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Mathematical Reading Comprehension in Problem-Solving Skills of Students: An Experimental Study

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ABSTRACT

The major purpose of this study was to find out how much better the Mathematical Reading Comprehension (MRC) intervention made pupils at solving problems. A quantitative pre-experimental design used one group for a pre-test and a post-test. We looked at the average and standard deviation of the students' scores and performed a paired t-test to check if there was a statistically significant difference between the scores on the pre-test and the post-test. The results showed that students' ability to solve problems was limited at first, but it got much better after the intervention and reached a high level. The t-value and p-value that were determined showed a very significant difference, even though the effect size was negative. These results showed that how well students could read and understand math materials had a big effect on how well they could solve problems. The study indicated that adding reading comprehension strategies to math instruction helped pupils think critically and solve problems better. People proposed that teachers utilize these methods in class to assist kids understand arithmetic better.

INTRODUCTION

Many students find it difficult to solve arithmetic issues because they fail to understand the terminology and context of the problems, not because they lack computational skills. Problem-solving is one of the challenging and frustrating areas for a substantial proportion of students, causing them to feel overwhelmed and dissatisfied with their abilities (Baroja, 2019). Another study at Universiti Selangor involved four student groups enrolled in various foundation programs in Malaysia. The findings revealed that 70% of the students face challenges in problem-solving and resort to employing strategic approaches until they tackle word problems. In contrast, the remaining 30% seek assistance from external sources to resolve these issues (Maegala et al., 2021). Furthermore, in Thailand, it was found that students cannot solve mathematics problems and lack problem-solving skills. It shows that 7.84% have an excellent level of problem-solving skills, 15.69% have a good level, 33.33% of the students are in the medium level, and 43.14% are in the weak level (Thngkingdang & Thongmoon, 2018).

In the Philippines, a study conducted by Ambasa and Tan (2022) in Valencia City, Bukidnon, Philippines, revealed that all 46 students, accounting for 100% of the sample, exhibited very low problem-solving skills, as evidenced

by a mean score of 14.20, indicative of poor performance in this area. These findings highlight a persistent trend of inadequate cognitive and analytical abilities among Filipino students in various regions. Such results emphasize the need for nationwide targeted educational interventions to enhance learners' problem-solving competencies.

Meanwhile, Davao de Oro's study of Velez and Abuzo (2024) showed that the students have very poor problem-solving skills. The result revealed that the students got an overall mean of 19.41, indicating that the students have very low problem-solving skills. The student's understanding of problem-solving is impoverished; students have difficulty in devising a plan, which is the skill to draw strategies for solving mathematics problems. Also, the students lack the skills to perform the method to solve problems in mathematics. Lastly, students have poor problem-solving skills when looking back, which is the skill to check and validate their solution.

Additionally, in the local context, the researcher observed a real need to enhance the students' reading comprehension skills in relation to their problem-solving skills. Math teachers in the same institution also observed this. The researcher intends to conduct this research to see if mathematical reading comprehension influences students' problem-solving skills in public higher education in Davao de Oro during the academic year 2024-2025.

Statement of the Problem

This study aims to determine the effectiveness of reading comprehension in enhancing students problem-solving skills. Specifically, the study seeks answers to the following questions. This study specifically aimed to provide answers to the following questions:

1. What is the class proficiency as reflected in the pre-test?
2. What is the class proficiency as reflected in the post-test?
3. Is there a significant difference in the pre-test and post-test results?

Hypothesis

The hypothesis of this study is stated as follows:

HO_1: There is no significant difference in the level of students' problem-solving skills in the pre-test and post-test results of the students

Literature Review

The selected literature sources have been meticulously curated from a diverse array of resources due to their pertinence to the research topic, specifically focusing on the predictive nature of mathematical reading comprehension with students' problem-solving skills. Reading comprehension is one skill necessary to survive in the 21st century. Schools are warned that one cannot function well in the 21st century without comprehension skills. Comprehension is a basic human need, especially in mathematics (Bangayan-Manera, 2019). In addition, Can (2020) stated that reading comprehension and math word problems are two key components of a solid educational foundation. Many students often face challenges when understanding complex texts and solving word problems.

Moreover, Brandon (2021) states that reading comprehension is the ability of a person to recognize and understand the meaning of the text or words; reading comprehension is a gateway for learners to understand other lessons, particularly in solving mathematical problems. Additionally, reading comprehension is one of the most essential tools in any aspect of life, including analyzing and solving problems. Also, English is the medium of instruction for mathematics subject, so the students' skills in solving word problems can be related to their level of reading comprehension; since the solutions of the word problems need their translation to have the correct mathematical phrases, learners with good comprehension can also understand the logic behind the problem easily, in contrast, learners with low comprehension can encounter difficulties in solving mathematical word problems (Calub, 2019). As Kuhn et al. (2015) stated, fluency denotes the precise identification of words, automaticity guarantees rapid reading without deliberate effort, and prosody encompasses reading with suitable emotion and phrasing. These elements collaborate to improve understanding by alleviating the cognitive burden linked to decoding (Rasinski, 2014). In the absence of fluency, it is notable that readers frequently encounter difficulties comprehending the text given to them, as their cognitive resources focus on recognizing the words instead of understanding their meaning (Paige et al., 2017). This indicates the need for strategies that improve fluency in reading instruction to boost students' understanding and make them more skilled.

