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Impact of Paraphrasing Strategy on Mathematical Problem-Solving Skills and Performance: Exploring Their Interrelationship

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Abstract. This quasi-experimental study was conducted to determine the impact of paraphrasing strategy on the mathematical problem-solving skills and mathematics performance of first-year college students while also exploring the interrelationship between these skills and performance. The 40 participants of this study were randomly assigned into the experimental and control groups following the pre-test and post-test equivalent group design. The instruments used were the Mathematical Problem-Solving Skills Inventory by Chirinda (2013) and a researcher-made performance test. Statistical analyses were the independent sample t-test, paired sample t-test, and Pearson r. The experimental group was taught using a paraphrasing strategy, while the control group was taught using the traditional method. According to the findings, there is a statistically significant difference between the post-test scores of the experimental and control groups, with the experimental group scoring higher. Even though both groups improved in their post-test, the significant difference in the mean gain scores shows that the experimental group performed better than the control group, and this improvement was due to the use of a paraphrasing strategy. A significant correlation also existed between mathematical problem-solving skills and mathematics performance, implying that as the mathematical problem-solving skill increases, performance increases. Theoretically, these findings support the cognitive learning theory, which emphasizes the importance of active engagement strategies like paraphrasing in enhancing understanding and retention. This study suggests that educators should incorporate paraphrasing strategies into their teaching methods to improve students' mathematical performance. It can be concluded that a paraphrasing strategy can be used to increase performance in Mathematics. Further research is recommended to explore the long-term effects of paraphrasing strategy on different student populations.

Keywords: Mathematical problem solving skills; Mathematic learning; Paraphrasing.

1.0 Introduction

One of the reasons why students have difficulty in solving mathematics is their comprehension skill. A successful problem solver can understand what was expected of the problems they face. In other words, they know all the details surrounding the problem, which is an essential step in solving problems. Studies have found that difficulties in reading comprehension can negatively impact children's development in mathematics skills (Salihu et. Al, 2018). Additionally, studies have highlighted that unfamiliarity with the specialized vocabulary used in math word problems can affect students' performance, as everyday words take on new meanings in a mathematical context (Mulwa, 2015).

Mathematical problem-solving skills are a fundamental aspect of mathematics education, as they enable students to apply mathematical concepts to real-world problems. Research has consistently shown that problem-solving skills are influenced by various factors, including student profiles, teaching methods, and learning environments. The impact of the student profile, such as demographics, prior knowledge, and motivation, on problem-solving skills has been well-documented. For instance, Estonanto and Dio (2019) identified mathematics anxiety among senior high school students as a significant factor affecting their performance in calculus.

Teaching methods also play a crucial role in shaping problem-solving abilities. Studies have demonstrated that varied instructional strategies, such as differentiated instruction and the use of social media-based learning materials can enhance students' understanding and engagement. Hernandez et al. (2021) found that modular and social media-based learning materials significantly improved student performance in basic calculus. Similarly, Chen and Chen (2017) highlighted the effectiveness of differentiated instruction in a calculus curriculum for college students in Taiwan, emphasizing its positive impact on academic achievement and student engagement.

Furthermore, the learning environment, whether online or traditional, significantly influences problem-solving skills. The transition to online learning environments during the COVID-19 pandemic underscored the benefits of Learning Management Systems (LMS) like Moodle. Evardo Jr. and Itaas (2024) demonstrated that a Moodle-based courseware package effectively enhanced students' performance on the least taught topics in basic calculus. In contrast, traditional classroom settings also have their advantages. Kandeel (2017) analyzed errors in solving limits of trigonometric functions and stressed the importance of direct teacher-student interactions in addressing conceptual misunderstandings in a traditional learning environment. The relationship between problem-solving skills and mathematics performance is also a topic of ongoing investigation, with studies highlighting the positive influence of problem-solving skills on learning outcomes (Sinaga et al., 2023).

