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IMPROVING MATHEMATICAL PROBLEM SOLVING ABILITY USING GEOGEBRA LEARNING MEDIA ON SMPN 4 MUARO JAMBI STUDENTS

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ABSTRACT
This study aims to describe the improvement of mathematical problem solving skills using Geogebra learning media for students of SMP Negeri 4 Muaro Jambi, and identify the difficulties experienced by students in solving mathematical problem solving skills test questions. This research is motivated by the problem of students who still consider mathematics as a complicated lesson, difficulty in applying mathematical concepts, and learning that is still monotonous with limited learning media. This research is a quantitative study with research data obtained based on pretest and posttest results in both sample classes. This study also applied the Nonequivalent Control Group Design design with a population of VIII grade students of SMP Negeri 4 Muaro Jambi, with samples obtained based on saturated sample selection techniques. Data analysis in this study began with validating the research instrument in the form of test questions, and continued with hypothesis testing. The results showed that the use of Geogebra learning media was effective in improving students' mathematical problem solving skills, as evidenced by the rejection of H_0 and acceptance of H_1. The experimental class showed a moderate improvement with an average pretest of 10.31 increasing to 45.27 on the posttest and an n-gain value of 65%, while the control class obtained an average pretest of 7.6 increasing to 31 on the posttest with an n-gain of 42%.
Keyword: geogebra; lerning media; problem solving skills

ABSTRAK
Penelitian ini bertujuan untuk mendeskripsikan peningkatan kemampuan pemecahan masalah matematis menggunakan media pembelajaran Geogebra pada siswa SMP Negeri 4 Muaro Jambi, serta mengidentifikasi kesulitan yang dialami siswa dalam menyelesaikan soal tes kemampuan pemecahan masalah matematis. Penelitian ini dilatarbelakangi oleh permasalahan siswa yang masih menganggap matematika sebagai pelajaran yang rumit, kesulitan dalam mengaplikasikan konsep matematika, serta pembelajaran yang masih monoton dengan keterbatasan media pembelajaran. Penelitian ini merupakan penelitian kuantitatif dengan data penelitian yang diperoleh berdasarkan hasil pretest dan posttest di kedua kelas sampel. Penelitian ini juga menerapkan desain Nonequivalent Control Group Design dengan populasi siswa kelas VIII SMP Negeri 4 Muaro Jambi, dengan sampel yang diperoleh berdasarkan teknik pemilihan sampel jenuh. Analisis data dalam penelitian ini dimulai dari melakukan validasi instrument penelitian berupa soal tes, dan dilanjutkan dengan uji hipotesis. Hasil penelitian menunjukkan bahwa penggunaan media pembelajaran Geogebra efektif dalam meningkatkan kemampuan pemecahan masalah matematis siswa, dibuktikan dengan penolakan H_0 dan penerimaan H_1. Kelas eksperimen menunjukkan peningkatan sedang dengan rata-rata pretest 10,31 meningkat menjadi 45,27 pada posttest dan nilai n-gain 65%, sedangkan kelas kontrol memperoleh rata-rata pretest 7,6 meningkat menjadi 31 pada posttest dengan n-gain 42%.
Kata Kunci: *geogebra, kemampuan pemecahan masalah; media pembelajaran*

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Introduction

Based on Law No. 20 of 2003 concerning the National Education System in article 1, it explains that education is a conscious and planned effort to create a learning atmosphere and learning process so that students can actively develop their potential to have religious spiritual strength, self-control, personality, noble character, and skills needed by themselves, society, nation and state (Depdiknas, 2003). Education is a very important factor in improving the quality of human resources in any society to deal with the complex interactions between knowledge growth, technological advances, and scientific advances that occur over time. The development of science and technology seriously affects the desire to learn which can increase student activeness in developing their potential (Siki et al., 2023).

Mathematics is a universal science that is the foundation for today's modern technological advancements. According to Anggraeni & Kadarisma (2020), that mathematics is one of the lessons that can be used to maximize the ability to calculate, measure, and apply mathematical formulas to daily activities. This statement is in line with Yuliza et. al, (2024), which states that mathematics is a science that studies how to think rationally related to existing science, such as the patterns in numbers, the formulas that accompany them, and the existence of mathematical logic. Meanwhile, according to Haryono et al., (2021), Mathematics is one of the subjects needed by students to solve problems in their lives. Mathematics plays a key role as a tool for solving various life problems. The existence of mathematics is very important in the learning process, starting from elementary school to college level, because it plays a role in developing logical thinking skills. Mathematical concepts are abstract in a hierarchical order that is tiered, and still requires special evidence. Therefore, in learning mathematics, it is important to master previous concepts, because this is a basic requirement for understanding more advanced concepts (Suandito, 2017). Not only concept understanding, problem solving is also needed in learning math.

