Utilization of Geogebra Application as Learning Media in Learning The Three-Dimensional to Increase Students' Interest in Learning

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Abstract

This activity aims to describe students' interest in learning, learning outcomes, and the benefits of using GeoGebra in learning the three-dimensional. The data collected were analyzed using descriptive analysis. The research subjects were 59 students of SMA Negeri 1 Megamendung. Data collection techniques used tests and questionnaires. This research consists of 2 cycles. In cycle 1, the results obtained based on students' interest in learning showed that on average students strongly agreed 18.6%, agreed 31.1%, moderately 44.3%, and disagreed 5.9%. In cycle 2 after using the GeoGebra application, student interest increased to strongly agree 30.9%, agree 48.7%, moderately 18.6% and disagree 1.7%. Based on the learning outcomes in cycle 1, it shows 42.37% of students can solve problems well, while in cycle 2 there is an increase in the percentage of learning outcomes to 56.59%. Based on the results of the above analysis, it can be concluded that GeoGebra is very useful as a learning media and there is an increase in student interest and learning outcomes in learning the three-dimensional using GeoGebra.

Keywords: benefit, GeoGebra, interest, learning outcomes, three dimensional

INTRODUCTION

Mathematics is a field of science that studies patterns of structure, change, and space. Mathematics studies three main areas, namely algebra, analysis, and geometry. Mathematics is one of the compulsory subjects at almost all levels of education because it is a very important subject. In practice, mathematics is one of the subjects that is often considered difficult by students. Many students have difficulty understanding abstract mathematical concepts and applying them in real life (Mulyadi et al., 2013). One of the most difficult materials in mathematics is the three-dimensional.

In the three-dimension material, students need deeper reasoning to understand the concepts. Students are expected to be able to use their imagination in thinking to solve the material. However, the difficulty in learning the three-dimensional can be seen from the frequent errors in working on problems. This happens because of students' lack of

understanding of this material. The lack of student understanding can be caused by several factors, including the learning process used is still a conventional model that is teacher-centered (Widyantini et al., 2023). In this model, students only focus on the teacher. They are not involved in the learning process which can cause boredom in the learning process. This can lead to a decrease in student achievement. According to the results of the test conducted by Trends in International Mathematics and Science Study (TIMSS), the achievement of Indonesian students in working on three-dimensional material is still low (Julita et al., 2022). This results in the mastery of the three-dimensional material being lacking so it requires the use of learning media as a tool in explaining the three-dimensional material at school. The use of learning media is expected to be more effective for students to understand the material presented by the teacher because it can visualize abstract concepts into something real so that students become easier to understand (Nurrita, 2018). Currently, many learning media can be used by teachers to help students understand mathematics, especially three-dimensional material, including Wingeom ((Sutrisno & Atira, 2020); (Rhosyida, 2015); (Pinahayu et al., 2018)), Cabri 3D ((Friansah et al., 2015); (Pitriani, 2017); (Noviyanti & Moerti, 2019)), and GeoGebra ((Subakti & Listiani, 2022); (Abidin et al., 2023); (Retta & Fitriasari, 2022))

GeoGebra is one of the software that can be used to study mathematical materials, especially geometry and algebra (Nur, 2017). This application is a dynamic math application that combines geometry, algebra, and calculus (Nari, 2017). GeoGebra has facilities that can be used to demonstrate concepts and become a tool for constructing mathematical concepts (Lestari & Sundi, 2021). Currently, GeoGebra 6 has appeared as an improvement from previous versions.

