



# Peer-Tutor Assisted Problem-Based Learning Model on Mathematics Critical Thinking

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## ABSTRAK

Hasil sumatif tengah semester matematika menyatakan siswa kelas IV memerlukan remedial karena kemampuan menyelesaikan soal masih rendah hal ini menandakan kemampuan berpikir kritis siswa rendah. Berdasarkan observasi hal ini terjadi karena kurangnya interaksi yang mengaktif siswa serta proses pembelajaran tidak mengajak peserta didik untuk memecahkan permasalahan. Penerapan model pembelajaran mempengaruhi peningkatan kemampuan berpikir kritis serta mampu mengaktif pembelajaran. Tujuan penelitian ini yaitu menganalisis pengaruh signifikan model berbantuan Tutor Sebaya terhadap Kemampuan Berpikir Kritis Matematika kelas IV Sekolah Dasar. Jenis penelitian yang digunakan eksperimen semu (quasi – experimental) dengan rancangan nonequivalent posttest only control group design. Populasi penelitian yaitu sepuluh rombel kelas IV sekolah dasar di Gugus IV. Penentuan sampel menggunakan teknik random sampling dengan 2 kelompok yaitu eksperimen dan kontrol. Metode pengumpulan data adalah metode tes uraian sebanyak 6 butir. Analisis data dilakukan secara deskriptif dan inferensial. Hasil penelitian ini yaitu rata-rata skor posttest kelompok eksperimen 90, 20 dan rata-rata skor posttest kelompok kontrol 52, 94. Sehingga, rata – rata skor posttest kelompok eksperimen lebih besar dari kelompok kontrol. Hasil hipotesis diperoleh terdapat pengaruh yang signifikan model berbantuan tutor sebaya terhadap kemampuan berpikir kritis Matematika siswa kelas IV Sekolah Dasar. Disimpulkan bahwa signifikan model berbantuan tutor sebaya dapat meningkatkan kemampuan berpikir kritis matematika.

## ABSTRACT

The mid-semester summative mathematics results stated that grade IV students needed remedial because the ability to solve problems was still low, indicating low critical thinking skills. Based on observations, this occurs because of the need for more interaction that activates students, and the learning process does not invite students to solve problems. The application of learning models affects the improvement of critical thinking skills and being able to activate learning. This study aimed to analyze the significant effect of the Peer Tutor assisted model on the Ability to Think Critical Mathematics in Grade IV Elementary School. This type of research used quasi-experimental (quasi-experimental) with a nonequivalent posttest-only control group design. The research population was ten groups of class IV elementary schools in Cluster IV. Determination of the sample using a random sampling technique with 2 groups, namely experimental and control. The data collection method is a description test method of 6 items. Data analysis was carried out descriptively and inferentially. This study's results are the experimental group's average posttest score, 90.20, and the average posttest score of the control group, 52.94. So, the average post-test score of the experimental group is greater than the control group. The results of the hypothesis show a significant effect of the peer tutor-assisted model on the critical thinking skills of students in grade IV elementary school. It was concluded that the peer tutor-assisted model significantly improves critical thinking skills in mathematics.

## 1. INTRODUCTION

In realizing educational goals, one way to do this is by issuing the Merdeka curriculum based on Strengthening the Pancasila Student Profile, which consists of several dimensions, namely first, faith, devotion to God Almighty, second, global diversity, third, mutual cooperation, fourth, independence, fifth,

critical thinking and creative sixth (Mery et al., 2022; Rachmawati et al., 2022; Santika, 2022). In the independent curriculum there are several compulsory subjects, one of which is mathematics. Mathematics is a subject that can shape students to have critical, creative and systematic thinking patterns, therefore mathematics lessons are always available in every level of education from elementary school to college. (Awalia et al., 2019; Syakroni et al., 2021; Yudha, 2019). Critical thinking is the ability to solve problems through an investigation that will produce a conclusion or decision (Benyamin et al., 2021; Wijayanti & Siswanto, 2020). Critical thinking is a process that is clearly directed through mental activities such as solving problems, making decisions, analyzing assumptions and conducting scientific research. (Ariani, 2020; Damayanti et al., 2020; Sartika, 2019).

