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The Effect of Problem Based Learning Model on Problem Solving Ability and Mathematical Disposition

Novi Ayu Yulia[1,2*], Winston Hendricks[2]
[1] Universitas Zainul Hasan Genggong, Indonesia
[2] University of Fort Hare, South Africa
Email : novi_yulia@gmail.com

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Abstrak

Tujuan utama dari penelitian ini adalah untuk meneliti apakah model pembelajaran berbasis masalah memiliki dampak signifikan terhadap kemampuan pemecahan masalah dan disposisi matematis siswa kelas sebelas di SMA Negeri 1 Kraksaan. Penelitian ini mengadopsi desain penelitian kuasi-eksperimental dengan kelompok kontrol pretes-pos tes. Populasi untuk penelitian ini terdiri dari semua siswa kelas sebelas, dengan total 245 siswa. Teknik pengambilan sampel yang digunakan adalah cluster random sampling, di mana kelas XI.1 dipilih sebagai kelompok eksperimen dan XI.2 sebagai kelompok kontrol. Data untuk penelitian dikumpulkan melalui lembar observasi pelaksanaan pembelajaran, tes kemampuan pemecahan masalah, dan kuesioner disposisi matematis. Data yang terkumpul kemudian dianalisis menggunakan analisis statistik deskriptif dan analisis statistik inferensial. Hasil pengujian hipotesis mengungkapkan nilai p yang signifikan sebesar 0,000 untuk kemampuan pemecahan masalah. Oleh karena itu, hipotesis nol (H0) ditolak, dan hipotesis alternatif (H1) diterima, menunjukkan pengaruh signifikan dari model pembelajaran berbasis masalah terhadap kemampuan pemecahan masalah siswa di SMA Negeri 1 Kraksaan. Demikian pula, hasil pengujian hipotesis untuk kuesioner disposisi matematis siswa menunjukkan nilai p yang signifikan sebesar 0,000. Akibatnya, H0 ditolak, dan H1 diterima, menunjukkan pengaruh signifikan dari model pembelajaran berbasis masalah terhadap disposisi matematis siswa di SMA Negeri 1 Kraksaan.

Abstract

The main objective of this study is to investigate whether the problem-based learning model has a significant impact on the problem-solving abilities and mathematical disposition of eleventh-grade students at SMA Negeri 1 Kraksaan. The study adopts a quasi-experimental research design with a pretest-posttest control group. The population for this study consists of all eleventh-grade students, totaling 245 individuals. The sampling technique employed is cluster random sampling, whereby class XI.1 is selected as the experimental group and XI.2 as the control group. Data for the research is collected through learning implementation observation sheets, problem-solving ability tests, and mathematical disposition questionnaires. The collected data is then analyzed using descriptive statistical analysis and inferential statistical analysis. The results of hypothesis testing reveal a significant p-value of 0.000 for problem-solving ability. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, indicating a significant influence of the problem-based learning model on the problem-solving abilities of students at Public Senior High School in Kraksaan City. Similarly, the hypothesis testing results for the student mathematical disposition questionnaire demonstrate a significant p-value of 0.000. Consequently, H_0 is rejected, and H_1 is accepted, suggesting a significant influence of the problem-based learning model on the mathematical disposition of students at Public Senior High School in Kraksaan City.

INTRODUCTION

Mathematics is a subject that can foster logical, systematic, critical and rational thinking (Rahayu & Istikomah, 2020). For this reason, mathematics lessons need to be given to students starting from elementary school to university level to equip them with the ability to think logically, critically, systematically, and the ability to work together in solving various problems faced. One

*Corresponding author.
E-mail addresses: novi_yulia@gmail.com

of the goals of learning mathematics that has been formulated by NCTM is that students learn to solve problems (Marbun, 2020). Problem solving ability is a very important part of the mathematics curriculum, because in the learning process and its completion students may gain experience using the knowledge and skills they already have to apply to solving routine problems (Yusri, 2018). But in reality, Wulandari et al (2020) stated that the ability of Indonesian students is still low in solving story problems related to mathematics, especially non-routine ones, in other words students are still weak in understanding problems and planning solutions. Judging from the achievement of the Program for International Student Assessment (PISA) score in 2018, it is still relatively low, the mathematics indicator obtained far below the average of 379 (OECD, 2019). This shows that students' problem solving skills are still lacking. It is likely that this is due to the lack of active students in the learning process, lack of mastery of mathematical concepts, and difficulty in solving various problems given by the teacher.