The use of learning media can increase student interest in learning (Rahmawati et al., 2019). This student learning interest greatly affects the learning outcomes of students significantly (Aprijal et al., 2020). The higher the student's interest, the higher the learning outcomes obtained. Based on the description above, the researcher considers it necessary to use suitable learning media in learning as a solution to increasing student interest and learning outcomes. In this study, the learning media used is the GeoGebra application. Previous research has been conducted to see the effectiveness of learning using GeoGebra, including research by Reza et.al (2023) showed an increase in students' enthusiasm and interest in learning trigonometry using GeoGebra, Armiznah & Rismawati, 2023 showed the use of GeoGebra media in learning geometry space material can increase student interest, Proklamanto & Rudhito, 2013 showed that learning by utilizing GeoGebra effectively helped students in understanding derivative material, Pauweni et al., 2022 showed that there was an increase in learning outcomes using GeoGebra on Pythagorean theorem material, Khoiriyah & Pitaloka, 2019 shows that the use of GeoGebra learning media can improve the average student learning outcomes compared to conventional learning, and Putra et al., 2019 showed that GeoGebra-based learning media can be accepted as learning media. Other research also shows the use of GeoGebra can stimulate students' thinking creativity (Nari, 2017), able to improve students' critical thinking skills (Hidayati & Kurniati, 2018), able to improve students' mathematical reasoning skills (Rahmadi et al., 2015), able to improve students' mathematical communication skills (Rahmatika et al., 2022), and able to improve

students' mathematical problem solving skills (Dwijayani, 2020). Simarmata & Sirait, (2020) also shows that GeoGebra is effective as a learning media in increasing students' mathematical understanding. This study aims to describe aspects of learning interest, student learning outcomes, and the benefits of using GeoGebra in learning mathematics on three-dimensional for XII-grade students at SMA Negeri 1 Megamendung.

METHODS

This research was conducted at SMA Negeri 1 Megamendung, Bogor Regency. The subjects of this study were class XII students as many as 59 people. The data collection techniques used were tests and non-tests (questionnaires). Observations were made to describe how students use GeoGebra. The test technique was used to determine the improvement of student learning outcomes after using the GeoGebra application. The questionnaire was used to describe the increase in student interest in learning after using the GeoGebra application in learning the three-dimensional. The instruments in this study were observation sheets of teacher activities and student activities, learning outcomes tests, and questionnaires on the benefits of GeoGebra and student interest in learning. The data analysis technique used in this research is descriptive analysis. The test data used the percentage of achievement of the minimum completeness criteria, and the questionnaire data used a Likert scale. The scale and points of the benefits and learning interest aspects can be seen in Table 1.

Table 1. Scale and Points for Benefit Aspects and Student Learning Interest

Scale	Points
Strongly Agree (SA)	5
Agree (A)	4
Moderately (M)	3
Disagree (D)	2
Strongly Disagree (SD)	1

After that, find the percentage value of the results of the student questionnaire. The percentage assessment is as follows.

$$P = \frac{n}{M} \times 100\%$$

Description:

P: percentage of students based on aspects of student learning benefits and interest

n: students' answers to each questionnaire on the aspects of benefits and students' interest in learning

M: the maximum score of each questionnaire in terms of benefits and students' interest in learning.

The average percentage results are converted into qualitative values as in Table 2 (Destiniar et al., 2021).

Table 2. Criteria for the Student Interest Rating Scale

Score (%)	Category
$80 \leq P \leq 100$	Very Good
$69 \leq P < 80$	Good
$40 \leq P < 60$	Moderately
$20 \leq P < 40$	Less Good
$P < 20$	Not Good

In its implementation, this activity was carried out in three stages, namely:

Preparation Stage

At this stage, the team made observations at SMA Negeri 1 Megamendung by meeting the vice principal of the curriculum to make a permit to carry out research activities. This research aims to see the benefits of using the GeoGebra application, student interest, and learning outcomes in learning mathematics three-dimensional material using GeoGebra for students at the school. This stage is continued by surveying problems in learning mathematics that occur in the school. In this preparation stage, the team also prepared pre-tests and post-tests, as well as questionnaires in the form of the benefits of using the GeoGebra application and students' interest in learning before and after using the GeoGebra application.