Many studies have shown that fluency and comprehension are closely connected. Hudson, Lane, & Pullen (2016) state that students with higher fluency levels tend to understand their reading better because they can process language smoothly and expressively. Fluency is the ability of students to read with rhythm and intonation. Further, fluency has explicitly been associated with enhanced comprehension as they are most likely connected, demonstrating an awareness of sentence structure and meaning (Paige et al., 2017). However, students who read in a fragmented style frequently encounter difficulties with understanding, as they do not grasp the inherent rhythm of language, which is why these two should be enhanced together. This indicates that fluency education must emphasize speed and expressive reading, as this shows students' knowledge in this aspect of reading, which aids students in internalizing the text's structure and intent (Kuhn et al., 2015). Fluency instruction may occur in several formats, with repeated and guided oral reading identified as particularly successful techniques. Rasinski (2014) discovered that repeated reading, in which pupils read the same material several times, will significantly enhance the fluency and comprehension skills of the learners. This method allows learners to develop their vocabulary and expressions simultaneously, resulting in more fluent and instinctive reading comprehension. In addition, activities guided by the teachers, in which a teacher or peer offers assistance and feedback, aid learners in enhancing accuracy and expressiveness (Pikulski & Chard, 2014). Different strategies, such as making students perform activities that enhance their comprehension, such as simulation, have improved fluency by motivating children to engage in meaningful and enjoyable reading-aloud practices (Paige et al., 2017). These methods concentrate on the mechanical parts of reading and the skills needed for deep understanding. This understanding will help create an exceptional reader.

Motivation and involvement in helping students build their fluency are essential. Students who struggle with fluency often feel frustrated and disengaged from reading. This will lead students to avoid reading activities, and their comprehension skills will not improve (Pikulski & Chard, 2014). Students with improved fluency will gain more confidence in efficiently tackling challenging word problems. Having that positive feedback in mind will aid in boosting their passion for reading and lead to a willingness to take on the problems without misunderstanding. As a result, they gain confidence in reading more text and enhance their fluency further (Rasinski, 2014). Additionally, programs that offer reading materials and interactive activities that help improve fluency significantly improve students' attitudes towards reading. (Hudson et al., 2016). Studies show that people with higher reading fluency can easily manage intricate reading materials in different real-world situations, like college work and other reading-related requirements (Kuhn et al., 2015). Inadequacy of reading fluency constitutes an adverse impact specifically on those reading-related tasks. Fluency in reading in college and professional settings is much stricter than that in the lower years in school. Training that can improve fluency should be injected into the schools' curriculum since this will significantly impact the learners' decoding ability and enable them to read smoothly, accurately, and with understanding.

Studies show that learners with advanced decoding skills better comprehend sentences and can perform tasks efficiently. This skill makes learners more acquainted with meaning rather than struggling to recognize words. (Ehri, 2014). Hoover and Gough (2016) argue that the Simple View of Reading states that reading comprehension comes from the interaction between decoding and language understanding. Accordingly, several factors may affect learners' decoding ability; these include phonemic awareness, vocabulary knowledge, and working memory. Kim's (2017) study suggested that the early development of phonemic awareness strongly predicts how good your decoding skills may become. Ouellette and Beers (2016) highlighted that vocabulary knowledge is key in decoding as word familiarity leads to quick word recognition. Studies show that enhancing phonemic awareness improves decoding skills and reading comprehension (Foorman et al., 2016). Organizing phonemic programs, specifically synthetic phonics, has been proven effective in boosting learners' decoding skills, especially those of young readers (Torgesen, 2018). Visual, auditory, and kinesthetic elements are essential skills to develop since they will assist in developing comprehension skills (Birsh & Carreker, 2018). Reading fluency, which refers to the ability to read quickly and accurately with proper expression, is always associated with decoding productivity. Rasinski et al. (2019) found that learners who have advanced their decoding skills show better comprehension skills, leading to better comprehension skills. Repeated reading and guided oral reading are a few interventions focusing on decoding and fluency; these are crucial factors in the overall improvement of reading comprehension skills of the learners who find reading comprehension challenging (Hudson, Pullen, Lane, & Torgesen, 2016).
Studies show that learners' background knowledge plays a key role in understanding and remembering information from different reading texts. This highlights the importance of background knowledge for every learner with high reading comprehension skills. Therefore, engaging students in various reading activities is

suggested (Bittermann et al., 2023). Research has always suggested that background knowledge greatly affects how someone comprehends the reading material. Research emphasizes that the foundation of learning new information is based on existing schemas and knowledge (Tyner, A., & Kabourek, S., 2020).

