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THE EFFECTIVENESS OF THE PROBLEM-BASED LEARNING MODEL ON FLAT-SIDED GEOMETRICS MATERIAL ON STUDENTS CRITICAL THINKING ABILITIES AT SMPN 1 KAJEN

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ABSTRACT

Mathematics aims to improve skills such as reasoning, critical thinking and problem solving in order to prepare students for life and further education. However, mathematics is generally considered a science that does not allow for critical thinking. In the learning process, most students are passive in solving mathematical problems so they cannot practice their critical thinking abilities The main aim of this research is to find out whether the problem-based learning model is effective on students' critical thinking abilities. This study uses a quantitative approach. This research is used a type of quasi-experimental research (quasi-experimental). The population of this study was all class VIII students at SMPN 1 Kajen, totaling 288 students. The sample from this research was 64 students consisting of an experimental class that applied a problem-based learning model and a control class that applied conventional learning. The results of this research show that the critical thinking abilities of students who receive the problem-based learning model are significantly different from students who receive the conventional learning model. The N-Gain test results show the effectiveness of the learning process. The use of problem-based learning models produces better critical thinking abilities compared to conventional learning models.

ABSTRAK

Matematika bertujuan untuk meningkatkan keterampilan seperti penalaran, berpikir kritis, dan pemecahan masalah guna mempersiapkan siswa menghadapi kehidupan dan pendidikan lebih lanjut. Namun, matematika umumnya dianggap sebagai ilmu yang tidak memungkinkan adanya pemikiran kritis. Dalam proses pembelajaran, sebagian besar siswa pasif dalam menyelesaikan masalah matematika sehingga tidak dapat melatih kemampuan berpikir kritisnya. Tujuan utama dari penelitian ini adalah untuk mengetahui apakah model pembelajaran berbasis masalah efektif terhadap kemampuan berpikir kritis siswa. Penelitian ini menggunakan pendekatan kuantitatif. Penelitian ini menggunakan desain penelitian kuasi-eksperimen. Populasi dari penelitian ini yaitu semua siswa kelas VIII SMPN 1 Kajen yang berjumlah 288 siswa. Sampel dari penelitian ini berjumlah 64 siswa yang terdiri dari kelas eksperimen yang menerapkan model pembelajaran berbasis masalah dan kelas kontrol menerapkan pembelajaran konvensional. Hasil dari penelitian ini menunjukkan bahwa kemampuan berpikir kritis siswa yang memperoleh model pembelajaran berbasis masalah berbeda secara signifikan dengan siswa yang memperoleh model pembelajaran konvensional. Hasil uji N-Gain menunjukkan adanya keefektifan proses pembelajaran. Penggunaan model pembelajaran berbasis masalah menghasilkan kemampuan berpikir kritis yang lebih baik dibandingkan dengan model pembelajaran konvensional.

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INTRODUCTION

As a branch of science, mathematics has an important role in the development of science and technology, both as a tool in applying other fields of science and in the development of mathematics itself. Mathematics is not a science that is only for its own purposes, but a science that is useful for other sciences (Siagian, 2016). Mathematics aims to improve skills such as reasoning, critical thinking and problem solving in order to prepare students for life and further education. However, mathematics is generally considered a science that does not allow for critical thinking. In the learning process, most students are passive in solving mathematical problems so they cannot practice their critical thinking abilities (Biber, 2015).

Students often experience difficulties in developing critical thinking abilities in the context of mathematics learning. Learning methods that focus on routinely solving practice problems and understanding the mechanics of mathematical concepts can hinder the development of students' critical thinking abilities. In an effort to overcome these challenges, implementing a problem-based learning model is an effective solution. The problem-based learning model encourages students to identify real, relevant problems to everyday life, collect and analyze the necessary data, and formulate and solve problems using critical thinking abilities (Haniyyah, 2019).

In the context of mathematics learning, the application of a problem-based learning model has the potential to improve students' critical thinking abilities (Nasution, 2017). By providing assignments and projects that involve solving flat-sided geometric problems in real-world situations, the problem-based learning model can encourage students to think critically, analyze information critically, and make decisions based on existing data. Based on information obtained by researchers from one of the class VIII mathematics teachers at SMPN 1 Kajen on November 3 2023, they said that the learning carried out by mathematics teachers was classical learning. Students only actively record material according to what is assigned or written by the teacher on the blackboard, so that only students who have a high level of understanding are able to receive lessons well, while other students only follow the teacher's directions and this method does not make students think critically in solving mathematical problems. Therefore, mathematics teachers need to look for new strategies to improve the learning process so that students' critical thinking abilities can increase so that student learning outcomes are optimal. This is what made the researcher choose research at SMPN 1 Kajen, Pekalongan Regency because at SMPN 1 Kajen, Pekalongan Regency, they have not implemented learning using a problem-based learning model in the mathematics class learning process regarding building flat-sided space.