One key aspect of problem-solving skills is the ability to reflect on one's own thinking and learning. This reflective thinking is critical in identifying and addressing errors and developing effective problem-solving strategies. A study by Toraman et al. (2020) analyzed the relationships between mathematics achievement, reflective thinking of problem-solving, and metacognitive awareness. The findings highlighted the positive influence of problem-solving skills on learning outcomes, emphasizing the importance of reflective thinking in mathematical problem-solving.

Another crucial aspect of problem-solving skills is the ability to learn from errors. When students encounter difficulties or make mistakes, they can either become discouraged or use these experiences as opportunities for growth. A study by Wang et al. (2022) examined the impact of learning from errors on problem-solving skills and mathematics performance. The results showed that students who learned from errors had higher problem-solving skills and better mathematics performance, underscoring the importance of embracing mistakes as a natural part of the learning process.

In addition to reflective thinking and learning from errors, problem-solving skills are also influenced by learning independence. Students who are able to work independently and manage their own learning are better equipped to develop problem-solving skills.

Finally, studies have also explored the effectiveness of various problem-solving strategies and models. A study by Raehanah et al. (2018) evaluated the effectiveness of a problem-solving model, including the search, solve, create, and share (SSCS) and cooperative problem-solving (CPS) methods. The findings showed that students who used these methods had better problem-solving skills and mathematics performance, highlighting the importance of incorporating these strategies into mathematics education. In conclusion, the relationship between problem-solving skills and mathematics performance is complex and multifaceted. Research has consistently shown that problem-solving skills are influenced by various factors, including reflective thinking, learning from errors, learning independence, and the use of effective problem-solving strategies.

Numerous studies have investigated the influence and effectiveness of paraphrasing strategies on problem-solving; however, this study introduces several unique elements that distinguish it and provide novel insights. While many studies have explored paraphrasing strategies in broad problem-solving contexts, this research specifically targets mathematical problem-solving skills and performance. Mathematics presents unique cognitive challenges that require specific strategies, and this focused approach addresses the nuanced needs of mathematical learning, an area often underexplored in general problem-solving research. Additionally, most studies on paraphrasing strategies typically explore their use in language arts and reading comprehension. However, this study uniquely applies this strategy to mathematics, a field where the emphasis is often on numerical and procedural skills rather than linguistic approaches. This cross-disciplinary application opens new avenues for understanding how cognitive strategies from language learning can enhance mathematical problem-solving.

Indeed, the use of a paraphrasing strategy, in particular, could potentially enhance students' problem-solving abilities and, in turn, their mathematics performance. By incorporating these strategies into mathematics education, educators can better support students in developing the problem-solving skills necessary for success in mathematics and beyond. In this study, the researcher made use of paraphrasing strategy to improve performance as well as a possibility in increasing the mathematical problem solving skills of the student.

2.0 Methodology

2.1 Research Design

The experimental method of research is the only method of research that can truly test hypothesis concerning cause and effect relationship. It represents the most valid approach to the solution of educational problems, both practical and theoretical, and to the advancement of education as science (Gay, 1992). This study used the quasi-experimental pretest and posttest design with equivalent groups. The control group has almost the same characteristics as the experimental group. The participants were selected by pairing of scores based on the result of the pretest.

2.2 Research Locale

The study was carried out in Passi City College, City of Passi, Province of Iloilo, Western Visayas, Philippines. Passi City College is located in Barangay Bacuranan, along Iloilo East Coast - Capiz Road, within Passi City, Iloilo, Philippines. It serves as a prominent educational institution in the area, offering a range of academic programs and vocational courses to students. The college plays a vital role in the local community, contributing to the educational advancement and skills development of its students.

2.3 Research Participants

The subjects of the study were the 40 first year college students of Passi City College classified into two groups: the experimental group composed of 20 subjects and another 20 subjects for the control group. The subjects were randomly selected through pairing of scores.

2.4 Research Instrument

This study utilized an adopted and validated research instrument as its principal tool and primary data source to investigate the research questions. The research adhered strictly to ethical guidelines, with participation from respondents being voluntary. The validation process included several key steps: initially, educational and assessment experts reviewed and refined the research instrument to ensure their alignment with the study's objectives. Subsequently, a pilot test involving a small subset of participants was conducted to pinpoint any ambiguities in question wording and to evaluate the overall clarity and comprehensibility of the instruments.

