THE EFFECTIVENESS OF PROBLEM-BASED LEARNING MODEL ASSISTED BY GEOGEBRA TOWARDS STUDENT'S MATHEMATICS ACHIEVEMENT OF SOLID GEOMETRY FOR 10th GRADE STUDENTS

Sri Elissa Febrianti[a],Sunaryo[b]
Program Studi Pendidikan Matematika Universitas Ahmad Dahlan
Jalan Ring Road Selatan, Tamanan, Banguntapan, Bantul, Yogyakarta
[a]srielissafebrianti@gmail.com, [b]sunaryo.bener@yahoo.co.id

ABSTRACT

The use of fewer media to explain material resulted in students is less active when the learning process so that students have difficulty understanding material. This is guessed to be one of the factors of mathematics student's value is low. This research is intended to know (1) whether or not differences in mathematics learning outcomes by using GeoGebra assisted problem-based learning model with a direct learning model, and (2) to know the effectiveness of two models on the learning outcomes of X class Of SMA Muhammadiyah 5 Yogyakarta In Academic Year Of 2016/2017. The population of this research is students of X classes of Muhammadiyah Senior High School 5 Yogyakarta (SMA Muhammadiyah 5 Yogyakarta) in the academic year 2016/2017. Samples were taken by random sampling technique to class, to get XF as experiment class and XB as control class. This experiment design is a post-test only control design. The data get from the post-test result in the description. Analysis of test instrument use validity test and reliability test. The analysis technique consists of (1) test of requirement: test of normality and test of homogeneity, and (2) test of hypothesis. Test of hypothesis use statistics test of t-student. Hypothesis testing is done two times; the first hypothesis and the second hypothesis. The result on significance is 5%, and df = 62 showed that: (1) there were differences in mathematics learning outcomes using GeoGebra assisted problem-based learning model with a direct learning model. It is showed by t_{count} = 5,031541 and t_{table} = 1,999. So that t_{count} = 5,031541 > t_{table} = 1,999, (2) problem-based learning model more effective than direct learning model to learning outcomes of the student. It is showed by t_{count} = 5,031541 and t_{table} = 1,670. So that t_{count} = 5,031541 > t_{table} = 1,670.

Keywords: Problem Based Learning Model, Direct Learning Model, Geogebra, Mathematics Learning Outcomes

INTRODUCTION

Based on the Law of the Republic of Indonesia Number 20 of 2013 concerning the National Education System says: Education is a conscious and planned effort to realize learning and learning processes so that students actively develop the potential needed to increase spiritual strength, move, wander around, care, challenge, morals noble and intelligence that is needed, society, nation, and country. By the above resolution, learners' potential can be developed with a learning process that uses appropriate learning strategies and models. Successful learning successfully achieves the expected results. According to Reiguleth (in Khodijah, 2014), various learning outcomes are depending on the model or theory used., Educators need to develop models, plans, or patterns that are used as directions in learning.

Various types of learning models that can be applied in the learning process, one of which is problem-based learning (PBL). Based on Tan (in Amir, 2015): problem-based learning has characteristics such as learning that starts with the help of problems. Usually, problems related to the real world, students in groups actively formulate problems, consult with the help of research, find out for themselves material related to the problem, and report the solution to the problem. Problems with PBL are not the same as ordinary problems like questions for discussion. According to Amir (2015: 23), in a discussion, questions raised for students who are connected with the material related. At the same time, problems in PBL require an explanation of a phenomenon.

In addition to using an appropriate learning model, instructional media also supports the learning process. Various types of media can be used in the learning process; one of these media is computer-based learning media using Geogebra software. Geogebra is a software that supports mathematics learning. According to Fahmi (2014: 1), Geogebra is referred to as Dynamic Mathematics

for Schools, meaning that it is a software for doing dynamic math in schools. Geogebra can connect variables to numbers, vectors, and points. On October 20, 2016, an interview was conducted with one of the teachers at SMA Muhammadiyah 5 Yogyakartawho taught mathematics, Mr. Heri Setiawan, S.Sc. The interview was conducted to study the implementation of learning in schools. This teacher teaches mathematics learning in the classroom using a direct learning model in the form of lectures, questions and answers, assignments, and discussions that are carried out varies. Also, the use of Geogebra as a learning medium is still not used in the learning process.

Interviews were also conducted with some students of SMA Muhammadiyah 5 Yogyakartawho obtained information about most students saying that mathematics in special three-dimensional material was complicated. This causes students not to understand the concepts and principles of the material being studied. Some students had difficulty because there were no teaching aids or electronic media that could be used to clarify the material presented. Based on observations made on October 17, 2016, obtained information about the majority of students who have not reached the MMC value of 70. As in Table 1

Table 1. Results of the second semester Joint Repetition assessment 2016/2017 school year mathematics subjects

No	Class	Total students	Score Percentage	
			≥ 70	**< 70**
1.	XA	32	0%	100%
2.	XB	31	0%	100%
3.	XC	32	12,5%	87,5%
4.	XD	31	0%	100%
5.	XE	31	3,23%	96,77%
6.	XF	33	6,06%	93,94%

The objectives to be achieved in this study are:

1. To determine whether or not there are significant differences in mathematics learning outcomes of three-dimensional geometry material between students using GeoGebra-assisted problem based learning models and direct learning models in class X of the 2016/2017 school year.
2. To discover the effectiveness of Geogebra-aided problem-based learning models with direct learning models to the learning outcomes of mathematics in three-dimensional material in class X students of SMA Muhammadiyah 5 Yogyakarta 2016/2017 school year.

