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The Effect of Using Geogebra Learning Media on Student's Mathematical Understanding

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Abstract

This study aims to determine the effect of using Geogebra learning media on students' mathematical understanding on class XI geometry transformation material at one of the vocational high schools in Bekasi. This research uses a quantitative approach with quasi-experimental methods. The population in this study was all grade XI students of the school totaling 144 students with a sample of 51 students obtained randomly through the Cluster Random Sampling technique. The instrument used to collect data is a multiple-choice test, in accordance with indicators of mathematical understanding of the subject of geometric transformations totaling 25 questions. Based on the results of hypothesis testing, values are obtained which means rejected and accepted, namely the effect of using Geogebra learning media on students' mathematical understanding on geometry transformation material in class XI at one of the vocational high schools in Bekasi for the 2022/2023 academic year.

Keywords: Geogebra, Learning media, Mathematics comprehension.

1 INTRODUCTION

Understanding is etymologically defined as the correct understanding, opinion, thought, school, point of view, and understanding according to the Big Indonesian Dictionary (KBBI) is a way, process, or act of understanding or understanding. Understanding has a meaning that becomes the foundation or basis, namely putting each part of learning according to its proportion (Lilawati & Rohmah, 2019).

Mathematics is a subject taught at every level of education from elementary, junior high, and high school, to college. Mathematics has become a necessity and a provision of human life. This is shown by human activities that are inseparable from mathematics in all activities, such as buying and selling, measuring quantities, numerating objects, the existence of machines, and so on. The term mathematics comes from the Greek "*mathein*" or "*manthenein*" which means to learn. However, it is suspected that the word is also closely related to the Sanskrit word "*medha*" or "*widya*" which means intelligence, knowledge, or intelligence (Darmandi, 2017).

Mathematics is a very important and influential science in life, to many branches of mathematics. In the world of education, mathematics subjects have always existed from low to high education levels. This shows that mathematics has become a very important science because with mathematics humans learn to solve problems and improve logic and logical ways of thinking for brain development.

When learning mathematics, of course, involves many abilities, one of which is the ability to understand mathematics. Based on previous research, a percentage of 53 scores was obtained and it was said that students' comprehension ability was low. This is also supported by the results of the PISA (Program for International Student Assessment) survey in 2018 which showed Indonesia occupies the 72nd position out of

79 countries in the world with an average value of 379 points for mathematical ability (OECD, 2019). Meanwhile, in terms of mathematical and science literacy from the results of the TIMSS (Trends International Mathematics and Science Study) study in 2015, Indonesia was only able to rank 38 out of 42 countries, with an achievement score of 397 and still below the international average score of 500.

In the world of education, many factors affect the learning process both from internal and external factors. One of the internal factors is the diverse character of students, so we as teachers must have an effective and efficient delivery strategy to add value to the meaning and quality of learning.

Not only internal factors, teachers must also pay attention to external factors. External factors have an important function in improving students' abilities in learning outcomes and learning achievement. One of the factors is the use of learning media. The use of learning media can facilitate teachers in the teaching and learning process in the classroom. Students can also feel the benefits, namely understanding the material and maximum learning. But in fact, a survey in 2021 conducted by the Center for Information and Communication Technology (Pustekkom) of the Ministry of Education and Culture (Kemendikbud) stated that only 40% of non-ICT teachers are ready with technology.

This is assumed to be one of the factors why the learning process is less than optimal. These factors can trigger other factors such as low student learning outcomes and reduced comprehension abilities. Other factors such as learning and the perception of unpleasant mathematics difficulties further make things worse for achieving quality learning.

The results of observations and interviews in class XI precisely on December 21, 2022, the results of the researchers' observations stated that students still experience problems in learning mathematics. Students find it difficult to solve problems due to a lack of understanding of mathematics, besides that learning is less interesting and makes them bored quickly, their attention is not focused on the learning that takes place. These activities become one of the obstacles to achieving maximum learning outcomes and learning processes. This triggers students to feel indifferent to the teaching and learning process. Students are more excited about their activities outside of learning maths and want the ongoing maths learning process to be completed quickly. This is because students lack interest in the teaching and learning process or ongoing learning due to various factors, for example, such as classes that are not conducive, teacher delivery methods that are not optimal or inappropriate, students are bored with teaching methods carried out by teachers or problems with teaching materials and school facilities and teacher competencies that are not optimal.