The indicators of critical thinking ability in mathematics are the first, namely interpreting, which is understanding the problem shown so that you can interpret the meaning of the problem, second, Analysing, namely identifying the relationships between questions, statements and concepts in the problem shown by making appropriate mathematical models and providing appropriate explanations. correct, third Evaluating is using the right strategy in solving problems, complete and correct in carrying out calculations, fourth Differentiating is making conclusions correctly (Fahrum, et al., 2018). There are 2 data, namely: First, based on data from the results of the 2015 Trends in International Mathematics and Science Study (TIMSS), which shows that the mathematics scores of Indonesian junior high school students are at level 45 out of 50 countries. (Azizah et al., 2018). Second, based on 2015 Ministry of Education and Culture data, it is stated that the ability of Indonesian students in working on questions using critical thinking patterns (reasoning) shows that this ability is still very minimal. (Azizah et al., 2018). Students in Indonesia have low problem solving abilities, this was proven in the 2018 PISA survey, especially in the mathematics category, Indonesia was in 73rd place out of 80 participants who took part in the program with an average score of 397 (Arta et al., 2020). Likewise, at Gugus IV Elementary School, Buleleng District, based on interviews with class IV teachers, it was found that students' critical thinking abilities were still low and this was seen based on the average mid-semester summative score following the written test assessment rubric using intervals in the Merdeka curriculum. Based on observations by mathematics teachers at cluster IV Elementary School, Buleleng District, the learning process mostly uses lecture, question and answer and assignment methods. Many teachers use the lecture method so that only the teacher is active, which has an impact on students' low critical thinking abilities (Munarsih et al., 2020; Syakroni et al., 2021). Observation results show that students pay more attention to what the teacher says, then when there is a question and answer session given by the teacher, students tend to be more silent, then students are assigned to work on practice questions on the board or in the students' books according to the explanation that has been given previously. . This is what causes students' critical thinking abilities to be low because of the habit of learning directly at school by providing material and then giving practice questions that have been given examples previously. (Saraswati & Agustika, 2020).

Mathematics learning needs to train critical thinking skills, for this reason, implementing mathematics learning is not enough just to provide theories or concepts in rote form, but learning needs to be oriented towards developing skills in problem solving. (Azizah et al., 2018; Fasha et al., 2018; Ratnawati et al., 2020). Based on research, it is recommended that teachers use innovative learning models accompanied by providing open-ended practice questions to hone students' critical thinking skills. (Purbonugroho et al (Anggreni et al., 2020; Yuwandari1 & Hariyani, 2019). So it can be concluded that the mathematics learning process at cluster IV Elementary School, Buleleng District, does not activate students enough so that learning becomes teacher-centered and does not stimulate students to think critically because teachers tend to use the lecture method and teachers have not been seen using innovative learning models. For this reason, we need a student-centered, problem-based learning model that can train and develop students' critical thinking abilities. The Problem Based Learning learning model is a learning model that is suitable for improving students' critical thinking skills in mathematics subjects in elementary schools. (Azizah et al., 2018; Dwi et al., 2013; Nurmanita et al., 2019). PBL is a student-centered learning model that will direct students to solve a problem, where the problem is related to the students' daily lives. (Amin et al., 2020; Rahmat et al., 2020; Yonanda et al., 2019). The Problem Based Learning model is a model of learning activities that has an orientation on how to solve problems that occur in everyday life, which aims to ensure that students have the ability to solve problems logically and improve students' critical thinking skills. (Ismail et al., 2018; Marwah & Suchyadia, 2021). So the Problem Based Learning model is suitable to be used to improve students' critical thinking skills, but there are shortcomings in the Problem Based Learning learning model, namely that it requires quite a long study time and students often find it difficult to understand the problems given because the students' abilities are different. (Anazifa & Djukri, 2017; Hussin et al., 2018).

Students who have difficulty understanding problems tend to remain silent because they are embarrassed to ask the teacher. The Problem Based Learning model can be used with the help of Peer

Tutors. Using tutors to implement the Problem Based Learning model more effectively, one of the tutors in question is peer tutoring (Nasihah et al., 2018). The Problem Based Learning Learning Model assisted by peer tutors is an alternative that can be used to improve students' thinking skills. Students will be trained to think critically by solving, analyzing and proving problems that have been given with the help of peer tutors who have a higher understanding. Previous research stated that the average score of problem solving abilities using the Problem Based Learning learning model assisted by Ice Braker was higher than those using the conventional model (Arta et al., 2020). Other research states that there is an influence of peer tutors in the Problem Based Learning model on critical thinking abilities (Nasihah & Lesmono, 2019). The mathematical problem solving abilities of students who use Problem Based Learning with peer tutoring are higher than students who use the conventional model (Maulidiya & Nurlaelah, 2019; Ramda et al., 2022). Therefore, based on previous research and research suggestions, this research seeks to develop previous research by applying it to elementary schools. Based on the explanation above, theoretically the Problem Based Learning Model and peer tutoring can be alternative learning models in schools to improve critical thinking skills. The aim of this research is analysed the significant influence of the Problem Based Learning model assisted by Peer Tutors on Critical Thinking Ability in Mathematics in Grade IV Elementary School.

