

Exploring Students' Perspectives on Peer Collaboration in Enhancing Mathematics-Based Problem-Solving Skills

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Abstract: Using a qualitative approach, this study investigates the challenges faced in peer collaboration and its perceptions in solving mathematics-based problem-solving among students in Sto Tomas College, Danao City. Data were gathered by purposive sampling from 20 students in Grades 8 to 9 for the interview and analyzed using Braun and Clarke's (2006) Thematic Analysis. Findings reveal that several students greatly benefit from peer collaboration since it helps them solve problems and determine solutions. In contrast, other students view peer collaboration as a distraction. Facing challenges such as a lack of cooperation and confidence. The study also highlights the strategies to enhance students' mathematics-based problem-solving skills with the help of peer collaboration, including proper cooperation and communication with each other, building confidence and courage about their answers, teaching one another to avoid confusion, and understanding the given problem easily. The study emphasizes how solving mathematical problems alone can be difficult, but with the help of peer collaboration solving difficult questions would make it easier to answer and to understand.

Keywords: Peer collaboration, mathematics, students' perceptions, problem-solving skills, collaborative learning strategies.

1. Introduction

In the field of mathematics education, international conferences, academic exchanges, and research publications have been increasing. However, significant challenges persist, including inadequate resources, limited access to quality education, cultural barriers, and insufficient teacher training (Agbata et. al., 2024). Many students were reportedly struggling with mathematics problem-solving and this finding should not be taken lightly (Tambychik, Meerah, 2010). Therefore, productive collaboration takes place when students build and maintain a shared understanding of a mathematical problem (Hansen, 2022). Peer tutoring is an instructional strategy that consists of student partnerships, linking high achieving students with lower achieving students or those with comparable achievement, for structured reading, science, and math study sessions (Batz et. al., 2015; Bellen & Jomoc, 2017; Fuchs, et. al., 2002; Rohrbeck et. al., 2003). Several studies claim collaboration results in deeper learning, in which students

give their ideas and expertise (Blair, 2024; Andrews et al., 2020; Scager et al., 2017). Research shows that in a collaborative mathematical problem-solving scenario, several students typically take part in the open-ended mathematical issue. In this way, group members complete tasks to solve problems and work together by listening to each other's opinions. (Zhang, Cao, 2024).

Research studies show that a collaborative learning approach has a positive effect on the academic achievement of the students in Turkish courses in comparison with traditional methods. In the end of the analysis done in terms of random effect models, the average effect value was calculated as 1,034 with 0,110 errors (Tavşanlı, et. al., 2018). A study conducted in Malaysia surveyed 100 secondary school students using a randomly distributed questionnaire. The research aimed to determine students' understanding, knowledge, and attitudes toward collaborative learning, as well as the relationship among collaborative learning and demographic factors such as gender and family background. These findings revealed that the students preferred to work in groups rather than individually. The students believed that collaborative learning encouraged everyone to contribute their best efforts and enhanced socialization among group members (Nasir et al., 2020). A study in Indonesia states the Indonesian Government's launching of the 'strengthening the profile of Pancasila students' project (P5), a project-based learning that aims to enhance problem-solving skills and promote mutual understanding among students (Prasetyarini, et. al., 2024). In the United States of America, specifically in Pennsylvania, an article claimed that social studies are essential for understanding and generating texts. Scholars led to this conclusion from students' difficulties in producing academic texts that were rooted in solitary activities, such as not sharing their reading with others and asking peers for help with composing papers (Lazar, 2010).

Students' competency in mathematics has become a major concern, as many find it difficult to acquire critical problem-solving abilities. The Philippines ranked second-lowest in mathematics with an average score of 353, significantly below the OECD average of 489.

It highlights that more than 50% of Filipino students scored below the lowest proficiency level in mathematics, indicating a pressing need for educational reforms to address these gaps in quality education (Juan, 2019). This performance drop is indicative of more serious issues with the educational system, such as deficiencies in instructional methods and student involvement. According to a study in Iloilo, Philippines, the results of their study showed students' attitudes about mathematics were shown to have significantly changed before and after the intervention, indicating that the peer collaboration technique successfully raises students' attitudes toward mathematics (Pendón, 2024). On the other hand, another study in the Philippines that was conducted on Talipán National High School researchers discovered that students' performance in math was decreasing over the past few years. Which resulted in a frequent growth of failures on students' work in mathematics. Researchers then conducted an experiment on grade 9 students, an experiment to know how effective math-collab learning would be to students. A test was conducted for the students to determine how they will improve their mathematical proficiency when they undergo math-collab. The result showed significant improvement of their academic performances among students who underwent math-collab than students who worked by themselves (Taracina, 2024).