Polya (1973) defines problem solving as an effort to find a way out of a difficulty in order to achieve a goal that is not so easily achieved. Problem solving is a thought that is directed directly to find a solution or solution to a specific problem (Noviyana, 2019; Ovi and Vahlia, 2017). Problem solving is a process or individual effort to respond or overcome obstacles or obstacles when an answer or answer method is not yet clear. Meanwhile, according to Hartono (2014), mathematical problem solving is an effort to apply the knowledge gained previously to overcome mathematical problems that have just been faced. Vahlia and Agustina (2017) Problems must be adjusted to the level of ability. Meanwhile, according to Pratiwi and Musdi (2021), problem solving ability is an ability that must be developed in learning mathematics, the more students' problem solving ability increases, the students' mindset will also increase.

Based on observations during the Teaching Campus activities at SMP Negeri 4 Muaro Jambi, it was found that the learning process in mathematics subjects still has many students who think that mathematics is a complicated counting lesson

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and too many formulas. In addition, abstract mathematical objects also cause students to have difficulty in applying mathematical concepts to the daily problems presented. Students also have difficulty in solving basic math problems such as simple arithmetic operations. There are limitations in learning methods and media applied in the classroom, as well as teaching in this subject, often delivered monotonously in the form of lectures by teachers, which causes students to feel bored, bored, and less motivated to learn. This obstacle is related to the use of media that does not support student understanding due to lack of motivation and the tendency to use monotonous whiteboards and markers. In addition, the way the material is delivered by the teacher is not effective and efficient, making it difficult for students to focus and understand the content of the material.

According to Felton, the use of media in the learning process can significantly improve the achievement of learning outcomes (Mutaaliah & Komala, 2020). According to Ummah (2021), learning media is defined by the words media and learning. learning media is a tool that helps the teaching and learning process with the aim of improving the achievement of learning objectives (Kustandi and Sjipto 2011). Learning media is an instrument used to visualize facts, concepts, principles, and procedures to make them more concrete and easier to understand (Moreira, Pereira, and Gusmao 2018).

In applying learning media, teachers who act as facilitators must be able to provide learning facilities so that students can easily obtain information. This statement is in line with Wulandari et. al, (2023), which states that the use of media can change the role of teachers to be more positive and productive. The statement is also in line with Susanna et. al (2019), and Sanulita et. al (2024), which states that through learning media, teachers can present abstract learning materials to be concrete so that students understand them more easily. For this reason, teachers must innovate by utilizing technology in learning to attract the attention of all students involved in learning. From several schools, there are already teachers who utilize learning media in mathematics, but the lack of understanding of teachers about technology makes teachers prefer to learn using existing facilities. One of the innovations that can be done by teachers is to create learning media, namely learning media in the form of Geogebra.

According to Nur'aini et al. (2017), geometry is one of the fields of Mathematics that studies points, lines, fields and spaces as well as their properties, sizes, and relationships with one another. These three displays are dynamically interconnected. This helps students in learning geometry and algebra objects that are abstract. In addition to this, Geogebra is easy to use and can be obtained for free. Based on research that has been conducted by Ramadhani (2016), It is said that the application of Geogebra software has a significant effect on the Problem-based learning model used in improving student learning outcomes. Capitalizing on these findings, the researcher wants to ascertain whether the results of the research that has been conducted by Ramadhani (2016) With the help of Geogebra software, it will have the same impact on improving students' mathematical problem solving skills.

Based on the description above, the authors are interested in conducting a study entitled “Improving Mathematical Problem Solving Ability Using Geogebra Learning Media on SMPN 4 Muaro Jambi Students.”

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Research Methods

The research was conducted at SMP Negeri 4 Muaro Jambi in the 2023/2024 school year. The study population was all VIII grade students of SMP Negeri 4 Muaro Jambi. The sampling technique used the Saturated Sampling technique. According to Sugiyono (2019), Saturated sampling is a sampling technique when all members of the population are used as samples. This is often done when the population is relatively small. Another term for saturated sample is census, where all members of the population are sampled. based on this description, those used as samples in this study included 19 female students and 23 male students in class VIII SMP Negeri 4 Muaro Jambi.