All the outside information the reader brings to the reading process makes up background knowledge. Over the past forty years, studies on reading have underlined the need for previous knowledge to influence middle school pupils' reading capacity (Castles et al., 2018). While lesser readers could slightly offset their relatively poor reading abilities in the setting of a high degree of background knowledge, readers with less background information gain more from material with great cohesiveness (Smith et al., 2021). Building background knowledge is a fundamental component of good literacy education; it is generally known that the degree to which a reader can create connections between new textual material and their current knowledge directly influences their reading comprehension. Accessibility also plays a role in the load imposed by reading; limited accessibility of background knowledge implies an effortful search for the required expertise and, therefore, enhanced extrinsic stress (Kintsch, 2009). According to Khataee, E. (2018), our assimilated direct experiences of life and its manifold activities, as well as our assimilated verbal experiences and encounters, It is crucial to engage their background knowledge before reading a book through exercises that would equip the students for reading and result in a better understanding. Therefore, engaging the students in prior knowledge activation through exercises will prepare them for reading and improve their learning (Siddiek, A. G. et al., 2013). In the study of Hall et al. (2020), inference ability is the most essential factor influencing reading comprehension. Comprehending requires a cognitive and mental process known as inference (Logan & Johnston, 2009; Savic, 2018). It is a talent that pulls underlying knowledge into how something is written or spoken. Reading is sometimes challenging and demanding, especially in books with unknown vocabulary items, intricate frameworks, and sophisticated patterns. Drawing inferences when reading is an essential skill aligned with standards and a vital skill as far as reading comprehension is concerned. (Hall, C. et al., 2017). As individuals develop, their ability to conclude is markedly enhanced. Older students with better critical thinking abilities excel in drawing facts and extracting key information. This improved cognitive capacity helps people understand complex books and situations more clearly. Higher grade levels provide more complex capability for compelling inference (Ribeiro et al., 2016).
Mastery of inferencing is an essential teaching goal that helps readers receive maximum information from the text; consequently, inference abilities help readers read with intent. Inference helps readers be involved in the story, enabling people to feel connected. Inference depends on readers' knowledge and what they learn (Logan & Johnston, 2009). Consistent data showing that vocabulary instruction improves reading comprehension challenges this perspective (Ouellette & Shaw, 2014). Studies show that oral vocabulary level is a good indicator of reading and writing ability. Students with more sophisticated oral vocabulary usually show better reading comprehension. Khasawneh, F. (2019) According to Colenbrander (2015), it can help to increase reading comprehension. This underlines the need to add oral vocabulary training in educational practice and remedial action, implying a causal relationship between oral vocabulary abilities and reading comprehension. Research repeatedly shows that better reading comprehension correlates precisely with an extensive vocabulary basis. More words help readers to grasp the message of books more precisely. Oral vocabulary and reading comprehension have a complex interaction. With a broader vocabulary, readers will be better able to decode and understand written language, improving their general understanding. The vital link between oral vocabulary abilities and reading comprehension is shown by Corpuz et al. (2024).

Furthermore, Boonen et al. (2016) pointed out that to be successful in solving mathematical word problems, students need both reading comprehension and mental representation skills. To add, Sabine (2021) asserts that to be able to solve a mathematical word problem, the pupils should not only know how to perform the mathematical nine process and operations, but at the same time, they should have the ability to read and understand the written text, in short, one of the reasons why students struggling in solving mathematical word problems relates to reading processes. Students who encounter a word problem cannot apply the knowledge they have acquired and lack the necessary knowledge structure for problem-solving (Yalçin, 2018). In addition, students with lower reading comprehension levels may struggle to understand the material presented in a problem. In contrast, those with higher reading comprehension levels are likelier to make connections and solve problems effectively (Capone et al., 2021). Also, students who struggle to comprehend mathematical texts may face difficulty understanding directions, formulas, and the underlying concepts of a problem (Horne & Lowe, 2018). Rasinski (2006) stated that using fluency promotes faster learning, directly developing students'

understanding. Proficient readers have enhanced capabilities to understand the words, synthesize information, formulate conclusions, and monitor their comprehension. Research consistently supports that fluency is an essential indicator of reading comprehension. Readers can allocate cognitive resources to comprehend text by learning prosodic reading and achieving automaticity in word recognition. Enhancing reading comprehension necessitates using fluency assessments and pedagogical approaches that address all three dimensions of fluency.

Problem-solving Skills. Since it links mathematical concepts to real-world events, problem-solving is the most crucial aspect of math instruction (Rauf et al., 2020). According to Alcock (2019), problem-solving experts invest a significant amount of mental effort, including identifying the issue, translating it into mathematical terms, developing a plan of action, monitoring their progress, and verifying the solution. This finding is consistent with Cariaga's (2022) study, which emphasized the need to modify math instruction to sustain learning, particularly during the pandemic. Adapting to challenges also enhances your ability to reflect on yourself, a metacognitive skill that improves problem-solving abilities (Kim & Lim, 2019). Hiltrimartin (2018) asserts that for students to be proficient in problem-solving, they must possess a solid foundation in mathematics. Students' ability to solve math problems has also been found to improve when technology is used in the classroom (Wang & Tahir, 2020). In support of this, Cariaga, Pospos, and Dagunan (2024) conducted a qualitative study examining how ICT tools and creative teaching methods can enhance math education, particularly in rural areas. The study concentrated on the potential of technology-based remedial programs to close learning gaps. The goal of education in the twenty-first century also includes problem-solving (Gunawan et al., 2020). To improve student performance, Cariaga (2024) emphasized the importance of integrating critical thinking, communication, teamwork, and innovation. This holistic approach aligns with the notion that problem-solving is a high-level cognitive function, as stated by Nurhayanti et al. (2020). Additionally, Demitra and Sarjoko (2018) emphasized the importance of enabling students to think critically about the content and draw logical conclusions. By assisting students in developing their reading and math skills, parental involvement can support this (Cariaga, 2023). While Abdullah and Fadil (2019) assert that the Higher-Order Thinking Skills (HOTS) framework is practical, Mukuka et al. (2021) recommend using the SOLO taxonomy to assess an individual's problem-solving abilities. These frameworks align with the global perspective of Cariaga and ElHalaissi (2024) on design thinking and social business education, which also emphasizes critical and culturally responsive learning. Preschool comprehension has a significant impact on later math abilities, as noted by Ompok et al. (2018), so children must learn the fundamentals at a young age. This is comparable to the research conducted by Cariaga et al. (2024), who examined parental narratives and their impact on academic and social-emotional outcomes. It implies that family support plays a critical role in students' educational journeys. This was supported by Aquino et al. (2019), who emphasized the importance of assisting students in developing their problem-solving skills at a young age to promote balanced development.