Implementation Stage

At this stage, the research is divided into 2 cycles, namely cycle 1 is a preliminary action in the research. In this cycle, the team gave an initial test and questionnaire to determine the learning outcomes and student interest and as a reference for improvement to carry out the next cycle. In the next cycle, the team carried out cycle 2 learning using GeoGebra media. In this cycle 2, the team introduced GeoGebra, the use of GeoGebra, the features in GeoGebra, and the menus in GeoGebra. Furthermore, the team explained the three-dimensional material being studied in class, including point-to-point distance, point-to-line distance, and point-to-plane distance using GeoGebra. At this stage, students immediately practiced each explanation using their respective devices in applying the concept of distance using GeoGebra. After the implementation of learning, students are given a final test to determine learning outcomes and student interest after using GeoGebra.
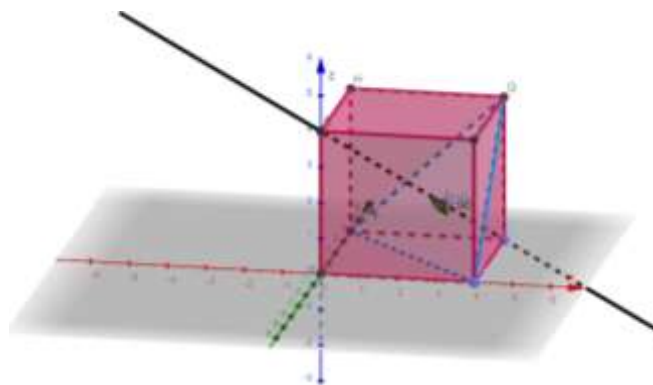

Figure 1. Application of GeoGebra on the Material of the Three-dimensional

Final Stage

After students have started to become proficient in using GeoGebra, students are given three three-dimensional test questions about distance, including point-to-point distance, point-to-line distance, and point-to-plane distance using the GeoGebra application. Students who successfully answer correctly will get a reward so that students in the class are more motivated to learn mathematics using GeoGebra. Furthermore, students were given a questionnaire sheet on the benefits of GeoGebra and students' interest in learning using GeoGebra.

RESULTS AND DISCUSSION

Interest Aspect Assessment

In assessing the interesting aspect, students were given a questionnaire with the same questions before learning (cycle 1) and after learning (cycle 2). The results of the percentage of student interest before learning (cycle 1) can be seen in Table 3.

Table 3. Percentage results of student interest before learning (Cycle 1)

Indicator	SA	A	M	D	SD	Average
I understand the teacher's explanation in class about the three-dimensional material	11,9%	35,6%	45,8%	6,8%	0%	70,5%
I am happy and excited about learning	16,9%	30,5%	49,2%	3,4%	0%	72,2%
I try to understand the material independently when and after the teacher explains it	23,7%	33,9%	37,3%	5,1%	0%	75,3%
I try to ask about material that I do not understand	13,6%	28,8%	54,2%	3,4%	0%	70,5%
After learning about dimension three, I can do problems well	16,9%	18,6%	50,8%	13,6%	0%	67,8%
I learned dimensional three on my own accord	15,3%	11,9%	64,4%	8,5%	0%	66,8%
I try hard so that I get optimal results	27,1%	67,8%	5,1%	0%	0%	84,4%
I look for other ways when I make a mistake in working on a problem	23,7%	22,0%	47,5%	6,8%	0%	72,5%
Average	18,6%	31,1%	44,3%	5,9%	0%	72.5%

In cycle 1, it shows that before the implementation of learning using the GeoGebra application, 45.8% of students felt that they understood the teacher's explanation in class about the three-dimensional material, 49.2% considered it quite happy and excited during learning the three-dimensional, 37.3%. As many as 37.3% of students felt sufficient in understanding the material independently when and after the teacher explained, 54.2% considered sufficient in trying to ask questions about the material, and 50.8% considered sufficient to be able to solve the three-dimensional problem well. Furthermore, 64.4% of

students felt sufficient in learning the three-dimensional of their desire, 67.8% enough to work hard to get optimal results and 44.3% felt sufficient in finding other ways if they experienced mistakes in doing the problems. In general, students rated each question on the interest aspect as sufficient. The average of each question regarding the interesting aspect is in a good category with a percentage between 60-80%. For the question about students working hard to get optimal results, it was in the good category at 84.4%. From all questions regarding the interesting aspect, the average interest in learning of students who chose strongly agree (18.6%), agree (31.1%), moderately (44.3%), disagree (5.9%), and strongly disagree (0%). The average percentage of students' interest in learning before learning was 72.5%. After distributing questionnaires on aspects of interest before learning (cycle 1), then students were given learning using GeoGebra on three-dimensional material. After completing the learning, students were given another questionnaire to see the assessment of interest aspects after learning using the GeoGebra application (cycle 2), The results of the percentage of student interest after learning can be seen in Table 4.

