



The Analysis of learning interest in three-dimensional material (Utilizing Augmented Reality Features in Geogebra 3D)

Indra Rukmana

Senior High School IT Raudhatul Jannah Cilegon, Banten, Indonesia,
indra.math@raudhatuljannah.or.id

Imalia Dwi Rosmayanti

Senior High School IT Raudhatul Jannah Cilegon, Banten, Indonesia,, dwimalia@gmail.com

Shendy Septyaneu Nurizza

Senior High School IT Raudhatul Jannah Cilegon, Banten, Indonesia,
shendy@raudhatuljannah.or.id

Meta Apriani

Senior High School IT Raudhatul Jannah Cilegon, Banten, Indonesia,
metaapriani94@guru.sma.belajar.id

Afiatul Latifah

Senior High School IT Raudhatul Jannah Cilegon, Banten, Indonesia,
aflatifa@raudhatuljannah.or.id

Hana Mutiara Scarayu

Senior High School IT Raudhatul Jannah Cilegon, Banten, Indonesia,
scarayu@raudhatuljannah.or.id

Al Azhary Masta

Mathematics Study Program, Universitas Pendidikan Indonesia, West Java, Indonesia,
alazhari.masta@upi.edu

Nadia Ulfa

Mathematics Education Study Program, Universitas Pendidikan Indonesia, West Java, Indonesia,
nadiaulfa@upi.edu

Muhammad Taqiyuddin

Department of Mathematics, University of Auckland, New Zealand,
muhammad.taqiyuddin@auckland.ac.nz

ABSTRACT

This research is motivated by the results of observations which show that the results of the three-dimensional daily assessments are still not optimal. This is influenced by several factors, especially the student's interest in learning in class. They still have difficulty visualizing the three dimensions so in calculating the questions given, they still experience difficulties completing them. Three-dimensional material requires a good understanding of the shapes of three-dimensional space and related concepts. Therefore, the Augmented Reality (AR) feature is needed in the Geogebra application. This research aims to analyze students' learning interests by using the Augmented Reality (AR) feature in the Geogebra application. This research used a qualitative approach where the research subjects were 61 students consisting of 33 students in class XII IPA 1 and 28 students in class XII IPS 1 at SMAIT Raudhatul Jannah Cilegon. The research results show that the presentation of each



indicator on the student interest scale questionnaire has an average of 80.19%, which means that almost all students already have an interest in learning three-dimensional material using the Augmented Reality (AR) feature in the Geogebra application. This research can be a bridge for other researchers to develop the results of this research, as well as improve the quality of learning, especially in mathematics learning with the help of the Geogebra application to increase insight.

Keywords: *Learning Interest, Three Dimensions, Augmented Reality (AR), Geogebra.*

ABSTRAK

Penelitian ini dilatarbelakangi dari hasil observasi yang menunjukkan bahwa hasil penilaian harian dimensi tiga dan penilaian akhir semester masih belum maksimal. Hal ini tentu saja dipengaruhi oleh beberapa faktor, terutama faktor minat belajar peserta didik di kelas. Mereka masih mengalami kesulitan dalam memvisualisasikan dimensi tiga sehingga dalam perhitungan soal-soal yang diberikan, masih mengalami kesulitan dalam mengerjakannya. Materi dimensi tiga membutuhkan pemahaman yang baik tentang bentuk-bentuk ruang tiga dimensi dan konsep yang terkait. Oleh karena itu, dibutuhkan fitur Augmented Reality (AR) di aplikasi geogebra. Tujuan dari penelitian ini yaitu untuk menganalisis minat belajar peserta didik dengan menggunakan fitur Augmented Reality (AR) di aplikasi geogebra. Penelitian ini menggunakan pendekatan kualitatif dimana subjek penelitian yaitu 61 peserta didik yang terdiri dari 33 peserta didik kelas XII IPA 1 dan 28 peserta didik kelas XII IPS 2 di SMAIT Raudhatul Jannah Cilegon. Hasil penelitian menunjukkan bahwa presentasi setiap indikator angket skala minat belajar peserta didik memiliki rata-rata 80,19% yang artinya hampir seluruh peserta didik sudah memiliki minat belajar pada materi dimensi tiga dengan menggunakan fitur Augmented Reality (AR) pada aplikasi Geogebra. Diharapkan kepada peneliti lain agar dapat mengembangkan hasil dari penelitian ini, serta meningkatkan kualitas pembelajaran khususnya pada pembelajaran matematika dengan bantuan aplikasi geogebra untuk menambah wawasan.

Kata Kunci: Minat Belajar, Dimensi Tiga, Augmented Reality (AR), Geogebra.

INTRODUCTION

Students' interest in learning is a crucial factor in ensuring an effective learning process. Without it, students may struggle to engage, leading to suboptimal outcomes. Interest serves as the foundation for success in learning. Komariyah et al. (2018) emphasized that students achieve better results when they have a high interest in the subjects taught. Interested students are more likely to engage seriously throughout the learning process, resulting in better cognitive, affective, and psychomotor outcomes. Conversely, low interest can hinder the achievement of these learning goals. Three factors influence the development of interest: internal motivation, social interactions, and emotional engagement (Hadi, 2023). Safari (2003) identified indicators of students' interest, including feelings of pleasure, attention, curiosity, and involvement in learning. Teachers play a key role in fostering this interest by using engaging methods, innovative strategies, and interactive learning models.

