Integrating Peer-Pair Tutoring in Improving Students' Mathematics Motivation in Geometry

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Article Info	Abstract
	Peer- pair tutoring refers to a flexible grouping strategy where a student that excels academically is paired with a struggling student to reinforce motivation in learning mathematics. The study utilized a one-shot case study design to assess the outcomes of the peer- pair tutoring intervention on grade 8 students' mathematics motivation in geometry. The researchers used paired sample T-test as a statistical tool. Moreover, a matrix-formed close- ended questionnaire was utilized as the instrument in gathering students' mathematics motivation. The instrument used was pilot tested by Fiorella, Yoon, Atit, Power, & Panther (2021) with a Cronbach's alpha of 0.85. Furthermore, the result of the study implies that the level of Grade 8 students' mathematics motivation is relatively high. However, the integration of Peer- Pair Tutoring does not improve the mathematics motivation of Grade 8 students in Geometry. While peer tutoring has proven to be a valuable educational tool in many contexts (Lim 2014), including mathematics education, its effectiveness in improving students' motivation towards mathematics can be influenced by various factors.

Introduction

Motivation plays a crucial role in how students perceive and engage with the subject, affecting their willingness to learn, participate, and excel in mathematics. If students view mathematics as boring, difficult, or irrelevant to their lives, they are less likely to be motivated to engage with the material. Bouris (1998) and Bettice (2012) both emphasize the importance of active learning and real-life applications in enhancing motivation. One research-based tool that educational institutions are currently implementing to address poor performance and prevent dropping out of school is the integration of peer tutoring programs (Hardegree, 2012).

When students lack motivation in geometry, they may struggle to grasp important concepts and skills. This can lead to poor performance on assessments, a lack of confidence in their abilities, and a negative attitude towards the subject. Over time, this can result in students falling behind in their studies and potentially giving up on mathematics altogether.

Peer tutoring is a flexible grouping strategy where a student that excels academically is paired with a struggling student to reinforce academic skills or knowledge. Lim (2014) found that peer-tutoring activities in a university

mathematics course improved student motivation. Similarly, Mean (2021) emphasized the potential of peer interactions to enhance motivation in a mandatory mathematics course. The study suggests that peer tutoring is particularly effective in improving students' understanding and retention in Geometry concepts compared to those who received traditional classroom instruction (Johnson et al.,2016, Omar, 2018).

Noperta (2023) further supported these findings, showing a significant improvement in motivation when students learned humanistic mathematics with the support of peer tutors. The peer-pair tutoring approach involves pairing students to work together on academic tasks, with one student serving as the tutor and the other as the tutee. The tutor provides guidance and support to the tutee, which can lead to improved understanding and retention of mathematical concepts.

Furthermore, research by Roscoe and Chi (2007) demonstrated that engaging in peer discussion during tutoring sessions led to improved conceptual understanding and problem-solving skills. This collaborative learning strategy has gained attention in educational research due to its potential to enhance mathematics motivation, promote social interaction, and improve student engagement.

In addition, one key advantage of Peer- Pair Tutoring is the opportunity for students to receive personalized support from their peers. Moreover, this approach promotes active learning and critical thinking skills, as students engage in discussions and problem-solving activities with their peers. Research has shown that explaining concepts to others can deepen one's own understanding, so students acting as tutors can reinforce their own knowledge while helping their peers. Additionally, peer pair tutoring can foster a supportive learning environment, as students may feel more comfortable seeking clarification from a peer rather than a teacher (Outhred, 2010).

Action Research Questions

This action research aimed at examining the Grade 8 students' mathematics motivation in Geometry through Peer-Pair Tutoring at Bukidnon State University- Secondary Laboratory School (BukSU- SLS). This study answers the question:

1. What is the level of Grade 8 students' mathematics motivation in Geometry in terms of:
   a. Pre-test; and
   b. Post-test?
2. Is there a significant level of improvement on Grade 8 students' mathematics motivation in Geometry after incorporating Peer-Pair Tutoring?

Hypothesis:

Ho= There is no significant level of improvement on Grade 8 students' mathematics motivation in Geometry after incorporating Peer-Pair Tutoring.

Proposed Innovation, Intervention, and Strategy

The Peer- Pair Tutoring strategy was the intervention used in this study. In a meta-analysis conducted by Topping (1996), it was found that peer tutoring had a positive impact on the motivation of students across different subjects and age groups. The study concluded that peer tutoring was particularly effective in improving students' motivation and retention of material.