According to Tiwari (2020) Problem-based learning is conducive to the development of students' critical thinking because problem-based learning embodies the principle that the starting point of learning is the problem, where students provide reasons through the learning process and think critically in overcoming each stage of problem solving.

METHOD

Researchers use a type of quasi-experimental research (quasi-experimental), namely research to obtain data that originates from conjecture for data obtained through field experiments in situations where monitoring and/or manipulation of related variables is not possible. The quasi-experimental design used is the non-equivalent group design, this is because it cannot monitor variables closely. The classroom atmosphere as a location for monitoring treatment does not allow for such strict monitoring. So researchers can monitor variables based on the existing atmosphere. The research approach used is a quantitative approach, because the data used in the research is in the form of numbers and the analysis uses statistics (Sandu, 2015).

Researchers used 288 class VIII students at SMPN 1 Kajen as the population. Samples are data obtained from part of the population (Nalim & Salafudin, 2012). Determining the sample size based on percentages was developed by Yount in a book entitled "Research Procedures for a Practical Approach" that if the population is 0-100 then the sample size is 100%, if the population is 101 - 1000 then the sample size is at least 10% (Arikunto, 2016). So the researcher determined the sample consisting of class VIII B, totaling 32 students, as the experimental class by applying the problem-based learning model and class VIII C, totaling 32 students, as the control class. So the number of samples used was 64 students.

RESULTS AND DISCUSSION

The mean pretest score for experimental class students is 46.2891, so it is in the very low category. Meanwhile, the mean posttest score for the experimental class was 81.25, which is in the high category, while in the control class, the mean pretest and posttest scores were 45.5078 and 65.8203, which were categorized as very low and medium.

Table 1. Results of Descriptive Analysis of the Experimental Class

Descriptive Statistic	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Experimental Class	32	25	62,5	46,29	12,28
Posttest Experimental Class	32	68,75	93,75	81,25	8,7
Valid N (listwise)	32				

Table 2. Results of Descriptive Analysis of the Control Class

Descriptive Statistic	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Control Class	32	25	62,5	45,51	12,22
Posttest Control Class	32	50	81,25	65,82	11,22
Valid N (listwise)	32				

It can be concluded that the comparison of the mean posttest for the experimental class applying the problem-based learning model is greater than the control class which applies conventional learning, in the experimental class it is categorized as high and in the control class it is categorized as medium, so that the problem-based learning model is effective for critical thinking abilities.

Table 3. Percentage of Teacher Activity

Mean	62,67
Percentage	89,52%
Criterion	Very good

It is known that the teacher's ability to manage teaching and learning activities by implementing a problem-based learning model obtained an average score of 62.67 with a percentage of 89.52% (very good).

Table 4. Percentage of Student Activity

Mean	61,33
Percentage	87,62 %
Criterion	Very good

It is known that the students' activities when learning by applying problem-based learning can be categorized as very good with a score of 61.33 and a percentage of 87.62%.

Table 5. Normality Test of Pretest Data for Experimental Class and Control Class

Class	Kolmogorov − Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimental Class	0,150	32	0,065	0,907	32	0,009
Control Class	0,123	32	0,200	0,916	32	0,016

Based on the normality test output in the table above, the Kolmogorov-Smirnov value of the experimental class pretest data is 0.065 and the Kolmogorov-Smirnov value of the control class pretest data is 0.200 > a, so the data is normally distributed.

Table 6. Pretest Homogeneity Test Experimental and Control Classes

Test of Homogeneity of Variance				
	Levene Statistic	df'l	df2	Sig.
Based on Mean	0,005	1	62	0,945
Based on Median	0,000	1	62	1
Based on Median dan with adjusted df	0,000	1	61,234	1
Based on trimmed Mean	0,003	1	62	0,956

Based on the output of the homogeneity test using the Levene test in the table above, the significance value is 0.945 > a, so the control and experimental class students have the same variance (homogeneous).