## 2. METHOD

The research approach used is quantitative. The type of research is quasi-experimental (quasi-experimental). Quasi-experiments are used in this research with the aim of providing information obtained through actual experiments, which do not allow controlling all relevant variables (Syahza, 2021). This research will use two groups, namely the experimental group, namely the group that will be taught using the Problem Based Learning model assisted by peer tutors and the control group that will be taught the conventional model, with a non-equivalent post-test only control group design. This research procedure consists of three stages, namely stages, preparation for treatment, implementation of treatment and completion of treatment. The preparation stage includes pre-research observations at basic schools in Cluster IV Buleleng District, discussions with teachers regarding the implementation of learning, preparation of teaching modules, and preparation of instrument grids. The implementation stage includes instrument preparation, instrument testing, analysis of instrument test results, and treatment in the experimental group and observation in the control class then posttest in both groups. The final stage is analyzing the posttest results and drawing conclusions from the research results. The population in this study was 10 class IV students at the Gugus IV Elementary School, Buleleng District, with a total of 273 students. The data source for this research is a representative population, namely the sample. Before determining the research sample, it is necessary to prove that the abilities of all students in the population are equal in terms of academics so that an equality test is carried out with the summative scores for the middle of the odd semester in mathematics for class IV students with the help of IBM Statistics SPSS 20 For Windows, the ANOVA significance value is obtained more. The significance level is greater than 5% ( $0.314 > 0.05$ ), which means there are no significant differences between members of the population so they can be declared equal.

Determination of the research sample was determined using random sampling techniques. In this study, 2 samples were needed, namely the experimental group and the control group. The results of data analysis showed that there were 29 students in the experimental group, namely class IVB students at SD Negeri 1 Banyuasri and 20 students in the control group, namely class IV students at SD Negeri 3 Banyuasri. The data collection method used in this research is a test method, namely a description type test. In preparing the description test, it is based on 4 indicators of critical thinking, namely Interpreting, Analyzing, Evaluating and Differentiating. Using the operational verbs of Revised Bloom's Taxonomy (C4 - C6) to make it easier to prepare tests. Of the 10 essay tests, 6 questions were used for research when students were given the posttest. 10 question items were tested before the instrument had been tested for its content validity by 2 instrument experts, then the results of the content validity test were managed using the Gregory formula, obtaining a coefficient of 1.00, which means it was in the very high category. Based on the validity test, the questions stated that all the questions were valid, followed by the rehabilitation test with the Alpha formula, the result was 0.752, which means it was in the high category. The difficulty level test obtained 1 easy level question, 2 difficult level questions and 7 medium level questions, then the last test, namely the distinguishing power, obtained the results of the differentiating power of the questions categorized as "fair" and "good". So questions about critical thinking skills in mathematics are worthy of being used and used as instruments in research. The instrument grid is presented in Table 1. Based on the validity test, the questions stated that all the questions were valid,

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**Table 1. Instrument Grid**

<b>CRITICAL THINKING ABILITY INSTRUMENTS</b>	
4.37	Using a table to present data on the number of objects using a graph to compare, sort and analyze more of one object than another
4.37.1	A problem is presented with a table that uses a ruler. Students are asked to interpret the table. (C4)
4.37.2	Presenting a problem with a table using a guide, students are asked to make a table to solve the problem by analysing (analysing indicators). (C6)
4.38	Change the presentation of data in tabular form into pictograms, bar charts and line charts
4.38.1	When a problem is presented in tabular form, students are asked to solve it by making a pictogram. (Indicator evaluates) (C6)
4.38.2	When a problem is presented in tabular form, students are asked to solve it by making a bar chart. (Indicator evaluates) (C6)
4.38.3	Presenting a problem in tabular form, students are asked to solve it by presenting a line diagram (evaluating indicators) (C6)
4.3.9	Solve problems related to calculating the data listed in pictograms, bar charts, and line charts
4.39.1	Presented with a problem, students are asked to conclude the most correct data which is presented in three different forms, namely in the form of pictograms, bar diagrams and line diagrams. (C5)
4.39.2	Presented a problem for participants to conclude the most accurate average student from 2 bar charts (C5).