After being analyzed at the school, mathematics teachers have not maximized the use of technology-based learning media, some teachers only use conventional-based learning media. Currently, the use of technology-based learning media has not been maximized and varied. One of the reasons is to use technology-based media, of course, school facilities or things needed to support the use of these media get maximum results.

Therefore, in addition to teacher competence in the IT field, school facilities must also be improved, such as increasing the number of laptops, and LCDs, facilitating wifi, and so on. Teachers must be able to improve the ability to build students' mathematical understanding so that learning outcomes and learning processes are of higher quality. One of the possible efforts made by teachers to improve mathematics understanding is to use appropriate learning media. Because now many learning media have developed and are very feasible to be used in the teaching and learning process.

Learning media can be defined as physical or unintended tools that are used as intermediaries between teachers and students in understanding learning material to be more effective and efficient (Rahmawati, Susilowati, & Eltivia, 2022). So that learning material is more quickly accepted by students intact and attracts their interest in learning more deeply. According to Sudirman, the environment of students that can stimulate them to learn the use of media in the learning process must also be adjusted. Therefore, teachers must be able to choose good learning media to be used when teaching. Good

learning media must meet several criteria, including (1) suitability with learning material; (2) ease of use, and (3) attractiveness to students so that optimal learning goals are achieved (Trisnawati et al., 2021).

Mathematics learning media has varied from conventional, digital, and technology-based. One of the most multifunctional technology-based mathematics learning media is Geogebra, this media is in the form of software which provides many options to support mathematics learning.

Geogebra is a computer program to learn mathematics, especially geometry and algebra (Tamam & Dasari, 2021). Geogebra capabilities in algebraic systems can be used to solve important things related to certain functions such as determining and describing extreme points, determining the roots of a number, describing curves, using function formulas and coordinate points directly on input bars, and finding derivative and integral values of a function (Priatna & Arsani, 2019).

Geogebra can improve students to be active in building an understanding of geometry and algebra. This program allows students to make simple drawings of geometry concepts, making it easier for students to be able to find, put forward, and make mathematical representations of ideas or ideas owned by students (Yanti et al., 2019).

Several research results revealed that the use of Geogebra can affect students' mathematical understanding, such as research conducted by Rochim, Herawati, and Nurwiani (2021) at XI SMK Muhammadiyah 1 Baron obtained the results of students ' mathematical understanding before and after the use of Geogebra video media, quadratic function material, there is a fairly noticeable difference, namely from the initial mathematical understanding of 9% to 45%. Santoso's (2017) research in grade V of SDN Sukarasa II Garut Regency using a contextual model obtained results that there were differences in students' mathematical comprehension ability before and after learning using a contextual learning model. In this case, researchers tried to use Geogebra learning media to determine its effect on students' mathematical understanding. The formulation of the problem in this study is "is the use of Geogebra learning media better than conventional learning media for students' mathematical understanding?". The purpose of this study was to determine the effectiveness of using Geogebra learning media on students' mathematical comprehension abilities.

2 RESEARCH METHODS

This research uses a quantitative approach with the Quasi-Experimental method carried out at the school. With the Posttest Only Control Group Design (Sugiyono, 2019), it can be seen as follows.

Table 1. Posttest Only Control Group Design

Group	Treatment	Posttest
Experiment	X	O_1
Control	-	O_2

Information:
X = Treatment using Geogebra media
O_1= Final test (posttest) in the experimental class
O_2= Final test (posttest) in the control class

The population of this study is all grade XI students of the school for the 2022/2023 academic year totaling 144 students. Sampling in this study used the Cluster Random Sampling technique. In the process of collecting data in this study using test instruments that refer to indicators of mathematical understanding of geometry transformation material. The test form given is in the form of 25 multiple-choice questions with the subject of geometric transformations.

3 RESULT AND DISCUSSION

3.1 Mathematical comprehension

The results of this study are in the form of student mathematics comprehension test score data as an impact of the application of the use of Geogebra learning media in experimental classes and conventional learning in control classes. Students' math comprehension scores are obtained through posttests.

