Analysys of the impact of mathematical learning with geogebra assistance on critical thinking ability

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Abstract. This study aimed to analyze the impact of mathematics learning assisted by geogebra software on students' critical thinking skills. This research was an experimental research with a quantitative approach. There were two groups of samples used, namely the experimental group with learning assisted by geogebra software, and the control group with learning without using geogebra software. The population in this study were students of class VIII Junior High School 2 Banda Aceh with students of class VIII-2 as an experimental class and VIII-8 as a control class. The instruments used were pre-test and post-test critical thinking skills. Data analysis techniques using non-parametric statistics with Mann-Whitney test and analyzed with SPSS statistics 22 software. The results showed that mathematics learning assisted by geogebra software has an impact on increasing students' critical thinking skills.

Keywords : Critical Thinking Ability, Software Geogebra

1. Introduction

Critical thinking is a very important ability to be possessed by every student, as expressed by[1], if critical thinking skills are not developed since childhood, then most likely mathematical abilities will not mature in adolescence and adulthood later. Even critical thinking has been made as to the most important ability possessed by every individual in the 20th century [2]. Critical thinking is an individual's ability to interpret arguments, analyze arguments, and evaluate arguments, so as to make a logical conclusion. This is also expressed by [3] which stated that critical thinking is an individual's ability to interpret, evaluate and arrange judgments about the adequacy of arguments, data, so they can draw conclusions. However, it is not easy to do because abstract concepts are very inherent in mathematics, even one of the problems of learning mathematics is the difficulty of finding and visualizing abstract concepts [4]. So that it requires the use of multimedia that has been highly developed in today's era, even the NCTM (National Council of Teachers of Mathematics) also revealed that the use of technology is one of the six principles in mathematics learning "Technology is essential in teaching and learning mathematics; It influences the mathematics that is taught and enhances students' learning " [5], Besides, the use of technology in learning can increase learning interest and enthusiasm of students who tend to feel bored in learning mathematics [6]. Previous researches also stated that the use of technology is useful as a tool to support teaching and learning, especially for mathematics [7]
One of the technologies that can be applied in the process of learning mathematics is Geogebra Software. It is an abbreviation of Geometry and Algebra which is a mathematical software that can be used as a medium in conveying mathematics subject matter, especially in geometry, algebra, and calculus. Mathematical learning with GeoGebra software can help students visualize, discover, formulate concepts, procedures, mathematical formulas that are abstract, this is in line with what was expressed by [8] namely learning by using GeoGebra to make objects in mathematics which is abstract can be seen clearly. Geogebra software has also been proven to be very helpful and effective in learning mathematics [9]. Besides learning mathematics, specifically relating to geometry using dynamic geometry software can help students improve their understanding of the definition of geometry concepts [10], such as Software Geogebra that is used for topics related to geometry [11].

2. Method

This research was an experimental research with a quantitative approach, which aimed to determine the impact of critical thinking skills through learning using GeoGebra software. There were two groups of samples used in this study, namely the experimental group with learning assisted by GeoGebra software, and the control group, which was taught without using GeoGebra software. the population in this study was eighth-grade students of Junior High School 2 Banda Aceh.

The sample selection method used was random sampling, class VIII-2 was selected as the experimental group and class VIII-8 as a control group. The research instrument used was a matter of pre-test and post-test critical thinking skills guided by 4 indicators that would be measured, including (a) Interpretation, namely, making Interpretation, and explaining the meaning of a problem (b) Analysis of Categorizing, checking the truth and sort out the information that is there to get a relationship and find the focus of the problem (c) Evaluation, namely providing a comprehensive assessment of the quality of truth or error of an argument, procedure and information found and provide solutions to problem-solving (d) Explanation, namely explaining the truth or error of an argument logically and based on facts to be able to describe the impact of mathematics learning assisted by GeoGebra software on students' critical thinking skills, then data from the pre-test, post-test, and N-Gain scores would be analyzed using SPSS statistics 22 software.

3. Result and Discussion

The data used in this study were data that researchers had collected through the results of the pre-test, post-test and N-Gain scores in the experimental class and the control class. The data collected were analyzed using SPSS statistics 22 software. The following is a description of the results of research data processing.

| Table 1. Descriptive data of research results | N | Minimum | Maximum | Mean | Std. Deviation |
|---------------------------------------------|---|---------|---------|------|---------------|
| Pree-test Experimen                          | 28 | 31,25   | 81,25   | 54,68| 14,19         |
| Post-test Experimen                          | 28 | 62,50   | 93,75   | 83,25| 9,77          |
| Pree-test Control                            | 28 | 18,75   | 81,25   | 48,21| 19,08         |
| Post-test Control                            | 28 | 37,50   | 81,25   | 58,25| 14,93         |
| Valid N (listwise)                           | 28 |         |         |      |               |
Table 1 shows that the average value and standard deviation of the experimental pre-test data were 54.68 and 14.19 respectively. The average value and standard deviation of the experimental class were 83.25 and 9.77, respectively the average and standard deviation of the control class post-test data were 48.21 and 19.08, while the mean and standard deviation of the post-test class data were 58.25 and 14.93.

