Vygotsky: Jurnal Pendidikan Matematika dan Matematika
8 (1) February 2026, pp. 13 - 20
E-ISSN: 2656-5846 P-ISSN: 2656-2286
Journal Page is available to
https://jurnalpendidikan.unisla.ac.id/index.php/VoJ

The Effect of the Application of Geogebra Software Android Version on the Mathematical Ability of *Politeknik Ilmu Pelayaran Makassar* Cadets

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ARTICLE INFO

Article History

Received	:	2 Aug 2025
Revised	:	2 Feb 2026
Accepted	:	22 Feb 2026
Available Online	:	28 Feb 2026

Keywords:
Mathematical Skills
GeoGebra
Maritime
Geometry
Mathematical Concepts

Please cite this article APA style as:
Fitriani, F., Ada', W., & Ahzan, Z. N. (2026). The Effect of The Application of Geogebra Software Android Version on the Mathematical Ability of *Politeknik Ilmu Pelayaran Makassar* Cadets. *Vygotsky: Jurnal Pendidikan Matematika dan Matematika*, 8(1), pp. 13-20.

ABSTRACT

Mathematics is used in various aspects of life, including the maritime and marine world. Mathematical concepts are widely used to solve problems in this field. Understanding abstract mathematical concepts requires a tool to bridge these concepts into concrete forms. The aim of this study is to determine the effect of using the Android version of GeoGebra software in improving the mathematical abilities of cadets. GeoGebra is a comprehensive and easy-to-use mathematical software. A study conducted on cadets at *Politeknik Ilmu Pelayaran Makassar* found that the use of the GeoGebra application had a positive impact on their understanding of mathematical material. This was demonstrated by inferential statistics tests and supported by the cadets' responses to the application's use in learning.

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1. Introduction

Mathematics is a fundamental science that is essential and can be applied in science, technology, agriculture, economics, education, and other fields, including maritime and marine affairs. Some instances of applications or problems of mathematics in the maritime field include calculating angles to determine the location of objects, the Cartesian system to identify the location of an object, flat and spatial geometry to determine the area or calculate the volume of hydraulic

E-ISSN: 2656-5846
P-ISSN: 2656-2286

systems, navigation, and various other technical calculations related to ship operations, among others (Agus et al., 2024). However, the abstract nature of mathematical concepts often hinders students' understanding of the concepts themselves (Ninung et al., 2025)(Suciati et al., 2022). Abstract mathematics must be interpreted concretely to facilitate comprehension (Edo & Renoat, 2024). In this context, a tool is needed to help students understand these concepts effectively.

One of the educational providers in the maritime and marine sector is the *Politeknik Ilmu Pelayaran Makassar*, specifically its nautical study program. This program produces graduates with competencies as shipping officers. Graduates of this program can also work in other sectors such as mining, the defense industry, and other maritime sectors. One of the subjects in this program is applied mathematics. This subject is offered because its application can be used for calculating ship position, navigation, and various other technical calculations related to ship operation.

In technology-based mathematics learning and in the digital era, a tool is needed to help male and female cadets at the *Politeknik Ilmu Pelayaran Makassar* understand mathematical concepts and strengthen their mathematical abilities. In the field of mathematics, there are various mathematical software that can be used, including Maple, Matlab, Geogebra, and so on. One simple mathematical application that covers many concepts and can be applied in solving mathematics is Geogebra. This software is lightweight software that can be applied via PC or Android cellphone. In addition, Geogebra software also uses a small storage capacity. By using this ligh and flexible software in terms of the devices used, the researcher hopes that the use of this device will be an alternative that can improve the mastery of concepts and mathematical abilities of cadets at the *Politeknik Ilmu Pelayaran Makassar*. This study aims to determine the effectiveness of using software in improving mathematical abilities of cadets at the *Politeknik Ilmu Pelayaran Makassar*.

