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The Effect of Using Cabri 3D Software on Students' Ability to Understand Mathematical Concepts

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Abstract

Understanding mathematical concepts is a very important ability in learning mathematics. With the ability to understand concepts, students will more easily learn what the teacher teaches, with this ability students can also express it again in their own language and with the same meaning. The aim of this research is to find out whether the use of Cabri 3D software affects students' ability to understand mathematical concepts. This research was carried out at SMPIT Al-Halimiyah Jakarta for the 2022/2023 academic year. This research includes quantitative research using quasi experimental design. The sample for this research was 59 students, with 30 students in class VIII-1 using cabri 3d software (experimental class), and 29 students in class VIII-3 using the conventional approach (control class). The sample selection for this research was carried out using cluster random sampling. The research results showed that students experienced a significant increase in the use of Cabri 3D software. Thus, it can be concluded that there is an influence of Cabri 3D software on students' ability to understand mathematical concepts in flat-sided geometric material.

Keywords: Cabri 3D software, Learning media, Understanding mathematical concepts.

1 INTRODUCTION

The ability to understand concepts is one of the learning objectives that is very important in the learning process, including students' understanding of mathematics lessons. Students' difficulties in understanding the material presented by the teacher will greatly influence the learning process, especially in mathematics lessons. According to Susanto (2016), mathematics is a scientific discipline that can improve thinking and argumentation skills, contribute to solving daily problems and in the world of work, as well as providing support in the development of science and technology. Mathematics is an exact and systematically organized branch of science; Mathematics is the knowledge of numbers and calculations; Mathematics is the knowledge of logical reasoning and has something to do with numbers; Mathematics is the knowledge of quantitative facts and problems about space and shape; Mathematics is knowledge of logical structures; Mathematics is knowledge related to strict rules (Nurhayanti, Hendar, & Wulandari, 2021). The aim of learning mathematics at school is so that students are not only skilled in using mathematics, but can provide provisions for students by emphasizing understanding of mathematical concepts. Learning mathematics is a requirement to continue your education to the next level. Because by studying mathematics, we will learn to reason critically, actively and creatively. Mathematics are abstract ideas that contain symbols, so mathematical concepts must be understood first. However, until now there are still many students who experience difficulties in the learning process, mathematics is also

considered a difficult, boring and unpleasant subject. According to Mashuri (2019), mathematics is a universal science that has an important role in various scientific disciplines and the development of human thinking power, as well as underlying the development of modern technology. According to Zahra, Mazlan, and Zaiyar (2020), students' ability to understand concepts can be seen in students' ability to find, explain, translate and conclude a mathematical concept based on their own abilities, not just memorizing. Most students experience difficulties in the learning process, even on simple material. This proves that there are still many students who experience difficulties in learning mathematics because students have not mastered the ability to understand concepts and students are only encouraged to memorize and use formulas, so that when applying a mathematical concept, they cannot apply it well.

Apart from improving students' ability to understand concepts in mathematics learning, teachers are also expected to be able to optimize their abilities to improve students' ability to understand concepts through more varied media or learning models. With today's developing technology, teachers can innovate in implementing the learning process. Based on the results of observations, it is known that there are still many learning activities carried out in conventional ways so that students easily get bored while following lessons even though multimedia devices are fully available in the classroom. This can be seen from the lack of ability to understand concepts in mathematics material which causes students' mathematics learning outcomes to be low when compared to other subjects. According to Regulation of the Director General of Basic Education, Ministry of National Education Number 506/C/Kep/PP/2004 dated 11 November 2004, that indicators of understanding mathematical concepts include: Restate a concept; Clarifying objects according to certain properties in accordance with the concept; Provide examples and non-examples of a concept; Presenting concepts in various forms of mathematical representation; Developing necessary or sufficient conditions of a concept; Using and utilizing and selecting certain procedures or operations; Apply concepts or algorithms to problem solving.