In addition to problem solving skills, mathematics learning also pays attention to affective aspects such as mathematical disposition, which is related to how students perceive and solve problems; whether they are confident, diligent, interested, and think flexibly to explore various alternative problem-solving strategies. Mathematical disposition is one of the factors that determine student learning success (Rosita & Yuliawati, 2017). Students need mathematical disposition to be able to persist in dealing with a problem, be responsible in learning and apply good work habits in mathematics (Dewi & Zathy, 2019).

Based on the results of observations made at SMA Negeri 1 Kraksaan on December 15, 2021, there are the same problems, one of which is the low problem solving ability which causes low student learning outcomes. This can be seen from the results of the students' end-of-semester exams which are still low, the average even semester exam results of class X students of SMA Negeri 1 Kraksaan in mathematics get a score of 43.75 or in the low category. Although the teacher provided remedials, it did not have a big impact. This is evidenced by the inability of students to understand problems in math problems, make problem solving plans, carry out the plans that have been made, and re-examine the answers that have been found. In addition, based on the results of interviews with several students at SMA Negeri 1 Kraksaan, another problem was found, namely that students' mathematical disposition was not good, which showed a negative attitude towards mathematics. These problems eventually lead to the assumption that math is a boring and difficult subject to master. When faced with math problems, students avoid and are afraid to start learning math.

One of the factors that influence the low problem solving ability and mathematical disposition of students is the learning model used by the teacher. Based on observations during the learning process, the teacher always uses a direct learning model (conventional), where the teacher is actively involved in the learning process which causes students to not understand the material taught because students only listen and record the material presented on the blackboard. This is emphasized by Arends' opinion (Harefa & Surya, 2021) which states that in teaching using the direct learning model, teachers always demand that students learn and rarely provide lessons on how students learn, teachers also demand students to solve problems, but do not teach students how to solve problems. Seeing the problems that exist above, the teacher can apply a learning model that is able to improve students' problem solving ability and mathematical disposition. One of the learning models that can help these problems is the problem-based learning (PBL) model. According to Maryati (2018) the problem-based learning model is a learning process whose starting point is based on real-life problems and then from these problems students are stimulated to learn problems based on new knowledge and experiences.

Based on the results of research conducted by Marbun (2020), the improvement of mathematical problem solving skills of students whose learning uses problem-based learning (PBL) is higher than those whose learning uses conventional learning. The highest indicator of problem solving ability in PBL learning occurs in the indicator of understanding the problem, and the increase in mathematical disposition of students whose learning uses PBL is higher than those whose learning uses ordinary conventional learning.

METHOD

This type of research is quasi experimental, which has a control group but cannot function fully to control external variables that affect the implementation of the experiment (Sugiyono, 2018, p. 118). The design in this study uses a pretest-posttest control group design, where 2 groups are randomly selected or random to determine the difference between the experimental group and the control group (Sugiyono, 2018, p. 116). The population in this study were all 11th grade students of SMA Negeri 1 Kraksaan in the 2022/2023 school year, consisting of 8 classes with a total of 245 students, where all students had the same level of problem solving ability and mathematical disposition with sample withdrawal using cluster random sampling technique. The cluster random sampling technique is a sampling technique that is randomized to groups/classes, not to individual subjects (Sugiyono, 2018, p. 131).

So that the samples in this study were class XI.1 and class XI.2 with 30 students each. Data collection techniques in this study used test sheets, questionnaire sheets, and teacher and student observation sheets. Data on students' problem solving skills were collected using tests, mathematical disposition data were collected using questionnaires, then data on learning implementation were collected using teacher and student observation sheets. Then the data analysis technique used in this research is descriptive analysis and inferential analysis. Descriptive analysis aims to find the mean, median, mode, standard deviation, and variance. Then for inferential analysis aims to test the hypothesis using statistical package for social sciences (SPSS).

RESULTS AND DISCUSSION

Research Results

Descriptive Analysis Results

Description of pretest data of problem solving ability of experimental class and control class

Table 1. Pretest result data

Pretest Score	Experiment Class	Control Class
Highest Score	62	62
Lowest Score	21	18
Mean	47,23	38,77
Median	49.00	38,00
Modus	51	38
Standard Deviation	10,200	11,010
Variance	104,047	121,220

Based on table 1, it can be seen that the problem solving ability in the experimental class with the highest score obtained by students is 62 which is in the medium category, the lowest score is 21 which is in the very low category, with the mean, median and mode of students' problem solving ability still classified as low, and a standard deviation value of 10.200 which indicates that the distribution of data from the mean value is in the small category. While the problem solving ability in the control class with the highest score obtained by students of 62 which is in the moderate category, the lowest score of 18 which is in the very low category, with the

mean, median and mode of students' problem solving ability still classified as very low, and a standard deviation value of 11.010 which indicates that the data distribution of the average value is in the small category.