Peer tutoring was shown to be a useful tool in improving students' academic performance in Mathematics (Ycong et al., 2019). According to Soroño-Gagani, F., Olvido, M. M., & Bonotan, A. M. on research conducted at Cebu Normal University, Cebu City (2019) "The students recognized that there were benefits and incentives derived from their participation in the program. They also admitted that it was a challenging task that developed their creativity and initiative because they have to understand varying personalities as they embrace their social responsibility." Students are encouraged to collaborate in this method, which has been shown to increase their critical thinking and math comprehension. Collaborative learning strategies give students a place to query, test, and improve their mathematical comprehension through interactive discussion and peer problem-solving (Peñeda, 2023).

2. Literature review

A. On Challenges Faced by Students in Peer Collaboration for Mathematics Problem-Solving

Peer collaboration in mathematics problem-solving poses several difficulties for pupils, particularly in the context of the Philippines. These difficulties can be divided into contextual, cognitive, and social difficulties. Recent research has described the mathematical, or cognitive, struggles students encounter when solving challenging mathematics problems, as well as teachers' responses to such struggles (Warshawer, 2015). Students may struggle to explain a solution strategy of theirs to a peer or to understand a peer's explanation, limiting their ability to engage substantively with the mathematics (Franke et al., 2015). Problem-solvers struggling with complex tasks may

experience negative emotions, leading to uncertainty of not knowing the definite answer, which places demands on peer support (Hannula, 2015). The inability of pupils to effectively communicate mathematical concepts and strategies is one of the main obstacles to peer collaboration. It might be challenging for pupils to express themselves clearly when it comes to mathematics since it demands precise language and logical reasoning. Members of the group frequently misinterpret one another as a result of poor communication, which makes problem-solving techniques ineffective.

Additionally, mathematics requires students to recall prior knowledge and apply it effectively, which can create a high cognitive load during collaborative tasks. Many pupils struggle to keep up with their peers because they don't fully grasp mathematical topics. According to the findings of Guan, K. (2024) indicated that most learners found that challenges resulted from the improper designation of group work, interaction within the small society, and participation of the teachers. This reliance on peers for explanations can lead to superficial learning rather than deep comprehension.

B. On Students' Perception of Peer Collaboration in Solving Mathematical Problems

Given the challenges students face in solving mathematics problems, communication and interaction are strategies to improve their performance. According to Webb et. al. (2021), exchanging and engagement of ideas between students can promote learning in multiple ways. With the help of considering each other's ideas, students make connections between problem information and knowledge of mathematical operations, patterns, and rules (Mousoulides et al., 2010; Stohlmann and Albarracín, 2016).

Students tend to understand mathematics problems more when they work in groups as opposed to working alone. A recent study concluded that Cooperative Problem-Solving Learning is beneficial for students by enhancing social skills growth, critical thinking skills, and mathematics performance. In line with this, the results of both qualitative and quantitative data on 105 grade 11 students further proved the effectiveness of cooperative problem-solving when it comes to increasing students' confidence in solving non-routine mathematics problems (Ahmed et al., 2020).

C. On Strategies that Students Find Most Effective in Collaborative Problem-Solving Settings

Strategies like Math Talks and Think-Pair-Share encourage students to discuss mathematical ideas using specific vocabulary. Students deepen their understanding and gain confidence when they explain concepts and receive feedback from peers (Al-Mahrooqi & Denman, 2017). Additionally, social acceptance and friendships were found to positively influence outcomes in collaborative settings (Frontiers, 2021). Flexing grouping supports deeper understanding by enabling students to share and compare solution methods (Gillies, 2003).

Another strategy is the CL approach, it is structured around

principles such as positive interdependence, individual accountability, promotive interaction, and group processing. A study in the U.S. Department of Education (2003) “the Cooperative Learning (CL) approach significantly improved mathematical problem-solving skills, particularly in geometry, multiplication/division, and proportionality. Using these principles for cooperation leads to gains in mathematics, an increase of .59 on students’ mathematics achievement scores in general (Capar and Tarim, 2015). Based on the results of the study of Kwame, E. & Samuel, A. (2020) it showed that students performed better using the cooperative learning instructional strategy.