One way to improve students' ability to understand mathematical concepts is by using learning media. The use of mathematics learning media is necessary so that students have a more interesting and varied learning experience in mathematics learning. Some software that can be used as a mathematics learning medium include Geogebra, Autograph, Cabri 3D, Maple, Carmetal, and Geometer's Sketchpad. According to Akhirni and Mahmudi (2015), Cabri 3d has many menu icons that can be used to study Al-gebra, Analytical, Geometry and Trigonometry material. The Cabri 3D program has 6 menus including file, edit, display, document, window, and help. According to Rososzczuk (2015) Cabri 3D is a software which connects geometry and algebra to enable measuring length, distance, area, angles, scalar product, volume and use them in calculations or in algebraic expressions. The software used in this research is Cabri 3D software.

Apart from being easy to understand and use, Cabri 3D software also has an attractive appearance so that it can attract students' interest in learning. According to Kösa and Karakuş (2010) Cabri 3D software is one of the Dynamic Geometry Software (DGS) which is used to explore three-dimensional geometry and is computer software that can display variations of three-dimensional geometric shapes, providing facilities for exploration, investigation, interpretation and solving mathematical problems quite interactively. Cabri 3D software also has advantages in visualizing spatial concepts. Cabri 3D software is a change in position of spatial shapes that can rotate so that students can see all parts of the shape which is also equipped with color effects that can be changed as desired to further clarify the material being presented. As a result, this can increase students' conceptual understanding of three-dimensional material, especially distance in space. According to Hendriana (2019), 3D cabri has several advantages and according to Chen et al. (2021), 3D cabri also has disadvantages. Disadvantages of Cabri 3D software: (a) The measurement still lacks accuracy because it uses

decimals, (b) Poor originality and sensitivity. While, the advantages of Cabri 3D software: Can do algebraic computations; Can do analysis; Can work on various mechanical and optical (physical objects); Has many built-in commands in libraries and packages for extensive mathematical work; Has facilities for working on plotting and animation for graphics in both 2nd and 3rd dimensions; Has a worksheet-based interface; Has facilities to create documents in various formats; Has programming language facilities that make it easier for students to understand concepts; Very good for training students' fluency, flexibility and detail; The sketch results are better than using Autograpsh and Maple.

2 RESEARCH METHODS

This research uses an experimental method with a quasi experimental design with the aim of finding out differences in students' ability to understand mathematical concepts between after and before using Cabri 3D software. This research was carried out at SMPIT Al-Halimiyah Jakarta in the 2022/2023 academic year with 1 class of the research sample being class VIII. With the post test only design in Sugiono (2017) it can be seen at Table 2.

Table 1. Research Plan

Class	Treatment	Posttest
Experiment	X	O_2
Control	-	O_2

Note: X= Research treatment using Cabri 3D software, O_2= Final test (posttest)

The research population in this study was all class VIII of SMPIT Al-Halimiyah Jakarta for the 2022/2023 academic year. The samples taken in this research were students from class VIII 1 as the control class and class VIII 3 as the experimental class where there were 30 students in the experimental class and 29 students in the control class. Sampling in this study used cluster random sampling. This technique is carried out by randomly selecting members from the population. Data collection in this research uses a test in the form of essay questions which are indicators of the ability to understand mathematical concepts. There are 8 questions. The instruments that will be used are valid instruments and will be distributed in the research sample. There are three criteria for a good research instrument, namely: validity, reliability, and practicability.

3 RESULT AND DISCUSSION

The results of this research are test score data on the ability to understand mathematical concepts. Students with the application of 3D cabri software in the experimental class and conventional learning in the control class. The score for students' ability to understand mathematical concepts is obtained from the post test results.

Students who applied Cabri 3D software got an average score = 85,1; median = 85,7; mode = 86,9; variance = 66,241; standard deviation = 8,1389; highest value = 100; lowest score = 67. Data on the ability to understand mathematical concepts in the experimental class can be presented in the form of a histogram and polygon as in Figure 1.