Based on the pretest results in table 1 above, the results of math problem solving ability are also presented in a percentage table with the acquisition of math problem solving ability tests which can be seen in table 2 below.

Table 2. Percentage score of pretest results of problem solving ability

Rate	Experiment Class		Control Class		Category
	Students	Percentage	Students	Percentage	
80 – 100	0	0%	0	0%	Very High
66 – 79	0	0%	0	0%	High
56 – 65	8	27%	3	10%	Medium
40 – 55	15	50%	9	30%	Low
0 – 39	7	23%	18	60%	Very Low

Based on table 2, it can be seen that the results of students' problem solving skills in mathematics subjects after being given a pretest in the experimental class and control class are in 3 categories, namely moderate, low, and very low.

a. Description of posttest data of problem solving ability of experimental and control class students

Table 3. Posttest score data

Pretest Score	Experiment Class	Control Class
Highest Score	95	77
Lowest Score	67	41
Mean	84,27	54,90
Median	85,00	54,00
Modus	87	54
Standard Deviation	6,102	9,189
Variance	37,237	84,438

Based on ŧTable 3, it can be seen that the problem solving ability in the experimental class with the highest score obtained by students of 95 which is in the very high category, the lowest score of 67 which is in the high category, with the mean, median and mode of students' problem solving ability in the very high category, and a standard deviation value of 6.102 which indicates that the distribution of data from the mean value is in the small category. While the problem solving ability in the control class with the highest score obtained by students of 77 which is in the high category, the lowest score of 41 which is in the low category, with the mean, median and mode of students' problem solving ability still in the low category, and a standard deviation value of 9.189 which indicates that the data distribution of the average value is in the small category.

Based on the pretest results in table 3 above, the results of math problem solving ability are also presented in a percentage table with the acquisition of math problem solving ability tests which can be seen in Table 4 below.

Table 4. Percentage score of pretest results of problem solving ability

Rate	Experiment Class		Control Class		Category
	Students	Percentage	Students	Percentage	
80 – 100	21	70%	0	0%	Very High
66 – 79	9	30%	2	7%	High

Rate	Experiment Class		Control Class		Category
	Students	Percentage	Students	Percentage	
56 – 65	0	0%	12	40%	Medium
40 – 55	0	0%	16	53%	Low
0 – 39	0	0%	0	0%	Very Low

Based on table 4, it can be seen that the results of students' problem solving skills in mathematics subjects after being given a posttest in the experimental class obtained very high and high categories. While the control class students' problem solving ability is in 3 categories, namely high, medium, and low.

b. Description of pre-survey data on mathematical disposition of experimental and control class students

Table 5. Pre questionnaire score data

Pre-Asket Score	Experiment Class	Control Class
Highest Score	62	57
Lowest Score	30	30
Mean	47, 90	44,87
Median	49,00	44,00
Modus	55	42
Standard Deviation	8,652	8,525
Variance	74,852	72,671

Based on table 5, it can be seen that the mathematical disposition of students in the experimental class with the highest value obtained by students of 62 which is in the good enough category, the lowest value of 30 which is in the very poor category, with the mean, median and mode of students' mathematical disposition in the poor category, and a standard deviation value of 8.625 which indicates that the distribution of data from the mean value is in the small category. While the mathematical disposition of students in the control class with the highest score obtained by students of 57 which is in the good enough category, the lowest score of 30 which is in the very poor category, with the mean, median and mode of students' mathematical disposition still in the poor category, and a standard deviation value of 8.525 which indicates that the data distribution of the average value is in the small category.

Based on the pretest results in table 5 above, the results of mathematical disposition are also presented in a percentage table with the acquisition of students' mathematical disposition questionnaire can be seen in table 6 below.

Table 6. Percentage score of mathematical disposition pre-survey results

Rate	Experiment Class		Control Class		Category
	Students	Percentage	Students	Percentage	
80 – 100	0	0%	0	0%	Very good
66 – 79	0	0%	0	0%	Good
56 – 65	5	17%	2	7%	Fairly Good
40 – 55	20	66%	21	70%	Less Good
0 – 39	5	17%	7	23%	Very Poor

Based on table 6, it can be seen that the results of students' mathematical disposition towards mathematics subjects in experimental and control classes are in 3 categories, namely quite good, less good, and very poor. Where most students still have a poor mathematical disposition.

c. Description of pretest data of problem solving ability of experimental class and control class

