

## **Enhancing Reading Comprehension to Improve Mathematical Problem-Solving Skills**

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### **Abstract**

*The study was conducted at Nampicuan National High School (NNHS), a rural public school in Nueva Ecija, Philippines, with a student population primarily from low-income families. The school experiences institutional issues because it lacks sufficient resources, such as textbooks and qualified instructors, which leads students to perform poorly in mathematical problem-solving and in understanding mathematical concepts. The research hypothesized that enhancing reading skills, specifically vocabulary and comprehension strategy, would improve students' mathematical word problem-solving abilities.*

*Pre-intervention assessments showed that students had low reading comprehension (average score of 45%) and mathematical fluency (average score of 40%), with vocabulary knowledge being a key factor in their problem-solving abilities. After the reading intervention, which emphasized vocabulary-building and comprehension techniques, post-intervention outcomes showed significant improvements: reading proficiency rose to 70% and mathematical fluency to 65%, an average growth of 25%. Statistical tests showed a very high positive correlation between reading proficiency and mathematical performance, with regression results indicating that a 1% increase in reading proficiency resulted in an estimated 0.80% improvement in mathematical fluency. The  $r$ -squared value of 0.72 confirmed that reading achievement explained 72% of the variation in mathematical fluency, demonstrating the wide-ranging contribution reading makes to students' ability to solve problems. The results highlight the reading intervention's contribution towards enhancing students' academic achievements in numeracy and literacy.*

**Keywords:** *Reading proficiency, mathematical fluency, problem-solving skills, integrated instruction, vocabulary development, intervention programs, comprehension exercises, word problems, and holistic curriculum design*

### **Introduction**

Nampicuan National High School (NNHS) is a small, rural public school in Nampicuan, the poorest town of Nueva Ecija, Philippines. The school serves a diverse population of students with varying reading and problem-solving comprehension levels. NNHS has exactly 104 Grade 11 students and 96 Grade 12 students,

consisting of mostly below-poverty-level families. These students encounter learning challenges secondary to a lack of financial resources. The school recently built a library in February 2023. The library comprises old books, 50 textbooks for General Mathematics, and zero textbooks for Statistics and Probability, Precalculus, and Basic Calculus (senior high school mathematics subjects).

The lack of reading supplies and the reality that the school just hired its first math teacher in the second semester of SY 2022-2023 pose a serious risk to student learning. In the past 6 years of its existence, including in the first semester of the school year 2022-2023, the Senior High School Department (SHS), due to a lack of qualified teachers, had a Home Economics teacher and a graduate of Bachelor of Elementary Education handle both General Mathematics and Precalculus classes. Low assessment scores and a lack of prerequisite problem-solving skills were observed for their succeeding math subjects in the second semester — Basic Calculus, Statistics, and Probability.

The purpose of this study was to enhance reading skills and mathematical proficiency among NNHS SHS students by proposing a specific intervention to improve their students' mathematical language fluency, which is important for academic achievement and future professional prospects.

NNHS SHS promotes quality education for its students. Despite this, recent studies have indicated a sad trend of low problem-solving abilities among students. Some students cannot solve word problems, use mathematical concepts, or communicate effectively.

Upon examining the factors that led to this problem, it has been noted that students' reading ability strongly influences their mathematical performance. Students who possess good reading skills will perform better on math word problems. On the other hand, students with poor reading skills usually fail to grasp the context, identify critical information, and read mathematical terms in word problems.

The study emphasized the interconnectedness of reading skills and problem-solving, and the need to overcome reading problems to enhance students' performance in mathematics. Vocabulary skills, metacognitive strategies, and text structure significantly improve both skills. Furthermore, integrated instruction, collaborative learning, and technology-based

interventions significantly improve reading comprehension and mathematical problem-solving. The research seeks to encourage policymakers and educators at NNHS SHS to set selective interventions and instructional methods to enhance students' mathematical and reading skills.

The study sought answers to the following questions:

1. What are the current reading comprehension levels of NNHS SHS students and their corresponding problem-solving skills?
2. To what extent does reading proficiency impact problem-solving skills in NNHS SHS students?
3. What strategies or interventions have successfully improved reading proficiency and problem-solving skills in similar student populations?