To further establish the reliability and validity of the research instruments, a validity and reliability test was conducted. The initial questionnaire consisted of 30 questions. After the pilot testing, 26 questions were retained. The reasons for deleting certain items were based on item-analysis which identified ambiguities, redundancies, and questions that did not align well with the study's objectives. The results of the validity and reliability tests confirmed the appropriateness of the remaining questions, ensuring the robustness of the research instruments.

2.5 Data Gathering Procedure

This study followed a systematic procedure to gather data. First, participants were selected from first-year college students enrolled in mathematics-related courses, ensuring representation across relevant criteria. Second, participants were randomly assigned to either the experimental group (EG) or the control group (CG) to minimize bias in group composition. Third, pre-test assessments were administered to both groups using validated instruments to establish baseline measurements of mathematical problem-solving skills and performance. These assessments were designed to provide a clear starting point for evaluating the impact of the paraphrasing strategy intervention.

Next, the paraphrasing strategy intervention was implemented exclusively within the EG. A standardized strategy was developed and participants received training on its application to mathematical problem-solving tasks. This step aimed to equip participants with the skills necessary to effectively utilize the paraphrasing strategy. Following a 20-day intervention period, post-test assessments were conducted using the same instruments to measure changes in problem-solving skills and performance across both EG and CG. This comparative approach allowed for an assessment of the intervention's effectiveness in enhancing mathematical problem-solving abilities.

Throughout the data collection process, strict controls were maintained to ensure consistency and reliability. Ethical guidelines regarding participant consent, confidentiality, and fair treatment were strictly adhered to. Participants were assured of the confidentiality of their responses and informed that the study's findings would only be used for academic and educational purposes.

2.6 Ethical Considerations

This research study adhered to stringent ethical guidelines to safeguard participants' rights and ensure the integrity of the research process. Participation in the study was voluntary, and participants had the option to withdraw at any point without consequences. Measures were implemented to minimize harm, including physical, social, and psychological risks, ensuring the safety and well-being of all participants, particularly first-year college students enrolled in mathematics-related courses.

Confidentiality of participant information was maintained throughout the study. All data collected were kept strictly confidential and used solely for research purposes. Participants' identities were protected, and their responses were anonymized in reporting and dissemination of findings to uphold privacy and confidentiality standards. Furthermore, the dignity and rights of participants were consistently respected. Ethical guidelines were followed to ensure fairness, respect, and sensitivity in all interactions and procedures related to the study. This included obtaining informed consent from participants, explaining the nature and purpose of the study, and addressing any concerns they may have had regarding their involvement.

3.0 Results and Discussion

3.1 Mathematics Performance in the Pre-test and Post-test

Mathematics performance refers to the ability of students to solve mathematical problems and demonstrate understanding of mathematical concepts as measured through standardized tests. Table 1 presents the pre-test and post-test mean scores of both the experimental and control groups. It highlights the performance levels before and after the intervention of the paraphrasing strategy for the experimental group.

Table 1. Mathematics performance in the pre-test and post-test of the experimental and control group

Group		Pre-test			Post-test		
	N	Mean	SD	Description	Mean	SD	Description
Experimental	20	6.20	2.46	Fair	12.45	3.63	Good
Control	20	6.20	2.46	Fair	9.30	3.34	Good

Note: *Excellence (17.00-20.00); Very Good (13.00-16.99); Good (9.00-12.99); Fair (5.00-8.99); Poor (1.00-4.99)*

In Table 1, the performance of both the experimental and control groups in mathematics was assessed through pre-tests and post-tests. Initially, during the pre-test phase, both groups demonstrated similar performance levels, with the experimental group achieving a mean score of 6.20, interpreted as "Fair," and the control group also achieving a mean score of 6.20, similarly interpreted as "Fair." Following the intervention period, marked by the implementation of a paraphrasing strategy within the experimental group, significant changes in performance were observed in the post-test results. The experimental group showed a notable improvement, achieving a mean score of 12.45, interpreted as "Good." In contrast, the control group, which did not receive the intervention, demonstrated a mean score of 9.30, also interpreted as "Good."