Research data analysis techniques include descriptive statistical analysis and inferential statistics with the help of the IBM SPSS Statistics 20 For Windows program. Descriptive statistical analysis includes a comparison of the maximum and drinking scores for each group, modes, media, mead, range, standard deviation and qualifying learning outcome scores for each group with the Five Scale Benchmark Assessment (PAP). Then, inferential statistical analysis to test the hypothesis and conclude the research results, before testing the hypothesis there are two prerequisite tests, namely testing normality and homogeneity of variance. After the prerequisite tests are met, proceed with hypothesis testing.

### 3. RESULT AND DISCUSSION

#### Result

Data resulting from critical thinking skills in mathematics were analyzed using descriptive statistics and inferential statistics. Descriptive statistics include measures of central tendency (mean, median, mode) and measures of variability (standard deviation and variance). The results of the

descriptive analysis of the mathematical critical thinking abilities of the experimental group and the control group are presented in Table 2.

**Table 2. Descriptive Statistics Results Post-test Score Data for Experimental Group and Control Group**

Descriptive Statistics	Experimental Group	Control Group
Mean	90.20	52.94
Modus	90.00	60.00
Median	90.00	51.65
Varians	47.62	90.28
Maximum Score	100.00	73.30
Minimum Score	76.60	40.00
Standard Deviation	6.90	9.50
PAP Qualifications	Very High	Medium

Based on the data presentation, it can be seen the difference in the average posttest scores between the two groups, namely the experimental group and the control group. The average of the experimental group is greater than the control group. Data on mathematical critical thinking abilities in the experimental group was obtained through a posttest on 29 students. The highest score is 100 and the lowest score is 76.60. The average is 90.20. The median is 90.00. Mode 90.00. The standard deviation is 6.90 and the variance is 47.62. The data was converted to the Five Scale Benchmark Assessment (PAP) based on the criteria that the ideal average (Mi) and ideal standard deviation (Sdi) of the experimental group were classified as very high. Then, obtain data on the mathematical critical thinking abilities of a control group of 20 students. The highest score obtained by students was 76.60 and the lowest score was 40.00. The average is 52.94. The median is 51.65. Mode 60.00. The standard deviation is 9.50 and the variance is 90.28. This data was converted into a Five Scale Benchmark Assessment (PAP) based on the criteria of the ideal average (Mi) and ideal standard deviation (Sdi) for the control group which was classified as moderate. The descriptive analysis of the average achievement of critical thinking ability indicators in mathematics is presented in Table 3.

**Table 3. Average Achievement of Mathematical Critical Thinking Ability Indicators**

Indicators	Experimental Group	Control Group
Interpreting	25.20	9.80
Analyze	25.00	9.00
Evaluate	26.90	11.46
Inferring	26.40	10.50

Based on the explanation above, it can be seen that the achievement of indicators between the experimental group is greater than that of the control group, namely with the results for the Interpreting indicator (25.20 > 9.80), the Analyzing indicator (25.00 > 9.00), the Evaluating indicator (26.90 > 11.45) and the Inferencing indicator (26.40 > 10.50). Inferential testing includes assumption testing (prerequisite testing) and hypothesis testing. First, a prerequisite test was carried out with 2 tests, namely the normality test and the homogeneity test. Followed by the t-test to test the hypothesis. The data distribution normality test was carried out with the help of IBM Statistics SPSS 20 for windows in the Kolmogorov - Smirnov significance column (0.200 and 0.200) greater than the 0.05 significance level (p > 0.05), So it is stated that the distribution of data on the results of critical thinking skills in mathematics in the two experimental groups and the control group is stated to be normally distributed. The normality test results are presented in Table 4.

