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The Effect of The Use of Geogebra on Understanding in Analytical Geometry Course

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Abstract

The main objective of this research is to analyze the effect of learning using Geogebra software on student learning outcomes in analytic geometry courses. The type of research used in this study is a quasi-experimental and data obtained by using test instrument testing, both pretest and posttest. The pretest that was first distributed was used to determine the students' initial abilities, while the posttest was given to determine the level of understanding (learning outcomes) of students. The population in this study were students in the fifth semester who took the Analytical Geometry Course at the Tadris Mathematics Study Program FTIK (Faculty of Tarbiyah and Teacher Training) IAIN Pekalongan. Respondents in this study consisted of two classes, namely the control class (class B) and the experimental class (class C). Analysis of the data used in this study is using the free sample t test. The results obtained concluded that there was no difference in learning outcomes between students who were given the Geogebra learning model and students who were given the conventional (conventional) learning model. This can be seen from the results of the t test, with a significance value of 0.126> 0.05.

Keywords*: geogebra, analytic geometry, and student learning outcomes*

INTRODUCTION

Currently, computer-based technology has been considered as one of the important components of the modern curriculum (Ringstaff and Kelley, 2002). The next challenge is the need to conduct research to find out whether learning using software (computer applications) can provide benefits for students. In mathematics education, computers have played a role in generating certain ideas that can solve problems more easily, generating new ways to explain and use mathematical information, and provide choices about materials and teaching methods that we have never known before.

Problems in the field, in learning mathematics, students often have difficulty understanding the material when faced with objects that require abstraction and depiction abilities. Harizon (2005) has found that students have difficulty in determining the properties of two tangents, proving the relationship between the angle formed by a tangent and a line segment, and answering questions related to the tangent of two circles. The students could not understand the concept accurately because they could not imagine the concept and its application. Therefore we need teaching materials in the form of pictures to help students get better information and be able to connect information, new experiences and existing knowledge bases. In addition, students also experience problems in understanding and memorizing mathematical concepts in circular geometry (Chianson et al., 2010: 33-36).

Many mathematical software have been introduced and widely practiced around the world, such as Sketch Geometer (GSP), Autograph, Maple, Matlab, Mathematica, and so on (Bakar et al., 2010). This software has proven to be a very important part of learning activities. Bakar et al. (2010: 4650–4654) have demonstrated the importance of Autograph, an educational software that can be used by students to modify and animate drawn graphics, shapes or vectors. This activity can stimulate students' interest, encourage conceptual understanding and further understand mathematical phenomena in real life.

However, one of the well-known and quite good mathematical software in providing visualization is Geogebra. Geogebra has been proven to have a lot of positive effects in increasing students' understanding. Oktaria et al. (2016) found that the use of Geogebra software in learning can improve students' mathematical representation skills on SPLDV material. On the other hand, Ekawati (2016) stated that Geogebra software really helps teachers in conveying abstract mathematics material more easily because the software can visualize it, besides that this software was created to foster student creativity and critical strength.

According to Green and Robinson (2009: 6–10) Geogebra has many constructive features and is useful in visualizing mathematical concepts. Using Geogebra as a teaching tool is not new to other countries (Hohenwarter et al., 11th

International Congress on Mathematical Education. Monterrey, Nuevo Leon, Mexico, 2008). Geogebra is free, open source and dynamic math software and is rapidly gaining popularity in the teaching and learning of mathematics worldwide.

Geogebra has many constructive features and is useful in visualizing mathematical concepts (Green & Robinson, 2009; Harizon, 2005; Bakar et al., 2010b; Lu, 2008). Utilizing Geogebra as a teaching tool is not new to other countries (Hohenwarter et al., 2008; Lu, 2008). Geogebra is a free, open source, dynamic math software and is rapidly gaining popularity in the teaching and learning of mathematics around the world. Currently, Geogebra has an influence on mathematics education in most countries (Lavicza, 2012). However, the use of open source software in mathematics teaching and learning is still considered new in Malaysia (Bakar et al., 2010a).

Based on observations and interviews as a preliminary study, researchers suspect that there will be differences in students' understanding of the circle material if it is delivered with the help of Geogebra software. With these problems, researchers are interested in analyzing the effect of learning using Geogebra software on student learning outcomes in analytic geometry courses.

METHOD

The type of research used in this research is a quasi-experimental with pretest and posttest involving the control class and the experimental class to test the use of Geogebra in learning analytic geometry of circle material. This design is considered the most appropriate in investigating treatment effectiveness in the complete group and is used when an ideal experimental design is not possible.