Table 7. Post-questionnaire score data

Post-test score	Experiment Class	Control Class
Highest Score	92	66
Lowest Score	72	40
Mean	83,63	54,20
Median	83,50	54,50
Modus	85	49
Standard Deviation	6,009	6,925
Variance	36,102	47,959

Based on table 7, it can be seen that the mathematical disposition of students in the experimental class with the highest score obtained by students of 92 which is in the very good category, the lowest score of 72 which is in the good category, with the mean, median and mode of students' mathematical disposition in the very good category, and a standard deviation value of 6.009 which indicates that the distribution of data from the mean value is in the small category. While the mathematical disposition of students in the control class with the highest score obtained by students of 66 which is in the good category, the lowest score of 40 which is in the unfavorable category, with the mean, median and mode of students' mathematical disposition still in the unfavorable category, and a standard deviation value of 6.925 which indicates that the data distribution of the average value is in the small category.

Based on the pretest results in table 8 above, the results of mathematical disposition are also presented in a percentage table with the acquisition of students' mathematical disposition questionnaire can be seen in table 8 below.

Table 8. Percentage score of mathematical disposition pre-survey results

Rate	Experiment Class		Control Class		Category
	Students	Percentage	Students	Percentage	
80 – 100	19	63%	0	0%	Very good
66 – 79	11	37%	2	7%	Good
56 – 65	0	0%	12	40%	Fairly Good
40 – 55	0	0%	16	53%	Less Good
0 – 39	0	0%	0	0%	Very Poor

Based on table 8, it can be seen that the results of students' mathematical disposition in st math subjects in the experimental class obtained very good and good categories. While the mathematical disposition of students in the control class is in 3 categories, namely good, good enough, and not good enough.

Results of Inferential Statistical Analysis

a. Normality Test

The normality test used in this study used the Kolmogorov-Smirnov test with the help of SPSS. The results of the normality test of the pretest and posttest of problem solving ability as well as the results of the pre- and post-tests of mathematical disposition that have been carried out, can be seen in table 10 below.

Table 9. Normality test result data

No.		Class	Sample Quantity	Significant	Conclusion
1.	***Pre-test***	Experiment	60	0.168	Normal
		Control		0.200	

2.	***Post-test***	Experiment	60	0.093	Normal
		Control		0.200	
3.	*Pre-Questionnaire*	Experiment	60	0.081	Normal
		Control		0.193	
4.	*Post-Questionnaire*	Experiment	60	0.063	Normal
		Control		0.200	

Based on the table above, the significance value of the protest and post-test data in the experimental and control classes has a significance value greater than the α (alpha) value or the significance level (0.05), which means that the protest and post-test data are normally distributed. Likewise, the acquisition of the significance value of the pre- and post-questionnaire results in both classes also obtained a significance value greater than the specified significance level of 0.05, which means that the data from the questionnaire is normally distributed.

b. Homogeneity test

After conducting the normality test, homogeneity testing was carried out to see that the two classes came from the same variance. The results of the homogeneity test for experimental and control class data for the problem solving ability test and mathematical disposition questionnaire can be seen in the following table.

Table 10. Homogeneity test data of test and questionnaire

Nilai	**Significant**	**Conclusion**
Pretest	0,817	Homogen
Posttest	0,081	Homogen
Pre-Questionnaire	0,902	Homogen
Post-Questionnaire	0,337	Homogen

Based on the table above, the significance value of the pretest, posttest, pre-survey and post-survey data has a significance value greater than the α (alpha) value or the significance level (0.05), which means that the data is homogeneous.

c. N-Gain Test

Table 11. Data from the n-gain test of problem solving ability and mathematical disposition

Category	**N-Gain Frequency**			
	Test of Problem Solving Ability		**Mathematical Disposition Questionnaire**	
	Experiment Class	Control Class	Experiment Class	Control Class
High	16	0	16	0
Medium	14	14	14	2
Low	0	16	0	28
Average N-Gain	0,7	0,3	0,7	0,2
Number of Learners	30	30	30	30

Based on the table above, it can be seen that the average value of the N-Gain results of the problem solving ability test and the questionnaire of students' mathematical disposition in the experimental class is 0.7 which is in the high category. While the average value of the N-Gain results of the problem solving ability test in the control class was 0.3 which was in the medium category, and the results of the mathematical disposition questionnaire in the control class were 0.2 which was in the low category.

d. Hypothesis Test

The hypotheses in this study are that the problem solving ability of 11th grade students of SMA Negeri 1 Kraksaan taught using problem-based learning model is higher than that of 11th

grade students of SMA Negeri 1 Kraksaan taught using direct learning (conventional), and the mathematical disposition of 11th grade students of SMA Negeri 1 Kraksaan taught using problem-based learning model is higher than the disposition of 11th grade students of SMA Negeri 1 Kraksaan taught using direct learning model (conventional). This hypothesis testing uses an independent sample t-test on the posttest value of the experimental class and control class, as well as the post questionnaire value of the experimental class and control class.