2. Method

This research is quantitative pre-experimental design research, namely one-grup pretest-posttest design (O1 X O2), with the treatment given is the application of GeoGebra software media android version. The sampling technique used was a cluster sample with a total sample of 159 cadets. Learning was conducted in a blended manner over 10 sessions, with one session for the pre-test, eight sessions for blended learning, and one session for the post-test. Before the treatment was given, the sample was given a pre-test to determine mathematical abilities and after the treatment was given a final test. The research was conducted at the *Politeknik Ilmu Pelayaran Makassar* in January 2024. The population in this study were all male and female cadets at the *Politeknik Ilmu Pelayaran Makassar* who were currently programming mathematics courses.

The data obtained in this study were mathematics ability in the form of pretest and posttest results, as well as student response questionnaires. The study began with observations at the *Politeknik Ilmu Pelayaran Makassar* campus, preparing research instruments, and coordinating with the head of the Nautical study program. Next, a pretest was conducted, followed by the provision of mathematical materials and concepts through online learning and the assistance of GeoGebra software in the experimental class for approximately four meetings. A posttest was then administered. After data collection, descriptive and inferential

E-ISSN: 2656-5846
P-ISSN: 2656-2286

data analysis were conducted. The inferential analysis began with a normality test using software assistance for the pretest and posttest data. After that, a homogeneity test was conducted, followed by a comparative test using the student *t*-test.

3. Results and Discussion

Before administering treatment to the *Politeknik Ilmu Pelayaran Makassar* cadets, they were given an initial test to determine their initial abilities, particularly in geometry. This initial test consisted of ten multiple-choice questions, each weighted at ten points. After the treatment, a final test was administered with different questions, but with the same difficulty level and number of questions. Overall, the average, median and range of scores for the initial and final tests are presented in the following graph.

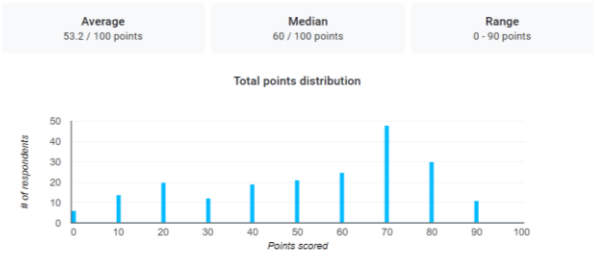


Figure 1. Initial Test Score Graph

Figure 1 shows that the lowest value obtained by respondents is still 0 and the highest value is 90. The middle and average values are not that far apart, indicating that the initial test value data is centered on the average and median value range.

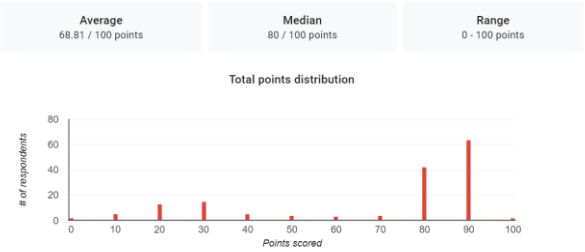
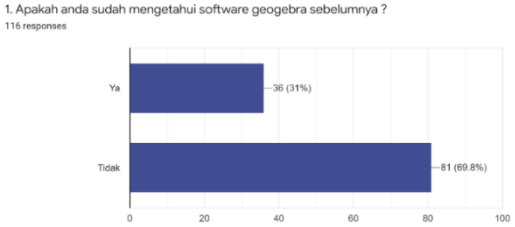


Figure 2. Final Test Score Graph

Figure 2 illustrates that the range of scores obtained by respondents in the final test is 0 to 100. The respondents' scores are centered around 80-90. This indicates an increase in scores on the final test. It can be seen from Figures 1 and 2 that the average increase in scores from the initial test to the final test is 15.61%.



E-ISSN: 2656-5846
P-ISSN: 2656-2286

Figure 3. Response Regarding Knowledge of GeoGebra Software

Figure 3 is the questionnaire responses from respondents, namely male and female cadets of the Nautical Study Program. It was found that 31% of respondents were previously familiar with the GeoGebra application, while 69% were not. The relevant question of Figure 3 was converted to "Do you know about GeoGebra before?".