The research was carried out in the Odd Semester of the 2019/2020 academic year. This study used a population of students in semester V who took the Analytical Geometry Course at the Mathematics Tadris Study Program FTIK (Faculty of Tarbiyah and Teacher Training) IAIN Pekalongan. The population consists of 3 classes (Table 1), from the 3 classes, one class will be chosen randomly as the experimental group. The control group is one class that was chosen randomly as well.

Table 1. Demografi Respondent

ASPECT	CRITERIA	N	%
Gender	Male	28	23%
	Female	94	77%
Class	A	39	32%
	B	41	34%
	C	42	34%

From Table 1 it can be seen from the gender that the percentage is very different between men and women. The percentage of respondents with female gender (77%) is much higher than respondents with male gender (23%). In terms of the distribution of the number of students per class is quite evenly distributed, the majority of respondents are in Class C with 42 students (34%) and the second largest class is Class B with 41 students (34%), while the least class is class A with only 39 students (32%).

The experimental group/class will be given learning using Geogebra and conventional learning will be delivered to the control group/class. According to Gall et al. (2014) the number of members in each group must be at least 15 participants, to be compared in experimental research. Thus, the sample sizes in both groups have met the requirements for conducting research.

Table 2. Class Data

Number	Mata kuliah	Criteria
1	Geometri Analitik A	-
2	Geometri Analitik B	Kelas Eksperimen
3	Geometri Analitik C	Kelas Kontrol

The sampling technique used is cluster random sampling. This technique is used to randomly select the class that will be the experimental group. The simple random sample selection was carried out with the help of Microsoft Excel program.

This study was designed using a quasi-experimental with pretest and posttest involving a control class and an experimental class to test the use of Geogebra in learning analytic geometry of circle material (Table 2). This design is considered the most appropriate in investigating treatment effectiveness in the complete group and is used when an ideal experimental design is not possible.

Table 3. Design Experimental

Class	Pretest	Variabel Independen	Posttest
E	Y1	G	Y2
K	Y1	B	Y2

Noted:
E: Eksperiment Class K: Control Class
Y1: *Pretest* Y2: *Posttest*
G: Geogebra Class B: Conventional Class

There are two instruments used, namely exam questions in the form of a description of geometry, especially the circle material. This question is used to assess the students' pretest and posttest abilities. These exam questions are based on practice questions that were selected and modified from the book UT by Sukirman, Calculus and Analytical Geometry Volume 1 by Thomas-Finney (1986) and the book Analytical Geometry by I Made Suarsana (2014). The data collection technique used in this research is the test method. This test is used to determine the initial and final ability of the circle material. The data will be analyzed using independent sample t test. Independent sample t test is also called unpaired test. The t-test is used when the two variables being measured are independent and distributed separately. Independent samples are easiest to obtain when selecting participants by random sampling.

RESULT AND DISCUSSION

Research Data Description

In this study, an overview of the research variables in this study used a descriptive statistical table that shows the theoretical range, actual (actual) range, median, mean (mean) and standard deviation which can be presented in Table 4 below. :

Table 4. Respondent Description Pretest

Descriptive Statistics

	Kelas Kontrol	Kelas Eksperimen	Valid N (listwise)
N	42	41	41
Minimum	28.00	27.00	
Maximum	71.00	73.00	
Mean	551.905	563.902	
Std. Deviation	1.134.866	1.122.915	
Variance	128.792	126.094	

Table 4 contains descriptive statistics of the pretest scores. It can be seen that the number of samples in the control class is 42 students, while the number of samples in the experimental class is 41 students. The minimum pretest values for the control class and the experimental class were 28.00 and 27.00, while the maximum values were 71.00 and 73.00. These two data are similar, meaning that the initial abilities of the two classes are similar. Likewise, the average pretest score for the control class is 551,905, almost the same as the average pretest for the experimental class of 563,902. This shows that in nominal terms/quantity, there is no difference in initial ability between students in the control class and in the experimental class, although later a different average test will be carried out on the two data distributions, to ensure that statistically the two data groups are (pretest value data) have the same average.

By looking at Table 4, it is found that the standard deviation of the pretest and posttest values are 11,34866 and 11.22915, respectively. This value indicates that the distance between the scores of each student and the average. The two values represent almost the same number.