In addition, upon the integration of Peer- Pair Tutoring, the concept of Zone of Proximal Development (ZPD) will be employed. The proposed ZPD by Vygotsky explains the difference between what a learner can do without help and what they can achieve with guidance and instruction. Peer tutoring aligns with this theory by providing students with the opportunity to work within their ZPD.

The concept of learning through peer tutoring is based on a social constructivist view of learning that emphasizes the role of the students to generate learning where students coach peers through social interaction within their zones of proximal development (Vygotsky, 1978). Consequently, the more knowledgeable peer can scaffold the learning for their peer by providing guidance, explanations, and support tailored to the specific needs of their partner. This targeted assistance within the ZPD can lead to improvements in mathematical understanding and problem-solving skills.

Furthermore, the intervention was implemented in Grade 8- Joy of Bukidnon State University- Secondary Laboratory School (BukSU- SLS). Before the implementation of Peer- Pair Tutoring, the researchers conducted a one-week discussion without the intervention. After which, there was a pre- test given to students and then the Peer- Pair Tutoring was implemented for the next four weeks. Furthermore, the study incorporated the reciprocal peer tutoring (RPT) model. It is the strategy that was employed in this study where two students paired together acting as the tutor and tutee during the session, with equitable time in each role. Moreover, higher performing students are paired with lower performing students.

Method

Research Design

The study employed a one-shot case study design to assess the outcomes of the peer- pair tutoring intervention on grade 8 students' mathematics motivation in geometry. A one-shot case study design was used because a single group was observed on a single occasion after experiencing some intervention, treatment, or event. The design was selected to examine whether peer-pair tutoring improves the motivation of the Grade 8 students in Geometry. The independent variable examined in this study was Grade 8 students, meanwhile mathematics motivation serves as the dependent variable. Furthermore, the peer-pair tutoring strategy was the intervention employed.

Study Setting and Participants

The respondents of this study were the Grade 8 Secondary School Laboratory students, with ages ranging from

12 to 16 years old, and are enrolled in the S.Y.2023-2024. Specifically, there were 40 participants selected in this study. The Grade 8- Joy was chosen as the respondents for this study for the convenience of the researchers since the researchers are handling them for practice teaching. Moreover, a purposive sampling technique was used in determining the respondents of the study. Purposive sampling is a sampling technique in which a group is selected because they have characteristics that the researchers need in their sample.

Research Instrument

The researchers used a matrix-formed close- ended questionnaire as the instrument that will help us gather students' mathematics motivation. The instrument used was pilot tested by Fiorella, L., Yoon, S. Y., Atit, K., Power, J., Panther, G. (2021) with a Cronbach's alpha of 0.85 which indicates an acceptable internal consistency. The questionnaire consists of 19 items questions and is grouped as follows: 3 intrinsic value questions, 4 self-regulation questions, 4 self- efficacy questions, 4 utility value questions, and 4 test anxiety questions. A reverse scoring procedure was done for negative statement which is the test anxiety.

Data Gathering

In gathering data, the researchers conducted a one-week lesson demonstration without implementing the Peer-Pair Tutoring. After one week, the researchers then administered a pre- test for the next lesson discussion. By this time, the researchers implemented the Peer- Pair Tutoring for four weeks, pairing the high performing students with the low performing students.

Moreover, to administer the peer- pair tutoring, pairs are seated beside each other during the discussion of the lesson in order for them to brainstorm, ask clarification, and discuss the procedures while listening to the teacher. A post-test was then conducted four weeks after the intervention was applied. The same instrument was used in conducting the post- test. After which, the data was analyzed using the paired t-test statistical tool.

Data Analysis

A Paired t-test was used to investigate if there was a significant difference in the students' mathematics motivation in Geometry before and after the intervention of Peer- Pair Tutoring. The data collected from the respondents was presented through the use of descriptive statistics by getting the mean score and the standard deviation of their pretest and posttest scores.

Results and Discussion

This section presents the data gathered together with the corresponding analysis and interpretation of results. The data are presented in textual and tabular form organized in a sequential manner. Table 1 shows the participant's level of mathematics motivation before and after the implementation of Peer- Pair Tutoring.