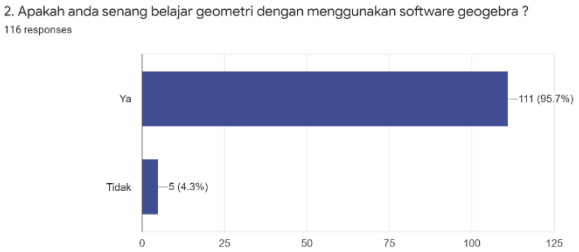


Figure 4. Responses Regarding the Pleasure of Using Geogebra

The question of Figure 4 is literally translated as "Do you derive pleausure from learning Geometry through the use of GeoGebra software?". As many as 95.7% of respondents stated that they enjoyed learning mathematics, especially geometry, using this software. One of the most common reasons respondents cited was that GeoGebra is very easy to use because it is a lightweight application. They also found it very easy to use, as it's available as a PC and Android app.

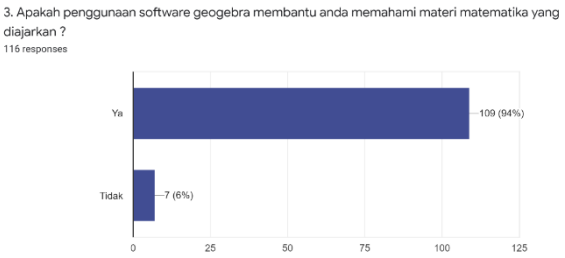
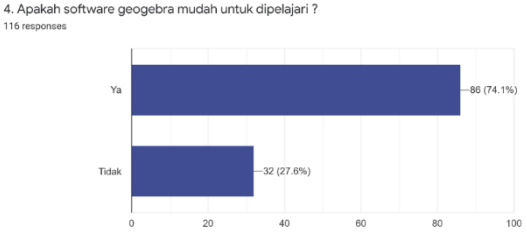


Figure 5. Responses Regarding GeoGebra's Ease of Use in Understanding the Material

The question of Figure 5 is directly translated as "Does GeoGebra Software help you to understand the mathematical material being taught?". Respondents commented that the app is very helpful in solving math problems with its graphical display. The graphics might be two- or three-dimensional. Up to 94% of respondents indicated that utilizing GeoGebra makes learning math easier.



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P-ISSN: 2656-2286

Figure 6. Responses about GeoGebra are Easy to learn

Figure 6 contains the equation translated to "Does GeoGebra Software easy to learn?". The software was deemed user-friendly by 74.1% of respondents in terms of its simplicity of learning. To strengthen the descriptive data analysis, an inferential analysis was conducted to strengthen the assumptions of the research hypothesis. Before conducting statistical tests to determine the effect of a treatment, a prerequisite test, namely the normality test, is required. Once these two tests have been conducted and fulfilled, the *t*-test can be continued to determine the effect of a treatment. Statistical testing will be conducted using SPSS software to reduce the error rate and inaccuracy of manual calculations. The following are the results of the normality test for the initial and final test data.

Table 1. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Initial Test	.138	159	.307	.933	159	.780

a. Lilliefors Significance Correction

Based on the SPSS program, the significance value was 0.307 > 0.05, indicating that the initial test data met the normality requirements. The results of the normality test for the initial test were similar. Similarly, the results of the normality test for the final test were 0.423 > 0.05, indicating that the final test data also met the normality requirements. This can be seen in the SPSS results table below.

Table 2. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Final Test	.306	159	.423	.744	159	.810

a. Lilliefors Significance Correction

Moreover, a homogeneity test was no longer necessary because the samples used came from a single sample class. The following explains the *t*-test results obtained using SPSS.

3.1 Paired Sample t-Test

This study took one sample class and received treatment. Before the treatment, there was a pre-test on mathematics ability, specifically geometry, and after the treatment, a post-test on mathematics ability, specifically geometry, was given with different questions but at the same level of difficulty. Thus, to test whether the treatment had an effect, a paired-samples t-test was used.

Table 3. Paired Samples Statistics

		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Initial Test	44.8428	159	26.76327	2.12247
	Final Test	74.9686	159	20.89377	2.65698

The average of the final test was higher than the average of the initial test, indicating a difference in the averages with a sample of 159 respondents. Furthermore, to determine whether the difference is truly real (significant) from the increase in the average of the first and final tests, see Table 4.

