



EFFICACY OF ONE-ON-ONE PEER TUTORING IN IMPROVING THE PROBLEM-SOLVING PERFORMANCE AMONG THE GRADE 10 LEARNERS

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Abstract:

This study aimed to determine the effectiveness of peer tutoring on the mathematical problem-solving performance of Grade 10 students in a public school in Cebu City during S.Y. 2021-2022. Utilizing a single-group pre-test and post-test research design, the study assessed the impact of peer tutoring on selected students' problem-solving performance in mathematics. Participants were chosen based on their math performance, and peer tutoring was conducted in a one-on-one tutor-tutee format. Two research tools were used: a Learner's Questionnaire to gather students' profiles and perceptions of the peer tutoring sessions and a Learners' Achievement Test to measure their mathematical problem-solving performance. Both descriptive and inferential statistics were employed to analyze the data. Descriptive statistics, including weighted means and Likert scales, were used to summarize the students' perceptions, while a z-test and paired t-test were used to compare pre-test and post-test scores. The results showed a significant improvement in the students' mathematical problem-solving abilities after the peer tutoring intervention, with a significant increase in their post-test scores. Furthermore, students perceived peer tutoring as highly beneficial in enhancing their understanding and ability to solve math problems. Based on these findings, it is recommended that educators utilize peer tutoring as an instructional strategy to improve students' mathematical problem-solving skills. This approach can also foster greater student participation and interest in learning mathematics.

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1. Introduction

Peer tutoring is a learning approach that involves pairing high-performing students with lower-achieving peers or students of similar academic levels to engage in structured study sessions focused on reading and mathematics (Candelaria, 2022). By creating an environment where students can learn from one another, peer tutoring fosters a sense of shared responsibility and encourages active participation in the learning process.

Developmental learning theorists introduced the concept that teachers could enhance their effectiveness by structuring learning in a gradual, sequential way and linking it to students' existing knowledge and experiences (Bates, 2019). In the context of mathematics, this approach can provide struggling students with personalized guidance, making abstract concepts more accessible through peer explanations and repeated practice (Attard & Holmes, 2022). In addition to promoting academic growth, peer tutoring has been shown to influence students' problem-solving skills, particularly in mathematics positively. When students engage in collaborative learning, they are exposed to diverse problem-solving strategies, which can deepen their understanding and enhance their ability to approach complex mathematical challenges (Setiawan *et al.*, 2020). As a result, peer tutoring improves mathematical comprehension and builds confidence and fosters critical thinking, both of which are essential for effective problem-solving.

Problem-solving instruction offers students the chance to apply mathematical concepts, connect previously isolated ideas, and achieve a more profound understanding of mathematics as a whole (Olivares, Lupiáñez, & Segovia, 2021). Research has shown substantial academic gains across various subjects, including mathematics, with notable benefits for students facing emotional and behavioral challenges (Osei-Himah *et al.*, 2022; Bowman-Perrott *et al.*, 2022).

Several research findings showed the different challenges faced by the learners in solving mathematical problems. Despite including mathematics as a core subject in the educational curriculum, the mathematics problem solving skills of the students are still relatively low (Sekaryanti, 2022). One of the significant challenges students face in mastering mathematics is their lack of proficiency in understanding mathematical symbols, formulas, concepts, and representations (Mohd, 2016).

Thus, gaining insight into the problem-solving process can enhance students' academic performance and overall learning outcomes. (Hsiao *et al.*, 2018). Recognizing the problem as a key step in the problem-solving process engages students' cognitive abilities to find a solution and effectively communicate their reasoning (OECD, 2003). The outcome of the students' mathematical problem-solving performance resulted from their ability to understand the problem by applying the prior skills learned.

Math problem-solving is a critical aspect of higher-order thinking skills, making it an essential ability for learners. Thus, addressing this concern of low mathematical problem-solving proficiency is a key challenge that must be tackled.

2. Literature Review

This chapter highlights the literature and relevant studies that focus on peer tutoring to the mathematical problem-solving performance of the students.