The results of hypothesis testing for the problem solving ability test can be seen in the following table.

Table 12. Data table of problem solving ability test results

Class	Sig-(2-tailed) *Posttest*	Sig-(1-tailed)	α	Decision
Experiment	0.000	0.000	0.05	H_0 rejected
Control				

Based on the table above, the Sig (1-tailed) result of the posttest of the experimental class and control class is 0.000, where the significance value is smaller than the significant level of 0.05, which means that H0 is rejected and H1 is accepted, which means that there is a significant effect of the application of the problem-based learning model on the problem solving ability of class XI students of SMA Negeri 1 Kraksaan.

Furthermore, the results of testing the hypothesis of students' mathematical disposition questionnaire can be seen in the following table.

Table 13. Data table of mathematical disposition questionnaire hypothesis test results

Class	Sig-(2-tailed) *Posttest*	Sig-(1-tailed)	α	Decision
Experiment	0.000	0.000	0.05	H_0 rejected
Control				

Based on the table above, the Sig (1-tailed) result of the post-questionnaire of the experimental class and control class is 0.000, where the significance value is smaller than the significant level of 0.05, which means that H0 is rejected and H1 is accepted, which means that there is a significant effect of the application of the problem-based learning model on the mathematical disposition of the 11th grade students of SMA Negeri 1 Kraksaan.

Discussion

Based on the research results presented in the previous sub-chapter section for class XI SMA Negeri 1 Kraksaan taught using the problem-based learning model, the problem-solving ability test results were obtained with an average value of 84.27 in the very high category. Then for those taught using the direct learning model (conventional), the results of the problem solving ability test with an average value of 54.90 with a low category. This shows that the problem solving ability of students taught using the problem-based learning model is higher than that of students taught using the direct learning model (conventional). This is also evidenced by the results of the N-Gain analysis which shows that the average N-Gain value for students taught using the problem-based learning model is higher than that of students taught using the direct learning model (conventional).

Furthermore, based on the research results presented previously for class XI SMA Negeri 1 Kraksaan which was taught using the problem-based learning model, the results of the students' mathematical disposition questionnaire were obtained with an average value of 83.63 with a very high category. Then for the class taught using the direct learning model (conventional), the results

of the student mathematical disposition questionnaire with an average value of 54.20 in the low category were obtained. This shows that the mathematical disposition of students taught using the problem-based learning model is higher than that of students taught using the direct learning model (conventional). This is also evidenced by the results of the N-Gain analysis which shows that the average N-Gain value for students taught using the problem-based learning model is higher than that of students taught using the direct learning model (conventional).

Based on the results of research conducted by Gozali et al (2022), it shows that there is a significant effect on the problem solving ability and mathematical disposition of students taught using the problem-based learning model. The increase in students' problem solving ability and mathematical disposition is because the problem-based learning model aims to help students develop thinking, problem solving, and intellectual skills (Nadhifah & Afriansya, 2016). The problem-based learning model encourages students to play a more active role in the learning process because this model begins with the formation of several groups consisting of 5 - 6 students, where each group works together, exchanging ideas in finding solutions to existing problems. The application of the problem-based learning model is able to increase student activity in the learning process with a pleasant atmosphere, develop students' abilities in critical thinking, and direct students to be able to learn independently (Herminarto et. al, 2017, p. 159).

CONCLUSIONS AND SUGGESTIONS

Based on the results of the research and discussion that has been stated, it can be concluded that. The problem solving ability of students taught using the problem-based learning model is classified in the high category. Problem solving ability taught using direct learning model (conventional) is classified in moderate category. Mathematical disposition of students taught using problem-based learning model is classified in high category. Mathematical disposition of students taught using direct learning model (conventional) is classified in moderate category. Problem solving ability of students taught using problem-based learning model is higher than problem solving ability of students taught using direct learning model (conventional). Mathematical disposition of students taught using problem-based learning model is higher than students taught using direct learning model (conventional).

The suggestions from researchers in conducting this research, namely, the process of learning mathematics by applying the problem-based learning model can be an alternative that can be used in learning mathematics to improve problem solving skills and mathematical disposition in students. Math class hours should be conducted in the morning because students will find it easier to capture or understand the subject matter provided by the teacher.

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