This study focuses on three-dimensional geometry, a branch of mathematics, requires students to solve problems involving points, lines, and planes, and to apply these concepts to real-life situations. Observations from mathematics-teachers authors show that students' performance in

daily and semester assessments on this topic remains below expectations. This underperformance is largely suspected due to students' difficulty in visualizing three-dimensional objects, which hampers their ability to solve related problems. Previous studies have reported challenges that teachers and students faced in teaching and learning three-dimensional geometry. Teaching three-dimensional (3D) geometry is challenging due to the inherent complexity of spatial concepts and the limitations of conventional instructional methods. Teaching approaches which rely heavily on static diagrams and two-dimensional (2D) geometric representations often fail to bridge the gap between abstract mathematical concepts and students' ability to visualize and manipulate 3D geometric forms (e.g., Francis & Whiteley, 2015; Fujita et al., 2020). On the other hand, students often struggle to mentally reconstruct 3D geometric objects from 2D geometric representations, a mental activity that demands high spatial visualization skills (Parzysz, 1988; Duval, 1998; Pittalis & Christou, 2010). These pedagogic and learner challenges highlight the need for innovative instructional strategies that address both the cognitive and affective dimensions of 3D geometry education.

One of the ways to address those challenges is by utilizing a virtual manipulative such as Augmented Reality (AR) in teaching and learning three-dimensional geometry. Research on AR in teaching and learning have pointed out several benefits. First, AR allows students to interact with these virtual 3D geometric objects in real-time and in real-life situation (e.g., Sara, 2021; Herrera et al., 2019). Second, AR creates immersive environments where students can manipulate 3D geometric objects, observe spatial relationships from multiple perspectives, and engage in hands-on problem-solving (e.g., İbili et al., 2020; Osypova et al., 2020). These benefits highlight the potential of utilizing AR in teaching and learning geometry.

While previous studies have shown that AR enhances spatial understanding and problem-solving skills (e.g., Arifin et al., 2020; Andriyani & Buliali, 2021), few have explored its impact on students' socio-emotional aspects of learning such as learning interest, especially in mathematics (see Su et al, 2022). Thus, this study aims to contribute to this gap by investigating on how AR's interactive features can foster emotional engagement and motivation in learning three-dimensional material. AR's correlation with learning interest lies in its ability to create engaging, interactive environments that make abstract concepts more tangible, stimulating curiosity, attention, and enjoyment (Sudirman et al., 2020; Putrawangsa & Hasanah, 2018).

More specifically, the purpose of this research is to analyze the impact of using Augmented Reality (AR) features in the GeoGebra 3D application on students' interest in learning three-dimensional geometry. This study aims to determine whether the interactive and immersive characteristics of AR can enhance students' motivation, attention, and overall engagement in mathematics. By focusing on both cognitive and affective aspects, the research seeks to provide insights into how AR can not only improve students' understanding of complex spatial concepts but also increase their enthusiasm and willingness to participate actively in the learning process.

METHOD

This study employs a descriptive qualitative approach. According to Hardani, et al. (2020), descriptive research is research that is directed to provide symptoms, facts, or events systematically and accurately, regarding the characteristics of a particular population. In descriptive research, there tends to be no need to seek or explain interrelationships and test hypotheses.

There are several types of research classified under descriptive research, and this study employs survey research. Survey research involves collecting information from a sample through questionnaires or interviews, aiming to describe various aspects of the population (Fraenkel et al., 1993).

The sampling technique is purposive sampling. According to Soesana, et al. (2023), purposive sampling is a sampling determination technique based on the researcher's considerations regarding which samples are most appropriate, useful, and considered to be able to represent a population (representative). Hardani, et al. (2020) stated that the main characteristic of this purposive sampling is when the sample members are selected specifically based on the research objectives. The sample to be taken is determined based on knowledge of a population, its members, and the purpose of the study. According to Retnawati (2017), this type of sampling is very good if used for exploratory studies (initial studies for research or evaluation), which are then followed by further research whose samples are taken randomly.

Therefore, the subjects in this study were students from SMAIT Raudhatul Jannah in class XII IPA 1 and XII IPS 2. The two classes were selected based on the researcher's considerations by looking at the condition of the class and students and aimed for the class to represent the science and social science majors. Class XII IPA 1 has 33 students including 22 male students and 11 female students. Class XII IPS 2 has 28 students comprising 13 male students and 15 female students.