These results indicate that the paraphrasing strategy intervention positively impacted the problem-solving skills and overall mathematics performance of the experimental group. The higher mean score in the post-test for the experimental group suggests that the paraphrasing strategy effectively enhanced their mathematical proficiency, highlighting its potential value as an educational intervention strategy in mathematics. Supporting these findings, Çeşme (2022) emphasizes the importance of paraphrasing in academic writing, particularly for second language learners, noting that structured paraphrasing instruction can significantly enhance students' performance. Çeşme's study identifies specific challenges students face when paraphrasing and suggests that explicit instruction and practice can lead to improved outcomes (Çeşme, 2022). This aligns with the observation that a targeted paraphrasing intervention can enhance mathematical proficiency, underscoring the broader academic benefits of paraphrasing strategies as effective educational tools.

3.2 Mathematical Problem Solving Skills in the Pre-test and Post-test

Mathematical problem-solving skills refer to the ability of students to apply mathematical concepts and techniques to solve various types of problems effectively and efficiently. Table 2 presents the pre-test and post-test mean scores of both the experimental and control groups. It highlights the performance levels before and after the intervention of the paraphrasing strategy for the experimental group.

Table 2. Mathematical problem solving skills in the pre-test and post-test of the experimental and control group

Group	Pre-test				Post-test		
	N	Mean	SD	Description	Mean	SD	Description
Experimental	20	3.25	.41	M+MPSS	3.93	.44	+MPSS
Control	20	3.26	.54	M+MPSS	3.50	.38	+MPSS

Note: *Highly Positive MPSS (H+ MPSS) [4.20-5.00]; Positive MPSS (+MPSS) [3.40-4.19]; Moderately Positive MPSS (M+ MPSS) [2.60-3.39]; Moderately Negative MPSS (M- MPSS) [1.80-2.59]; Negative MPSS (-MPSS) [1.00 - 1.79]*

In Table 2, during the pre-test phase, both groups exhibited moderately positive mathematical problem-solving skills, with the control group achieving a mean score of 3.26 and the experimental group scoring 3.25. Following the intervention period, characterized by the implementation of a paraphrasing strategy within the experimental group, significant improvements in problem-solving skills were observed in the post-test results. The control group demonstrated a slight increase in mean score to 3.50, indicating positive mathematical problem-solving skills. In contrast, the experimental group showed a more substantial improvement, achieving a mean score of 3.93, also interpreted as positive mathematical problem-solving skills.

These findings suggest that the paraphrasing strategy intervention had a beneficial impact on the problem-solving abilities of the experimental group. The higher post-test mean score for the experimental group underscores the effectiveness of the paraphrasing strategy in enhancing their mathematical problem-solving skills. This highlights the potential utility of paraphrasing strategies in educational settings to improve students' cognitive abilities and problem-solving proficiency.

The finding supports the study of Haidayati (2022) who found a significant positive effect of the paraphrasing strategy on students' comprehension abilities. Haidayati demonstrated that paraphrasing helps in comprehending narrative texts by restating information in their own words. The experimental group in the study, which used the paraphrasing strategy, showed a significant improvement in their post-test scores compared to the control group that did not use the strategy. This further supports the conclusion that paraphrasing strategies are beneficial educational interventions across different subjects.

3.3 Subscales of Mathematical Problem Solving Skills in the Pre-test and Post-test

Table 3 presents the mathematical problem-solving skills of both the experimental and control groups broken down by sub-scales. Table 3 presents the mathematical problem-solving skills of both the experimental and control groups, broken down by sub-scales. In the pre-test, the experimental group exhibited the following mean scores across sub-scales: Attitudes towards Mathematics had a mean of 3.34, Willingness to engage in problem-solving activities had a mean of 3.34, Perseverance during the problem-solving process had a mean of 3.94, and Self-confidence with respect to problem-solving had a mean of 2.81. These scores were interpreted as "Moderately Positive Mathematical Problem-Solving Skills." Similarly, the control group showed mean scores of 3.38 for Attitudes towards Mathematics, 3.39 for Willingness to engage in problem-solving activities, 3.39 for Perseverance during the problem-solving process, and 2.71 for Self-confidence with respect to problem-solving, all interpreted as "Moderately Positive Mathematical Problem-Solving Skills.