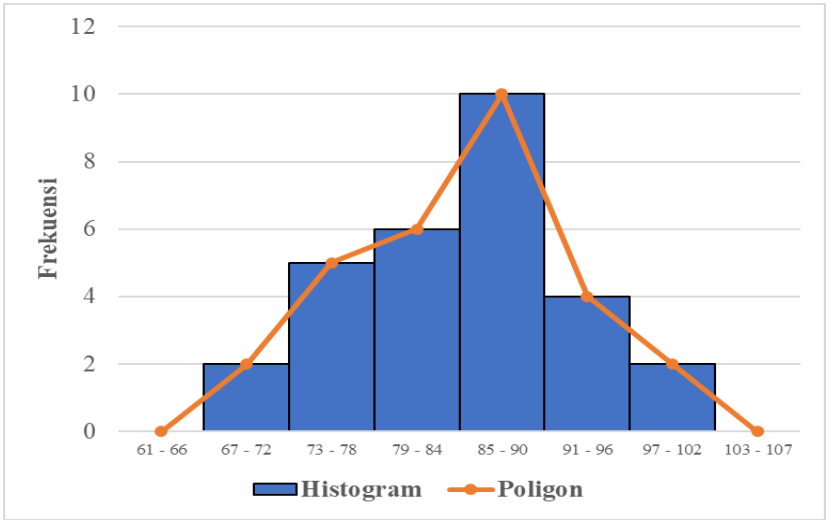


Figure 1. Histogram and Polygon Graph for Experimental Class

Students with conventional learning got an average score = 70,38; median = 71,55; mode = 73,6; variance = 110,2354; standard deviation = 10,4993; highest score = 90; Lowest score = 50. Data on the ability to understand mathematical concepts in the control class can be presented in the form of a histogram and polygon as in Figure 2.

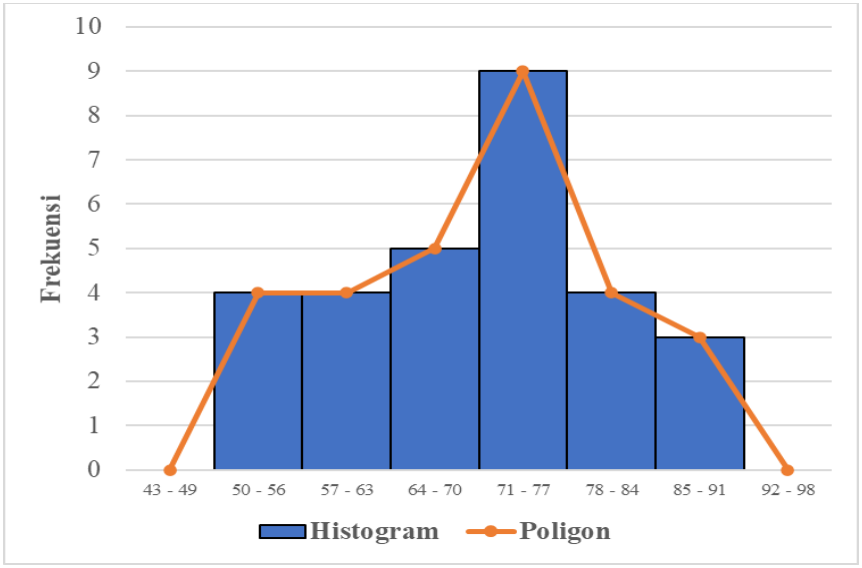


Figure 2. Histogram and Polygon Graph for Control Class

Before carrying out a hypothesis test, first carry out prerequisite tests, namely the normality test and homogeneity test.

3.1 Normality Test

The normality test aims to determine whether the experimental class test score data and control class test scores have a normal frequency distribution or not. Normality testing using the Liliefors test. The results of normality testing can be seen in Table 2.