Table 5. Description Score Posttest

Descriptive Statistics

	Kelas Kontrol	Kelas Eksperimen	Valid N (listwise)
N	42	41	41
Minimum	56.00	59.00	
Maximum	83.00	81.00	
Mean	678.333	701.951	
Std. Deviation	760.589	620.572	

Table 5 contains descriptive statistics of the posttest scores. It can be seen that the number of samples in the control class is 42 students, while the number of samples in the experimental class is 41 students. The minimum posttest scores for the control and experimental classes were 56.00 and 59.00, while the maximum values were 83.00 and 81.00. These two data are similar, meaning that the initial abilities of the two classes are similar. Likewise, the average posttest score for the control class was 678,333, almost the same as the average pretest for the experimental class of 701,951. This shows that nominally / quantitatively, there is no difference in ability between students in the control class and in the experimental class, although later on, the average difference test will still be carried out on the two data distributions, to ensure that statistically the two data groups of data (pretest value data) have the same average.

By looking at Table 5, it is found that the standard deviation of the pretest and posttest values are 7.60589 and 6.20572, respectively. This value indicates that the distance between the scores of each student and the average. Both values are smaller than the standard deviation of the pretest scores, meaning that the level of student understanding is more evenly distributed, because the distance between each student's score and the average is getting closer.

Normality Test

The results of the normality test were obtained from the pretest and posttest scores for both the control class and the experimental class. From the test results using SPSS, the significance value is 0.223, respectively; 0.888; 0.257; 0.668. All of these four numbers are greater than 0.05, so it can be concluded that the four data groups are normally distributed.

Table 6. Homogenity Test

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Pretest	.002	1	81	.963
Hasil Belajar	1.100	1	81	.297

From the results of the homogeneity test of the pretest scores and learning outcomes using Levene Statistic as shown in Table 6, it was obtained data that the significance value (Sig.) was 0.963 and 0.297, respectively. This value is greater than 0.05, which means that the variance of the two classes being compared is not significantly different, so it can be concluded that the data is homogeneous.

Analysis Data

Because this study compares two different (unrelated) classes, namely between the control class (class C) and the experimental class (class B), the test that will be carried out is the free sample t test (independent t test).

Table 7. T-Test Score Pretest

			Pretest	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		.002	
	Sig.		.963	
t-test for Equality of Means	T		-.484	-.484
	Df		81	80.985
	Sig. (2-tailed)		.630	.630
	Mean Difference		-119.977	-119.977
	Std. Error Difference		247.861	247.829
	95% Confidence Interval of the Difference	Lower	-613.143	-613.081
		Upper	373.190	373.127

Based on Table 7 above, it is known that the value of Sig. Levene's Test for Equality of Variances is 0.963 > 0.05, which means that the data variance between the control class and the experimental class is homogeneous or the same (V. Wiratna Sujarweni, 2014: 99). So that the interpretation of the Independent Samples Test output table above is guided by the values contained in the "Equal variances assumed" table.

Based on Table 7 the "Independent Samples T Test" output in the "Equal variances assumed" section is known to be the Sig. (2-tailed) of 0.630 > 0.05, so as the basis for decision making in the independent sample t test, it can be concluded that H0 is accepted and Ha is rejected. Thus, it can be concluded that there is no significant (significant) difference between the average pretest scores of students in the control class and the experimental class. From the results of this test, it can be concluded that the students' initial abilities are the same.

Tabel 8. T-Test Score Posttest

			Hasil Belajar	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		1.100	
	Sig.		.297	
t-test for Equality of Means	T		-1.548	-1.552
	Df		81	78.546
	Sig. (2-tailed)		.126	.125
	Mean Difference		-236.179	-236.179
	Std. Error Difference		152.579	152.206
	95% Confidence Interval of the Difference	Lower	-539.763	-539.164
		Upper	.67405	.66807

Based on Table 8 above, it is known that the value of Sig. Levene's Test for Equality of Variances is 0.297 > 0.05, it means that the data variance between the control class and the experimental class is homogeneous or the same (V. Wiratna Sujarweni, 2014: 99). So that the interpretation of the Independent Samples Test output table above is guided by the values contained in the "Equal variances assumed" table.

Based on Table 8, the output of "Independent Samples T Test" in the "Equal variances assumed" section is known to be the Sig. (2-tailed) of 0.126 > 0.05, so as the basis for decision making in the independent sample t test, the decision was obtained that H0 was accepted and Ha was rejected. Thus, it can be concluded that there is no significant (significant) difference between the average posttest scores of students in the control class and the experimental class. This means that there is no difference in learning outcomes between classes that are taught with geogebra and without geogebra.