Students who struggle with language frequently find it challenging to solve word problems (Inci Kuzu, 2021). People can feel more in control and confident when they are encouraged to solve problems independently, according to Schoen et al. (2019). This finding is consistent with the results of Isnaniah and Imamuddin (2020), who discovered that using manipulative media helped children understand how to subtract. According to Xie and Zhang (2021), you must control your cognitive load and be aware of how you think in order to solve math problems effectively. Star and Rittle-Johnson (2020) also discussed how students often struggle to grasp fractions because they do not grasp the concept. According to Melawati et al. (2022), the level of engagement and comprehension children exhibit when solving problems is correlated with their math performance. According to Sinaga et al. (2023), competent problem solvers are aware of when and how to apply their knowledge. Purposeful and introspective learning is how this is developed. Additionally, when examining how well students performed, Cariaga (2024) emphasized the significance of connecting 21st-century skill development with student achievement indicators. According to Simatupang et al. (2019) and Nikmah et al. (2019), students often struggle to develop organized techniques because they are either uninterested in them or have not encountered them previously. When discussing how students were reluctant to plan how to solve problems, Alvi and Nausheen (2019) made the same statement. In his research on literacy and numeracy, Cariaga (2023) noted that these disparities could result from insufficient parental or educational assistance during the formative years of learning. According to Rojas-Drummond and Padilla-Melendez (2019), students benefit from experimenting with various strategies, such as creating diagrams or decomposing problems into smaller components. This notion supports the claim made by Kim and Park (2020) that students who plan their approaches tend to perform better on

challenging assignments. However, poor math foundations, low interest, or insufficient tool use continue to hinder the implementation of these strategies (Simatupang et al., 2019; Alvi & Nausheen, 2019).

It is crucial to keep a close eye on things and adjust your tactics accordingly (Xu & Huang, 2021). At the same time, Aisyah et al. (2018) caution that relying solely on formulas that students have memorized without understanding can lead to shallow learning. Moustafa (2019) advocates teaching students how to effectively carry out plans. Because reading comprehension is essential for decoding math language, sentence structures, and symbols, students also gain from guided organization during implementation (Shaftel et al., 2022). Understanding "math language literacy," or the connection between language and math, is crucial (Schleppegrell, 2007). In his analysis of Philippine education, Cariaga (2023) emphasized the need for creative, multidisciplinary approaches that foster literacy and content mastery. Reading comprehension provides cognitive scaffolding for math problem-solving, making it more than just a literacy skill (Sweller et al., 2011). While schema-based instruction provides structured guidance (Jitendra et al., 2015), teaching strategies such as visual models and simplified language help reduce cognitive load (Van Garderen & Montague, 2003). Desoete and De Craene (2019) and Montague (2008) noted that students who practice metacognitive strategies—like asking questions, summarizing, and visualizing—show improved problem-solving performance. According to Fagella-Luby et al. (2012), close reading strategies help students methodically deconstruct challenging word problems. Social context matters too. To make math more approachable, Moschkovich (2015) encouraged teachers to draw on their students' linguistic and cultural backgrounds. This finding is consistent with qualitative research on educational experiences in rural areas by Cariaga et al. (2024), which found that inclusive, creative teaching methods greatly enhance learning outcomes. Additionally, technology contributes by providing instant feedback and personalized learning (Kiili et al., 2018). Students who struggle can benefit from resources such as embedded glossaries and text-to-speech tools (Pape et al., 2017). To accurately measure reading proficiency and content comprehension, assessment procedures must be revised (Abedi & Lord, 2001). Dual-diagnostic instruments can pinpoint areas in which pupils require assistance. Fisher and Frey (2014) highlighted the importance of professional development in preparing educators to handle cognitive and content-area literacy issues.

Early language, math, and reading abilities predict later math achievement, according to Bailey et al. (2020), underscoring the long-term effects of interventions that combine reading and problem-solving. To mold contemporary learners, Cariaga (2024) emphasized the importance of this in his call for educational reforms based on creativity, communication, and critical thinking. Problem-solving is also influenced by cognitive processes such as inhibition, working memory, and cognitive flexibility (Bull & Lee, 2018). Blair et al. (2015) found that even with moderate math fluency, children with stronger executive function outperformed their peers on complex problems. Cirino et al. (2018) suggested self-regulation techniques and underlined the significance of working memory in comprehending mathematical vocabulary. According to Moschkovich (2020), translanguaging can serve as an effective support system, and multilingual learners contribute valuable linguistic tools to math problem-solving.

Similarly, research by Prediger, Wilhelm, and Gürsoy (2019) found that explicit teaching of academic language, such as logical connectors like "if," "then," or comparative terms, significantly improved understanding and performance among German-Turkish students solving algebraic word problems. This shows a need for math instruction that clearly presents mathematical language instead of assuming it. Another area that needs more exploration is how feelings, especially math anxiety, interact with reading comprehension during problem-solving. Ramirez et al. (2018) found that students with high levels of math anxiety performed worse not only in calculations but also in understanding problem contexts. The fear reduced available working memory, making it harder to combine text and numbers.