D. Research questions

This study aims to explore students’ perspectives on how peer collaboration influences their mathematics-based problem-solving skills. Specifically, this research seeks to understand the challenges students face, their perceptions regarding the role of collaboration, and the strategies they find most effective in collaborative problem-solving. To achieve this, the study aims to answer the following research questions:

- What challenges do students face when engaging in peer collaboration for mathematics problem-solving?
- How do students perceive the role of peer collaboration in solving mathematical problems?
- What strategies do students find most effective in collaborative problem-solving settings?

3. Methodology

A. Research Design

A qualitative approach was used in this study to explore students’ perceptions of peer collaboration in enhancing their mathematical problem-solving skills. Phenomenology was used as the design as it focuses on understanding and interpreting individuals’ lived experiences (Williams, 2021). The researchers found this design suitable for this study as it expounds an understanding of a complex phenomenon that involves learning behaviors and communication towards people (Neubauer, et al., 2019). Purposive sampling was used in this study to select the participants who fit the criteria in the semi-structured interview on their challenges, perceptions, and strategies for collaborative mathematics problem-solving.

B. Sample / Participants

The participants in this study will be the Grade 8 to Grade 9 students at Sto. Tomas College Danao. These students were chosen to provide different perspectives on how peer collaboration impacts the mathematical-based problem-solving of individuals. The respondents of this study, who were from grade 8 to grade 9 students, were selected based on the following criteria:

- Engages in peer collaboration during their mathematics subject;

- Students in the 8th to 9th grade of Sto. Tomas College, Danao; and
- Ages between 13-15; regardless of gender.

The study will take place at Sto. Tomas College Danao, an educational institution that fosters collaborative learning among students. The school provides a well-structured academic place where students regularly engage in group-based studies, including peer discussions, study groups, team building, and project-based mathematical activities.

C. Instrument(s)

This research examines the role of peer collaboration in students’ problem-solving skills in mathematics through the use of semi-structured interviews. As Kallio et al. (2016) explained, a semi-structured interview combines the advantages of both verbal guidance as well as conversational flexibility to receive comprehensive answers. Researchers can present clarifying follow-up questions to gather rich information regarding the participants’ experiences (Adams, 2015). The interview features follow up questions that aim to collect participants’ views, experiences, challenges, and benefits relating to peer collaboration in mathematics. There will also be follow-up questions to clarify confusion as necessary to capture the purpose of participants’ answers. This instrument enables an understanding of how students’ learning of mathematics is affected by collaboration with peers.

D. Data collection procedures

The researchers construct a letter of request to the institution, Sto. Tomas College, Danao Inc., to formally seek permission for conducting the study. The researchers selected respondents who were more suitable for the study, and based on the respondents’ judgment, the researchers created a questionnaire with the approval of the school principal and school president. Upon approval, the researchers proceeded to collect data from a total of 20 respondents, which included 14 Grade 8 students and 6 Grade 9 students. The researchers conducted interviews with the students, following a semi-structured interview guide. The allotted time for each student to complete the interview was 15 to 20 minutes.

The data collection, including interviews and observations, was planned to be secure and respectful of the students’ time. All data was made concealed to protect privacy and kept safe in both research paper and digital forms. To keep the information secure, the researchers set up rules to allow only authorized people to access it. Backup copies were also made to ensure the data stayed safe and could be used for future questions.

E. Data analysis

Since the study follows a semi-structured approach, the data will be analyzed using Braun and Clarke’s (2006) Thematic Analysis, a widely used qualitative method for identifying patterns and themes in research data. This study aims to find the students’ perspectives on peer collaboration in mathematical-based problems using an open-ended questionnaire. Provided that this is Braun and Clarke’s Six-Step Thematic Analysis

Process included (1) Familiarization with the Data The collected responses will be read and re-read to gain a deep understanding. Notes will be taken on recurring ideas, emotions, and unique responses that will emerge from the students' answers. (2) Generating Initial Codes - Data will be broken down into smaller, meaningful units (words, phrases, or sentences). These units will be assigned to members to incodes what they represent, key ideas are (e.g., "improved problem solving," "challenges with group dynamics," "peer pressure," etc.). Each unit will be assigned to a team member for systematic coding. (3) Searching for themes, the generated codes will be examined for patterns and grouped into broader themes based on their similarities. Potential themes might include the benefits of Peer Collaboration (e.g., increased motivation, improved understanding), Challenges in Group Work (e.g., unequal participation, distractions), Preferred Learning Approaches (e.g., working in groups vs. working alone) (4) Reviewing Themes, the identified and known themes will be reviewed and understood to make sure that they accurately show and reflect the data. Some themes may be merged to make a much refined, or a better-restructured version of the data if they are too broad or do not have enough supporting details. (5) Defining and Naming the themes, every theme will be given a clear definition and supported with given examples from the data. This procedure ensures that the given themes will effectively get the students experiences and point of views. (6) When Producing the Final Report The final analysis will include a comparative summary of the experiences of Grade 8 (study buddy approach), this report will show how students perceive teamwork and peer collaboration and how it affects their mathematical problem-solving skills.