Table 4. Percentage results of student interest after learning

Indicator	SA	A	M	D	SD	Average
I understand the teacher's explanation in class about the three-dimensional material.	28,8%	47,5%	20,3%	3,4%	0%	80,3%
I am happy and excited about learning	33,9%	54,2%	11,9%	0%	0%	84,4%
I try to understand the material independently when and after the teacher explains it	30,5%	47,5%	20,3%	1,7%	0%	81,4%
I try to ask about material that I do not understand	32,2%	49,2%	18,6%	0%	0%	82,7%
After learning about dimension three, I can do problems well	30,5%	42,4%	25,4%	1,7%	0%	80,3%
I learned dimensional three on my own accord	32,2%	39,0%	25,4%	3,4%	0%	80,0%
I try hard so that I get optimal results	28,8%	67,8%	3,4%	0%	0%	85,1%
I look for other ways when I make mistakes in doing the problem.	30,5%	42,4%	23,7%	3,4%	0%	80,0%
Average	30,9%	48,7%	18,6%	1,7%	0%	81.8%

The results obtained show that there is an increase in student interest in learning the three-dimensional. This can be seen from the average percentage of interest in learning from each question point which is above 80% with a very good category and the overall average is 81.8% with a very good category. When compared to the assessment in cycle 1, in cycle 2, students mostly agreed and strongly agreed, and there was a decrease in the disagreement assessment in each aspect of the interest assessment after learning. In the condition after learning, on average, students who chose strongly agree (30.9%), agree

(48.7%), moderately (18.6%), disagree (1.7%), and strongly disagree (0%). This shows that there is an increase in students' interest in learning mathematics, especially the three-dimensional material after using the GeoGebra application.

Assessment of Student Learning Outcome Aspects

In this study using the assessment of aspects of student learning outcomes, in cycle 1 students were given 3 pre-test questions, which included the distance from point to point, point to line, and point to plane, each as much as 1 question. Student learning outcomes in cycle 1 can be seen in Table 5.

The pre-test results show that in problem 1 regarding the distance from point to point, 50.84% of students were able to solve correctly. In problem 2 and problem 3, the percentage of students who answered correctly decreased to 42.37% for the distance from point-to-line question and 33.9% for the distance from a point to plane question. The average number of students who answered correctly in cycle 1 was 42.37%. This can be caused by student errors in determining the perpendicular line in solving the two problems. In cycle 2, student learning outcomes from the three questions increased in answering questions correctly to 56.49%. Based on the post-test results, 67.79% of students can answer the question of point-to-point distance, 59.32% of students can answer the question of point-to-line distance, and 42.37% of students can answer the question of point-to-plane distance.

Table 5. Student Learning Outcomes in Cycle 1

	Problem 1		Problem 2		Problem 3		Average Correct Answer
	Correct	Wrong	Correct	Wrong	Correct	Wrong	
Pre-Test	50,84%	49,15%	42,37%	57,62%	33,9%	66,1%	42.37%
Post-Test	67,79%	32.21%	59.32%	40.67%	42,37%	57,62%	56.49%

GeoGebra Benefit Aspect Assessment

This study also used an assessment of the benefits of GeoGebra for students in learning the three-dimensional. This questionnaire is given after students do learning by using the GeoGebra application. The results of the assessment of the benefits of using GeoGebra for students can be seen in Table 6. Based on the benefit aspect, the use of GeoGebra makes the three-dimensional material more interesting and easier to understand. By using GeoGebra, students get a clearer visual experience in understanding the concept. In addition, using GeoGebra as a learning media is easier than without using learning media. The results of the assessment of the benefits of using GeoGebra obtained a result of 83.31%.