Closely related is the idea of "cognitive interference." This occurs when anxiety-driven intrusive thoughts disrupt the focus needed to understand and use mathematical concepts (Foley et al., 2017). The authors suggest that teachers include emotional regulation strategies in the classroom, such as mindfulness or expressive writing, before tests. These methods have shown improvements in tasks that are heavy on reading. Recent teaching innovations have focused on creating frameworks for teaching literacy and numeracy. One example is the Quantitative Literacy (QL) framework. It encourages reasoning with numbers in real-world situations and combines it with critical reading strategies. In the study by Adams and Pegg (2022), students who experienced

QL-integrated lessons showed significant improvements in math comprehension scores and their ability to interpret graphs and data-based word problems. Additionally, classroom activities like "Math Talks" and reciprocal teaching in math help students express their thought processes aloud. These methods have strengthened comprehension and collaborative reasoning (Mercer et al., 2019). These approaches create dialogic learning environments that support both subjects naturally. In addition, the role of digital literacy and AI-supported tools in math comprehension has become more important in recent years. Adaptive platforms like DreamBox and Carnegie Learning use reading aids and natural language processing to provide personalized support as students work on word problems. A study by Liu, Li, and Peng (2021) showed that students using AI-enhanced platforms for six months had a 20% larger increase in problem-solving accuracy than their peers in traditional classrooms. These tools give feedback on content and track metacognitive markers, such as the time spent reading versus solving problems, which helps teachers understand how students engage with math problems in a textual way. Recent findings highlight the importance of visualization skills for improving reading comprehension and mathematical reasoning. Visualization helps learners create mental images of textual scenarios. This strategy is beneficial for tackling abstract mathematical problems found in word problems (Booth & Newton, 2018). When students are taught to mentally or graphically map out word problems, such as drawing number lines, diagrams, or simple sketches, they often show better comprehension and accuracy. This supports cognitive theories that suggest dual coding, which combines verbal and visual representations, greatly improves information processing (Mayer, 2017).

Additionally, concept mapping—a technique where learners organize and connect ideas using visual nodes—has been used as a helpful tool for linking mathematical vocabulary, formulas, and problem-solving steps. A study by Kalyuga and Singh (2016) showed that students who participated in concept mapping activities developed a stronger understanding of word problem structures and became more skilled at selecting the right mathematical strategies. These methods lessen the abstract burden and promote relational understanding. This approach shifts focus from memorizing formulas to truly understanding their meaning. The teaching implications of these findings are significant. Teachers who demonstrate visual strategies while reading mathematical texts aloud, highlighting keywords, converting phrases into diagrams, and visually guiding students to represent problems can help connect text with mathematics. This dual approach supports struggling readers and improves all learners' grasp of complex problem-solving processes. Importantly, these visualization strategies are not limited to visual learners. When applied interactively—through collaborative whiteboard problem-solving or digital concept mapping tools—they cater to multiple learning styles and deepen comprehension through peer dialogue and reflection. Thus, visualization and mapping techniques emerge as not just cognitive aids but as inclusive pedagogical strategies to enhance understanding in math-rich contexts.

This study is anchored on Newman (1977) Newman's Error Analysis; it asserts that a student undergoes five stages when solving a mathematical word problem namely (a) reading error is the ability of students to read mathematical problems given and to identify sentences and mathematical symbols used, (b) comprehension errors of the ability of students to understand math problems, (c) transformation errors that is the ability of students to determine the method of mathematical solution, (d) process skill errors that is the ability of student in doing process skill errors of mathematics correctly or not, and (e) encoding errors that is student ability to write encoding errors according to question. These five stages in solving mathematical word problems are essential in enhancing the students' problem-solving skills. In addition, the theory states that mathematical reading comprehension is important to improve students' problem-solving skills.

Moreover, it is supported by Sweller's theory (1988). Cognitive load refers to the amount of information our working memory can process at any time. For educational purposes, cognitive load theory helps us to avoid overloading learners with more than they can effectively process into schemas for long-term memory storage and future recall. When students are tasked with reading mathematical texts or solving problems, they must decode language, understand symbols, and make connections between abstract concepts. The cognitive load increases if the text or problem is complex, hindering comprehension and problem-solving. These theories are essential for the learners to demonstrate mastery not just in their problem-solving skills but also in their mathematical reading comprehension skills. Teachers and students should bear in their minds that there are different steps and aspects essential for developing problem-solving skills and mathematical reading comprehension skills. Therefore, mathematical reading comprehension and problem solving are seen as cognitively demanding tasks requiring

effective management of cognitive resources, and they need to be enhanced together for the holistic development of the learners.

MATERIALS AND METHODS

Locale

This study was carried out at a public higher education institution in Davao de Oro, Philippines—an institution originally established through Republic Act No. 10598 and later renamed as Davao de Oro State College under Republic Act No. 11574. Committed to serving the people of Davao de Oro and neighboring municipalities, the college has steadily grown in its mission to make quality higher education more accessible. One of its campuses, located in the municipality of New Bataan, offers three key programs: Bachelor of Science in Entrepreneurship; Bachelor of Secondary Education with majors in Mathematics, English, and Social Studies; and Bachelor of Elementary Education major in Generalist. The New Bataan Campus has become a vital academic hub in the region, supported by dedicated faculty, strong local government partnerships, and community stakeholders. Its presence has helped reduce the burden on students who would otherwise need to travel far from home to pursue a college degree. Within this setting, the study focused on understanding how mathematical reading comprehension (MRC) can influence students' problem-solving skills. A total of 22 students from the New Bataan Campus, enrolled for the Academic Year 2024–2025, participated in the research. The study aimed to explore whether reading comprehension strategies tailored to mathematical texts could help students better understand and solve mathematical problems. To assess this, a quantitative approach was used, specifically a quasi-experimental design, to measure students' performance before and after the intervention. While the findings provide meaningful insights into how MRC may support learning, it is important to note that the results are grounded in the specific context of this institution and sample group.

