



# The Effectiveness of Peer Tutoring on Student's Understanding of Mathematical Concepts

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## ABSTRAK

Rendahnya pemahaman siswa dalam pembelajaran matematika disebabkan kurangnya penggunaan metode pembelajaran yang menarik siswa untuk mengikuti pembelajaran dengan baik. Tujuan dari penelitian adalah untuk menganalisis efektifitas penggunaan metode pembelajaran tutor sebaya terhadap kemampuan pemahaman konsep matematika siswa. Penelitian ini merupakan penelitian eksperimen semu dengan desain penelitian Pretest-Posttest. Populasi penelitian mencakup siswa siswi Sanggar Bimbingan. Metode pengumpulan data menggunakan observasi dan tes. Instrumen penelitian meliputi tes pemahaman konsep matematika. Analisis data dalam penelitian ini menggunakan uji independen sampel T-test, karena data bersifat normal. Hasil analisis menunjukkan bahwa peningkatan kemampuan pemahaman konsep matematika siswa yang menerapkan metode tutor sebaya lebih baik dibandingkan siswa yang belajar dengan pembelajaran konvensional. Penggunaan metode tutor sebaya lebih efektif diterapkan pada pembelajaran matematika terhadap pemahaman konsep matematika siswa. Oleh karena itu, metode tutor sebaya lebih efektif digunakan dalam proses pembelajaran di kelas dalam meningkatkan kemampuan pemahaman konsep matematika siswa. Implikasi penelitian ini yaitu penerapan metode pembelajaran peer tutor yang sangat berguna khususnya bagi guru yang dapat dijadikan alternatif metode pembelajaran di sekolah untuk meningkatkan pemahaman konsep matematika siswa.

## ABSTRACT

The low understanding of students in mathematics is due to the need for more use of learning methods that attract students to participate in learning well. The research aims to analyze the effectiveness of using peer tutoring learning methods on students' ability to understand mathematical concepts. This research is a quasi-experimental research with a Pretest-Posttest research design. The research population includes students from the Guidance Studio. Data collection methods use observation and tests. The research instrument includes a test of understanding mathematical concepts. Data analysis in this study used an independent sample T-test because the data is normal. The analysis results show that the increase in the ability to understand mathematical concepts for students who apply the peer tutoring method is better than those who use conventional learning. The peer tutoring method is more effectively applied in mathematics learning towards students' understanding of mathematical concepts. Therefore, peer tutoring is more effective in improving students' understanding of mathematical concepts in the classroom learning process. This research implies that applying the peer tutor learning method is very useful, especially for teachers, which can be used as an alternative learning method in schools to improve students' understanding of mathematical concepts.

## 1. INTRODUCTION

Mathematics is one of the subjects taught in schools from elementary to college. Mathematics can equip students with logical, analytical, systematic, critical, creative, and other thinking skills (Ayu & Musa, 2020; (Mansur, 2018; Öztürk et al., 2020). To assist students in working together to be able to solve the problems given (Budiono & Suhendar, 2019; Wahyu

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Lestari et al., 2019). Mathematics is also a science that has an important role in everyday life. Nowadays, many students assume that mathematics is a very difficult and number-filled subject (Anwar, 2018; Wiryanto, 2020). Even around us, there are still many students who have difficulty learning mathematics. This is because mathematics contains symbols, calculations, and abstract concepts, so students find it difficult to understand mathematical material (Sabilla et al., 2020; Yantoro et al., 2021). Another factor that also influences the low mastery of Indonesian students in the field of mathematics is abstract mathematics, so many students find mathematics difficult, confusing, and even scary (Nugraheni, 2017; Nurdin et al., 2019). Mathematics is one of the fields of science that requires a strong understanding of concepts to solve problems and make the right decisions. Understanding mathematical concepts is very important because when students understand a concept, students will be able to remember the mathematics lessons they have learned in the long term (Radiusman, 2020b; Rahayu & Hidayati, 2018). Understanding mathematical concepts has an important role in determining the process of solving problems in mathematics (Achdiyat & Utomo, 2018; Suri et al., 2022; Wiryanto, 2020). A good understanding of the concept will be the main asset a teacher will have when teaching in class. A person who understands what is taught and what is conveyed will be more easily accepted by those being taught. One indicator of concept understanding is the ability to classify concepts or algorithms into problem solving (Suhendar & Ekayanti, 2018; Sumarni et al., 2020). Indicators of understanding mathematical concepts are (1) restating a concept; (2) classifying objects according to certain properties according to their concepts; and (3) giving examples and not examples of a concept. (4) presenting concepts in various forms of mathematical representation; (5) developing necessary or sufficient conditions for a concept; (6) using, utilizing, and choosing certain procedures or operations; and (7) applying concepts or algorithms to problem solving (Kartika, 2018).