Based on the data obtained from the results of testing mathematical comprehension with a question test instrument consisting of 25 students as a whole, it can be described as follows: mean value (mean) = 72.28; median (Me) = 73; mode (Mo) = 73.75; standard deviation = 9.60; maximum value = 88; Minimum value = 48. The experimental class comprehension data can be presented in the form of a histogram as shown in Figure 1.

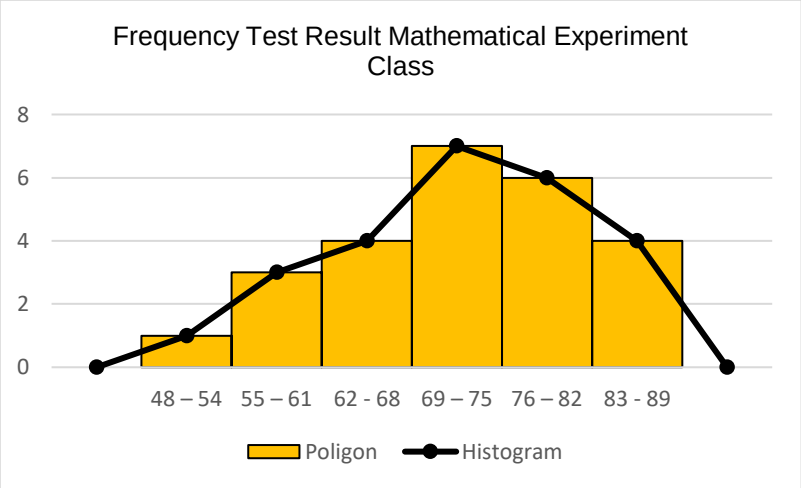

Figure 1. Histograms and Polygons Frequency Test Results Mathematical Comprehension Experimental Class

While the control class math comprehension data: mean value (mean) = 52.31; median (Me) = 52.5; mode (Mo) = 54.84; standard deviation = 10.67; maximum value = 72; minimum value = 32. The control class comprehension data is presented in the form of a histogram as shown in Figure 2.

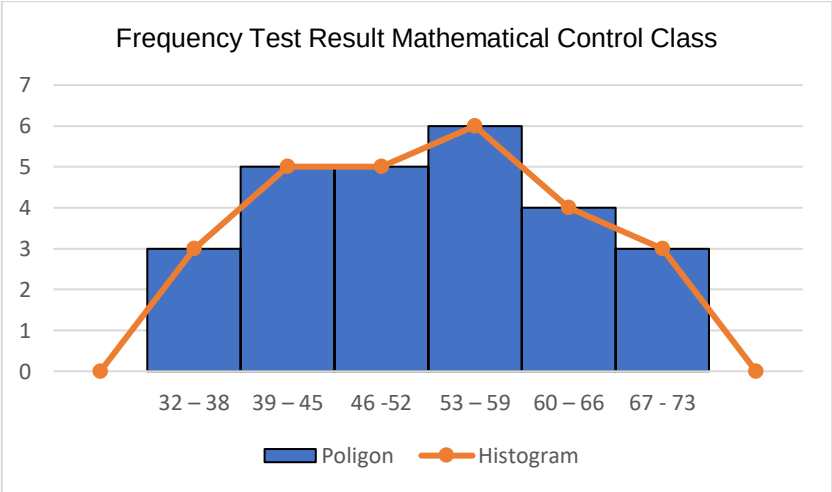

Figure 2. Histograms and Polygons Frequency Test Results Mathematical Comprehension Control Class

Before hypothesis testing is carried out, prerequisite testing is first carried out on the data obtained, analysis prerequisite testing consists of a normality test and homogeneity test.

3.1.1 *Normality Test*

The normality test is carried out to find out whether the data to be analyzed is normally distributed or not. The calculation results of the normality test can be seen in Table 2.