While this research hypothesis is:

1. There is a significant difference between mathematics learning outcomes of three-dimensional material in students who use Geogebra-assisted Problem Based Learning (PBL) models and those who use direct learning models.
2. Learning using the Geogebra-assisted Problem Based Learning (PBL) model is more effective in learning outcomes of mathematics in three-dimensional material in students than learning with direct learning models.

METHODS

This type of research is quantitative research by applying the Geogebra-assisted problem-based learning model. The place of research is Muhammadiyah 5 Yogyakarta High School. At the same time, the research was conducted in the even semester of the 2016/2017 school year. The population of this study was all students of class X of SMA Muhammadiyah 5 Yogyakartain the 2016/2017 academic year consisting of 6 classes, namely XA, XB, XC, XD, XE, and XF with a total of 190 students. Sampling uses a simple random sampling technique for the class. The random sampling results obtained XF class as an experimental class (using Geogebra-assisted problem-based learning models) and XB class as a control class (using direct learning models). This experimental design uses the form of an actual

experimental design with the type of posttest-only control design. The research design used can be seen in Table 2 as follows.

Table 2. Research Design

Group	Treatment	Learning Outcomes Test (Post-test)
Experiment	X_1	O_1
Control	X_2	O_1

(Sugiyono, 2015:112)

The methods used for data collection are test and documentation techniques. The documentation technique was used to obtain data on students' names and the results of the Joint Examination with X grade students in even semester mathematics subjects. The test technique is used to evaluate student learning outcomes after the learning process. The tests included initial ability tests and post-tests in essay questions on the three-dimensional material of Muhammadiyah 5 Yogyakarta High School.

Before being given treatment, each sample class is given an initial ability test to obtain students' initial ability data. Testing the test instrument of learning outcomes (post-test) using the validity test and reliability test. According to Sugiyono (2015:182), testing the validity of constructs is based on relevant theories. Technically, testing the construct validity can be assisted by using the instrument lattice. There are variables examined in the grid, indicators as benchmarks, and item number questions that have been translated from the indicators. A validity test is done by asking for expert opinion, namely, Drs. Sunaryo, M.Pd as a validator.

According to Arikunto, Suharsimi (2013: 100) states that a test can be said to have a high level of confidence if it can provide permanent results. The understanding of the test's reliability is related to the problem of the determination of the test results. The reliability testing of the instruments in this study will be carried out using the Cronbach Alpha coefficient technique. Data analysis is directed to answer the problem formulation or test the hypothesis that has been formulated and then conclusions drawn. Before testing hypotheses, prerequisite tests need to be done. Two prerequisite tests must be met, namely the normality test and the homogeneity test. Then the data were analyzed using a t-test.

RESULTS AND DISCUSSION

The initial analysis is needed to determine the initial state of the two samples. The data used in the initial analysis is the value of the results of the initial ability test given to the experimental class, the control class, and the test class.

The normality test aims to determine whether the experimental class and control class students' initial mathematical ability is usually distributed or not—the calculation of normality test using the chi-square test statistic (χ^2). The summary of the analysis results of the normality of students' initial mathematical abilities can be seen in the following table 3.

Table 3. Summary of the results of the initial ability normality calculation

Group	χ^2_{count}	χ^2_{table}	df	Information
Experiment	1,408714	7,8147	3	Normal distribution
Control	3,564208	7,8147	3	Normal distribution

A homogeneity test is performed to determine whether the sample used has a homogeneous variance or not. Homogeneity testing for initial ability tests uses the chi-square test statistic (χ^2). A summary of the homogeneity test calculation results on the initial ability test can be seen in Table 4.

Table 4. Summary of the results of the initial ability homogeneity calculation

Learning	S_i^2	χ^2_{count}	χ^2_{table}	Info.
Experimentation Class	338,1921	-275,129	3,8415	Homogeneous data
Control class	106,5024			

Student mathematics learning outcomes are obtained from tests given to the experimental class and the control class. The test is given in the form of a description of 5 questions. The prerequisite test analysis is the test for normality and homogeneity. Then the hypothesis test is conducted, consisting of the first hypothesis test and the second hypothesis test.

The normality test aims to determine whether the value of mathematics learning outcomes of three-dimensional material in the experimental class and the control class has a normal distribution. The calculation of the normality test uses the chi-square test statistic (χ^2). The summary of the results of the analysis of the normality of student mathematics learning outcomes can be seen in Table 5.

