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The Effect of Problem-Based Learning Models with the Monopoly Game on Mathematical Critical Thinking Abilities of Class IX Students at MTs Negeri 3 Majalengka

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Abstract: This study focused on the critical mathematical thinking skills of Class IX students at MTs Negeri 3 Majalengka. Researchers implemented problem-based learning models with the use of the Monopoly game to enhance students' mathematical abilities. The aim was to explore how these models influenced students' critical thinking abilities in mathematics. The study employed quantitative research methods with an experimental approach, involving a total of 155 Class IX students, including 19 from Class IX A and 21 from Class IX B. Data collection methods included observations and tests, and data analysis utilized normality tests, homogeneity tests, and t-tests. Based on the post-test results, the experimental class had an average score of 83.9, whereas the control class had an average score of 68.9. The results of the t-test on the post-test data showed a value of 0.000, which is less than 0.05, confirming that H1 was accepted. Thus, it can be concluded that problem-based learning models with the use of the Monopoly game significantly enhance students' mathematical critical thinking skills.

Keywords: mathematical critical thinking ability; monopoly game; problem-based learning

A. Introduction

Times continue to change every day and future technological challenges require students to prepare themselves from an early age**.** One way to develop students' potential is through education. National Education Law Number 20 of 2003 Education is the creation of a learning atmosphere and a conscious and planned learning process that enables students to actively develop their potential and equip themselves with religious spiritual strength, self-control, personality, intelligence, morality, nobility of character, as well as skills needed by themselves and society.(Mutmainah & Nuha, 2023)

In accordance with the objectives of mathematics, one of the most important abilities possessed by students is the ability to think critically mathematically. Mathematical thinking ability is a mental process in humans that is used in decision-making activities, making arguments, and analysis in scientific research. The ability to think critically in mathematics is closely related to understanding mathematical material, through this ability, students can explore and understand mathematical concepts in more depth. (Putri et al., 2020)

The development of student learning achievement in mathematics, especially in junior high schools (SMP) in Indonesia, still shows a low level of knowledge. From PISA data

(Programme for International Student Assessment) said that students' abilities in mathematics, especially in Indonesia, aged 15 years, were at a very low level. In the PISA ranking, Indonesia is in 64th position out of 65 participating countries, this shows that there are serious problems in the mathematical abilities of students in this country. Apart from that, the average results of the National Examination (UN) for mathematics at junior high school level have also shown a decline in recent years. This decline can be an indicator of problems in understanding students' critical mathematical thinking abilities.

From the data above, it can be concluded that students' critical mathematical thinking skills have not yet reached a good level, and efforts to improve the mathematics education system in Indonesia are needed. Critical thinking ability is a thinking ability that can be explained as a form of carrying out careful analysis, with the aim of avoiding cognitive biases and errors in making decisions. Mathematical critical thinking is also a systematic ability to combine initial knowledge, mathematical thinking skills that can be used to solve mathematical problems. (Hasanudin et al., 2022) The ability to think critically in mathematics is the most important aspect for mastering mathematics well, this is also relevant to students' needs in facing challenges in real life. So from these sources, it can be seen that students' critical mathematical thinking skills are still not good and need improvement. (Mashuri et al., 2019)

There are factors that influence a person's critical thinking ability, including: (a) Physical condition: Good physical condition is important to ensure basic physiological needs are met. (b) Motivation: Strong motivation can be a driving force for someone to develop critical thinking skills. (c) Anxiety: Excessive anxiety can interfere with critical thinking abilities. (d) Intellectual development: A person's mental abilities and intellectual development play an important role in critical thinking abilities. (Hamidah & Ain, 2022)

The results of preliminary observations carried out by researchers at MTs Negeri 3 Majalengka on February 25 2023, by interviewing one of the class IX mathematics teachers with a total of 19 students, showed that the level of critical mathematical thinking skills of students at that school was very low. Several factors are caused by students' low critical mathematical thinking skills, namely lack of concentration in learning in class, this can prevent students from participating in learning and understanding mathematical material well. Difficulty working on mathematics problems is closely related to students' ability to analyze in solving mathematics problems individually. Students still work on questions relying on example questions from the teacher, this can hinder students' mathematical critical thinking abilities. Students need to be encouraged to think more deeply and find creative solutions to every mathematical problem they face, because understanding this problem requires very high thinking abilities. Events in the field carried out by teachers only use inappropriate models so that learning does not meet expectations.