Table 6. Assessment Results of the Benefits of Using GeoGebra Aspects for Students

Indicator	Average	Category
The use of GeoGebra learning media makes the material taught easier to understand	87.6%	Very Good
The use of GeoGebra learning media encourages me to be more independent	84.6%	Very Good
The use of GeoGebra learning media makes it easier for me to solve problems about the three-dimensional	84.4%	Very Good
The use of GeoGebra learning media encourages me to think critically	82.8%	Very Good
The use of GeoGebra learning media encourages me to think creatively	85.2%	Very Good
The use of GeoGebra learning media makes mathematics learning more interesting	87.2%	Very Good
The use of GeoGebra learning media encourages my enthusiasm for learning about three-dimensional material	80%	Very Good
I find it easier to learn using GeoGebra learning media than the way I used to learn before	80.4%	Very Good
The use of GeoGebra learning media encourages my curiosity to better understand the material about the three-dimensional	83.6%	Very Good
GeoGebra learning media is very easy to use so it increases my interest in learning mathematics	80.8%	Very Good
The use of GeoGebra learning media improves my understanding of the concept of the three-dimensional	83.2%	Very Good
The use of GeoGebra learning media makes me happy to learn mathematics	80%	Very Good
Average	83.31%	Very Good

CONCLUSION

The use of GeoGebra in determining the distance from point to point, point to line, and point to plane in three-dimensional space for class XII IPA students at SMA Negeri 1 Megamendung makes the material more interesting and easier to understand. In assessing aspects of interest and learning outcomes, it consists of 2 cycles. In cycle 1, the results obtained based on students' interest in learning showed that on average students strongly agreed 18.6%, agreed 31.1%, moderately 44.3%, and disagreed 5.9%. In cycle 2 after using the GeoGebra application, student interest increased to strongly agree 30.9%, agree 48.7%, moderately 18.6% and disagree 1.7%. This shows that there is an increase in interest in learning the three-dimensional by using GeoGebra. Based on the learning outcomes in cycle 1, it shows 42.37% of students can solve problems well, while in cycle 2 there is an increase in the percentage of learning outcomes to 56.49%. The results of the analysis based on the benefits of using GeoGebra obtained 83.31% which showed

very good criteria. Based on the results of the above analysis, it can be concluded that GeoGebra is very useful as a learning medium and can increase student interest and learning outcomes in learning the three-dimensional.

REFERENCES

Abidin, Z., Faradiba, S.S., Khasanah, I. (2023). Pelatihan Aplikasi GeoGebra pada Materi Dimensi Tiga. *Jurnal Pengabdian Masyarakat dan Riset Pendidikan* 1(3):148–55. doi: 10.31004/jerkin.v1i3.32.

Aprijal, Alfian, Syarifudin. (2020). Pengaruh Minat Belajar Siswa Terhadap Hasil Belajar Siswa di Madrasah Ibtidaiyah Darussalam Sungai Salak Kecamatan Tempuling. *MITRA PGMI: Jurnal Kependidikan MI* 6(1):76–91. doi: 10.46963/mpgmi.v6i1.125.

Armiznah, D., Rismawati. (2023). Penggunaan Media GeoGebra Dalam Meningkatkan Minat Belajar Siswa Pada Materi Geometri Ruang. *PERISAI: Jurnal Pendidikan dan Riset Ilmu Sains* 2(2):225–34. doi: 10.32672/perisai.v2i2.255.

Destiniar, Rohana, Ardiansyah, H. (2021). Pengembangan Media Pembelajaran Berbasis Aplikasi Android Pada Materi Turunan Fungsi Aljabar. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika* 10(3):1797. doi: 10.24127/ajpm.v10i3.4050.

Dwijayani, N.M. (2020). Meningkatkan Kemampuan Pemecahan Masalah Mahasiswa dengan Menggunakan GeoGebra. *Jurnal Pendidikan Matematika* 11(1):110. doi: 10.36709/jpm.v11i1.10045.

Friansah, D., Zulkardi, Somakim. (2015). Pengembangan Bahan Ajar Berbasis Cabri 3D Materi Dimensi Tiga Kelas X SMA. *Jurnal Elemen* 1(2):81. doi: 10.29408/jel.v1i2.143.