This study used a quantitative approach with a quasi experimental nonequivalent control group design. The application of this design allows for special treatment for each experimental class and control class. Where in this study, the experimental class was given treatment by applying geogebra learning media, while the control class only learned as usual.

Data were collected through pretest and post-test using validated mathematical problem solving ability test instruments. The test questions were arranged based on indicators of problem solving ability, namely understanding the problem, planning, solving the problem, and checking back (Polya, 1973). The test instrument used has been tested for validity using the Product Moment Correlation formula as follows:

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}} \quad \text{.....(1)}$$

Description:

r_{xy} : Correlation coefficient between item score (X) and total score (Y)
N : Number of subjects
X : Item score or statement/question item score
Y : Total score

Based on the Product Moment Correlation formula above, the results of the validity test on class IX A students totaling 18 students in the form of essays with flat-sided space building material as many as 4 questions are in the validity criteria $0{,}80 \leq r_{xy} < 1{,}00$ is included in the very high validity category.

The reliability test obtained high criteria with a value based on the Cronbach Alpha formula is r = 0.826. Data analysis was carried out with prerequisite tests of normality and homogeneity, followed by hypothesis testing using the t-test. The improvement of mathematical problem solving ability was analyzed using N-gain score, with the learning effectiveness criteria determined based on the predetermined gain effectiveness interpretation category.

Results and Discussion

In this study, the description of the data from the student mathematical problem solving ability test results is as follows:

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1. Pretest Test of Mathematical Problem Solving Ability

Pretest was conducted before learning took place in both sample groups. After obtaining the pretest results from both classes, a normality test was carried out to determine whether the two selected samples were normally distributed or not. Furthermore, the homogeneity test is carried out with the aim of whether the two samples have a homogeneous variance or not. Pretest was conducted to determine the initial conditions between the experimental group and the control group. The following data description of the results of students' problem solving thinking ability can be seen in Table 1. as follows:

Table 1. Data description of pretest results

Group	x_{max}	x_{min}	Measures of central tendency			Measures of group variance	
			$\bar{x}$	M_o	M_e	R	Sd
Experiment	13	8	10,31	10	10	5	1,61
Control	12	4	7,6	9	8	8	2,08

Based on Table 1. it can be seen that the pretest results before the learning takes place, the highest score in the experimental class is 13 and the control class is 12. While the lowest score of the experimental class is 8 and the control class is 4. For the value of the measure of central tendency which includes the average (mean) in the experimental class is 10.31 and the control class is 7.6. While the mode in the experimental class is 10 and the control class is 9. The median value in the experimental class is 10 and the control class is 8. As for the mode in the experimental class is 10 and the control class is 9. The group variance measure consists of the range or range in the experimental class is 5 and the control class is 8. While the standard deviation in the experimental class is 1.61 and the control class is 2.08.

2. Posttest Test of Mathematical Problem Solving Ability

The post-test was conducted to see how much using geogebra learning media in the experimental class and conventional learning in the control class had an effect on students' mathematical problem solving skills After the posttest data was collected, the normality test and homogeneity test were carried out. Normality testing is carried out to ascertain whether the two samples selected are normally distributed or not, and the homogeneity test is carried out to see if the two classes have the same variance. After completing the normality and homogeneity tests, then test the hypothesis using a paired t-test to determine whether geogebra learning media can improve students' mathematical problem solving skills. The following is a summary of the data description of the results of students' mathematical problem solving skills can be seen in Table 2. as follows:

Table 2. Description of posttest result data

Group	x_{max}	x_{min}	Measures of central tendency	Measures of group variance

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			$\bar{x}$	M_o	M_e	R	Sd
Experiment	62	40	45,27	48	45	22	4,65
Control	46	20	31	29	30	26	5,53

Based on Table 2. it can be seen that the posttest results after the learning takes place, the highest score in the experimental class is 62 and the control class is 46. While the lowest score of the experimental class is 40 and the control class is 20. For the value of the measure of central tendency which includes the average (mean) in the experimental class is 45.27 and the control class is 20. The median value in the experimental class is 45 and the control class is 30. As for the mode in the experimental class is 48 and the control class is 29. The group variance measure consists of the range or range in the experimental class is 22 and the control class is 26. While the standard deviation in the experimental class is 4.65 and the control class is 5.53.