Design

This quantitative study employed a single-group quasi-experimental design to establish a causal relationship between an independent and dependent variable (Privitera & Delzell, 2019). The absence of randomly assigned groups characterizes a quasi-experiment, as participants are assigned depending on the requirements of the study. To determine specific learning outcomes, a quasi-experimental study is done in a particular group of students (Kowalczyk, 2021). This study used a quasi-experimental design to assess the relationship between an intervention and an outcome (Schweizer et al.,2016). This study used this research design to explore the relationship between mathematical reading comprehension and students' problem-solving skills.

Participants

The subjects of this study were 23 tertiary education students specializing in mathematics in a public higher institution in Davao de Oro who are enrolled for the academic year 2024-2025. The subjects are under the supervision of the researcher. The researcher utilized purposive sampling to choose the subjects of the study. Purposive sampling is appropriate in this study since it intentionally selects participants based on their characteristics, knowledge, experiences, or other criteria. Purposive sampling, sometimes called judgment sampling, is a participant's conscious decision based on their attributes. It is a method that is not random and does not require a predetermined number of participants or underlying assumptions. (Etikan, I. et al., 2016).

Research Instrument

This research used a researcher-made questionnaire that was validated by an expert panel and pilot-tested. The researcher created the problem-solving questionnaire to measure the students' problem-solving skills. These are chosen following the study's objectives.

Validation of Instrument

The identified experts from the higher education institution in Davao de Oro validated the researcher-made instrument. It was pilot-tested and carefully examined to verify its validity and reliability. To measure students' problem-solving skills, the researcher utilized the test questionnaire and the table of specification of the subject, which the program coordinator and the program head of the department validated. This questionnaire measured the level of problem-solving skills of the students. In determining the problem-solving skills, the means were interpreted using the parameter limits below:

Parameter Limits	Level	Interpretation
25-50	Low Mastery	This means that the problem-solving skills of student is very poor.
51-74%	Near mastery	This means that the problem-solving skills of student is poor.
75-82%	Mastery	This means that the problem-solving skills of student is fair.
83-91%	Near full mastery	This means that the problem-solving skills of student is good.
92 and above	Full mastery	This means that the problem-solving skills of student is excellent.

Based on DepEd Order No. 8, s. 2015

Data Collection Procedure

The researcher obtained necessary permissions, secured consent, provided a general orientation to research respondents, administered and collected the questionnaire, and meticulously checked, collated, and processed data to facilitate the smooth execution of this study. First, the researcher submitted the requirements to the Ethics Review Committee of the Graduate School. After receiving the clearance from the Ethics Review Committee and Certificate of approval, a letter of recommendation from the Dean of the Graduate School was submitted requesting to conduct this study in the selected research location. A letter of request addressed to the President of the higher education institution through the Director of Research and Development, requesting permission for the study to be conducted. Following that, the letter was accompanied by any required supporting documents specified by the institution. After obtaining all necessary approvals and consent, the researcher administered the pre-test examination to the subjects before the intervention. After retrieving all the data, the researcher conducted the intervention for six weeks. The researcher divided the sessions into 5 according to what is needed for the learners to be enhanced. The first session focuses on developing the learners' oral vocabulary, which is more about the terminologies present in the discussion, which are essential for the learners to solve word problems. The second session focuses on the development of the decoding ability of the learners, involving translating written words into spoken sounds, essentially sounding out words, which are essential for the easy understanding of the terminologies in the discussions. The third session is more about fluency; this will help them generate their ideas faster and help them solve problems quickly, since they can easily understand the problem. In the fourth session, the researcher focused more on the students' background knowledge of the topic. This knowledge helps readers make connections, understand vocabulary, and interpret the text's meaning in the problem. Lastly, the fifth session is about inferencing, allowing the learners to draw conclusions based on the text and background knowledge. They can also infer what was asked in the word problem.

Statistical Treatment

The information obtained from the questionnaire was recorded and tallied, and the following statistical tools were used: Mean was used to determine the level of mathematical reading comprehension, mathematics self-efficacy, and problem-solving skills. Standard deviation was used to determine how to spread mathematical reading comprehension and mathematics self-efficacy to problem-solving skills. Paired t-test was used to determine the difference in problem-solving skills before and after the mathematical reading comprehension intervention.

Ethical Considerations

By rigorously following the study protocol and putting all recommendations regarding this study into practice, the researcher complied with ethical standards in the administration of the study. The researcher sought and obtained the necessary consent from relevant school authorities and local authorities in the specific location where the research was conducted regularly. The study's sample shall be duly authorized, with explicit consent obtained, giving them complete protection of their rights, especially in the handling of data, including but not limited to: This research addressed the effects of mathematical reading comprehension on students' problem-solving skills. This study aims to discover different strategies and pedagogies that helped educators in teaching