Table 3. Mathematical problem solving skills in the pre-test and post-test of the experimental and control group according to sub-scales

Indicators	Experimental			Control		
	Pre-test	Post-test	Description	Pre-test	Post-test	Description
1. Attitudes towards Mathematics	3.34	4.06	+MPSS	3.38	3.56	+MPSS
2. Willingness to engage in problem-solving activities	3.34	3.85	+MPSS	3.39	3.56	+MPSS
3. Perseverance during the problem-solving process	3.94	3.94	+MPSS	3.39	3.54	+MPSS
4. Self-confidence with respect to problem solving	2.81	3.91	+MPSS	2.71	3.26	M^+MPSS

Note: *Highly Positive MPSS (H^+ MPSS) [4.20-5.00]; Positive MPSS (+MPSS) [3.40-4.19]; Moderately Positive MPSS (M^+ MPSS) [2.60-3.39]; Moderately Negative MPSS (M^- MPSS) [1.80-2.59]; Negative MPSS (-MPSS) [1.00 - 1.79]*

In the post-test, the experimental group showed significant improvements across all sub-scales. The mean scores were as follows: Attitudes towards Mathematics increased to 4.06, Willingness to engage in problem-solving activities increased to 3.85, Perseverance during the problem-solving process remained at 3.94, and Self-confidence with respect to problem-solving increased to 3.91. All these sub-scale scores were interpreted as "Positive Mathematical Problem-Solving Skills.

On the other hand, the control group showed the following post-test mean scores: Attitudes towards Mathematics increased slightly to 3.56, Willingness to engage in problem-solving activities increased to 3.56, Perseverance during the problem-solving process increased to 3.54, and Self-confidence with respect to problem-solving increased to 3.26. Except for Self-confidence, which remained as "Moderately Positive Mathematical Problem-Solving Skills," the other sub-scales were interpreted as "Positive Mathematical Problem-Solving Skills.

These findings indicate that the paraphrasing strategy intervention had a marked positive effect on the mathematical problem-solving skills of the experimental group, as evidenced by the significant improvements across all sub-scales in the post-test. The control group also showed improvements, but to a lesser extent, particularly in the area of self-confidence. This underscores the potential efficacy of the paraphrasing strategy in enhancing various aspects of mathematical problem-solving skills, particularly in fostering a more positive attitude, increased willingness to engage, greater perseverance, and improved self-confidence among students.

The results of the present study are in line with existing literature on the effectiveness of problem-solving strategies in mathematics education. Tambunan (2019) conducted an extensive study on the impact of problem-solving strategies on students' higher-order thinking skills (HOTS), including mathematical communication, creativity, reasoning, and overall problem-solving abilities. Tambunan's research demonstrated that these strategies significantly enhanced students' mathematical performance and their attitudes towards learning mathematics.

3.4 Difference in the Mathematics Performance in the Pre-test and Post-test

The table presents the differences in pre-test and post-test scores between the experimental and control groups, and within the groups.

Table 4. Difference on the Mathematics performance in the pre-test and post-test of the experimental and control group

Group	Mean	Mean Difference	Df	t-value	sig-value
Pre-test					
Experimental	6.20	.000	38	.000	1.000
Control	6.20				
Post-test					
Experimental	12.45	3.25	38	2.853*	.007
Control	9.30				

*significant at $p< 0.01$

Table 4 presents the differences in pre-test and post-test scores between the experimental and control groups. The results indicate no significant difference in the pre-test scores of both groups, with a p-value of 1.000 ($p > .05$). This suggests that at the beginning of the study, the experimental and control groups had similar characteristics and performance levels in mathematical problem-solving skills.