Table 2. Normality Test Results

Group	N	Test Statistics			Conclusion
		α	L_{count}	$L_{table\ (\alpha=0.05)}$	
Experimental Class	30	0.05	0.0981	0.161	Normally Distributed
Control Class	29	0.05	0.1401	0.164	Normally Distributed

Based on the table above, it is known that the Liliefors test for experimental class test scores obtained L_{count}=0.0981 and L_{table}=0.161 at the significance level α=0.05 and N_E=30. Because L_{count}=0.0981<0.161=L_{table}, it can be concluded that the experimental class test scores are normally distributed. Meanwhile, for the Liliefors test calculation results, the control class test values obtained L_{count}=0.1401 and L_{table}=0.164 at the significance level α=0.05 and N_C=29. Because L_{count}=0.1401<0.164=L_{table}, it can be concluded that the experimental class test scores are normally distributed.

3.2 Homogeneity Test

The homogeneity test aims to determine whether the value data from the experimental class and control class are homogeneous or not. The homogeneity test in this study used the *F*-test. The results of calculating the *F* values are in Table 3.

Table 3. The homogeneity test

Class	Variance	*df*	F_{count}	F_{table}	Conclusion
Experiment	66,241	29	1.664	1.875	Homogeneous
Control	110,2354	28			

F_{table} at a significance level of 5% with 29 degrees of freedom in the numerator and 28 degrees of freedom in the denominator is 1.875 compared to F_{table} obtained F_{count}<F_{table} so it is said that the values from the experimental class and control class are homogeneous

3.3 Test the hypothesis

After testing the prerequisites of the analysis, namely the normality test and homogeneity test are met, the next step is to test the statistical hypothesis. The technique used to test hypotheses is a parametric statistical formula with a *t*-test test based on normality and homogeneity tests. The results of hypothesis testing can be presented in Table 4.

Table 4. Hypothesis Test Results

Group	Mean	N	S^2	t_{count}	t_{table}
Experiment	83.1	30	66.241	6.031	1.671
Control	70.38	29	110.2354		

Based on the results of the analysis of the value of the experimental class and the control class, it is known that the value of t_{count}=6.031>1.671=t_{table}, so it can be stated that there is an influence of Cabid 3D software on the ability to understand mathematical concepts in the flat side room building material of class VIII SMPIT Al-Halimiyah Jakarta.

3.4 Discussion of findings

The results of the prerequisite test prove that the experimental class and the control class are from a normally distributed population and have the same or homogeneous variance. The hypothesis test shows that the values and results show that the hypothesis is rejected and accepted, meaning that there is an influence between 3D cabri software and the ability to understand students' mathematical concepts. This influence can also be seen from the

difference in the results of the students' comprehension of mathematical concepts test in the experimental class who obtained the highest score of 100 and the lowest score of 67, while in the control class who obtained the highest score of 90 and the lowest score of 50. The existence of a control class as a comparison reinforces that learning mathematics using 3D cabri software is more effective. This is in line with the results of research Hendriana (2019) that Cabri 3D Software is not only for presenting mathematics geometrically but can build mathematical knowledge by bringing up shapes that resemble the authenticity of the space building, with the help of Cabri 3D Software can help teachers and students overcome difficulties in learning to build space and can make the learning process easier and interesting, because Cabri 3D Software can visualize three-dimensional objects well, even allowing us to manipulate and see them from various directions. Cabri 3d software also helps students in developing spatial skills.

Based on the acquisition of data from the post math test, there is an influence of 3D cabri software on the ability to understand students' mathematical concepts. Thus, this study succeeded in proving the research hypothesis proposed that there is an influence of 3D cabri software on the ability to understand students' mathematical concepts in the flat side room building material of class VIII SMPIT Al-Halimiyah Jakarta.

3 CONCLUSION

Based on the results of post-test data analysis, the ability to understand mathematical concepts was obtained that there was a difference in the average score on students' understanding of mathematical concepts, students' understanding of mathematical concepts in the flat-sided room building material of experimental classes using 3D cabri software was higher than the understanding of mathematical concepts of control class students using conventional learning models. The results of hypothesis testing using the t-test obtained a value , so it was rejected accepted. Thus, the conclusion of the results of this study shows that there is an influence of 3D cabri software on the ability to understand concepts in flat side space building material.

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