The success of learning mathematics can be measured by the ability of students to understand and use concepts in problem solving that are managed properly. Students are said to have good concept understanding skills when they already know about what has been learned, the steps that need to be taken in solving problems, and can use mathematical contexts in everyday life (Wahyudi et al. 2021). Through a good understanding of students' mathematical concepts, it will bring out the critical mindset of students (Febriyanto et al., 2018; Radiusman, 2020a). Students' mathematical concept skills are good when students have learning experiences, and the teacher's role as a facilitator in the learning process (Herini et al., 2023). However, not everyone easily understands mathematical concepts. And there are some even having difficulty in learning the material (Mawaddah & Maryanti, 2016; Mukrimatin et al., 2018). Therefore, there are many teaching strategies and methods used to help students understand mathematical concepts better. In order for the learning process to run effectively, the right learning method is needed. Learning methods are a set of strategies based on certain theories and research foundations, including background, learning procedures, support systems, and learning assessment, which aim to achieve certain learning goals for teachers and students (Bilik et al., 2020; Suhirman et al., 2020). One method that has become popular in recent years is the use of peer tutors.

Peer tutoring is one model of cooperative learning (Munthe & Naibaho, 2019; Yael et al., 2022). The use of peer tutoring methods is expected to be more effective in helping students with their problems. In peer tutoring, there are no boundaries between students and tutors, and students will be more open, not shy about asking questions because the tutors are their own friends. Peer tutoring is one of the most common strategies for math learning. The peer tutor strategy is done effectively by assisting in peer-mediated math learning (Amaka, 2013; Tsuei, 2013). The peer tutor learning model is a learning model with the principle of activating students in learning (Hayati et al., 2018; Hwang et al., 2019). The learning method of peer tutors is expected to help students understand mathematical concepts. The effectiveness of peer tutor learning strategies can be attributed to student activeness and involvement in the learning

process (Amaka, 2013; Tetiwar & Appulembang, 2018).

The importance of peer tutor learning strategies includes improved student academic performance, communication skills, and enthusiasm for learning. It also instills a sense of responsibility and builds confidence (Flores et al., 2018 ; Rudland & Rennie, 2014). Students are more engaged in learning when they work with their peers (Hwang et al., 2019). Because they feel more connected to their peers when learning it allows them to work as a team, give, and receive responses and assess their learning activities (Hanson et al., 2016).

According to some studies, peer tutors can improve students' comprehension of mathematical concepts (Hayati et al., 2018; Rohmah, 2019; Suprijadi, 2010; Yael et al., 2022). students involved in peer tutor programs have a better level of understanding of mathematical concepts compared to students who are not involved in the program. The steps of the peer tutor learning model are: 1) students are formed into heterogeneous groups; 2) students are given teaching materials and activity sheets to be discussed in each group; 3) students are given sufficient time to discuss the material and questions given by the teacher; 4) representatives from each group are asked to present the results of the discussion in front of the class; 5) students are given a post-test to find out their understanding of the results of the discussion; and 6) students and teachers conclude together (Hastari, 2019). There have been several previous studies that have examined the effectiveness of peer tutoring methods. A study showing that peer tutoring methods are more effective than hands-on learning models for improving problem-solving skills (Tuvi Noryanti et al., 2019). Peer tutoring methods can improve the learning outcomes of number concepts (Nurmala et al., 2016). Peer tutor model with a scientific approach applied during mathematics learning in class VII E SMP Negeri 2 Sewon can increase students' understanding of concepts and learning motivation (Rohmah, 2019). Teaching methods undertaken by peer tutors can help students develop a better understanding of mathematical concepts because they learn from their peers who already understand the concepts. Other research found that students involved in peer tutor programs have better problem-solving skills and can more easily understand mathematical concepts (Amir, 2019; Tuvi Noryanti et al., 2019). In learning with the peer tutoring method, students will more easily understand concepts because there is interaction within peer groups using language that is simpler to understand (Tetiwar & Appulembang, 2018). The advantages of peer tutors in education are that in the application of peer tutors students are trained to communicate, express opinions, respect the opinions of others, be independent, mature and have a high sense of loyalty to friends. This peer tutor learning method has an important goal in groups, can train individual responsibility and teach students to help / collaborate with each other and encourage each other to make maximum efforts (Arnawa, 2021). Based on the research conducted, researchers saw that in learning at SB Rawang, teachers only give lectures at the time of learning. so that the learning material is not conveyed properly and students feel bored and not interested in the learning. Based on the description that has been given, this research was carried out with the aim of applying the peer tutor method to learning whether to increase students' understanding of mathematical concepts or not.