Peer tutoring is an interactive teaching method that promotes student inclusion and facilitates learning through collaboration between peers (Moliner & Alegre, 2020). Other educational professionals defined peer tutoring as a cooperative learning method that involves pairing students who have common learning goals (Topping *et al.*, 2017). Furthermore, mixed-ability peer tutoring groups were recommended because they provide more opportunities for assisting learners in need while also strengthening the skills of others (Rahmasari, 2017; Dvorak, 2004).

Numerous studies have reported various benefits for both tutors and tutees arising from peer tutoring experiences. In the study of Abdelkarim & Abuiyada (2016) on the effect of peer teaching on the mathematics achievement of undergraduate students, findings suggest that peer teaching strategy has been shown to positively impact students' academic achievement in mathematics. In a similar study, peer teaching enhances both cognitive and social development. This implies that students engage more deeply in the learning process through direct interactions in a comfortable environment, which promotes active learning.

Peer tutoring has influenced not only the tutee but also the tutors. In a study by Moliner & Legre (2020), results showed that when a student realizes he/she is able to explain mathematics contents to a peer, her/his confidence in his/her own abilities in mathematics increases. The academic impact of peer tutoring indicates that students involved in peer tutoring interventions experienced greater academic enhancements (Kim, *et al.*, 2021). Peer tutoring has been used significantly to address concerns in mathematics.

In the study of Cabello *et al.* (2024), students face several challenges in learning mathematics, including difficulties in recalling information from prior lessons, a tendency to forget material easily, and struggles with comprehending mathematical concepts. It has been noted that students who perceive mathematics as highly challenging are more likely to give up than those who view the subject as straightforward. Also, teachers believe that students are not putting in enough effort, failing to seek assistance from others, and struggling to effectively manage their time for learning (K & Kurukkan, 2015). On the other hand, students reported challenges in comprehending the language of mathematics and described the subject as highly confusing (Prasana *et al.*, 2023). This suggests that there is a need for efficient use of language support and more detailed explanations to enrich learning comprehension. In the same study, findings show that there is a considerable number of students indicated that they tend forget methods and

have difficulty with challenging questions. This implies the significant role of reinforcement and review activities in mathematics in improving retention and improving problem-solving skills.

In the PISA results for Mathematics, the country's mean score in Mathematics drops by an average of 15 points, which shows that students are unlikely to be able to correctly answer questions with difficulty levels 2 and higher (PISA, 2022).

As peer tutoring tries to address these issues, several studies have affirmed its influence on the math problem solving skills of the students. In the study of Passion & Marcelo (2024) on the benefits of peer tutoring in enhancing students' academic performance in mathematics, the study reveals significant improvements in students' mathematics scores following the intervention, supporting the effectiveness of the peer tutoring program in targeting the competencies that were least mastered. Peer tutoring is well-established as having a beneficial effect on students' academic achievement, improving their attitudes toward learning, as well as fostering critical thinking, problem-solving, communication, social skills, and academic abilities. (Barahona *et al.*, 2023). In addition, in Austin's (2006) study, students who undergo peer tutoring through the completed motivational assessment revealed an increase in positive attitudes towards math throughout the study. Furthermore, peer tutoring shows that tutees were successfully able to generalize their skills to solve mathematical word problems presented by unfamiliar peers and showed continued proficiency in solving problems presented by both assigned and unfamiliar peers (Davis *et al.*, 2022).

In general, mathematical problem-solving skills play a significant role in individual skills as they serve as a basis for solving real-life problems. With numerous studies that support it, peer-tutoring has been widely used to reinforce these skills.

3. Material and Methods

This research utilized a single group pre-test post-test research design using peer tutoring as an intervention to determine the efficacy of peer-tutoring to improve Mathematical problem-solving performance among the selected Grade 10 learners in one of the public schools in Cebu City. The study's respondents were the 10 Grade 10 students for the academic year 2021-2022. These 10 students were selected based on the student's performance in Mathematics.