Hidayati, D.W., Kurniati, L. (2018). Penerapan Bahan Ajar Geometri Ruang Berbantuan GeoGebra Pada Materi Irisan Bidang Pada Bangun Ruang. Dipresentasikan pada Seminar Nasional Pendidikan Sains dan Teknologi (Edusainstek). Semarang. Indonesia, 6 Oktober 2018.

Julita, Sucipto, L., Nasrullah, A. (2022). Efektivitas Penggunaan Media GeoGebra Ditinjau Dari Pemahaman Konsep Matematis Siswa Pada Materi Dimensi 3. *Journal of Math Tadris* 2(1):19–28. doi: 10.55099/jurmat.v2i1.38.

Khoiriyah, S, Pitaloka, D.A. (2019). Pengaruh Penggunaan Media Pembelajaran Berbasis GeoGebra Terhadap Hasil Belajar Siswa SMP. Dipresentasikan pada Seminar Nasional Matematika dan Pendidikan Matematika UIN Raden Intan. Lampung. Indonesia, 9 April 2019.

Lestari, D.P.A, Sundi, V.H. (2021). Pelatihan Penggunaan Aplikasi GeoGebra Untuk Mempermudah Pembelajaran Materi Program Linear. Dipresentasikan pada Seminar Nasional Pengabdian Masyarakat LPPM UMJ. Jakarta. Indonesia, 28 Oktober 2021.

Mulyadi, Azahra, F.L., Maharani T.S., Fadilah, D.N. (2023). Keefektifan Media Pembelajaran GeoGebra Dalam Memecahkan Persoalan Matematika. *Koudinstanta: Jurnal Matematika dan Ilmu Pengetahuan Alam,* 1(2), 218-226.

Nari, N. (2017). Penggunaan Software GeoGebra Untuk Perkuliahan Geometri. Dipresentasikan pada *2nd International Seminar on Education*. Batusangkar. Indonesia, 5-6 September 2017.

Noviyanti, M., Moerti, H. (2019). Pengaruh Penugasan Dimensi Tiga Berbantuan Cabri 3D Terhadap Hasil Belajar Dimensi Tiga Di Kota Pasuruan. *DOUBLECLICK: Journal of Computer and Information Technology*, 2(2), 41-49.

Nur, I.M. (2017). Pemanfaatan Program GeoGebra Dalam Pembelajaran Matematika. *Delta-Pi: Jurnal Matematika dan Pendidikan Matematika* 5(1). doi: 10.33387/dpi.v5i1.236.

Nurrita, T. (2018). Pengembangan Media Pembelajaran Untuk Meningkatkan Hasil Belajar Siswa. *MISYKAT: Jurnal Ilmu-ilmu Al-Quran, Hadist, Syari'ah dan Tarbiyah* 3(1):171. doi: 10.33511/misykat.v3n1.171.

Pauweni, K.A.Y., Uwange, D.I., Ismail, S., Kobandaha, P.E. (2022). Peningkatan Hasil Belajar Siswa pada Materi Teorema Pythagoras Menggunakan Aplikasi GeoGebra di Kelas VIII SMP Negeri 15 Gorontalo. *Jurnal Cendekia : Jurnal Pendidikan Matematika* 6(3):2660–72. doi: 10.31004/cendekia.v6i3.1547.

Pinahayu, E.A.R., Auliya, R.N., Adnyani, L.P.W. (2018). Implementasi Aplikasi Wingeom untuk Pengembangan Bahan Ajar di SMP. *Jurnal PkM Pengabdian kepada Masyarakat* 1(02):112. doi: 10.30998/jurnalpkm.v1i02.2544.

Pitriani. (2017). Pengembangan Lks Berbasis Pbl Berbantuan Cabri 3D Materi Dimensi Tiga Kelas X SMA. *FIBONACCI: Jurnal Pendidikan Matematika dan Matematika* 3(1):1. doi: 10.24853/fbc.3.1.1-10.