## **2. METHOD**

In this study, quantitative research methods are used. This type of research is quasi-experimental design, with a pretest-posttest control group design. Specifically, this study adopted the quasi- experimental design because it allowed the researchers to manipulate the variables of interest in this study. This research was conducted at Sanggar Bimbingan Rawang. The population in this study was all SB Rawang students, consisting of 3 classes. Of the 3 classes, 2 were selected as research samples. The selection of samples is based on the level of education. So the research sample in this study was determined by male and female students. Then the boys' class was given the conventional method (no treatment), while the girls' class was given the peer tutor method. Then the boys' class is called the conventional class, while the girls' class is called the peer tutor class. In this study, the instruments used were pre- and posttests about understanding concepts in Calculate operation addition,

subtraction, multiplication and division. The data collection technique used is a quantitative data collection technique. This data collection is used to see an increase in students' understanding of mathematical concepts obtained from pre-test and post-test results. Instrument Grid *Pretest* and *Posttest* understanding of Mathematical Concepts showed in [Table 1](#) and [Table 2](#).

**Table 1.** Instrument Grid *Pretest* Understanding of Mathematical Concepts

Material	Basic Competencies	Question Indicator	Question Number	Question Form
Calculate Operation	Explain and perform addition, subtraction, multiplication and division operations	Calculates addition, subtraction, multiplication and division operations (C4)	1,2	Description
		Finding concepts Solving problems related to addition, subtraction, multiplication and division operations of integers (C4)	3,4,5	Description

**Table 2.** Instrument Grid *Posttest* Understanding of Mathematical Concepts

Material	Basic Competencies	Question Indicator	Question Number	Question Form
Calculate Operation	Explain and perform addition, subtraction, multiplication and division operations	Calculates addition, subtraction, multiplication and division operations (C4)	1,2	Description
Material	division operations	Finding concepts Solving problems related to addition, subtraction, multiplication and division operations of integers (C4)	3,4,5	Description

Peer Tutoring Instructional Strategy (Experimental Group). Treatment in this group involved the following steps: Step 1: teacher presented the topic to be taught to the students. Step 2: teacher paired the students into groups (tutee) and a peer among the student which served as the tutor in the group. Step 3: the tutor in each group taught and explained the topic to other members which are the tutees under the supervision of the teacher . Step 4: teacher gave questions on the topic to the students in order to know to which extent they have learnt from the tutor. Step 5: students answered the questions individually without the assistance from the tutor. Step 6: teacher summarized the lesson. Step 7: teacher evaluated the students. Step 8: students were given a take-home assignment. Conventional Instructional Strategy (Control Group). Control group was taught using the following steps: Step 1: teacher presented the lesson in the form of a lecture. Step 2: students listened to the teacher's explanation on the topic. Step 3: students wrote down summaries in the form of note from the chalkboard. Step 4: students asked the teacher questions on areas of the topic that are not clear to them. Step 5: teacher summarized the lesson. Step 6: teacher evaluated the students. Step 7: students were given a take-home assignment.

### 3. RESULT AND DISCUSSION

#### Result

The peer tutor method is a method that can help teachers in discussion activities in the learning process (Wali et al., 2020). The application of appropriate learning methods can affect students' ability to understand mathematical concepts. The research was conducted at Sanggar Bimbingan Rawang to assess the influence of peer tutoring methods on students' ability to understand mathematical concepts. The application of this peer tutor method can encourage students to be more active and critical in learning, increase teamwork, give students the confidence to explain or present arguments on a material, communicate well, and train students to be tutors when the teacher is in business to create conducive and systematic learning room conditions (Amir, 2019). Students' mathematical comprehension abilities are obtained through pretests and posttests. The following table shows the data acquisition of pretest and posttest learning outcomes that has been carried out. The pretest- and posttest results are shown in Table 3.