From the problem above, it can be concluded that the learning model suitable in this research is a problem-based learning model that can help students learn mathematics. This model aims to improve students' ability to solve mathematical problems. This learning model aims to improve students' abilities in solving mathematical problems. There are five steps in the model *problem-based learning,* including: (a) Orienting students to a problem. (b) Organizing students to study. (c) Guiding both individual and group investigations. (d)

Developing and presenting the problem. (e) Analyze and evaluate a problem solution. (Elita et al., 2019) So from these 5 steps carried out by students, students will realize how important it is in the process of thinking and evaluating themselves in solving a problem.

For this reason, the solution is to be able to support it *model problem based learning* using the monopoly game. Monopoly is a graphic game whose game process is based on the number of dice dropped and follows certain rules. (Andriyanti, 2020) The goal of the game is to control all the plots on the board, buying, renting and exchanging properties in a simplified economic system. For example, buying and selling activities or activities carried out by cooperatives or banks that seek profits or losses. Teachers can create a pleasant classroom atmosphere in mathematics learning by combining monopoly game elements into the mathematics material they want to teach. Arithmetic monopoly can be created using images or writing but there is still a presentation of the desired material. By playing arithmetic monopoly, students can practice working on problems and collect their wealth. (Ramadhani et al., 2022)

The monopoly game in learning mathematics also requires an approach in everyday life. This is in accordance with National Ministerial Regulation no. 21 of 2006, explains the aim of learning mathematics so that students have the ability to apply it in everyday life. Thus, the use of the Monopoly game in mathematics learning is not only fun but also supports the achievement of the desired mathematics learning goals, such as application skills in everyday life and the development of critical, logical, systematic and objective thinking skills in students.

From the statement explained above, the researcher wants to develop a monopoly game as a mathematics learning medium entitled "The Influence of Models *Problem Based Learning* with the help of the Monopoly Game on the Critical Mathematical Abilities of Class IX Students of MTs Negeri 3 Majalengka".

B. Methods

In this research, researchers used a quantitative approach. In this research, an experimental design is used because it has an influence*(treatment)* which are given. In this research, assistance was provided to improve critical mathematical thinking skills in the form of a monopoly game. This research was carried out at MTs Negeri 3 Majalengka from 23 October 2023 to 6 November 2023.

In this population, researchers took all class IX students, totaling 155 students. The samples that the researchers took were class IX A, totaling 19 students, as the experimental class, and class IX B, totaling 21, as the control class. The data collection technique is using observation sheets and tests. The observation sheet was carried out by observer 1 by Mrs. Hj. Ida Sukaesih, S.Pd is a class IX mathematics teacher at MTs Negeri 3 Majalengka who gave a total average score of 3.23. Meanwhile, for observer 2, Taufik Hidayat, who is a 7th semester student, gave a total average score of 3.52. In accordance with the scoring guidelines, an average of 3.45 was obtained, where the interval was $3.45 \leq 4.00$ with very good criteria.

This test aims to measure students' abilities in critical mathematical thinking. The type of test used by researchers is in the form of essay questions consisting of 4 pre-test questions and 4 questions *post-test* which has been tested for content validity, item validity, and reliability testing. The pre-test and post-test instruments were given to validators who are experts in the

field of mathematics, namely Muhammad `Azmi Nuha, M.Pd, who is a mathematics lecturer at UIN Saizu Purwokerto, who gave an average score of 3.75 and 3.58, so they were in the very valid category. Meanwhile, the expert validator, namely Hj. Ida Sukaesih. S.Pd gives an average score of 3.75 and 3.75 so the category is very valid. The results of the validity test of the pre-test items contained 2 invalid questions and 1 invalid question in the post-test. The pre-test reliability test results were 0.690. In accordance with the significance value, namely 0.690 > 0.05. so it can be concluded that the pre-test questions are reliable. Meanwhile, the post-test questions were 0.706. In accordance with the significance value, namely 0.709 > 0.05. so it can be concluded that the post-test questions are reliable.

There are two types of data analysis techniques, namely implementation data analysis and influence data analysis. Implementation data analysis techniques use observation sheets, while influence analysis techniques use normality tests, homogeneity tests, and t tests

C. Results and Discussion

This research was carried out at MTs Negeri 3 Majalengka from 23 October 2023 to 6 November 2023. The learning process was carried out in 2 learning meetings, 2 meetings to fill in the questions*pre-test* and *post-test.* The experimental class was given treatment in the form of a model *problem based learning* with the help of monopoly games and control classes are given conventional models.