F. Ethical Considerations

This research study secures consideration of ethical implications and moral principles to ensure privacy and protect the participant's safety. This study will be conducted with a well-mannered approach, and appropriate questions will be followed during the interrogation. The request for proper consent will be taken, and participants will be given the right to withdraw from the inquiry at any time, along with the avoidance of adherence to any biases and manipulation. By being guided by these conditions and proactive steps to learn about the role of peer collaboration, especially in mathematics, researchers aimed to avoid conflict and to conduct respectful interviews with the participants.

4. Results

A. What challenges do students face when engaging in peer collaboration for mathematics problem-solving?

1) Lack of Cooperation and Communication as a Barrier to Problem-Solving

Working together in mathematics demands cooperation and clear communication. Nonetheless, certain students find it hard to work effectively because of unhelpful team members and insufficient communication clarity. When students do not

participate or interact, problem-solving turns chaotic and ineffective. This theme highlights the impact of a lack of teamwork and coordination on students' capacity to collaboratively solve math problems.

"One particular problem of ours is when the others won't listen, very noisy, and are very close-minded as it is hard particularly when they only care about their own opinion and not hearing about the others, as math is a crucial subject to think critically and carefully about your solution as it is the only way to get your answer." (Interviewee 12)

For instance, Interviewee 12 described how it was challenging to collaborate with some of their group members since they had narrow-minded opinions. These people ignored various viewpoints rather than having meaningful conversations, which is problematic in mathematics since critical thinking and other methods might produce superior answers. Problem-solving becomes more frustrating and ineffectual when there is a lack of transparency in collaboration.

"My challenge is that my other classmates don't collaborate and they don't help each other." (Interviewee 3)

"The main challenge I face is that some of my group mates do not cooperate. Sometimes, they are too nosy, and I can't focus on solving the problem. Instead of helping, they can be a distraction, which makes it harder for me to work efficiently." (Interviewee 6)

"One of the challenges I face is when some group members do not participate. This can make it difficult to solve problems efficiently." (Interviewee 7)

These responses expressed frustration over classmates who do not contribute to the group. Interviewee 6 noted that some members were more of a distraction than a help, making it harder to focus on solving problems. Interviewee 7 pointed out that leaders sometimes had to remind others to participate, or they would risk being removed from the group. This lack of engagement hinders the efficiency of problem-solving, as fewer people actively contribute to finding solutions.

"As most of my teammates sometimes wouldn't help and then I'd end up doing it alone, that is why I find working alone more efficient." (Interviewee 8)

"The difficulty I experienced is during the solving of the math problem that I was the only one solving and I really couldn't understand anything." (Interviewee 13)

As a result of these difficulties, some students find themselves working alone, even in a group setting. They would prefer to do tasks independently. This highlights how ineffective group dynamics can leave some students feeling isolated in the learning process.

These responses emphasize that for peer collaboration to be effective in mathematics problem-solving, students need to communicate openly, respect different perspectives, and actively participate. Without cooperation, teamwork becomes counterproductive, forcing some students to work alone or struggle with uncooperative members. The study revealed that without proper cooperation, group dynamics can lead to unequal participation, where some students may dominate

while others are marginalized. This underscores the importance of structured collaboration to ensure all members contribute meaningfully (Klang et al., 2021). Research conducted by Sofroniou and Poutos (2016) highlighted that group work in mathematics fosters critical thinking and analytical skills but requires careful management to avoid unequal participation. The study noted that students' perceptions of group work were positive when collaboration was structured and inclusive, but negative when group dynamics were unbalanced (Sofroniou & Poutos, 2016). To improve group work, strategies such as structured discussions, role assignments, and fostering a more inclusive environment should be encouraged to ensure that all members contribute meaningfully.