Table 2. Normality Test

Group	n	α	L_{count}	L_{table}	Conclusion
Experiment	25	0.05	0.1277	0.1730	Normal
Control	26	0.05	0.1064	0.1699	Normal

Based on Table 2, show that the data derived from the experimental class and the control class are seen from $L_{count}<L_{table}$, since 0.1277<0.1730 and 0.1064<0.1699 then at a significant level α=0.05, it can be concluded that the normality test results on the posttest data are normally distributed.

3.1.2 *Homogeneity Test*

The homogeneity test in this study is used to determine whether the basal sample is of the same variance or not (homogeneous). The results of the homogeneity test calculation can be seen in Table 3.

Table 3. Homogeneity Test

Group	Varians	*dk*	F_{count}	F_{table}	Conclusion
Experiment	92.17	24	1.2363	1.9375	Homogen
Control	113.95	25			

Based on Table 3, it is known that the calculation of the experimental class fisher test and the control class F_{count}=1.2363 which F_{table}=1.9375 at a significant level α=0.05, because $F_{count}<F_{table}$. Then it can be concluded that the sample comes from a homogeneous population.

3.1.3 *Test the hypothesis*

It is known that the posttest data on the mathematical comprehension ability of the experimental class and the control class are normally distributed and homogeneous, then hypothesis testing is carried out. Hypothesis testing performed using the *t*-test can be seen in Table 4.

Table 4. Hypothesis Test

Group	X	N	S^2	$S_{combination}$	t_{count}	t_{table}
Experiment	72.28	25	92.17	10.16	7.1333	2.0096
Control	52.31	26	113.95			

Based on Table 4, t_{count}=7.1333 is obtained as for t_{table} for the *t*-test on significance is t_{table}=2.0096. The results show that $t_{count}>t_{table}$ with decision criteria shows H_o rejected and H_1 accepted which means that the use of Geogebra learning media is better than conventional learning media for students' mathematical understanding of geometry transformation material.

3.2 Interpretation of Research Results

Based on the studies and research carried out, the use of Geogebra learning media affects students' mathematical understanding. Then based on the calculation results of

hypothesis testing using the *t*-test, $t_{count}=7.1333>2.0096=t_{table}$ can be stated, so that it can be stated that Ho is rejected and H1 is accepted, meaning that there is a significant effect between the use of Geogebra learning media and students' mathematical understanding.

This result is in line with the results of Santoso's (2017) research, almost the same as this study, which is an experimental research to determine the effect of the contextual learning model approach on students' mathematical understanding. Santoso (2017) further stated that the results of research and hypothesis testing, there were differences in students' mathematical comprehension ability before and after learning using contextual learning models.

This is because, in contextual learning, students use critical thinking skills with question-and-answer methods, discussions, and assignments. Students are fully engaged in striving for an effective learning process and working together with heterogeneous groups, exchanging opinions and knowledge.

Similarly, with the results of research by Rochim et al. (2021), the value of students' mathematical understanding before and after using Geogebra video learning media showed a positive increase with an increase of 36%. The results of the study state that Geogebra-assisted mathematics learning can be used as an alternative in developing students' mathematical understanding.

The results of previous research turned out to be in line with the results of this study, that the use of Geogebra learning media can affect students' mathematical understanding. However there are still differences with this study, the research of Rochim et al. (2021) saw the effect of the application of Geogebra learning media in the form of videos on students' mathematical understanding of quadratic function material. Meanwhile, Santoso's (2017) research focuses on the effect of the use of contextual models on students' mathematical understanding.

Based on the acquisition of data from post-mathematics tests, there is a positive effect on the use of Geogebra learning media on students' mathematical understanding. Thus, the research succeeded in proving the research hypothesis proposed that there is a positive effect on the use of Geogebra learning media on students' mathematical understanding in grade XI of the school.

4 CONCLUSION

There is a very significant difference in average scores in student understanding, students' understanding of geometry transformation material in experimental classes using geogebra applications is higher than the understanding of control class students. This is supported by the results of hypothesis testing using the *t*-test (difference test) obtained t_{count} greater than t_{table}, so that the stated research hypothesis (H_1) is accepted or H0 is rejected. This shows that there is a positive effect of using *Geogebra* learning media on students' mathematical understanding of geometry transformation material in class XI at one of the vocational high schools in Bekasi for the 2022/2023 academic year.

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