and learning. The results of this study were shared with the different departments such Commission on Higher Education and published in the online journal, so other related research studies can use it as a reference. Prior to collecting data, the researchers provided an informed consent form. The informed consent form was created to address and adhere to the provisions of the Data Privacy Act of 2012 and its corresponding Executive Regulations. Before the conduct of the study, the researchers disseminated the consent form. The consent form contained the study's title, the researchers' identity, information to ask about the student's participation in the study, and its significance to enable them to comprehend the utilization of their data. Participants were authorized to inquire about their involvement and the investigation. The primary objective of this study is to underscore the essential importance of safeguarding the rights of human participants involved in scientific research and clarifying the procedures used to ensure such protection. The researchers demonstrated sensitivity towards the needs and vulnerabilities of the participants. The participants were not forced to an extent that compromised their safety. The researcher explained all the benefits of being participants of the study. The study reduced participant risks as much as possible. Any predictable risks were discussed, and mitigating measures were implemented. The welfare of participants comes first. The researcher made sure that the participant's personal information, identity, and data gathered were kept confidential and secured to ensure that the Data Privacy Act of 2012 is being followed. The data collected was recorded using a laptop, and the files were transferred to a Google Drive, which only the researcher can access. The data was destroyed after the study was conducted. The selection of participants was fair and equitable. The benefits and burdens of research were distributed justly, avoiding the exploitation of vulnerable populations. To address this aspect of the study, the researcher disclosed the study's affiliations and objective to the participants. Additionally, the research participants were given a copy of the transcript of their answers to verify the reliability and validity of the data gathered. The researcher has enough experience conducting a study during college and graduate school.

RESULTS AND DISCUSSION

Class proficiency as reflected in the pre-test

This section presents the result of addressing the first statement of the problem, which examines the Class proficiency as reflected in the pre-test.

Table 1. Class proficiency as reflected in the pre-test

Items	No. of Students	Mean	SD	Class Proficiency	Descriptive Rating
Pre-test	**22**	**16.64**	**4.10**	**33.28%**	**Low mastery**

Table 1 shows that class proficiency as reflected in the pre-test from a 50-item test has a mean of 16.64 with a standard deviation of 4.10, and class proficiency of 33.28% which has a descriptive rating of "low mastery".

Table 2. Class proficiency as reflected in the post-test

Items		No. of Students	Mean	SD	Class Proficiency	Descriptive Rating
1.	**Post-test**	**22**	**35.86**	**2.25**	**71.72**	**Near Mastery**

Table 2 shows that Class proficiency as reflected in the post-test from a 50-item test of 22 students has a mean of 35.86 with a standard deviation of 2.25, and class proficiency of 71.72% which has a descriptive rating of "near mastery".

Difference in the level of students' problem-solving skills in the pre-test and post-test results

Before finding the significance of the difference in the students' problem-solving skills level in the pre-test and post-test results, a normality test was conducted using the Shapiro-Wilk test. It yielded a p-value of 0.108 (exceeding the 0.05 threshold), confirming that the data followed a normal distribution. This statistical validation justified the subsequent use of parametric analyses, including the paired t-test, as the dataset met the fundamental assumption of normality required for these tests.

Table 3. Significant difference in the level of students' problem-solving skills in the pre-test and post-test results.

Items	No. of Students	Effect Size	t	p-value	Remarks
Pre-test-Post-test	**22**	**-5.01**	**-23.49**	**<.001**	**Significant**

Table 3 shows that the Significant difference in the level of students' problem-solving skills in the pre-test and post-test results of 22 subjects revealed a -5.01 effect size, a t-statistic of -23.49, and a p-value of less than .001. Given the p-value of less than .001, the result is highly statistically significant; therefore, we reject the null hypothesis, which states that there is no significant difference in problem-solving skills between the pre-test and post-test

Class proficiency as reflected in the pre-test

The pre-test findings outlined in Table 1 indicate that first-year college students displayed a proficiency with a "low mastery" class proficiency as reflected in the pre-test average score, suggesting that many students encountered difficulties in effectively solving mathematical problems. There are a few possible causes for the poor performance. First, as students move from high school to college, they are usually exposed to more abstract and complex mathematical concepts, which call for complex problem-solving and critical thinking abilities. Students may find it challenging to satisfy the higher standards of college-level mathematics if they don't have a solid foundation in these areas. The low level of mastery may be attributed to challenges in understanding the language and structure of mathematical texts, which are essential components of effective problem-solving. Many college entry-level students struggle not with the numerical aspects of mathematics but with interpreting the problems accurately—a concern directly addressed by Newman's Error Analysis (1977), which identifies reading and comprehension errors as the first barriers to mathematical problem-solving. Students who cannot accurately decode or understand the problem are unlikely to reach the correct solution. This issue is further supported by Sweller's Cognitive Load Theory (1988), which emphasizes the mental demands placed on learners when simultaneously processing language, symbols, and operations. When these demands exceed a student's working memory capacity, comprehension and problem-solving are hindered. At this stage, the students' low proficiency suggests that the cognitive load required to interpret mathematical word problems was overwhelming without structured support. Mamona-Downs and Downs (2005) also underscored that reading mathematical text is a problem-solving activity. Recognizing symbolic and contextual information in a math problem requires deliberate effort and strategies beyond basic reading for the students to answer the issues. Therefore, the students' low pre-test mastery highlights the necessity of integrating reading comprehension strategies into mathematics instruction, notably to support learners at foundational stages, since they are still adjusting from their high school life and are still preparing for more complex mathematical terms in college. The significance of addressing comprehension as a fundamental component of mathematics learning is emphasized by this baseline performance; this will serve as a crucial basis for assessing the effectiveness of the mathematical reading comprehension intervention that will be conducted to improve the student's performance.