Furthermore, from the output table above, it is known that the "Mean Difference" value is -1.19977. This value shows the difference between the average student learning outcomes in the control class and the average student learning outcomes in the experimental class and the difference is -5.39763 to 0.67405 (95% Confidence Interval of the Difference Lower Upper).

The purpose of this study was to test whether there was an effect of learning using Android-based Geogebra software on the level of student understanding of the concept of circular geometry. In conducting this research, the researcher used a comparative analysis technique, namely the free sample t test. Based on the research data analyzed, a summary of the research results can be seen in the following research discussion.

From the free sample t-test analysis, it is known that the significance level is 0.297, which is greater than 0.05. This means that the learning outcomes of students who are given learning using geogebra are not different from the learning outcomes of students who are given conventional (conventional) learning.

The conclusion in this study is different from the results of research conducted by Martinez (2017) which tries to reveal whether the use of the Geogebra application has a positive influence on students' understanding of geometry in high school. Independent and paired sample t-tests were conducted to determine whether there was a significant difference between the scores of the treatment group and the scores of the control group on the math test module 5. Based on the results, students' scores increased when using the Geogebra application (treatment group). However, it was not statistically higher than the control group.

Meanwhile, the results of this study support the findings of Masri et al. in the Malaysian Journal of Society and Space Vol. 12 issue 7 (13 - 25) 2016. The results of the analysis show that there is no difference between the average score of student achievement in the experimental and control groups. However, experimental students showed positive attitudes towards using Geogebra software while studying the Circle III topic. This shows that not only this strategy can be used in learning mathematics but also in improving students' performance in learning mathematics for the long term.

Likewise, the results of this study are not in line with the findings of Jelatu et al. (Missio Journal of Education and Culture, No. 2, 2018: 162–171). Jelatu's conclusion shows that students' understanding of geometric concepts through Geogebra-assisted learning is better than students who are given ordinary/conventional learning. The second conclusion is that integrating Geogebra software can significantly improve geometry understanding in both domains (high and low spatial abilities).

Ekawati (Journal of Mathematics Education, No. 3, 2016: 148–153) suggests that Geogebra and Microsoft Mathematical software really helps teachers in conveying abstract mathematics material more easily because the software can visualize it, besides that this software was created to foster student creativity. and critical strength.

The research conducted by Dian Romadhoni Asngari is also not in line with the results of this study. Dian found that through various existing facilities Geogebra can make it easier for users to visualize abstract geometric objects quickly, accurately and efficiently. In addition, Geogebra can be used as a tool to construct mathematical concepts. With the Geogebra software, it is expected to be an alternative choice to help students learn geometry in an easy and fun way (Asngari, Papers, 2015).

Another research related to Geogebra that is not in line with this research is the research conducted by Isman M. Nur. He found that computer-assisted learning is very good to be integrated in learning mathematical concepts. Various computer programs have been developed and can be used in learning mathematics, one of which is Geogebra. Geogebra is a software that can visualize mathematical objects quickly, accurately, and efficiently. Geogebra can be used when starting to draw graphs and determining completion test points, as well as testing the optimum function at these points (Nur, Journal of Mathematics and Mathematics Education, No. 1, 2016).

Thus there is one study that is in line with the results of this study, namely the results of Masri et al., 2016 and seven studies that are not in line with this research, namely (Martinez, 2017; Nur, 2016; Asngari, 2015; Purwanti et al., 2016; Jelatu, 2018; Oktaria, 2016; Ekawati, 2016).

In general, the results of these different studies indicate that there are several factors that need to be considered by teachers in using software assistance, so that their use becomes effective. Among them are the completeness of tools/menus, friendly to use (easy to use) not complicated, software must be efficient in mathematical calculations. If a software can be run by all people who are just learning and experts, the element of convenience in terms of mathematical calculations will make the software liked by many people. If a software is liked, it will be able to attract students to use it in learning so as to increase understanding as evidenced by increased learning outcomes.

CONCLUSION

From the results of the analysis and discussion above, it can be concluded that from the free sample t-test analysis, it is known that the significance level is 0.297, which is greater than 0.05. This means that the learning outcomes of students who are given learning using geogebra are not different from the learning outcomes of students who are given conventional (conventional) learning. It is hoped that in future researchers, in addition to using the Geogebra application, modifications of strategies and learning models are also needed in the implementation of learning in the classroom.

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