2) *Struggles with Confidence and Hesitation in Group Settings*

Engaging completely in group problem-solving can be challenging for students who struggle with confidence and hesitation, which may ultimately affect their learning journey. This issue can be addressed by fostering an inviting and accepting environment where students can freely express their thoughts. Promoting open dialogues, appreciating various methods for problem-solving, and building self-assurance can improve collaborative learning in mathematics

"The difficulty I have encountered is my hesitation, as I hesitate with my answers." (Interviewee 9)

"The difficulties I often encounter are when I am assigned to solve a specific math problem. I tend to doubt and get anxious after answering it, because it might not be correct." (Interviewee 19)

"I also think that it's very hard for me to talk about as I may have the wrong answer or tell the others that they are wrong." (Interviewee 12)

This hesitancy and uncertainty highlight a barrier for students to fully engage in discussions, limiting opportunities for learning and improvement. When solving mathematical problems for the group, students frequently experience anxiety because they worry that their solution might be wrong. Fear of judgment and making mistakes can also contribute to hesitation in group settings. It illustrated how fear of making mistakes can discourage students from actively contributing.

"For me, the difficulties I encountered include my peers not immediately understanding my explanation on how I solved the problem, which makes it challenging for me." (Interviewee 15)

In addition, they had trouble expressing themselves when their classmates took a long time to understand what they were saying. This suggests that group dynamics may work against some pupils rather than help them solve problems. Lack of confidence and self-doubt have a detrimental effect on working with peers in mathematics.

3) *Different Levels of Understanding Causing Confusion*

Group work in mathematics often involves students with different levels of understanding. While collaboration can help weaker students learn from their peers, it can also cause confusion when members have different approaches to solving problems. When students struggle to understand each other's explanations, it can slow down the learning process and create

frustration within the group.

"I couldn't understand some of the mathematical problems so I asked my group mates so that I could answer. We had different ideas in solving an equation which is quite difficult as we had differences in our solutions." (Interviewee 11)

Collaboration in mathematics has both challenges and benefits, especially when students have different problem-solving approaches. Interviewee 11 noted that these differences can lead to confusion rather than productive discussions, making teamwork ineffective.

"I was the reporter with the topic of by conditional. But I didn't understand our topic. In peer collaboration, one of my group mates helped me to understand the topic and I was able to report it well." (Interviewee 14)

"For me, math is really difficult, but I'm lucky that my group mates are good at it, so they help me understand the topic better." (Interviewee 17)

The issue is struggling with comprehension of certain subjects, such as conditional topics or mathematics. Individuals may face challenges in completing tasks successfully unless they receive assistance. This scenario emphasizes the value of peer assistance and teamwork in improving comprehension and addressing learning difficulties.

"I struggled with understanding a particular problem, then me and my groupmate collaborated to help each other figure out how it is done." (Interviewee 16)

"I had difficulties understanding the topics and fortunately our leader taught us about the topic so that we would be able to understand it." (Interviewee 18)

This highlights advantages of peer collaboration, as their group members helped them better understand concepts. Research supports that collaborative learning environments enhance problem-solving skills and reduce confusion by fostering open communication and peer support (Hmelo-Silver, 2004; Johnson & Johnson, 2009). Similarly, struggling with comprehension of certain subjects, such as conditional topics or mathematics, highlights the importance of peer assistance and teamwork in improving understanding and addressing learning difficulties. Studies have shown that peer support is essential for academic success in challenging subjects like mathematics (Topping, 2005; Webb, 2013). Additionally, difficulties with complex problems or topics illustrate the benefits of collaborative efforts and leadership guidance in clarifying concepts and facilitating progress (Interviewees 16, 18), as supported by research on the effectiveness of teamwork and leadership in improving problem-solving skills (Hmelo-Silver, 2004; Slavin, 2015). Overall, when students collaborate with their classmates, they face three primary challenges: differences in comprehension levels, a lack of confidence and disinclination, and a lack of communication and cooperation. Collaboration was futile for many students because they found it difficult to work with uninterested or uncooperative group members. Some were self-conscious and were hesitant to share their solutions for fear of making a mistake. Additionally, the varying mathematical proficiency of the group members

occasionally led to confusion rather than clarity. These challenges suggest that while peer collaboration might aid in learning, its effectiveness depends on promoting better communication, student involvement, and strategies for enhancing self-esteem.

B. How do students perceive the role of peer collaboration in solving mathematical problems?

1) Peer Collaboration Aids Mathematical Skills

Collaborative work among peers during mathematical problem-solving skills is important, they can help each other in figuring out how to solve certain problems. Majority of the students agree with collaborative work rather than working alone, as it provides diverse perspectives, sharing of knowledge, increases motivation, and reduces anxiety.