Table 1: Profile of the respondents (n=10)

Profile		f	%
Age	15-17	7	70.00
	18-20	3	30.00
Gender	Male	5	50.00
	Female	5	50.00

Table 1 presents the data gathered on the profile of the respondents in terms of age and gender. From the survey, it was determined that most of the respondents were aged (15-

17) and only 3 respondents were aged (18-20) and there is an equal number of male and female respondents.

In this research, the researchers implemented a one-on-one tutor-tutee set-up during the conduct of peer tutoring. Informed consent was obtained from the respondents prior to administering the tutorial. Additionally, participants were informed of their right to withdraw from the data collection process if they felt uncomfortable continuing their involvement.

The research instrument used in this study includes Learner’s Questionnaires to determine the students’ profile and measure the students’ perception of peer-tutorial activity and the Learners’ Achievement Test to measure the students’ mathematical problem-solving performance. The test was administered to the learners before exposure to peer tutoring. Then a post-test is conducted. The data were analyzed using frequency count and percentage, weighted mean, standard deviation, and paired t-test.

4. Results and Discussion

This section presents the results of the data gathered in terms of mathematical problem-solving performance before and after the peer-tutoring activity, and the students’ perception of the peer-tutoring activity.

Table 2: Math Problem Solving Performance of the Grade 10 Learners in Pretest and Post Test

	n	H.M.	A.M.	SD	Computed z	Critical Value	P-value	Qualitative Rating
Pre-test	10	3	2.10	0.876	-3.25*	1.96	0.0012	Below Average
Post-test	10	3	4.70	0.483	11.13*	1.96	0.00	Above Average

*significant at $p < 0.05$ (two-tailed)

Table 2 presents the math problem-solving performance of Grade 10 learners before and after the peer-tutoring intervention. The students were given five problem-solving tasks in both the pre-test and post-test assessments. As shown, the average pre-test score was 2.10, indicating that students performed below average. A z-test was conducted to compare the actual mean of the pre-test scores to the hypothetical mean, revealing a statistically significant difference with a p-value of 0.0012. This result underscores the need for an intervention to improve students' mathematical problem-solving abilities.

Following the peer-tutoring activity, the post-test results show a marked improvement, with an average score of 4.70. This relatively high score suggests that students performed above average after receiving peer tutoring support. The z-test confirmed a significant difference between the actual post-test mean and the hypothetical mean, with a p-value of 0.00. These findings highlight the positive impact of the peer-tutoring activity in enhancing students' math problem-solving skills, demonstrating that the intervention effectively addressed the gaps in their performance. Similar findings in the study of Gan *et al.* (2010) showed that students in the peer tutoring groups

demonstrated greater interest in learning mathematics and showed higher confidence in their ability to succeed in the subject.

Table 3: Statistical Analysis of the Pre-test and Post-test Scores

n	Pre-test Mean	Post-test Mean	d	SD	Test Statistics				
					Computed t	Critical Value	P-value	Decision	Remarks
10	2.10	4.70	2.60	0.699	11.759*	2.306	0.000	Reject Ho	Significant

*significant at $p < 0.05$ (two-tailed).

Table 3 presents the analysis of the significant difference between the pre-test and post-test scores of students in terms of their mathematical problem-solving performance. The pre-test mean score was 2.10, while the post-test mean score increased to 4.70, indicating an improvement of 2.60 points. A paired t-test was conducted to statistically assess this difference. The computed t-value (11.759) was found to be significantly higher than the critical value (2.306), confirming that the difference between the two sets of scores is not due to random chance.

This substantial t-value strongly suggests that the peer-tutoring activity had a meaningful and positive effect on students' mathematical problem-solving abilities. The significant improvement in scores reflects how the peer-tutoring approach provided students with a more effective learning environment, allowing them to grasp and apply mathematical concepts more confidently. The results validate the effectiveness of collaborative learning, where students benefit from their peers' explanations and strategies, leading to better understanding and performance (Ghavifekr, 2020). Consequently, this peer-tutoring intervention proved to be a successful tool in enhancing the students' overall mathematical abilities, as evidenced by the significant gains from pre-test to post-test.