Pre-test, post-test and N-Gain scores that had been collected were through normality test first. Based on the results of statistical tests through SPSS statistics 22 software, it can be concluded that the pretest, posttest and N-gain data were not normally distributed. The test results can be seen in Table 2 below.

| Class            | Statistics | Sig.  | Information   |
|------------------|------------|-------|---------------|
| Pre-test Experimen | 0.951      | 0.213 | Normal        |
| Pre-test Control  | 0.892      | 0.007 | Not Normal    |
| N-Gain Experimen  | 0.945      | 0.152 | Normal        |
| N-Gain Control    | 0.883      | 0.005 | Not Normal    |

Table 1 shows that the value of sig. from the pre-test score of the experimental class was > significance level is 0.213 > 0.05 so that the experimental class data were normally distributed, while the pre-test scores in the control class have sig values. 0.007 with sig. < significance level that is 0.007 <0.05 so that the data were not normally distributed, then the test of the difference in the average pre-test score used nonparametric analysis with the Mann-Whitney test. Sig value from the experimental N-Gain score 0.945, sig. > the significance level was 0.945> 0.05 so that the N-gain experimental data were normally distributed, while the N-Gain score in the control class has a sig value. 0.005 with sig. <significance level that is 0.005 <0.05 so that the data were not normally distributed, the N-Gain score difference test used a nonparametric analysis with the Mann-Whitney test.

3.1. Average difference test

To find out if there were differences in the initial ability of the experimental class and the control class, an average difference of the experimental and the control class pre-test was carried out. The difference test in the pre-test average score used in this study was the Mann-Whitney test, this test was used because the data were not normally distributed so it must use nonparametric analysis. The results of statistical testing through SPSS statistics 22 software can be seen in Table 3.

| Class    | Mann-Whitney | Sig. (2 tailed) | Conclusion | Information   |
|----------|--------------|-----------------|------------|---------------|
| Experimen | 298,500      | 0.123           | Accep H0   | No difference |
| Control  |              |                 |            |               |

Test results of the average difference at the significance level = 0.05 indicated that the value of sig. > Significant level was 0.123> 0.05, so there was no difference in the average pre-test scores of students' critical thinking skills in both classes, and it can be concluded that students in both classes have the same critical thinking skills.
3.2. N-gain score difference test

The N-gain score difference test used aiming to determine the impact of students' critical thinking skills after being given treatment with the help of GeoGebra software, the results of statistical testing through the SPSS statistics 22 software can be seen in Table 4 below.

| Class   | Mann-Withney | Sig. (2 tailed) | Conclusion | Information |
|---------|--------------|----------------|------------|-------------|
| Experimen | 17,000       | 0,000          | Reject H0  | Difference  |
| Control  |              |                |            |             |

Table 3 shows that the test results of differences in the n-gain score at the significance level = 0.05, namely the sig value < significant level that is 0.00 < 0.05 so that the increase in the ability to think critically students in the experimental class is better than students in the control class. This showed that there were no other variables that affected the improvement of students' critical thinking skills in the experimental class. It can be concluded that the discovery learning model assisted by GeoGebra software can improve the critical thinking skills of students in class VIII of Junior High School 2 Kota Banda Aceh on prism and pyramid material.

Increasing students' critical thinking skills through learning mathematics assisted by GeoGebra software is influenced by several activities of teachers and students in learning such as, learning activities carried out by the teacher through the presentation of prism drawings and their types, pyramid and their types to guide students to interpret, analyze, explain, and evaluate the properties possessed by both geometrical spaces. In addition, GeoGebra software-assisted activities conducted by the teacher guided students to explore and discover the formula for surface area, prism and pyramid volume, and explore the problem-solving steps related to building prism and pyramid spaces. This is in line with the findings [12] that GeoGebra helped students to explore high-level thinking problems. Increasing critical thinking skills were also influenced by teacher activity in learning by asking questions that can explore or guide students in critical thinking. This was in accordance with the results of research [13], [14], [15] that addressing higher-order thinking questions so as to improve critical thinking skills. Thus, mathematics learning assisted by GeoGebra software had an impact on improving the critical thinking skills of students of class VIII of Junior High School 2 Banda Aceh on prism and pyramid material.

4. Conclusion

Based on the results of research and discussion, it can be concluded that learning mathematics assisted by GeoGebra software can improve the critical thinking skills of students of class VIII of Junior High School 2 Banda Aceh on the prism and limas material. Based on the results of this study, researchers suggested that prospective teachers, teachers, and authorities can use GeoGebra to guide students to improve their critical thinking skills.

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