Proklamanto, A.R., Rudhito, M.A. (2013). Efektifitas Pemanfaatan Program GeoGebra Pada Pembelajaran Matematika Dalam Upaya Membantu Pemahaman Materi Turunan. Dipresentasikan pada *Seminar Nasional Sains dan Pendidikan Sains VIII*. Salatiga. Indonesia, 15 Juni 2023.

Putra, I.P.D., Sariyasa, Sukajaya, I.N. (2019). Pengembangan Media Pembelajaran Berbasis GeoGebra Untuk Pembelajaran Persamaan Linier Dua Variabel Di SMP." *Jurnal Pendidikan dan Pembelajaran Matematika Indonesia* 7(1):1–12. doi: 10.23887/jppm.v7i1.2808.

Rahmadi, A.Z., Sari, N.P., Juliana, S., Rahman, B. (2015). Studi Literatur: Pembelajaran Matematika Menggunakan GeoGebra dalam Meningkatkan Kemampuan Penalaran Matematis Siswa. Dipresentasikan pada Seminar Nasional Matematika dan Pendidikan Matematika UNY. Yogyakarta. Indonesia, 2015.

Rahmatika, A., Batubara, I.H., Sari, I.P. (2022). Penerapan Software GeoGebra Dalam Kemampuan Komunikasi Matematis Mahasiswa Pada Ata Kuliah Trigonometri. *Jurnal EduTech*, 8(2): 162-167.

Rahmawati, N.S, Bungsu, T.K., Islamiah, I.D., Setiawan, W. (2019). Analisis Minat Belajar Siswa MA Al-Mubarok Melalui Pendekatan Saintifik Berbantuan Aplikasi GeoGebra Pada Materi Statistika Dasar. *Jurnal Of Education*, 1(3): 286-295.

Retta, A.M., Fitriasari, P. (2022). Pengembangan Lembar Kerja Siswa Berbantuan GeoGebra Pada Materi Dimensi Tiga Untuk Siswa SMA. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika* 11(2):819. doi: 10.24127/ajpm.v11i2.4249.

Reza, W., Jabnabillah, F, Sabarinsyah. (2023). Pelatihan Penggunaan Aplikasi GeoGebra Sebagai Media Pembelajaran Interaktif Pada Pembelajaran Matematika. *Jurnal SOLMA*, 12)1): 210-225.

Rhosyida, N. (2015). Pemanfaatan Program Wingeom Pada Pembelajaran Matematika Untuk Meningkatkan Pemahaman Geometri Siswa. *Trihayu: Jurnal Pendidikan ke-SD-an*, 1(3): 195-201.

Simarmata, J.E., Sirait, D.E. (2020). Pemanfaatan Aplikasi GeoGebra Dalam Pembelajaran Kalkulus I Pada Mahasiswa Program Studi Pendidikan Matematika, Universitas Timor. MES: Journal of Mathematics Education and Science, 6(1): 99-109.

Subakti, M.P., Listiani, T. (2022). Penggunaan GeoGebra Dalam Mengembangkan Kemampuan Visual Thinking Matematis Siswa Pada Pembelajaran Matematika Secara Daring [Using GeoGebra To Develop Students' Mathematical Visual Thinking Ability In Online Mathematics Learning]. *JOHME: Journal of Holistic Mathematics Education* 6(2):157-177. doi: 10.19166/johme.v6i2.2823.

Sutrisno, A.B., Atira. (2020). Keefektifan Penggunaan Aplikasi Wingeom Dalam Pemaparan Materi Pelajaran Dimensi Tiga. *De Fermat : Jurnal Pendidikan Matematika,* 3(1):37–45. doi: 10.36277/defermat.v3i1.70.

Widyantini, G.A.P.Y., Suastra, I.W., Arnyana, I.B.P. (2023). Pengaruh Model Project Based Learning Berorientasi Penguatan Profil Pelajar Pancasila terhadap Kemampuan Berpikir Kreatif dan Motivasi Berprestasi Siswa SMA. *Jurnal Pendidikan MIPA* 13(1):243–48. doi: 10.37630/jpm.v13i1.873.