**Table 4. Data Distribution Normality Test Results**

Class	Statistics	df	Sig.
Experiment	0.109	29	0.200
Control	0.135	20	0.200

The homogeneity test aims to prove that two or more groups of data have the same variance (homogeneous). Testing was carried out with the help of IBM Statistics SPSS 20 For Windows through the Homogeneity of Variance test. Based on the significance value of Levene's test for equality of Variances at Based On Mean 0.112. The significance value is greater than the significance level of 0.05 (0.112 > 0.05),

so that the variance of the two groups, namely the experimental group and the control group, is declared homogeneous. After the two prerequisite tests are fulfilled, the hypothesis test is carried out using the t-test. The hypothesis tested in this research is that there is no significant difference in the average results of critical thinking skills in mathematics taught with the Problem Based Learning model assisted by peer tutors, namely the experimental group, with the group taught with the conventional learning model, namely the control group. Hypothesis testing was carried out with the help of the IBM Statistics SPSS 20 For Windows program through an independent sample t - test, obtained a 2 - tailed significance value of 0.00 which was smaller than 0.05 ( $0.00 < 0.05$ ). Based on the testing criteria, there is a difference in the average results of mathematical critical thinking ability data from the experimental group and the control group. Thus, the null hypothesis is rejected and the alternative hypothesis is accepted,

## Discussion

The Problem Based Learning learning model assisted by peer tutors consists of several stages, namely orientation of students to the problem, organizing students, stages of helping independent or group investigations, stages of developing and presenting results and stages of analyzing and evaluating problem solving, with the stages of learning making it easier to implement. to be able to achieve learning objectives so that the Problem Based Learning learning model using peer tutoring is effectively used in mathematics learning. This is in line with research which states that the Problem Based Learning learning model is more effectively used in mathematics learning when compared to conventional learning models (Arifin & Tri Anzani Ashari, 2021; Dolapcioglu & Doğanay, 2020). Problem Based Learning with the steps of providing problem orientation, organizing students, helping with independent or group investigations, developing and presenting and the final step of analyzing and evaluating can improve critical thinking skills (Anazifa & Djukri, 2017; Menon & Poroor, 2020; Pambudiarso et al., 2018).

The advantage of this research is that using the help of peer tutors makes implementing the Problem Based Learning model easier. Peer tutoring is one of the learning programs to support meeting the needs of students so that learning, which is often a scary prospect for participants, is no longer scary because of the help of peer tutors which gives students a freer space to study. (Kumolontang, 2021; Nasihah et al., 2018; Nuryanti, 2019; Pratiwi et al., 2022). Apart from meeting the needs of students, peer tutors are also able to support the needs of teachers. The application of peer tutoring is much in demand nowadays because it prevents students from getting bored and makes teachers less bored and can make teachers' work easier because teachers are like having a panther to deal with students who have learning problems. (Angelia & Widiani, 2020; Pratiwi et al., 2022; Widiani et al., 2017). This is reinforced by research results which state that there are differences in mathematical problem solving (Problem Based) abilities between students who take part in the peer tutoring method of learning and students who take part in regular or conventional learning. (Noryanti et al., 2019). The Problem Based Learning learning model directs students to problem solving. Previous research states that peer tutoring has a positive effect on students' mathematical problem solving abilities (Dewi & Apsari, 2021). Likewise, in other research, the results of critical thinking skills in cycle II reached 94% so that in the research it was concluded that there was an influence of peer tutors on primary school students' critical thinking abilities. (Kumolontang, 2021). Through the research conducted, it was found that there was an increase in students' critical thinking abilities. Providing new experiences and atmosphere in the learning process for students and teachers. Students are active in learning, they are used to helping friends who have difficulty learning so this is quite helpful for teachers. The limitation of this research is that peer tutors have a sense of responsibility to guide their friends. Therefore, it is recommended that before choosing a peer tutor, it is a good idea for teachers to in still the values of mutual cooperation and mutual assistance so that students have a sense of responsibility and sensitivity towards friends who are experiencing difficulties. Study. This research has implications for students' critical thinking abilities, namely the ability to analyse and solve problems in students, then students are also able to conclude the problem solving that has been carried out and students become active in interacting so that difficulties experienced when learning mathematics can be conveyed and resolved together. Students become accustomed to solving problems, they are very enthusiastic about working on problem-based questions because they feel challenged to find ways to solve problems together, so that learning mathematics, which was previously a frightening prospect, turns into enjoyable learning.

## 4. CONCLUSION

Based on the results of the research and discussion, there are differences in critical thinking abilities in mathematics between the groups taught the Problem Based Learning model assisted by peer tutors, namely the experimental group and the group that did not use the Problem Based Learning model

assisted by peer tutors, in other words, namely the control group which only used the conventional model. It was concluded that the Problem Based Learning model could improve the critical thinking skills in mathematics of class IV students at Gugus IV Elementary School, Buleleng District. The Problem Based Learning learning model assisted by peer tutors creates a high sense of cooperation between tutors who try to make their friends able to understand the material and other friends' efforts to understand the material so that they help each other to overcome the learning difficulties they are experiencing.

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