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P-ISSN: 2656-2286

Table 4. Paired Samples Correlations

		N	Correlations	Sig.
Pair 1	Initial and Final Test	159	.599	.412

Table 4 shows the results of a correlation test, or relationship, between the two sets of data: the initial and final tests. Based on the significance value of 0.412 > probability of 0.05, it can be concluded that there is no relationship between the two variables in the initial and final tests.

Table 5. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Initial Test - Final Test	30.12579	30.50187	2.41896	34.90345	25.34813	12.454	158	.007

The output table above is the most important output because in this section, it can be seen whether there is an effect of the treatment or not. Based on the table, the Sig. (2-tailed) value is 0.007 < 0.05, which indicates that there is a difference in the average results of the initial test and the final test, so it can be said that there is an effect of the treatment, namely learning using the GeoGebra application.

Based on the descriptive results and the results of the inferential analysis, it was found that there was an effect of treatment in the form of teaching using media in the form of the GeoGebra application on the mathematical abilities of male and female cadets of the Nautical Study Program *Politeknik Ilmu Pelayaran Makassar*. This was also supported by qualitative response data from the cadets, which stated that the GeoGebra application was very helpful in understanding and learning mathematics, especially geometry.

According to (Zetriuslita et al., 2020), learning mathematics using media can generally help students learn independently. The availability of GeoGebra software in the Android version can also help independent learning, especially in the topic of geometric mathematics for male and female cadets. The same thing was also stated by (Saha et al., 2010)(Negara et al., 2022), that is to say the importance of using media in mathematics learning that can help students understand mathematical concepts contextually in relation to geometric interpretation. What is considered difficult in learning mathematics is the abstract nature of mathematical material and concepts, so that mathematics learners are required to be able to understand through a more contextual approach (Sari et al., 2024)(Putra et al., 2020). If the concepts and materials are understood through a contextual approach, it is hoped that they will be more meaningful, resulting in the material and concepts being able to remain in the long-term memory of the learners. Research conducted by (Romaito et al., 2021)(Diva et al., 2023) found that the use of media in learning can deepen mastery of mathematical concepts.

Qualitative data obtained from the questionnaire responses of male and female cadets showed a positive response to the use of the Geogebra application

E-ISSN: 2656-5846
P-ISSN: 2656-2286

in mathematics learning. A similar thing was found in research conducted by (Nzaramyimana, 2021) where students were happier and more active in the learning process when using Geogebra media compared to learning without using Geogebra media. In addition, research conducted by (Praveen & Leong, 2013)(Arbain & Shukor, 2015) said that learning independence was formed when students were given Geogebra media in learning abstract mathematical concepts such as in geometry topics. A similar thing was found in this study that the use of GeoGebra software Android version, can help improve the mathematical abilities of cadets at the *Politeknik Ilmu Pelayaran Makassar*.

4. Conclusions

Based on the research results and discussion, it can be concluded that there is an effect of the application of GeoGebra software on the mathematical abilities of cadets in the Nautical Study Program *Politeknik Ilmu Pelayaran Makassar*. This could be analyzed from the increase in scores from the initial test to the final test about 15.61% which is supported by descriptive, and inferential results through hypothesis testing which obtained a significance value of 0.007 <0.05 in the paired one-sample t-test shows a difference in the average pre-test and post-test scores. In addition, learning using this application received a positive response from respondents who attended the lecture as shown through the results of the response questionnaire made in the form of a Google form. Activeness is also reflected in how great the enthusiasm and eagerness of the cadets in participating in learning.

Author Contributions

This paper was completed thanks to the collaboration of a team consisting of three authors. The author team jointly conducted the research until the writing of this article. The first and third authors designed and schemed the research method; the second author contributed more to providing the place and time for the research and implementing the treatment in the form of using GeoGebra software in learning and data collection with the cadets *Politeknik Ilmu Pelayaran Makassar*. During the data analysis, the three authors worked together starting from data input to interpreting the results of the analysis using the SPSS application. Next, the three authors discussed the unique things in the research written in the background and also searched for the latest references to support the results of the research that had been carried out.

Declaration of Competing Interest

The author declares that it has no conflicts of interest.

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