Table 4 assesses students' perceptions of the peer-tutoring activity and its impact on their mathematical problem-solving performance. In general, the peer-tutoring activity yielded a mean score of 4.42, indicating that it was highly effective in improving students' mathematical problem-solving performance. The results highlight that peer-tutoring helped students solve math problems more effectively, especially when explained by their peers. Despite the inherent difficulty of some math topics, students (tutees) were able to better grasp concepts and solve problems, demonstrating the benefits of peer support in overcoming learning difficulties.

Table 4: Learners’ Perception on the Effectivity of Peer-Tutorial Activity in Reinforcing Math-Problem Solving Performance

Learner’s Perception	Weighted Mean	Standard Deviation	Qualitative Rating
1. Mathematical problem-solving becomes easy when taught by my classmates.	4.20	0.632	Effective
2. Problem-solving in Mathematics is theoretical and complex to be taught by my classmates. *	4.00	0.943	Effective
3. Small group discussions help me understand Mathematics in solving real-life problems.	4.70	0.483	Highly Effective
4. I seek assistance from my classmates when I am unable to solve a mathematical problem.	4.40	0.699	Highly Effective
5. My interest increases when a fellow classmate solves a mathematical problem on the board.	4.80	0.422	Highly Effective
General Weighted Mean	4.42	0.636	Highly Effective

The small group discussions fostered by peer-tutoring allowed learners to collaboratively explore different strategies for understanding and solving mathematical problems. By sharing their thoughts and approaches with their peers, students gained new perspectives on problem-solving techniques, deepening their comprehension of the problem. A similar research study indicates that students were able to exchange ideas with their peers and show a willingness to participate in class (Mundelsee & Jurkowski, 2021). This provided a platform where students could freely ask questions, seek clarifications, and test out various methods in a supportive setting.

Furthermore, students who initially struggled with solving problems were able to seek immediate assistance from their peers. This not only boosted their confidence but also led to increased interest and participation in math class. The opportunity to actively engage in the learning process with the guidance of peers helped transform their perception of mathematics to a more manageable one, enhancing both their performance and attitude towards the subject (Diez-Palomar, *et al.*, 2020). The peer-tutoring activity thus played a pivotal role in creating a collaborative and supportive learning atmosphere, which was key to improving students' overall engagement and success in mathematics.

5. Recommendations

Given the study's findings, which highlight the significant positive impact of one-on-one peer tutoring on students' problem-solving abilities, it is recommended that schools integrate peer tutoring programs into their standard curriculum and academic intervention initiatives, especially for subjects that emphasize problem-solving skills. Training students as peer tutors can improve both academic performance and interpersonal skills, fostering a supportive learning environment that benefits both tutors and tutees. Further studies are encouraged to explore the long-term effects of peer tutoring and its applicability across different subjects and age groups.

6. Conclusion

This study sought to explore the impact of peer tutoring on the mathematical problem-solving performance of Grade 10 learners. The results revealed a significant improvement in the students' mathematical problem-solving performance, with scores increasing considerably after the implementation of peer tutoring. This improvement suggests that peer tutoring plays a crucial role in enhancing learners' understanding and application of mathematical concepts.

Moreover, the learners expressed a positive perception of peer tutoring, identifying it as an effective learning strategy that helped them better engage with and solve complex mathematical problems. The nature of peer tutoring likely created a supportive learning environment where learners felt comfortable seeking clarification, practicing problem-solving techniques, and benefiting from the explanations and perspectives of their peers.

These emphasized the importance of peer-assisted learning models in education, especially in subjects like mathematics, where problem-solving is critical to mastery. The significant increase in the learners' performance support through peer tutoring boosts academic outcomes, which adds academic significance to the educational field. As the study demonstrated, peer tutoring can be a valuable tool in addressing gaps in understanding and improving overall mathematical performance.

The results of this study resonate with previous research on peer tutoring, which has consistently highlighted its efficacy in improving academic outcomes, particularly in mathematics (Topping, 2005). With its positive influence on learners' problem-solving abilities and perceptions, peer tutoring proves to be a strategic educational intervention for enhancing both student performance and engagement.

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