"They will try their best to explain thoroughly and they will make sure that I understand. It's like having a study buddy in math." (Interviewee 2)

"My group mates can teach me and the more that I am able to learn, the more I am able to understand the problem which can be easier for me to solve." (Interviewee 14)

"I can learn more with the help of my group." (Interviewee 10)

"It is very helpful for me. Why? Because my teammates would make me have a deeper understanding about the math topic." (Interviewee 20)

These assertions show how working with peers on mathematical problem-solving skills benefits them. They assist one another, ensuring that each member of the group completely understands and masters the topic. Interviewee 2 highlighted "It's like having a study buddy in math," proving how collaboration with other peers can greatly help them.

"Peer collaboration relies on teamwork and agreeing on one's personal opinions" (Interviewee 9)

Peer cooperation emphasizes communication, cooperation, and trust. They acquire a variety of viewpoints on the subject as they collaborate; therefore, each participant needs to be trusting and open-minded.

In conclusion, peer collaboration is helpful during mathematical solving, this provides more in depth understanding and mastery of the topic. Peer collaboration has been shown to improve understanding and retention of mathematical concepts. By working through problems together, and developing a deeper understanding of complex concepts; peer collaboration can also help reduce math anxiety and stress. When students work together, they can share the burden of problem-solving, making the experience feel less overwhelming.

2) Preference of Working Alone to Avoid Distractions

Students perceive peer collaboration as generally beneficial for solving mathematical problems, but its effectiveness changes depending on individual preferences and group dynamics. Many students appreciate the opportunity to learn from their peers gaining new insights to enhance their problem-solving skills. They find collaboration useful when their

classmates explain concepts clearly and properly, provide different perspectives, and help reinforce understanding. While teamwork fosters confidence, critical thinking, mind opening and skill development, its impact demands on the quality of interactions and distractions within the group. However, some students note that peer collaboration is only effective when group members are cooperative and engaged especially in tough situations. As well as the hindrance due to unrelated topic distractions.

"But it's not always effective because some people help, and some don't. I usually prefer to work alone so I can focus." (Interviewee 5)

"I prefer solving math problems alone because I can figure things out by myself without distractions." (Interviewee 6)

"I can't focus when there are people distracting me." (Interviewee 8)

In conclusion, some people agree with the idea of collaborative work among peers, but prefer to complete their work alone. Others express that they prefer working alone, getting better focus and fewer distractions rather than collaborating. Others express that it depends on the chemistry of the group. The productivity of the subject is dependent on how the group collaborates with the distractions around them.

3) Obtainment of New Knowledge and Confidence through Peer Collaboration

In a group, a collaborative team is fundamental for progress and success. It cultivates the attainment of knowledge, fostering self-assurance. This concept emphasized how peer collaboration broadens comprehension and nurtures confidence in solving mathematical problems.

"Peer collaboration also helps me gain confidence and express myself when discussing math problems." (Interviewee 7)

"I learned a lot being in a group and it also enhanced our skills and knowledge on solving equations." (Interviewee 11)

"It helps improve my mathematical problem-solving skills because, as I mentioned earlier, we combine our ideas." (Interviewee 17)

To conclude, several students favor peer collaboration in mathematical problem-solving as it enriches their understanding and confidence through sharing each other's ideas in class activities and schoolwork. By tackling mathematical problems with peers, students are exposed to different problem-solving strategies, helping them improve their ability to answer tasks that deepen their knowledge. Furthermore, collaboration fosters critical thinking that helps individuals gain confidence in solving mathematical problems.

Overall, the result highlights that developing mathematical problem-solving abilities requires peer communication. It helps students gain confidence, promotes a deeper understanding, and facilitates knowledge sharing. While group conversations are beneficial to many students, some prefer working alone in order to focus better and minimize distractions. The effectiveness of collaboration depends on the engagement and cooperation of group members, as well as the learning preference of each

student.

C. What strategies do students find most effective in collaborative problem-solving settings?

1) Role Assessment and Task Delegation to Enhance Cooperation

In peer collaboration, students take on distinct roles such as leader, contributor, or listener with corresponding responsibilities. With this method, every member is actively involved in the process, therefore, preventing group members from being uncooperative and disengaging. These clear role assignments encourage participation, strengthen problem-solving skills, and develop an understanding between group members.

“Choosing a role for someone so that everyone can contribute (Interviewee 1)

“Assigning what our contribution would be.” (Interviewee 20)

For instance, Interviewee 1 noted that some individuals often depend on the leader in solving mathematical problems. In which their assigned tasks would be passed on to the leader instead of a collaborative effort. As a method to address this problem, both Interviewee 1 and 20 suggested that assigning tasks is done to reduce students’ lack of cooperation and provide individuals with designated tasks.