The table shows that the Grade 8 students' mathematics motivation in their pre- test has a mean of 3.59 and a standard deviation of 0.589 which indicates a high level of motivation. Moreover, the mean score of students' mathematics motivation in their post- test after the implementation of Peer- Pair Tutoring has a mean of 3.68 and a standard deviation of 1.108 which also indicates a high level of mathematics motivation. This implies that students already have a relatively high motivation in learning mathematics even before the intervention was applied.

Table 1. Participants Mathematics Motivation before and after the implementation of Peer- Pair Tutoring

Study Groups	N	Mean	SD
Pre- Test	40	3.59	0.589
Post- Test	40	3.68	0.108

Legend:

Rating	Scale	Descriptive Rating	Motivational Level
Strongly Agree	4.50-5.00	Strongly Agree	Very High
Agree	3.50-4.49	Agree	High
Neutral	2.50-3.49	Neutral	Average
Disagree	1.50-2.49	Disagree	Low
Strongly Disagree	1.00-1.49	Strongly Disagree	Very Low

The results support Lim (2014) findings that students found peer-tutoring a motivating additional element in the classroom. It is a catalyst in enhancing the motivation drive of students when it comes to dealing with mathematics lesson and problem. In this study, students' mathematics motivation in Geometry is relatively high which implies that they do have the motivation even before implementing the intervention. Furthermore, the results are in line with that of Noperta (2023), who concluded that integrating peer- tutoring has a significant influence of increasing students' motivation to learn mathematics. It can be inferred that there is a relatively high motivation of students in learning mathematics.

Table 2 shows the relationship of pre- test and post- test results of Grade 8 students mathematics motivation with their corresponding interpretation.

Table 2. Mathematics Motivation Result

	Utilizing Peer- Pair Tutoring			
	Before		After	
	Mean	Interpretation	Mean	Interpretation
Intrinsic Value	**3.53**	**High**	**3.50**	**High**
I enjoy learning math	3.68	High	3.68	High
I find learning math interesting	3.68	High	3.63	High
I like math that challenges me	3.24	Average	3.20	Average
Self- regulation	**3.60**	**High**	**3.69**	**High**
I put enough effort into learning the math	3.80	High	3.88	High
If I am having trouble learning the math, I	3.85	High	3.73	High

	Utilizing Peer- Pair Tutoring			
	Before		**After**	
	Mean	**Interpretation**	**Mean**	**Interpretation**
try to figure out why				
I use strategies that ensure I learn math well	3.71	High	3.68	High
I prepare well for math tests and quizzes	3.05	Average	3.45	Average
Self- Efficacy	**3.28**	**High**	**3.51**	**High**
I am confident I will do well on math assignments and projects	3.27	Average	3.60	High
I am confident I will do well on math tests	3.20	Average	3.40	Average
I believe I can master the knowledge and skills in the math course	3.51	High	3.55	High
I believe I can earn a grade of "A" in the math course	3.17	Average	3.50	High
Utility Value	**3.72**	**High**	**3.78**	**High**
I think about how the math I learn will be helpful to me	3.73	High	3.78	High
I think about how I will use math I learn	3.73	High	3.60	High
I think about how learning math can help me get a good job	3.68	High	3.88	High
I think about how learning math can help my career	3.73	High	3.93	High
Test Anxiety	**3.81**	**High**	**3.86**	**High**
I become anxious when it is time to take a math test (rev)	3.85	High	4.03	High
I am nervous about how I will do on the math tests (rev)	4.05	High	4.03	High
I worry about failing math tests	4.10	High	4.08	High
I am concerned that the other students are better in math	3.44	High	3.55	High
		High		
OVERALL MEAN	**3.59**		**3.68**	**High**

Legend:

Rating	Scale	Descriptive Rating	Motivational Level
Strongly Agree	4.50-5.00	Strongly Agree	Very High
Agree	3.50-4.49	Agree	High
Neutral	2.50-3.49	Neutral	Average
Disagree	1.50-2.49	Disagree	Low
Strongly Disagree	1.00-1.49	Strongly Disagree	Very Low

The mean of the intrinsic value before and after the intervention decreased at 0.03 indicating a negative relationship. The mean difference of self- regulation was 3.09 which implies that the students' feeling that learning mathematics is quiet valuable. Meanwhile, a mean difference of 0.09 on self- regulation indicates that student's tendency to engage in behavioral learning strategies is low.