Class proficiency as reflected in the post-test

As presented in Table 2, the class proficiency in mathematical problem-solving significantly improved after implementing the Mathematical Reading Comprehension (MRC) intervention. From a 50-item post-test, the students achieved a higher mean score. This corresponds to a class proficiency earning a descriptive rating of "near mastery." This significant increase in students' performance over the pre-test results demonstrates the intervention's success in improving students' ability to comprehend and solve mathematical problems. Incorporating reading comprehension strategies into math instruction is the cause of this enhancement. The mathematical reading comprehension intervention greatly enhances students' understanding and ability to solve word problems. The students' improved performance led to more accurate and practical approaches to problem-solving by improving their capacity to perceive and comprehend mathematical problems. The near mastery level implies that students can use appropriate problem-solving strategies and better understand the principles and objectives of word problems. This finding is consistent with Newman's Error Analysis (1977), which describes how errors in comprehension and transformation commonly hinder students' ability to progress proficiently through the stages of problem-solving. By improving reading comprehension, students overcame early-stage

errors and were more capable of selecting the appropriate methods to find solutions. This development can also be understood through Sweller's Cognitive Load Theory (1988), which posits that learners have limited working memory when engaging with complex cognitive tasks such as mathematical problem-solving. The MRC intervention likely reduced unnecessary cognitive burdens by guiding students to process textual and symbolic information more efficiently. This allowed for a greater focus on actual problem-solving rather than decoding the language of the problem.

Moreover, the findings echo Mamona-Downs and Downs (2005), who asserted that reading mathematical texts is a form of problem-solving. The students' improved ability to understand mathematical word problems suggests that they were better equipped to generate a substantial interpretation of the word problems, an essential mathematical manipulation skill. The transition from low to near mastery resulted in a significant statistical increase and a more profound cognitive and strategic shift in students' interaction with mathematical word problems. This highlights the significance of adding reading comprehension to math instruction to boost educational outcomes.

Difference in the level of students' problem-solving skills in the pre-test and post-test results

The results presented in Table 3 offer compelling evidence of the effectiveness of the Mathematical Reading Comprehension (MRC) intervention in improving students' problem-solving abilities. The comparison between pre-test and post-test scores for 22 students shows a large effect size, t-statistic, and p-value. These statistical findings indicate that the observed difference in scores is not only meaningful but also highly statistically significant. The large negative t-value and effect size indicate a substantial increase in students' scores following the intervention. The direction of the t-statistic reflects the comparison order (post-test scores were higher than pre-test). Still, the magnitude of the effect size suggests a powerful educational impact. This confirms that the mathematical reading comprehension intervention supported minor improvements and brought about meaningful learning gains in how students approached and solved mathematical problems. These findings align strongly with Newman's Error Analysis (1977), which emphasizes that failures in problem-solving often stem from early stages of misunderstanding—reading and comprehension errors. The intervention focuses on equipping students with strategies to read better, interpret, and translate problem statements directly, targeting and minimizing these errors and facilitating smoother transitions through subsequent problem-solving steps.

Additionally, Sweller's Cognitive Load Theory (1988) provides a compelling explanation for the gains observed. The intervention helped students allocate more cognitive resources to actual reasoning and analysis by reducing the mental strain required to decode complex mathematical language. This more efficient use of working memory likely contributed to the significantly improved performance in the post-test scores. In conclusion, the statistically significant results affirm the effectiveness of the MRC intervention and suggest that strengthening students' mathematical reading comprehension can lead to transformative improvements in problem-solving proficiency.

Conclusion and Recommendation

The purpose of this study was to investigate whether assisting students in improving their reading comprehension, particularly in mathematics, could impact their problem-solving abilities. And the outcomes were unmistakable: it is effective. Many students had difficulty understanding math word problems before the intervention. Their low proficiency on the pre-test was probably caused by their inability to comprehend not only the math but also the structure and wording of the problems. However, a discernible improvement was observed following the implementation of the Mathematical Reading Comprehension (MRC) intervention. Strong statistical results—a high t-value, a low p-value, and a negative effect size that indicates meaningful change—support the students' post-test scores, which increased significantly. The intervention was beneficial. Students' proficiency in reading and math skills improved from low to near mastery. The change was noticeable and significant, despite the moderate effect size. It demonstrated that students' problem-solving skills improve when they are provided with the resources to better understand math problems, by emphasizing reading rather than just numbers. This study also highlights a broader issue: students' difficulties with math reading comprehension may not be specific to a particular classroom or area. These difficulties were evident in numerous communities and schools. Therefore, this is more than just a local problem; it may be a sign of a larger issue that needs to be addressed on a national level.

Here are some doable actions that could benefit educators and students alike, based on what we learned:

For Learners:
Don't just jump to the numbers; take your time reading math problems. Recognize the actual question. Your ability to solve problems accurately and confidently can be significantly impacted by this habit.

For Instructors:
Include reading comprehension techniques in math classes. Students can slow down and think more deeply by engaging in activities like paraphrasing the question, underlining essential terms, and posing guided questions. This improves understanding and problem-solving skills.

The Commission on Higher Education (CHED) should consider incorporating reading comprehension techniques into the college math curriculum. Enhancing teacher preparation programs and developing math literacy-focused resources can have a positive ripple effect on improving student achievement nationwide.

For Upcoming Researchers: There is still more to learn. Research could examine how these tactics function at various grade levels or how digital resources can enhance students' understanding of these concepts. Long-term studies could also investigate the long-term effects of consistently applying these tactics on academic development.

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