“I tend to tell my groupmates to be productive in order to help each other in terms of improving each other’s mathematical problems” (Interviewee 8)

“Some members would solve others equations and some would solve the others as well and they would also need to help each other to be more efficient” (Interviewee 14)

These responses express that with proper task delegation, results efficiency and improvement in solving mathematical problems. Interviewee 14 noted that the distribution of tasks where sets of members solve specific equations would result in a better understanding of the problem. Mathematics-based problem-solving becomes easier and comprehensive with the use of team effort.

The results indicate that students find role assessment and task delegation an effective strategy to enhance cooperation in collaborative problem-solving settings, particularly in mathematics. This underscores the effectiveness of delegation among group members in work efficiency and time management (Kamal and Raza, 2011). Analysis of data reveals that assigning specific roles and responsibilities in mathematical problem-solving will boost group productivity and efficiency. This approach minimizes the likelihood of uncooperative behavior by distributing work fairly.

2) Communication Being the Key to a Progressive Collaboration.

Peer collaboration is a team effort, as without communication, productivity falters. When their group mates communicate well, they enhance their learning experiences and create teamwork through peer collaboration, while creating a productive and inclusive space. Effective communication can

also create and strengthen collaboration by helping each other understand their given workload, get clarification, and efficiently develop strategies to solve problems through discussions and the proper transmission of information inside the group.

“By communicating more to them like always asking them which part is difficult. Cause if you are too shy to ask, you will struggle more because you have no one to ask or if you are struggling and you cannot ask anyone you can never learn.” – (Interviewee 2)

“My strategy is communication. When we talk and share ideas, we understand each other better. I also try to explain my part of the problem to others so we can solve it together. Another strategy is to teach step-by-step, so my groupmates can follow and learn the process.” – (Interviewee 5)

“The best strategy for me is communication. If we talk to each other and share our ideas, it’s easier to find the right solution. I also try to ask my groupmates about their thoughts and strategies so that everyone can contribute, and no one feels left out.” – (Interviewee 6)

“I think one strategy that helps us would be deepening our communication during group activities. It helps me gain more knowledge about a certain math discussion.” – (Interviewee 19)

Students often find it much more productive and beneficial when communication is applied thoroughly and consistently throughout their peer collaboration process, as it helps them better understand the material, engage with their peers, and retain information more effectively. Based on the answers of Interviewee 2, 5, 6, 19.

“Sharing their ideas.” – (Interviewee 3)

“Sharing and exchanging ideas about the topic.” – (Interviewee 17)

Allowing the sharing of suggestions not only makes the students feel a sense of ownership and participation among students but also creates a more inclusive and supportive environment where everyone feels valued and heard. This openness encourages many more perspectives, promotes collaborative learning, and helps ensure that all students have a voice in shaping their educational experience. Based on the answers given by Interviewee 3, 17.

“I usually ask questions in the group on how to solve and why it is like that, and they would tell me more about it.” (Interviewee 9)

“The strategy I found is asking my group’s assistance as I am having trouble solving mathematical problems. As I see their work, I would ask them, and they would help me to understand the problems.” – (Interviewee 10)

“I would ask the others whether my answers are correct or wrong and would ask for clarification.” – (Interviewee 13)

Asking questions is important for understanding problems more effectively, as it helps clarify misunderstandings, encourages deeper comprehension, and allows individuals to break down complicated concepts into more manageable pieces. Based on the answers given by Interviewees 9, 10, and 13.

“Our leader explains the topic to us specifically with topics that are difficult for us to understand.” – (Interviewee 18)

Explaining workloads thoroughly can remove group separation. Noted by Interviewee 18

The results of this study indicate that communication plays a crucial role in discussions and maintaining the organization. Communication is a fundamental aspect of successful teamwork, as it gives individuals the chance to share ideas, clarify misunderstandings, and work towards common goals. By asking questions while communicating, explaining concepts to one another, members reinforce their knowledge through what they learn from others which makes communication a viable key to peer collaboration. In conclusion, assigning roles and responsibilities through communication allows for equal participation, preventing reliance on a single individual. The emphasis on communication as a key factor in successful peer collaboration is well-supported by academic research. For instance, a study by Fawcett and Garton (2005) investigated the effect of peer collaboration on children's problem-solving abilities. They found that children who are immersed in collaborative tasks showed significant improvements in problem-solving skills compared to those who worked individually. The emphasis on communication as a key factor in successful peer collaboration is well-supported by academic research. For instance, a study by Fawcett and Garton (2005) investigated the effect of peer collaboration on children's problem-solving abilities. They found that children who are immersed in collaborative tasks showed significant improvements in problem-solving skills compared to those who worked individually.