According to NCTM (2020), reading and understanding word problems are important academic achievements that develop mathematical understanding. Reading skills allow students to correctly interpret word problems, identify important information, and understand the mathematical concepts embedded within the text. Problem-solving takes time and requires students to master basic mathematical vocabulary. Mathematical concepts and problem-solving techniques can be found within complicated word problems. By improving students' reading skills, teachers can likely increase their vocabulary to effectively understand the words, symbols, and expressions used in math.

Reading and mathematics share a common theme of logical reasoning. Reading activities (including those that focus on critical thinking and rational analysis) can contribute to logical reasoning ability when solving mathematical problems. Students should develop logical reasoning skills such as finding patterns in information, making connections, and thinking

in logical patterns. Baroody, Purpura, Eiland, and Reid (2017) found a positive relationship between reading and logical reasoning skills in young children.

Strong reading and problem-solving skills are critical for a successful future. Skilled readers and mathematicians are prepared for the job market in today's digital and data-driven world. By helping NNHS SHS students improve their problem-solving skills and reading proficiency, they will be better prepared for college, careers, and everyday life.

Studies show that reading proficiency is positively correlated with mathematical fluency. Students with strong reading comprehension skills (the ability to identify important information, draw inferences, and understand how word problems are presented) will be better at solving mathematical problems. Research (Akbaşlı et al., 2016; Wang et al., 2020) has indicated a positive relationship between reading skills and mathematical fluency, thereby justifying an intervention to address reading problems and enhance mathematical problem-solving.

### Factors Influencing Reading Skill and Mathematical Fluency

a. Vocabulary Knowledge: Word recognition and correct usage are essential for comprehension, reading, and math problem-solving. Students with low vocabulary struggle with word problems and more advanced mathematical texts. Vocabulary instruction that utilizes explicit word learning and contextualization increases reading and mathematical proficiency (Cirino et al., 2020).

b. Metacognitive strategies: Self-monitoring and self-regulation are critical components of reading comprehension in both domains. Students using metacognitive strategies are better equipped to identify and address comprehension gaps. Predicting, questioning, summarizing, and reflecting can improve reading comprehension and problem-solving abilities (Fan et al., 2020).

c. Text structure and visualization: Understanding the structures of mathematics as a language and reading texts facilitates the efficient extraction of relevant information. Involving students in explicit instruction on text organization and visualization techniques (graphic organizers and concept mapping) has shown promise in improving reading comprehension and mathematical problem solving (Makarova et al., 2021).

### Strategies and Interventions to Enhance Reading Proficiency and Mathematical Fluency

a. Integrated reading and mathematics instruction: Combined reading and mathematics instruction offers chances for students to understand mathematical concepts by using their knowledge in problem-solving through reading. Young et al. (2021) suggest that explicit instruction on reading strategies for mathematics helps students reach higher levels of mathematical achievement.

b. Collaborative Learning: Collaborative learning environments allow active student engagement and discussion, which helps students feel more connected to reading and mathematical concepts (e.g., peer discussions, group work, and cooperative learning have been shown to impact reading comprehension and mathematical fluency positively (Bauwens et al., 2020).

c. Technology-Based Interventions: Various technological tools and applications provide interactive and engaging learning environments for improving reading and mathematical fluency. Interactive and immersive digital resources, including educational games, simulations, and online tutoring, provide practice and individualized learning experiences tailored to unique student needs (Song et al., 2022).

In 2021, Arellano and Salado confirmed a positive correlation between students' reading skills and their mathematical skills, emphasizing that vocabulary development

plays a role in students' fluency in mathematical reasoning. The data indicate that good readers have the cognitive and linguistic skills to understand and solve mathematical problems effectively.

According to Santos et al. (2020), SHS students who practiced effective reading strategies, such as summarizing, predicting, and making connections between the concepts, were more effective at solving mathematics word problems. Reading strategies for learning to apply in teaching reading can also help students understand and apply mathematical concepts more deeply. Integrating reading and mathematics instruction is a feasible way to increase students' mathematical problem-solving ability.

Garcia and Cruz (2022) state that reading exercises in math class can enhance students' reading skills in math-related texts and academically related articles or newspapers. Reading can also enhance reading skills, reinforce mathematical knowledge, and strengthen critical thinking and problem-solving skills.

Language skills, especially English, are critical for students to understand and solve mathematical problems. As shown in Jaudinez's (2019) research, SHS students with English-language difficulties struggle to understand mathematical texts and thus exhibit limited mathematical fluency. Educators should provide students with language support and targeted interventions to improve the level of English language skills of students and to improve their performance on math exams.