Furthermore, the description of the prerequisite analysis testing data in this study is as follows:

1. Normality Test

The results obtained after the normality test of the average pretest and posttest scores of mathematical problem solving skills can be seen in the Table 3 below:

Table 3. Pretest normality test results of mathematical problem solving ability

Test of Normality			
Class	**Kolmogrov-Smirnov***		
	Statistic	**df**	**Sig.**
Control	.151	20	.200*
Experiment	.124	22	.200*

Based on Table 3, the pretest of students' mathematical problem solving ability, that the results show that each research class gets a Sig value $>$ 0.05 then H_0 is accepted, and H_1 is rejected. So, if it is concluded, H_0 is accepted, namely the data on the pretest value of mathematical problem solving ability for the experimental class and control class is normally distributed can be seen in Table 4. as follows:

Tabel 4. Results of the posttest normality test of mathematical problem solving ability

Test of Normality			
Class	**Kolmogrov-Smirnov***		
	Statistic	**df**	**Sig.**
Control	.159	20	.200*
Experiment	.188	22	.042

Based on Table 4. posttest of students' mathematical problem solving ability, that the results show that each research class gets a Sig value $>$ 0.05 then H_0 is accepted, and H_1 is rejected. So, if it is concluded, H_0 is accepted, namely the data

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on the posttest value of mathematical problem solving ability for the experimental class and control class is normally distributed.

2. Homogeneity test

The results of the homogeneity test of the pretest scores of the students' mathematical literacy test can be observed in the following Table 5.

Table 5. Homogeneity test results of mathematical problem solving ability pretest

Test of Homogeneity of Variance				
	Lavene Statistic	**df1**	**df2**	**Sig.**
Based on Mean	.820	1	40	.371
Based on Median	.621	1	40	.435
Based on Median and with adjusted df	.621	1	35.644	.435
Based on trimmed mean	.858	1	40	.360

Based on the results of Table 5., the decision-making criteria, the significance value is obtained $0{,}371 > 0.05$, i.e. the data variance of the two groups is homogeneous. So it is concluded, the pretest scores of the two classes have the same variance of pretest data on mathematical problem solving ability, which means that H_0 is accepted, which means that the sample comes from a normally distributed population can be seen in Table 6. as follows:

Table 6. Homogeneity test results posttest mathematical problem solving ability

Test of Homogeneity of Variance				
	Lavene Statistic	**df1**	**df2**	**Sig.**
Based on Mean	.740	1	40	.395
Based on Median	.776	1	40	.384
Based on Median and with adjusted df	.776	1	39.645	.384
Based on trimmed mean	.759	1	40	.389

Referring to the results of Table 6, the decision-making criteria, the significance value is $0{,}395 > 0.05$, namely the data variance of the two groups is homogeneous. So it is concluded, the Posttest scores of the two classes have the same variance of Posttest data on mathematical problem solving ability, which means that H_0 is accepted, which means that the sample comes from a homogeneously distributed population.

3. Hypothesis testing

The t-test analysis data with paired tests can be seen in Table 7. following:

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Table 7. Results of the mathematical problem solving ability test t-test

Paired Differences									
95% Confidence Interval of the Difference									
		Mean	**Std. Deviation**	**Std. Error Mean**	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	Before treatment - after treatment	-34,955	4.746	1.012	-37.059	-32.850	-34.547	21	.000

Based on Table 7. hypothesis testing of mathematical problem solving ability can be seen that the significance obtained is 0,000 this means sig < 0,05. This means that at the significance level $\alpha = 0{,}05$ is rejected. Therefore, it can be concluded that mathematical problem solving ability increases through geogebra learning media rather than conventional.

4. Observed Data on Improvement of Mathematical Problem Solving Ability

After the learning process was carried out in both classes then the posttest was held. Then, the posttest and pretest score data can be found to what extent the improvement of mathematical problem solving ability with the normalized gain formula (N-gain). N-gain data on mathematical problem solving can be presented in the Table 8 below:

Table 8. N-gain results of mathematical problem solving ability

No	**Experiment Class**		**Control Class**	
	Value	**Category**	**Value**	**Category**
1	0,72	High	0,43	Medium
2	0,69	Medium	0,31	Medium
3	0,59	Medium	0,44	Medium
4	0,70	High	0,51	Medium
5	0,63	Medium	0,48	Medium
6	0,66	Medium	0,44	Medium
7	0,67	Medium	0,39	Medium
8	0,65	Medium	0,38	Medium
9	0,57	Medium	0,41	Medium
10	0,63	Medium	0,33	Medium
11	0,96	High	0,45	Medium
12	0,58	Medium	0,65	Medium
13	0,57	Medium	0,23	Low
14	0,65	Medium	0,35	Medium
15	0,68	Medium	0,42	Medium
16	0,69	Medium	0,39	Medium
17	0,64	Medium	0,33	Medium
18	0,64	Medium	0,48	Medium