D. Peer Teaching Strengthens Collaboration and Learning

When students work together as a group, there are times when they need to share and explain ideas to members to help collaborate in making solutions to a certain problem. Teaching each other can deepen understanding, develop communication with each other, and enhance critical thinking to answer the given problems easily. In addition, it can also help the students understand the given problems more.

“I also try to explain my part of the problem to others so we can solve it together. Explain my part of the problem to others so we can solve it together.” (Interviewee 5)

“Teaching each other helps us understand the problem better.” (Interviewee 7)

“Teach your classmates where they can understand it more.” (Interviewee 12)

These responses indicate that students who know how to solve the problem can help their members, in a way that they can teach their part for others to understand the question easily. In interviewee 5's answers, they have stated that they try to explain their part to the others for them to understand and solve the problems together.

“Explain it to my groupmates how I solved it, so they know how to start answering the difficult problems on their own too.” (Interviewee 15)

“Explanations for each math problem on how it is solved.” (Interviewee 16)

“Our leader explains the topic to us” – (Interviewee 18)

These responses expressed that if an individual explains their work to their members, they can gather ideas to know how the problem should be solved. In interviewee 15's answers, they stated that for others to answer the problem on their own, they explain how they have answered the problem.

The results indicate that if members in a group have no one to explain their given problem, it would lead to confusion and hinder in understanding of the problems properly. For students to understand the problem more in a group activity, an individual must act as the little teacher to explain and guide their members on how to answer or solve the specific equation. The study showed that with the help of explanations or teachings from each individual, it can help students to understand the given problem more. A study by Edwin NM Masibo, O Elizabeth, and AN Mutsotso 2016 peer teaching encourages students to be motivated to learn mathematics. It enhances the understanding of students in mathematics, it also builds confidence in the students. Peer teaching offers a great opportunity for students as it helps them overcome any challenges, they may face in solving mathematical problems.

Overall, effective peer collaboration is achieved through role assessment, task delegation, communication, and teaching one another to enhance cooperation and problem-solving skills. Assigning specific roles encourages students to be active and reduces the imbalance of workload, whereas teaching others allows members to guide one another. Likewise, communication is mostly suggested as it allows students to share ideas and clarify potential misunderstandings in solving complex problems. These strategies result in a supportive and productive learning environment for students where they can enhance their efficiency and accuracy in solving mathematical problems.

5. Conclusions

The study's findings indicate that it can be challenging to solve mathematical difficulties. It has benefits and drawbacks when it comes to collaboration and problem-solving. According to the interviewee's response, peer collaboration has greatly benefited them since it allows for a thorough comprehension and mastery of the subject. Peer collaboration also encourages critical thinking, which boosts members' confidence and empowers them to take on challenges on their own. Additionally, several students favor teamwork since it provides them with fresh perspectives, methods, and approaches that can help them solve problems and determine solutions.

Peer collaboration is opposed by other interviewees, who asserted that group settings merely serve to distract people. Concerns have also been raised about certain members' refusal to collaborate, which hinders others' ability to work effectively and puts a burden on other members who genuinely want to

finish their tasks. These members believe that working in a group only makes their workload heavier, so they would rather work alone. Lack of confidence may also be a hindrance to one's work; some people lack confidence in their work because they are too bashful to voice their opinions or are too reluctant because they fear that others might criticize them.

A. Recommendation

In the study's result, discussions, and conclusion. Therefore, the following recommendations are to enhance peer collaboration in mathematical problem-solving. Educators should focus on improving their communication and cooperation through structured activities. Addressing students' struggles with confidence can be achieved by fostering a supportive environment, assigning clear roles in group tasks, and encouraging peer mentoring. Since different levels of understanding may cause confusion, peer teaching should be integrated to help students reinforce their own learning while assisting others.

A balanced approach should be considered when working in groups to avoid hindrances. In a collaboration, it is important to keep an open mind with the others' answers, asking for their own opinions, and taking its differences into consideration and making use of it to communicate effectively. Thus, peer collaboration helps to improve ones' mathematical skills that enhance their capability to solve mathematical problems and attain new knowledge from being taught by the group. In some cases, others prefer to work alone when handling problem-solving to focus well. It is important to take peer-collaboration in consideration as it could help them expound their knowledge more by sharing their ideas in the group, making them be more confident to cite their answers and teach their peers. Moreover, assigning different roles and giving tasks to the members can make them work more effectively as it establishes the cooperation as it strengthens the collaboration and learning through peer-collaboration.

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