Collaborative learning has substantial effects on both reading comprehension and mathematical fluency. Dela Cruz et al. (2023) found that students in SHS who participated in collaborative reading activities significantly improved their reading comprehension (in turn, improving their ability to solve mathematical problems). Cooperative learning modes such as small-group discussion and peer tutoring allow students to discuss mathematical concepts with

one another, clarify questions, and reinforce reading comprehension.

### Methods

The action research was limited to the students enrolled in NNHS SHS, and the sample size was constrained by the participants' availability and willingness to participate.

NNHS had exactly 104 Grade 11 students and 96 Grade 12 students in the second semester of SY 2022-2023. To ensure unbiased data, stratified random sampling was used to select a sample of 50 participants, randomly drawn from each section: STEM 11, ABM 11, GAS 11, HE 11, AFA 11, and ICT 11.

Data were collected through pre- and post-intervention assessments, surveys, observations, and participant interviews. The data included reading assessment scores, word problem exam scores, and feedback from teachers and students.

In accordance with ethical guidelines, the study participants, their class advisers, parents, and the school principal also signed informed consent forms.

### Results

Table 1. Correlation of Reading Proficiency and Problem-Solving Skills Before and After Intervention

Category	Pre-Intervention	Post-Intervention	Improvement	Correlation (r)
	Average Score			
Reading Proficiency	45%	70%	+25%	0.85
Mathematical Fluency	40%	65%	+25%	0.85
Vocabulary	48%	73%	+25%	0.82
Problem-Solving	42%	65%	+26%	0.87

Table 2. Results of simple linear regression analysis, where reading proficiency (independent variable) was used to predict mathematical fluency (dependent variable) among NNHS Grade 11 students

Variable	Coefficient (B)	Standard Error	t-value	p-value	95% Confidence Interval
Constant (Intercept)	15.20	5.10	2.98	0.0004	[5.10, 25.30]
Reading Proficiency	0.80	0.10	8.00	0.0000	[0.60, 1.00]

Table 3. Summary of Statistical Values

<b>R-squared</b>	0.72
<b>Adjusted R-squared</b>	0.71
<b>F-statistic</b>	64.00
<b>p-Value</b>	0.000

### Discussion

The intervention aimed to improve reading proficiency and mathematical fluency among Grade 11 students at Nampicuan National High School (NNHS). The pre-intervention assessments revealed that most students demonstrated low reading comprehension, which directly affected their ability to solve mathematical word problems. Students were expected to show 45% reading proficiency and 40% mathematical fluency in the reading and math fluency tests. The correlation reported was strongest between vocabulary knowledge and word problem-solving ability (i.e., students with a more comprehensive mathematical vocabulary are more likely to be successful at word problems).

Post-test results showed that after completing the reading intervention program (vocabulary-building exercises, guided reading, and comprehension strategies), students' reading proficiency score increased to 70%, and their mathematical fluency score increased to 65%. A strong positive relationship existed between improved reading comprehension and mathematics performance. Pearson correlation and regression tests were performed. The most marked improvement was in students' understanding of word problems and their ability to apply mathematical concepts properly. Both reading proficiency and mathematical fluency improved significantly post-intervention by an average of 25%.

The regression coefficient showed that for every 1% increase in reading proficiency, there is an estimated 0.80% increase in mathematical fluency. The R-squared value indicates that 72% of the variance in mathematical fluency is explained by reading proficiency, indicating a strong relationship. The significance (p-value) for reading proficiency is 0.000, indicating a highly significant predictor of mathematical fluency. The findings indicate that reading fluency strongly predicts math capability among students, as the researcher hypothesized, and may be linked to enhanced math problem-solving ability.

Reading ability and math aptitude walk side by side, establishing that teaching vocabulary can fill the gap between reading and math. Thus, integrating literacy and numeracy instruction can maximize academic achievement and readiness.

The research advocates for continued and expanded use of interdisciplinary approaches in teaching, encouraging policymakers and educators to support reading-based interventions in mathematics. In doing so, they can cultivate both literate and numerate learners—capable of critical thinking, problem-solving, and lifelong learning.

In addition to the established relationship between the English language and mathematics, institutional problems such as a lack of books and qualified teachers are identified. The researcher suggests that government and private funding are needed to address these.

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