In contrast, the post-test results reveal a significant difference between the groups, with a p-value of .007 ($p < .05$). This significant difference indicates that the experimental group, which received the paraphrasing strategy intervention, performed better in the post-test compared to the control group. The findings suggest that the paraphrasing strategy had a positive impact on the experimental group's mathematical problem-solving skills, leading to improved performance compared to the control group, which did not receive the intervention. This highlights the effectiveness of the paraphrasing strategy as an educational tool for enhancing mathematical problem-solving abilities.

This research finding aligns with the study conducted by Kong & Swanson (2017) showing the results that the paraphrasing group achieved significantly higher accuracy in solving word problems compared to the control group, especially benefiting students with initially lower problem-solving abilities. The study also suggests that teaching paraphrasing strategies can effectively improve word problem-solving skills in English learners at risk of mathematical disabilities. Additionally, paraphrasing aids students in better understanding problem statements, an essential step in the problem-solving process. This intervention could be integrated into mathematics instruction to help struggling students and prevent mathematical disabilities.

3.5 Difference in the Mathematics Performance of the Experimental and Control Group

The table presents the differences in pre-test and post-test scores between the experimental and control groups, and within the groups.

Table 5. Difference on the Mathematics performance of the experimental and control group in the pre-test and post-test

Group	Mean	Mean Difference	Df	t-value	sig-value
Experimental					
Pre-test	6.20	6.25	19	7.68*	.000
Post-test	12.45				
Control					
Pre-test	6.20	3.10	19	3.85*	.001
Post-test	9.30				

*significant at p<.001

Table 5 presents the differences in the pre-test and post-test scores for both the experimental and control groups. For the experimental group, the results indicate a significant difference between the pre-test and post-test scores, with a p-value of .000 ($p < 0.01$). This significant value demonstrates that the experimental group showed marked improvement in their mathematical problem-solving skills following the intervention of the paraphrasing strategy. Similarly, for the control group, the results also reveal a significant difference between the pre-test and post-test scores, with a p-value of .000 ($p < 0.01$). This indicates that the control group also showed improvement in their mathematical problem-solving skills over the course of the study.

These findings suggest that both groups experienced gains in mathematical problem-solving skills, although the improvement in the experimental group is attributed to the paraphrasing strategy intervention. The significant improvement in the control group could be due to factors such as natural progression and exposure to standard instructional methods during the study period. Overall, the results highlight the effectiveness of educational interventions, such as the paraphrasing strategy, in enhancing students' mathematical problem-solving abilities.

Supporting this result, the study conducted by Lein et al. (2020), found a significant improvements in mathematical problem-solving skills among students exposed to structured interventions, with both experimental and control groups showing notable gains. This meta-analysis reported that interventions such as schema-based and strategy instruction led to moderate to large effect sizes, demonstrating their efficacy in enhancing problem-solving abilities. These results reinforce the positive impact of the paraphrasing strategy observed in the experimental group, validating the effectiveness of such targeted instructional methods in improving mathematical performance.

3.6 Difference in the Mathematical Problem Solving Skills in the Pre-test and Post-test

The table presents the differences in pre-test and post-test scores between the experimental and control groups, and within the groups for mathematical problem-solving skills.

Table 6. Difference on the Mathematical problem solving skills in the pre-test and post-test of the experimental and control group

Group	Mean	Mean Difference	Df	t-value	sig-value
Pre-test					
Experimental	3.25	.006	38	.036	.971
Control	3.26				
Post-test					
Experimental	3.93	.443	38	3.36*	.002
Control	3.50				

*significant at p<.01

Table 6 presents the differences in the pre-test and post-test scores between the experimental and control groups. The results indicate no significant difference in the pre-test scores of both groups, with a p-value of .971 ($p > .05$). This suggests that at the beginning of the study, the experimental and control groups had similar characteristics and performance levels in mathematical problem-solving skills.

In contrast, the post-test results reveal a significant difference between the groups, with a p-value of .002 ($p < .01$). This significant difference indicates that the experimental group, which received the paraphrasing strategy intervention, performed better in the post-test compared to the control group. This finding suggests that the paraphrasing strategy had a positive impact on the experimental group's mathematical problem-solving skills, leading to improved performance compared to the control group, which did not receive the intervention. Overall, the results highlight the effectiveness of the paraphrasing strategy as an educational tool for enhancing mathematical problem-solving abilities.