**Table 3.** Table of Pretest and Posttest Test Results

	N	Min	Max	Mean	Std. Deviation	Variance
Pre-Test Eksperimen	20	35	70	54.50	10.880	118.368
Post-Test Eksperimen	20	80	97	88.50	5.247	27.526
Pre-Test Kontrol	20	40	72	57.65	8.647	74.766
Post-Test Kontrol	20	50	78	67.10	7.341	53.884
Valid N (listwise)	20					

Based on Table 3 using SPSS 18.0, it is known that the minimum value of the control class pretest is 40, while the maximum value is 72, the average is 57.65 and the variance is 74.766. As for the experimental class pretest, the minimum score is 35, the maximum score is 70, while the average is 54.50 and the variance is 118.368. Furthermore, for the control class posttest, it is known that the minimum value of the control class posttest is 50, while the maximum value is 78, the average is obtained 67.10 and the variance is 53.884. Furthermore, for the experimental class posttest, it is known that the minimum value of the experimental class posttest is 80, while the maximum value is 97, the average is obtained 88.50 and the variance is 27.526. The acquisition of data on students' concept understanding ability after being given learning using the peer tutor method is higher than before using the learning method. As a prerequisite test, it must be met before conducting a hypothesis test through an Independent sample t- test on research data through normality and homogeneity testing. The data is said to be normally distributed and homogeneous if the significance value is  $>0.05$ . As for the data that  $< 0.05$ , it is said to be not normally distributed and homogeneous. For the normality test it is shown in Table 4.

**Table 4.** Normality Test Results Table

	Class	Shapiro-Wilk		
		Statistic	df	Sig.
Concept Understanding Ability	Pre-Test Eksperimen	0,939	0	0,226
	Post-Test Eksperimen	0,949	20	0,358
	Pre-Test Kontrol	0,969	20	0,732
	Post-Test Kontrol	0,924	20	0,118

Based on Table 4 of the normality test using SPSS 18, the significance value of the Shapiro-Wilk pretest control class and experiment  $> 0.05$ , which means that the sample data obtained are normally distributed. The same is shown in the posttest signification value of the control class and experimental class  $> 0.05$ . So it can be concluded that the results of the pretest and post-test sample data used are normally distributed. Furthermore, to meet the requirements, a variance homogeneity test was carried out with the help of SPSS 18. For homogeneity tests



**Table 5. Homogeneity Test Results Table**

Levene Statistic	df1	df2	Sig.
0,336	1	20	0,569

The results of the variance homogeneity test were used to meet the requirements of this study. The variance homogeneity test was performed with SPSS version 18 software rock. The table of homogeneity test results data above shows that the statistical value of levene is 0.336 with the first degree of freedom (df1) of 1, the second degree of freedom (df2) of 20 and the significance value (Sig) of 0.569. A recognition result (Sig) greater than the established level of significance (0.05) showed that there was no significant difference in homogeneity of variance for the posttest data. So it can be concluded that the posttest result data of experimental classes using peer tutor learning models and conventional classes have the same variance.

Based on the prerequisite tests, namely normality and homogeneity tests, the results of the data are normally distributed and the data has the same variance (homogeneous). Because the data is normally distributed, the next is a parametric test using an independent test of the t-test sample using the SPSS 18 application to see the average difference in the posttest values of the experimental class and the control class. For the Independent Sample t Test shown in Table 6.

**Table 6. Independent Sample t Test Result Table**

		Levene's Test for Equality of Variances		T-test for Equality of Means		
		F	Sig	t	df	Sig.(2-tailed)
Concept Understanding Ability	Equal Variances assumed	0,336	0,589	7,092	20	0,000
	Equal Variances not assumed			7,092	19,605	0,000

Based on data analysis obtained Sig. (2-tailed) of  $0.000 < 0.05$  meaning As a result the initial hypothesis (H0) is rejected, and the idea of alternative (Ha) is accepted. The conclusion is that there is a significant average difference between the mathematical concept comprehension ability of experimental class students using peer tutor learning models and control (conventional) classes. Based on the analysis of the hypothesis, it was stated that there was a significant difference in the use of peer tutor methods in the understanding of students' mathematical concepts in control classes and experiments.