Table 5. Summary of the results of the calculation of the normality test scores of mathematics learning outcomes

Class	χ^2_{count}	χ^2_{table}	df	Information
Experiment	1,296747	5,9915	2	Normal distribution
Control	3,329166	7,8147	3	Normal distribution

A homogeneity test is performed to determine whether the sample used has a homogeneous variance or not. Homogeneity testing of students' mathematics learning outcomes uses the chi-square test statistic (χ^2). A summary of the results of the homogeneity test calculation scores on mathematics learning outcomes of three-dimensional material in students can be seen in Table 6.

Table 6. Summary of the results of the homogeneity test calculations the value of mathematics learning outcomes

Learning	S_i^2	χ^2_{count}	χ^2_{table}	Info.
Experimentation Class	111,936	-244,519	3,8415	Homogeneous data
Control class	96,432			

a. First Hypothesis Test

The first hypothesis test was conducted to determine whether there are differences in the value of mathematics learning outcomes between experimental class students (XF) and control class students (XB). The null hypothesis (H_0) and its comparison (H_1) for the first hypothesis test are as follows:

H_0: there is no difference between mathematics learning outcomes of three-dimensional material between students who use Geogebra-assisted problem based learning models and those who use direct learning models in class X SMA Muhammadiyah 5 Yogyakarta2016/2017 academic year.

H_1: there is a difference between mathematics learning outcomes of three-dimensional material between students who use Geogebra-assisted problem based learning models and those who use direct learning in class X SMA Muhammadiyah 5 Yogyakarta 2016/2017 school year.

The summary of the results of the first hypothesis test of the mathematics learning outcomes test scores of three-dimensional material in experimental class (XF), and control class (XB) students can be seen in Table 7.

Table 7. Summary of the results of the first hypothesis test the value of mathematics learning outcomes

t_{count}	t_{table}	df	Info.
5,031541	1,999	62	H_0 rejected

Based on the analysis results on the first hypothesis test with a significance level of 5% and a degree of freedom 62, the value of $t_{count} = 5{,}031541$ and $t_{table} = 1{,}999$ was obtained. Because $t_{count} = 5{,}031541 > t_{table} = 1{,}999$, H_0 is rejected and H_1 is accepted. So, it can be concluded that there are differences in mathematics learning outcomes of three-dimensional material between students who use Geogebra-assisted problem based learning models and those who use direct learning models in class X SMA Muhammadiyah 5 Yogyakarta 2016/2017 academic year.

b. Second Hypothesis Test

The second hypothesis test is conducted to determine which learning model is more effective than the two learning models used.

The null hypothesis (H_0) and its comparison (H_1) for the first hypothesis test are as follows:

H_0: learning using a Geogebra-assisted problem-based learning model is no more effective than learning that uses direct learning in three-dimensional material in class X SMA Muhammadiyah 5 Yogyakarta 2016/2017 school year.

H_1: learning using a Geogebra-assisted problem-based learning model is more effective than learning using a direct learning model of three-dimensional material in class X SMA Muhammadiyah 5 Yogyakarta 2016/2017 school year.

The summary of the second hypothesis test results from the mathematics learning achievement test scores of the experimental class (XF) and control class (XB) students can be seen in Table 8.

Table 8. Summary of the results of the second hypothesis test the value of mathematics learning outcomes

t_{count}	t_{table}	df	Info.
5,031541	1,670	62	H_0 rejected

Based on the results of the analysis conducted on the second hypothesis test with a significance level of 5% and a degree of freedom 62, the value of $t_{count} = 5{,}031541$ and $t_{table} = 1{,}670$ was obtained. Because $t_{count} = 5{,}031541 > t_{table} = 1{,}670$, then H_0 is rejected and H_1 is accepted. It can be concluded that learning by using a problem-based learning model assisted by Geogebra is more effective than learning that uses direct learning models in the material of three-dimensional dimensions of class X SMA Muhammadiyah 5 Yogyakarta 2016/2017 school year.

CONCLUSION

Based on the research that has been done as a result of the research described previously, the research conclusions can be drawn:

1. There are differences in mathematics learning outcomes of three-dimensional material between students who use Geogebra-assisted problem based learning models and those who use direct learning models in class X of SMA Muhammadiyah 5 Yogyakartain 2016/2017 school year. This is indicated by the results of the first hypothesis test with a significance level of 5% and a degree of freedom 62 obtained the value of $t_{count} = 5{,}031541$ and $t_{table} = 1{,}999$. So that $t_{count} = 5{,}031541 > t_{table} = 1{,}999$.
2. Learning using the Geogebra-assisted problem-based learning model is more effective compared to learning that uses direct learning in the three-dimensional class X material of SMA Muhammadiyah 5 Yogyakarta in the 2016/2017 school year. This is indicated by the results of the second hypothesis test with a significance level of 5%, and a degree of freedom 62 obtained $t_{count} = 5{,}031541$ and $t_{table} = 1{,}670$. So that $t_{count} = 5{,}031541 > t_{table} = 1{,}670$..

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