The findings from this study are supported by the research conducted by Barua (2020), which demonstrated that paraphrasing significantly enhanced the participants' engagement with the text and increased their motivation to read more. Moreover, the study found that paraphrasing helped students develop a better understanding of the material, as they were required to restate the text in their own words, ensuring a deeper processing of information.

The success of the paraphrasing strategy in improving reading comprehension, as observed by Barua, aligns with the results of the current study, where the paraphrasing intervention led to superior performance in mathematical problem-solving skills. The parallel between these two studies underscores the versatility and efficacy of paraphrasing as a cognitive strategy that can be applied across different domains of learning, from reading comprehension to mathematical problem-solving. Thus, the positive outcomes in Barua's research reinforce the conclusion that paraphrasing is an effective educational tool, capable of enhancing students' comprehension and performance in various academic tasks.

3.7 Difference in the Mathematical Problem Solving Skills of the Experimental and Control Group

The table presents the differences in pre-test and post-test scores of the experimental and control groups, and within the groups for mathematical problem-solving skills.

Table 7. Difference on the Mathematical problem solving skills of the experimental and control group in the pre-test and post-test

Group	Mean	Mean Difference	df	t-value	sig-value
Experimental					
Pre-test	3.25	.68	19	8.83*	.000
Post-test	3.93				
Control					
Pre-test	3.26	.24	19	3.71*	.001
Post-test	3.50				

*significant at p<.001

Table 7 presents the differences in the pre-test and post-test scores for both the experimental and control groups. For the experimental group, the results indicate a significant difference between the pre-test and post-test scores, with a p-value of .000 ($p < 0.001$). This significant value demonstrates that the experimental group showed marked improvement in their mathematical problem-solving skills following the intervention of the paraphrasing strategy. Similarly, for the control group, the results also reveal a significant difference between the pre-test and post-test scores, with a p-value of .001 ($p < 0.01$).

This indicates that the control group also showed improvement in their mathematical problem-solving skills over the course of the study. These findings suggest that both groups experienced gains in mathematical problem-solving skills, although the improvement in the experimental group is attributed to the paraphrasing strategy intervention. The significant improvement in the control group could be due to factors such as natural progression and exposure to standard instructional methods during the study period. Overall, the results highlight the effectiveness of educational interventions, such as the paraphrasing strategy, in enhancing students' mathematical problem-solving abilities.

The significant improvement observed in the experimental group due to the paraphrasing strategy is supported by the findings from the study of Hidayati (2022) demonstrating that students exposed to the paraphrasing strategy show greater improvement in their respective areas of learning compared to those who receive traditional instruction. Additionally, in the study of Reilly (2021), which examined the impact of the Summarization/Paraphrasing strategy and the Frayer Model on reading comprehension and student engagement. It was found that the Summarization/Paraphrasing strategy led to significant improvements in student reading comprehension. Furthermore, Reilly's research highlights that educational interventions designed to enhance specific skills can lead to marked improvements in student performance. This reinforces the effectiveness of the paraphrasing strategy used in the experimental group of the current study.

3.8 Difference in the Mathematics Performance Mean Gain Scores of the Experimental and Control Group

Table 8 presents the mean gain scores in mathematics performance of both the experimental and control groups.

Table 8. Difference in the Mathematics performance mean gain scores of the experimental and control group

Group	Mean Gain Scores	Mean Difference	t-value	sig-value
Experimental	6.25	3.15	2.75*	.009
Control	3.10			

*significant at p<.01

Table 8 shows that the experimental group's mean gain score was 6.25, while the control group's mean gain score was 3.10, resulting in a mean difference of 3.15. Analysis revealed a significant difference in the mean gain scores, with a p-value of 0.009 ($p < 0.01$). This significant difference indicates that the increase in the post-test scores of the experimental group can be attributed to the intervention. The paraphrasing strategy implemented with the experimental group was effective in enhancing their mathematical problem-solving skills more than the standard instructional methods used with the control group.