1. Model Implementation Data Analysis*Problem Based Learning* with the Help of Monopoly Game

Analysis of implementation data has been carried out by observer 1, namely Hj. Ida Sukaesih, S.Pd is a mathematics teacher at MTs Negeri 3 Majalengka and observer 2 Taufik Hidayat is a 7th semester student at Majalengka University. The results from the observer using the observation sheet are as follows:

Table 1. Model Implementation Results*Problem Based Learning* with Monopoly Game Help

No	Observer	Total Shoes	Rate-rate
1.	Observer 1	68	3,23
2.	Observer 2	74	3,52
3.	Score Rata-Rata	72,5	3,45

Based on the assessment criteria guidelines, the average value is 3.45 with a range of $3.25 \leq x \leq 4.00$ which is a very good criterion. It can be concluded that the model*problem based learning* by using a well-executed monopoly game.

2. Model Influence Data Analysis*Problem Based Learning* with the Help of Monopoly Game

Data analysis results*pre-test* and *post-test* before being given treatment in the experimental and control classes:

a. Data analysis *Pre-Test*

Result s*pre-test* The experimental class and control class were obtained before the researcher gave the treatment. These two categories are still treated the same by mathematics teachers in social arithmetic material (sales, purchases, profits, losses, interest and discounts). Here are the results *pre-test* critical mathematical abilities of experimental class and control class students.

Table 2. Value Results *Pre-Test* Experimental Class and Control Class

No	Mark	Experimental Class	Control Class
1.	Highest Score	64,5	58,0
2.	Lowest Score	29	25,8
3.	Standard Deviation	59,5	47,1
4.	Rate-rate	50	47,2

Based on the results of the table above, the experimental class has the highest score of 64.5, the lowest score is 29, the standard deviation value is 59.5, and the experimental class average is 50. Meanwhile the control class has the highest score of 58.0, the lowest score is 25.8, the standard deviation value 47.1, and the control class average was 47.2.

b. Normality test

If the level of significance *p-value*; $\alpha = 0.05$ then the data is not normally distributed. Meanwhile, if the level of significance *p-value* $\geq \alpha = 0.05$ then the data is normally distributed. Results of normality test questions *pre-test* the experimental class and control class are as follows:

Table 3. Normality Test Results*Pre-Test*

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Say.	Statistic	df	Say.
PreTest	.146	40	.032	.943	40	.044

a. Lilliefors Significance Correction

Based on the table above, the significance value *p-value* experimental class and control class is $0.032 \geq \alpha = 0.05$, if the decision is H_0 rejected then the data is normal. Therefore, it can be concluded that question *pre-test* normally distributed.

c. Homogeneity Test

The basis for homogeneity decision making is if the significance value is ≥ 0.05 then H_0 rejected and H_1 accepted, if significance <0.05 then H_0 accepted and H_1 rejected. Following are the results of the homogeneity test on the questions *pre-test* experimental class and control class.

Table 4. Homogeneity Test Pre-Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Say.	t	df	Say. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre Test	Equal variances assumed	.005	.943	1.319	38	.195	3.2499	2.4642	-1.7386	8.2383
	Equal variances not assumed			1.317	37.309	.196	3.2499	2.4684	-1.7502	8.2499

Based on the table above, the sig value. namely 0.943 ≥ 0.05. Therefore, it can be concluded that the pre-test data for both the experimental class and the control class are homogeneous.

d. Uji T Pre-Test

The t-test is used to compare the calculated sig value with 0.05. The hypothesis used in this research is as follows. H_0 accepted if the value of $t_{statistics}$ uji < t_{table} nilai sig. (2-tailed) > α H_1 accepted if the value of $t_{statistics}$ uji < t_{table} nilai sig. (2-tailed) < α

When there is acceptance at H_0 it can be concluded that there is no significant influence. Conversely if H_0 is rejected, it can be concluded that there is a difference in the average mathematical critical thinking abilities of the experimental class and the control class. Following are the results of the t test questions *pre-test* experimental class and control class.

Table 5. T Test *Pre-Test*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Say.	t	df	Say. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre Test	Equal variances assumed	.005	.943	1.319	38	.195	3.2499	2.4642	-1.7386	8.2383
	Equal variances not assumed			1.317	37.309	.196	3.2499	2.4684	-1.7502	8.2499

Based on the table above, a t-test was carried out, because the data was homogeneous, the first row significance value of 0.195 was used. So the significance value is 0.195 > 0.05, so H_0 accepted and H1 rejected. Thus, it can be said that the basic mathematical critical abilities of experimental and control class students are the same. Thus, model*problem based learning* using the monopoly game can be applied to the experimental class, namely class IX A and control class IX B which uses the conventional model.

a. Data analysis *Post-Test*

Results*post-test* the experimental class and control class were obtained after the researcher provided the treatment. These two categories are still treated the same by mathematics teachers in social arithmetic material (gross, tare, net). Here are the results *post-testt* critical mathematical abilities of experimental class and control class students.