## Discussion

Many factors cause the success of a learning process, one of which is the learning method chosen by the teacher to deliver teaching materials to students. From the results of the research above, it can be said that the learning method chosen by the author to be tested with conventional methods that have been commonly used before is much better at delivering material and increasing students' understanding of mathematical concepts. In learning mathematics, a child will be more able to understand teaching materials if his creative power can also develop and is not indoctrinated with the teacher's rules (Abineno et al., 2019; Dewi & Apsari, 2021). In learning with peer tutors, students will be more active and creative in solving problems related to mathematics so that students better understand everything if they are directly involved in solving problems (Suprijadi, 2010; Widiani et al., 2017). According to previous research, the benefits of the peer tutor method are that peer tutors have positive

benefits contained in this peer tutor learning method, one of which is that it can increase the confidence of students, who dare to appear in front of their friends (Hastari, 2019; Suprijadi, 2010). With this, students will prefer learning using the peer tutor method because the information received will be more easily absorbed (Nurhasanah Lisa, 2021). The results of the data analysis also show that there are differences in the use of the peer tutor method on the ability to understand students' mathematical concepts in the experimental class (using the peer tutor method) and the control class (conventional). Group learning with peer tutors provides opportunities for students to explore their potential, develop the ability to collaborate, understand each other, work together, help each other, listen to other people's opinions, accept joint decisions, and respect differences (Dewi & Apsari, 2021; Kumolontang, 2021; T Noryanti et al., 2019). Group learning with Peer Tutors allows students to learn to communicate in their own language. With student-centered learning, the teacher's function is only as a facilitator, guide, and companion for students in discovering the material's concepts (Hastari, 2019; Hendriansyah, 2013; Widiyani et al., 2017). So that teachers can concentrate more on classroom management efforts and not be too busy presenting material.

Therefore, the results showed that the use of peer tutoring methods is more effective in learning than conventional learning methods. By using the peer tutor method, students can further motivate and encourage themselves to be active in the learning process so that they are not only silent, take notes, and listen to lectures from the teacher, but they will also be actively involved in the learning process together with tutors and other members of their group (Hastari, 2019; Munthe & Naibaho, 2019). Similar research results showed that peer tutoring methods are more effective than hands-on learning models for improving problem-solving abilities (Tuvi Noryanti et al., 2019). Data analysis conducted showed that the average score in the experimental class was 74.89, while the average score in the control class was 68.68. This shows that classes using peer tutoring methods are more effective in positively influencing mathematical problem-solving skills compared to classes using hands-on learning methods.

In a similar study explained that students who did the peer tutor method were superior to others, namely those taught with conventional methods in mathematics (AbdulRaheem et al., 2017; Nawaz & Rehman, 2017; Olulowo et al., 2020; Tella, 2013). Other research found that peer tutors brought positive changes to students' outcomes in mathematics (Nawaz & Rehman, 2017). It was concluded that the peer tutor strategy turned out to be beneficial in improving the academic achievement of weak and mediocre students. The use of peer tutor methods affects the ability to understand mathematical concepts (Alvyanita & Priatna, 2021). Based on the results and discussion, it was found that there was a significant average difference in the ability to understand the concepts of students who were treated with peer tutor learning models compared to students who were not given treatment. This means that the peer tutor learning model can improve students' ability to understand mathematical concepts in online learning.

The application of the peer tutor method in learning mathematics provides several results that can be seen from the learning activities of students. By prioritizing the nuances of collaborative learning, students become more interactive in learning activities with their friends. In the aspect of learning material, when this peer tutor method is applied in learning mathematics, the results obtained are an increase in students' understanding of mathematics. Students who were previously unable to do the tasks given because they lacked understanding become able to do them because the tasks are done together with the help of their group peer tutors, who are their own playmates (Hastari, 2019; Kurniawan et al., 2023; Munthe & Naibaho, 2019). In other studies found that there is a significant influence of peer tutor learning model on mathematics learning achievement of grade VII students at SMP 20 Kupang (Abineno et al., 2019).

The implications of this study provide an overview and understanding of peer tutor learning methods that are very useful, especially for teachers who can be used as alternative learning methods in schools to improve students' understanding of mathematical concepts. This research is still limited because it only involves one guidance studio as a research subject, namely SB Rawang. So it is hoped that future research can deepen and expand the scope of research related to the use of peer tutor methods. The researcher is aware that the results of this study are

limited to students in Sanggar Bimbingan Rawang Selangor Malaysia only, therefore, suggesting that future research should be conducted in other related disciplines to evaluate the effectiveness of peer tutor learning strategies towards students' understanding of mathematical concepts.

#### 4. CONCLUSION

The results of this study have provided empirical data on peer tutors who are more effective in improving students' ability to understand mathematical concepts compared to conventional lecture methods. Because in the tutor peer learner the student is actively involved in the learning process it allows the transfer of control to the student in the classroom with active guidance from the teacher, giving the student the opportunity to explain their ideas. Conversely, the use of conventional lecture methods in the delivery of mathematical concepts does not provide the expected results of consequences on student passivity during the learning process.

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