The findings of this study are consistent with recent research by Jiang et al. (2022) , which explored factors affecting mathematical problem-solving abilities. Their research highlighted that elements such as self-regulation and paraphrasing can significantly influence problem-solving performance. This suggests that paraphrasing could be a valuable strategy for enhancing mathematical problem-solving skills in older students. These insights further underscore the potential advantages of paraphrasing strategies for improving college students' mathematics performance.

3.9 Correlation Between Mathematics Performance and Mathematical Problem-Solving Skills

Table 9 presents the correlation between mathematical problem-solving skills and mathematics performance in the post-test for both the experimental and control groups.

Table 9. Relationship of Mathematics performance and mathematical problem solving skills

	Mathematics Performance	
	r – value	p – value
Mathematical Problem Solving Skills	0.399	0.011*

significant at $p < 0.05$

Table 9 presents the correlation between mathematical problem-solving skills and mathematics performance in the post-test for both the experimental and control groups. The analysis reveals a weak positive correlation (r-value of 0.399) between mathematical problem-solving skills and performance. This indicates that there is a tendency for students with better problem-solving skills to also perform better in mathematics, but the relationship is not strong. The statistical significance of this correlation suggests that the observed relationship is unlikely to be due to chance. However, the strength of the correlation (0.399) is weak, which means that while there is a positive association, improvements in problem-solving skills are not strongly predictive of higher mathematics performance.

These findings highlight the importance of enhancing problem-solving skills as one of several factors that can contribute to better mathematics performance. Although the correlation is weak, developing students' problem-solving abilities can still play a valuable role in their overall mathematical success. Educators should consider integrating problem-solving strategies into their teaching methods as part of a broader approach to improving mathematics education.

The results of this study align closely with those of Purwanto et al. (2022), who examined the impact of mathematics problem-solving abilities and learning independence on mathematics achievement in online learning environments. Their findings revealed that students with superior problem-solving skills and greater learning independence achieved higher performance in mathematics, underscoring the necessity of fostering student autonomy. Additionally, research has consistently demonstrated a positive correlation between problem-solving skills and mathematics performance. Similarly, Melawati et al. (2022) investigated the link between problem-solving skills and mathematics performance, confirming that strong problem-solving abilities positively influence mathematics outcomes. These findings highlight the critical role of developing problem-solving skills within mathematics education.

4.0 Conclusion

The implementation of the paraphrasing strategy significantly improved the mathematical problem-solving skills and overall mathematics performance of the experimental group compared to the control group. The post-test results revealed a higher mean gain score for the experimental group, indicating that the intervention was effective. Additionally, a significant positive correlation was found between mathematical problem-solving skills and mathematics performance, suggesting that improvements in problem-solving skills lead to better overall performance in mathematics.

Practical Implications: These findings underscore the importance of incorporating paraphrasing strategies in educational settings to enhance students' mathematical abilities and performance. Educators and curriculum designers should consider integrating these strategies into mathematics instruction to provide students with effective tools for problem-solving.

Theoretical Implications: The study contributes to the existing body of knowledge by providing empirical evidence that supports the positive impact of paraphrasing strategies on mathematical problem-solving skills and performance. It also highlights the potential for these strategies to be applied in other subject areas to enhance learning outcomes.

Limitations: This study had several limitations. Firstly, the sample size was relatively small and confined to a specific educational setting, which may limit the generalizability of the findings. Additionally, the study was conducted over a short period, which may not fully capture the long-term effects of the paraphrasing strategy on mathematical performance.

Directions for Future Research: Future research should aim to replicate this study with larger and more diverse samples to enhance the generalizability of the findings. Longitudinal studies are also recommended to examine the long-term effects of paraphrasing strategies on mathematical performance. Moreover, future studies could explore the application of paraphrasing strategies in other subject areas and investigate their potential to improve overall academic performance.

5.0 Contributions of Authors

I confirm that I am the sole author of this work and have contributed to all sections. I have reviewed and approved the final manuscript.

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7.0 Conflict of Interests

The author declares no conflicts of interest about the publication of this paper.

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