is improved through the cultivation of solid problem-solving skills.

**3.Test of Moderating Effect of Students` Reading Comprehension on the Relationship Between their Perceived Problem-Solving Ability and Mathematical Competence**

**Table 3:**

*Model fit and Quality Indices*

| Index | Coefficient |
|---|---|
| Average Path Coefficient (APC) | = 0.271, P<0.001 |
| Average R-squared (ARS) | = 0.450, P<0.001 |
| Average Adjusted R-squared (AARS) | = 0.465, P<0.001 |
| Average Block VIF (AVIF) | = 3.029, acceptable if <=5, ideally <=3.3 |
| Average Full Collinearity (AFVIF) | = 3.120, acceptable if <=5, ideally <=3.3 |
| Tenenhaus GoF (GoF) | = 0.485, small >0.1, medium >0.25, large >=0.36 |
| Simpson's Paradox Ratio (SPR) | = 0.792, acceptable if >=0.7, ideally = 1 |
| R-Squared Contribution Ratio (RSCR) | = 0.954, acceptable if >=0.9, ideally = 1 |
| Statistical Suppression Ratio (SSR) | = 1.000, acceptable if >0.7 |
| Nonlinear Bivariate Causality Direction Ratio (NLBCDR) | = 1.000, acceptable if >=0.7 |

Table3 presents the model fit and quality indices of the structural equation model (SEM). Results showed the average path coefficient (APC=0.271), Average R-squared (ARS=0.450), and the Average Adjusted R-squared (AARS=0.465) with significant p-values of <0.001. The Average Block VIF (AVIF=3.029) and Average Full Collinearity Coefficient (AFVIF=3.120) showed acceptable results based on the acceptable interval implying that there is no pathological collinearity, and no common bias is observed in the model. Results also revealed that the model results with a large effect size that exceeded a Tenenhaus Goodness of Fit (GOF= 0.485). Results also demonstrated an acceptable coefficient (acceptable if ≥0.9, ideally if =1) on Simpson's Paradox Ratio (SPR=0.792), R-squared Contribution Ratio (RSCR=0.954) and likewise showed an acceptable value greater than 0.7 (>0.7) on Statistical Suppression Ratio (SSR=1.000) and an acceptable Nonlinear Bivariate Causality Direction Ratio (NLBCDR=1.000) ≥0.7.

**Table 4:** Results of the Hypotheses Testing *(Moderating Effects)*

| Hypotheses | *β* | *p* | *SE* | $F^2$ | *Decision* |
|---|---|---|---|---|---|
| **Intervening effect (moderation)** | | | | | |
| $H_2$. Perceived Problem-Solving Ability * Reading Comprehension □ Mathematical Competence | 0.324 | 0.027 | 0.080 | 0.051 | Accepted |

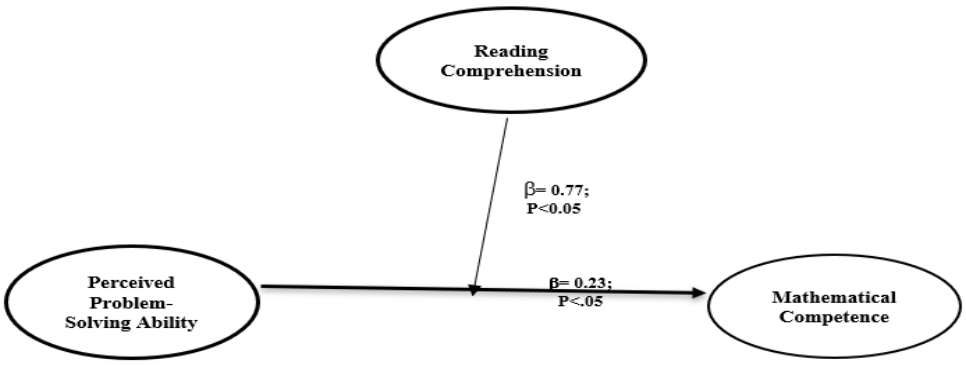


Table 4 displays the findings regarding the moderating role of reading comprehension in the relationship between students' perceived problem-solving skills and their mathematical performance. The analysis indicates that reading comprehension plays a significant moderating role, with a beta coefficient of 0.230 and a p-value less than 0.05 (β = 0.230, p < .05). This suggests that a student's ability to understand written information can influence how effectively they are able to utilize their problem-solving skills in mathematics. Even when students express confidence in their problem-solving abilities, limited reading comprehension may pose

challenges in accurately interpreting instructions, understanding problem contexts, and following the necessary steps to arrive at solutions. Conversely, students with stronger reading skills are generally better equipped to analyze word problems, identify relevant details, and carry out complex procedures, which can lead to higher math performance. Students with weaker reading abilities, on the other hand, may be more prone to overlooking critical information, potentially hindering their problem-solving effectiveness.

These results highlight reading comprehension as a crucial moderating factor that strengthens the positive link between problem-solving skills and math achievement. Akin (2022) found similar outcomes in his research, identifying problem-solving ability as a key moderator between reading skills and mathematics performance. Supporting this, Valenzuela et al. (2024) observed that students who demonstrated independent reading levels tended to achieve higher scores in math problem-solving tasks. Hadianto et al. (2021) also emphasized the significance of understanding linguistic elements in mathematical problems, noting that accurate interpretation of sentence structures is vital for effective problem resolution. Collectively, these studies affirm that reading comprehension not only supports but also enhances mathematical problem-solving abilities.

**Conclusion and Recommendations**

Improving students' comprehension abilities significantly boosts their capacity to interpret problem statements, recognize essential information, and select suitable strategies for finding solutions. Even when learners possess confidence in their problem-solving skills, insufficient reading comprehension can hinder the effective application of those skills. In this regard, reading comprehension acts as a crucial link that connects students' cognitive potential with their demonstrated performance in mathematics. To bridge this gap, embedding reading strategies into math instruction may provide a dual benefit—enhancing both literacy and numeracy. This integrated method encourages a balanced development of problem-solving competencies and mathematical achievement. Given the important role of reading comprehension in facilitating mathematical understanding, educators are advised to incorporate targeted comprehension strategies into math lessons. These strategies might include identifying critical vocabulary, restating problems in one's own words, and making interdisciplinary connections between language and mathematics. For students who struggle with reading, providing consistent comprehension checks and tailored support can help align their perceived skills with their actual performance, ultimately fostering greater academic confidence and success. Furthermore,tThe study's findings can be utilized in several important ways for policy formulation and practical implementation. At the DepEd/CHED policy level, the results provide strong justification for advocating a DepEd order or CHED memorandum that mandates the integration of reading comprehension strategies into mathematics instruction, supported by clear monitoring and evaluation mechanisms to ensure effective implementation. In terms of school leadership, principals and administrators can use these insights to initiate interdisciplinary collaborations, such as joint lesson planning and teaching initiatives between English and Math teachers, to foster both literacy and numeracy. For the community and parents, the findings support the development of workshops that equip parents with practical tools and strategies for supporting their children's reading and mathematics learning at home, thereby reinforcing classroom instruction and promoting holistic student development.

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