Moreover, the self- efficacy with a mean difference of -0.23 indicates a significant improvement in the students' belief that they have the necessary competence and capability to perform well in mathematics, whereas utility value having a mean difference of -0.06 shows that the students' perception that mathematics is relevant to their lives or future careers. Additionally, test anxiety, having a mean difference of -0.05 indicates that the students' feeling of anxiety toward being assessed in math or compared with others significantly decreased.

The results reveal that the overall mean score of students before implementing the peer- pair tutoring is not different from the overall mean score after the intervention was implemented. Table 3 displays the relationship of pre- test and post-test in Paired sample t-test.

Table 3. Paired t-test results of Pre- test and Post- test

Variables	Mean	Std. Deviation	t- value	P- value
Pre- Post	-0.9416	0.792	-0.752	0.456

A t- value of -0.752 and a P- value of 0.456 means we failed to reject the null hypothesis. Hence, there is no significant level of improvement in students' mathematics motivation before and after integrating Peer- Pair Tutoring. It can be inferred that while the integration of peer- pair tutoring as a catalyst in enhancing students' motivation in learning mathematics has been shown to have many benefits, such as increased academic achievement and improved social skills, there are instances where it may not lead to improvements in students' motivation towards mathematics. The study shows that there is not enough evidence to support the claim that peer- tutoring improves the mathematics performance of the students. This phenomenon is affected by several factors that was not considered during the implementation of the intervention.

The results supported Kirchhoff (2016) who emphasized the role of peer tutors in fostering students' motivation. Peer tutoring relies on positive interactions between students; however, negative peer dynamics can arise and impede students' motivation towards mathematics. Issues such as competition, comparison, or lack of trust among peers can create an environment that is not conducive to fostering motivation.

For the high performing students, they tend to care much about the result of their activities rather than spending much effort in tutoring their peers. On the other side of the spectrum, low performing students tend to rely on their peers because they feel that they already know how to answer the problem without their help which leads to decrease self- confidence and eventually, low motivation in learning. In such cases, instead of feeling supported and encouraged, students may feel demotivated or anxious about their mathematical abilities.

Furthermore, one of the reasons why peer tutoring may not improve students' mathematics motivation is the lack

of proper training for peer tutors. Heller (2019) claim that a novel peer- tutoring format, which minimized teacher involvement, was less efficient than traditional methods due to some students' lack of dedication. If peer tutors are not adequately trained in how to effectively motivate their peers, they may struggle to engage them and ignite their interest in mathematics. Without the necessary skills and strategies to inspire motivation, peer tutors may inadvertently contribute to a lackluster learning experience for their peers. In addition, the availability of resources plays a significant role in the success of peer tutoring programs.

Conclusion

Based on the findings of the study, the level of Grade 8 students' mathematics motivation before and after implementing Peer- Pair Tutoring was relatively high. However, the integration of Peer- Pair Tutoring does not improve the mathematics motivation of Grade 8 students in Geometry. Moreover, while peer tutoring has proven to be a valuable educational tool in many contexts, including mathematics education, its effectiveness in improving students' motivation towards mathematics can be influenced by various factors. Addressing issues such as training for tutors, matching learning styles, promoting positive peer dynamics, providing adequate feedback and support, and ensuring access to resources are essential steps towards maximizing the benefits of peer tutoring in enhancing students' motivation in mathematics.

Recommendations

The result and conclusion of the study led to the following recommendations for further research and action. Teachers should foster a positive and inclusive classroom environment where students feel comfortable seeking help from their peers. They should promote collaboration, mutual respect, and a growth mindset among students participating in peer tutoring.

Furthermore, to enhance the motivation of students, the tutors may be rewarded if their activities show good performance. Schools should encourage a culture of academic support and teamwork within the school community by recognizing and celebrating the achievements of both peer tutors and tutees. Schools should also provide resources such as study materials or technology tools to facilitate peer tutoring sessions. Parents and teachers should emphasize the importance of creating a supportive learning environment at home by encouraging open communication about academic challenges and promoting a collaborative approach to problem-solving.

Moreover, the current study is conducted on Grade 8 students of BukSU- SLS only. Therefore, further research studies are recommended involving other grade levels so that the problem under observations explored in depth. By addressing these key areas through targeted interventions and support mechanisms, the effectiveness of peer- pair tutoring in enhancing students' motivation to learn mathematics can be significantly improved.

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