Table 7. Pretest t-test for Experimental Class and Control Class

Independent Samples Test

	t-test for Equality of Means				
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances Assumed	0,255	62	0,799	0,78125	3,06255
Equal variances not assumed	0,255	61,998	0,799	0,78125	3,06255

In the table above, it is known that the significant value (sig.2-tailed) is 0.799 > a, so H0 is accepted or the average pretest score for the experimental class has no significant difference with the average pretest score for the control class.

Table 8. Normality Test of Posttest Data for Experimental Class and Control Class

Class	Kolmogorov – Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimental Class	0,139	32	0,120	0,900	32	0,006
Control Class	0,147	32	0,077	0,897	32	0,005

Based on the normality test output in the table above, the Kolmogorov-Smirnov value of the experimental class posttest data is 0.120 and the Kolmogorov-Smirnov value of the control class posttest data is 0.077 ≥ a, so the data is normally distributed.

Table 9. Posttest Homogeneity Test Experimental and Control Classes

Test of Homogeneity of Variance

	Levene Statistic	df'l	df2	Sig.
Based on Mean	4,530	1	62	0,037
Based on Median	3,181	1	62	0,079
Based on Median and with adjusted df	3,181	1	58,563	0,080

Based on trimmed Mean	4,523	1	62	0,037

Based on the output of the homogeneity test using Levene's test in the table above, the significance value is 0.037 > a, so control and experimental class students have the same variance (homogeneous).

Table 10. Posttest t-test for Experimental Class and Control Class

Independent Samples Test					
	t-test for Equality of Means				
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances Assumed	6,148	62	0,000	15,42969	2,50982
Equal variances not assumed	6,148	58,357	0,000	15,42969	2,50982

In the table above, it is known that the p-value for 2-tailed = 0.000. Because p-value = 0.000 < a then H0 is rejected and Ha is accepted, so it can be concluded that there is an increase in student mathematics learning outcomes after implementing the problem-based learning model.

Table 11. Experimental Class and Control Class N-Gain Test

	Experimental Class	Control Class	Effectiveness
N-Gain Score Percentage	64.953125	34.61185516	1.876614955
N-Gain Score	0.64953125	0.346118552	1.876614952

In the table above, it is known that the N-Gain Score Percent for the experimental class is 65 and the N-Gain Score Percent for the control class is 34 and the effectiveness calculation result is 1.9. So it can be concluded that if effectiveness is > 1 then there is a difference in effectiveness where learning with a problem-based learning model is more effective than conventional learning.

There were 16 students who met the KKM, and 16 students who did not meet the KKM out of a total of 32 experimental class students. It is known that 50% of students (16 students) met the KKM in Mathematics, while 50% of students (16 students) did not meet the KKM. This shows that some students have achieved the minimum competency set, but there are still some students who have not met these standards.

Based on the explanation above, it can be seen that through the problem-based learning model students can understand the concept of flat-sided geometric material, apart from that learning through PBL is very fun for students because learning takes place actively. Researchers concluded that most students were able to accept the learning that teachers carried out in class. With the problem-based learning model, students are able to answer questions, know the information contained in the material, they can name various objects in the form of flat-sided shapes around their residence, and can help activate the learning atmosphere in the classroom.

Teachers' and students' perceptions of the use of problem-based learning models can increase students' ability to think through the problems presented in learning. Where before using the problem-based learning model, learning was too monotonous, lacked enthusiasm and passive, and students also had difficulty understanding the material, students' dexterity in making decisions was still less than critical. Students' ability to think is less developed and less flexible. However, after implementing the problem-based learning model, students' ability to make decisions increases when looking for a way out of the problems they have, students also become more responsive to the essence of the problem, students also become creative, active and critical and increasingly able to find solutions to problems. and students' ability to think is increasingly developing and being flexible. So this learning model can be an option in learning, so that good learning goals are achieved.

CONCLUSION

Problem-based learning is effective compared to conventional learning models. From the results of this research, it can be seen that the posttest score for the experimental class was higher than the control class. And also based on the results of data processing on students' critical thinking abilities collected by researchers, it was obtained that 2-tailed = 0.000. Because $0.000 < \alpha = 0.05$ then $H0$ is rejected and Ha is accepted. So it can be concluded that the critical thinking abilities of students who receive the problem-based learning model are significantly different from students who receive the conventional learning model. Apart from that, the results of the N-Gain test show that there is effectiveness in the learning process as shown above. As for fulfilling the KKM, these results show that there are some students who need more attention to achieve the KKM as shown above. So it can be concluded that the problem-based learning model can be a reference for teachers in choosing a learning model that is able to improve critical thinking skills. Using a problem-based learning model produces better critical thinking abilities compared to conventional learning models.

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