Table 6. Value Results *Pre-Test* Experimental Class and Control Class

No	Mark	Experimental Class	Control Class
1.	Highest Score	93,5	87
2.	Lowest Score	67,7	38,7
3.	Standard Deviation	36,5	153,9
4.	Rate-rate	87	68,9

Based on the results of the table above, the experimental class has the highest score of 93.5, the lowest score is 67.7, the standard deviation value is 36.5, and the experimental class average is 87. Meanwhile, the control class has the highest score of 87, the lowest score is 38.7, the standard deviation value 153.7, and the control class average was 68.7.

b. Normality test

Results of normality test questions *post-test* the experimental class and control class are as follows:

Table 7. Normality Test*Post-Test*

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Say.	Statistic	df	Say.
PostTest	.168	40	.006	.900	40	.002

a. Lilliefors Significance Correction

Based on the table above, the significance value*p-value* experimental class and control class is $0.006 \geq \alpha = 0.05$, if the decision is H_0 rejected then the data is normal. Therefore, it can be concluded that question *post-test* normally distributed.

c. Hemogeneity Test

Following are the results of the homogeneity test on the questions *post-test* experimental class and control class.

Table 8. Homogeneity Test*Post-Test*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Say.	t	df	Say. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PostTest	Equal variances assumed	6.750	.013	4.822	38	.000	15.0236	3.1156	8.7164	21.3307
	Equal variances not assumed			4.964	30.946	.000	15.0236	3.0267	8.8502	21.1969

Based on the table above, the sig value. namely 0.13 ≥ 0.05. Therefore, it can be concluded that the data*post-test* both the experimental class and the control class are homogeneous.

d. Uji T

Following are the results of the t test questions *pre-test* experimental class and control class

Table 9. Homogeneity Test *Post-Test*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Say.	t	df	Say. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PostTest	Equal variances assumed	6.750	.013	4.822	38	.000	15.0236	3.1156	8.7164	21.3307
	Equal variances not assumed			4.964	30.946	.000	15.0236	3.0267	8.8502	21.1969

Based on the table above, a t test was carried out, the Sig of the independent sample was calculated at 0.000. Scores are calculated based on test criteria. namely 0.05. Sig value 0.000 < 0.05 to accept H1 and rejected H0 which means there are differences in learning outcomes for experimental classes that use the model problem based learning with the help of a monopoly game with a control class that uses a conventional model.

Visible resultspre-test and post-test showed that after being given treatment by the researcher, the average score for the experimental class was 83.9 and the average score for the

control class was 69.6. This means that the experimental class is better than the control class. Therefore, it can be concluded that the model problem based learning with the help of the monopoly game, it affects the mathematical critical thinking abilities of class IX students at MTs Negeri 3 Majalengka.

Based on the results of exploration and discussion results, next Can determine the root cause of a problem Students find it difficult to solve problems Mathematics at HOTS level ie. Limited conceptual understanding of participants Limitations of students' thinking, reasoning and abilities Ability to solve problems. consider nature Mathematics is very abstract to most people making things difficult for students Develop creative thinking skills and Critical. So a learning method is needed oriented to real life problems

D. Conclusion

This research reached the following conclusions based on the discussions and results:

1. Model *problem based learning* with the help of the monopoly game, it is very effective for learning mathematics in schools, especially at MTs Negeri 3 Majalengka. This model variation can also improve students' ability to think critically mathematically. The results of the observation sheet are in accordance with *syntax* problem-based learning model with an average of 3.45 and an interval of $3.25 \leq x \leq 4.00$, with very good criteria. Thus, it can be concluded that the model *problem based learning* with the help of the monopoly game it functions well and is suitable for use in various variations of mathematical models related to social arithmetic material.
2. Application of the model *problem based learning* with the monopoly game to improve critical mathematical thinking skills. Independent sample t test (t test), which obtains a Sig value. (2-tailed) of $0.000 < 0.05$, indicating that H_1 accepted, which shows that the experimental class and control class have differences in mathematical critical thinking abilities. Based on the value results *post-test* the experimental class had an average score of 83.9, while the control class had an average score of 68.9. The results of this research indicate that there is an influence of the *problem based learning* model on the mathematical critical thinking abilities of class IX students at MTs Negeri 3 Majalengka.

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