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No	Experiment Class		Control Class	
	Value	Category	Value	Category
19	0,57	Medium	0,55	Medium
20	0,57	Medium	0,37	Medium
21	0,57	Medium		
22	0,70	Medium		
Average	**0,65**	**Medium**	**0,42**	**Medium**
Percentage	**65%**	**Moderately Effective**	**42%**	**Moderately Effective**

Based on the calculation data of the experimental class N-gain value in Table 8. above, the average N-gain result obtained is 0.65 which shows a moderate improvement category and in percentage form to measure the effectiveness of the N-gain score with a percentage of 65% which is in the moderately effective category. Thus it can be stated that students' mathematical problem solving skills increase as seen from the increase in pre-test and post-test scores so that Geogebra learning media can be used in the learning process to improve students' mathematical problem solving skills. This is in line with research conducted by Ratna Kartika Sari (2023), it was found that the geogebra-assisted problem-based learning model can improve students' mathematical problem solving skills. The average score of students' mathematical problem solving ability increased from cycle to cycle. Furthermore, research conducted by Septian (2017), with the title "Application of Geogebra to Improve Mathematical Problem Solving Ability of Mathematics Education Study Program Students at Suryakencana University". The research shows that the improvement in mathematical problem solving skills of students who apply geogebra is better than students who use expository learning and students' attitudes towards the application of geogebra are positive.

Furthermore, research conducted by Ramadhani (2016), found that the improvement in the mathematical problem solving ability of students who use geogebra through a problem-based learning model is higher than the mathematical problem solving ability of students who get ordinary learning. The results of the questionnaire calculation of the use of geogebra software through the problem-based learning model in the learning process showed that geogebra software had a positive influence on the student's mathematics learning process, namely 56.5% of students strongly agreed that the use of geogebra software helped students in the learning process.

Based on its objectives, this study also participated in discussing the difficulties students have in solving the problems given, as for these findings, namely it was found that some students had difficulty using data and had difficulty interpreting problems into the form of mathematical language presented in the form of mathematical models, so that students could not make appropriate mathematical models in solving problems. This is in line with the opinion of Paridjo (2006), which states that difficulties using data include not using data that should be used, incorrectly entering data into certain variables and adding data that is not needed in answering a problem. This is because students are in a hurry, less careful in working on problems, confused about using data and unable to solve the problem until the end. In line with the opinion of Jana (2018), errors in the use

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of data due to a mismatch between what is known and the formulation used so that it does not match, also occurs because of misunderstanding what is known. In line with the opinion of Anjeli and Irwan (2019), which states that missing data is caused by students not being careful and not understanding well the problem solving steps.

In solving math problems, students experience errors in calculations and do not perform counting operations that should be. These errors are caused by students still having difficulty in multiplying and dividing large words and not understanding algebra. This statement is in line with the opinion of Khoirunnisa et. al, (2022), which states that students often experience difficulties in calculations because students are still confused if they have to reverse the formula or move the variable segment. In this study, students did not draw conclusions, this was proven based on the results of data processing conducted by researchers. The absence of drawing conclusions is due to the habit of students who tend to forget this stage, also caused by the rush by students in solving the problems given. This statement is in line with Ariyani (2019), who argues that students are not used to and sometimes forget to write the conclusion of the answer after the completion of the solution process. Another reason that also occurs is that students are unable to solve the problem until the end so they cannot make a conclusion.

Conclusion and Suggestion

The results showed that the use of Geogebra learning media was effective in improving students' mathematical problem solving skills in learning flat-sided spaces in class VIII SMP Negeri 4 Muaro Jambi. This increase is evidenced by the rejection of H0 and the acceptance of H1, where the average score of the experimental class using Geogebra increased from 10.31 (pretest) to 45.27 (posttest), with the n-gain value reaching 65%. While the control class that did not use Geogebra only increased from 7.6 to 31, with an n-gain value of 42%. This significant difference in improvement shows that learning with Geogebra media has a positive impact on students' mathematical problem solving skills.

However, based on the analysis of posttest results, there are still some obstacles that need attention in the implementation of learning using Geogebra. Students still have difficulty in some aspects of problem solving, especially in making calculations using mathematical models, inappropriate use of mathematical symbols in the problem solving process, and the habit of not writing complete conclusions from the problem solving results that have been obtained. This indicates the need for strengthening these aspects in learning mathematics using Geogebra media in the future.

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