In this study, the method used for data research is a non-test method in the form of a questionnaire/interest questionnaire, documentation, and interview guidelines. A questionnaire is a data collection technique by asking written questions to be answered in writing by respondents (Hardani, 2020). The questionnaire consists of 15 questions designed to measure students' interest in learning three-dimensional material. These questions are categorized into four indicators: (1) Pleasure, which assesses the enjoyment students experience during the learning process; (2) Interest, which evaluates students' enthusiasm and curiosity towards the subject; (3) Attention, which measures students' focus and concentration during lessons; and (4) Involvement, which gauges the extent of students' active participation in classroom activities. The questionnaire used consists of a set of questions that are adjusted to the learning interest indicators used in this research, to obtain data on students' learning interests in learning three-dimensional mathematics material using the augmented reality (AR) feature in the Geogebra application. The data analysis used in this study consists of two types. To calculate the average percentage of student answers per question item is determined by the formula:

$$\bar{P}_i = \frac{\sum f_i P_i}{n} \times 100\%$$

with the following information:

\bar{P}_i = average percentage of student answers for statement item-

f_i = frequency of student answer choices for statement item-

P_i = percentage of student answer choices for statement item-

n = number of students

Then, to calculate the average percentage of student answers per indicator and overall, it is determined using the formula:

$$\bar{P}_T = \frac{\sum \bar{P}_i}{k} \times 100\%$$

with the following information:

\bar{P}_T = average percentage of student answers per indicator or overall

$\sum \bar{P}_i$ = average percentage of student answers for statement item n -

k = number of statement items

Furthermore, the results of the quality questionnaire data analysis are based on the criteria based on Table 1.

Table 1. Criteria for Interpreting the Percentage of Questionnaire Answers

Criteria	Interpretation
$P = 0$	Nobody
$0 \leq P < 25$	A small number of people (fraction)
$25 \leq P < 50$	Almost half of it
$P = 50$	Half of it
$50 < P < 75$	Most of the
$75 \leq P < 100$	Almost all of it
$P = 100$	All of it

RESULT AND DISCUSSION

This study aims to analyze the impact of using Augmented Reality (AR) features in the GeoGebra application on students' interest in learning three-dimensional material. Data were collected through a questionnaire consisting of 15 questions, categorized into four indicators: pleasure, interest, attention, and involvement. A total of 61 students participated in the study, with 33 students from class XII IPA 1 and 28 students from class XII IPS 2.

Table 2. Presentation of Students' Learning Interests in Three-Dimensional Learning Using Augmented Reality (AR) Features

No	Indicator	Many Statements	Score	Total		Information
				Mean	Percentage	
1	Pleasure	3	154	51	86.34	Almost all of it
2	Interest	4	201	50.25	82.38	Almost all of it
3	Attention	4	190	47.5	77.86	Almost all of it
4	Involvement	4	181	45.25	74.18	Most of the
		Average			80.19	

The results indicate that the average percentage of students' interest in learning three-dimensional material using AR features is 80.19% (see Table 2), reflecting a high level of engagement across all indicators.

1. Pleasure: This indicator achieved the highest score at 86.34%, showing that students enjoyed learning when assisted by AR features. The interactive and visual nature of AR made lessons more fun and engaging.
2. Interest: With an average score of 82.38%, most students expressed increased curiosity and enthusiasm towards learning three-dimensional material after using AR. The novelty of interacting with 3D objects contributed to heightened motivation.
3. Attention: The attention indicator scored 77.86%, demonstrating that AR helped maintain students' focus during lessons. The ability to manipulate objects in real-time required students to remain attentive and engaged.
4. Involvement: This indicator scored 74.18%, indicating that most students actively participated in class activities. AR encouraged collaboration, discussions, and hands-on exploration, leading to greater involvement in the learning process.

DISCUSSION

The result of this study indicates that the use of Augmented Reality (AR) features in the GeoGebra application has a positive impact on students' interest in learning three-dimensional material. The average percentage of students' interest, which reached 80.19%, suggests that AR effectively enhances various aspects of students' engagement, including pleasure, attention, interest, and involvement.

These findings align with previous studies that emphasize the role of AR in improving both cognitive understanding and affective engagement in learning. According to Sara (2021), AR combines virtual objects into real-world environments, allowing students to interact with three-dimensional materials in real-time. This interaction enhances students' ability to visualize complex geometric concepts, making the learning process more intuitive and engaging.

Arifin et al. (2020) and Andriyani & Buliali (2021) also found that AR technology can significantly improve students' spatial reasoning and problem-solving skills. In this study, students reported that AR helped them overcome difficulties in visualizing three-dimensional objects, which had previously hindered their performance in geometry assessments. The pleasure indicator (86.34%) highlights that student found learning with AR enjoyable, and this sense of enjoyment likely contributed to increased motivation and engagement.

The positive response from students in the interest indicator (82.38%) suggests that AR sparked curiosity and a desire to explore three-dimensional material beyond the classroom context. This is consistent with findings from Sudirman et al. (2020), who observed that AR applications foster a dynamic and interactive learning environment that encourages students to engage more deeply with mathematical concepts.

The attention (77.86%) and involvement (74.18%) indicators further demonstrate AR's role in promoting active learning. Students were more focused and participated more actively in lessons when using AR, as it allowed them to manipulate and explore three-dimensional objects interactively. Putrawangsa & Hasanah (2018) noted that integrating digital technology, such as AR, in

mathematics education can enhance both student engagement and conceptual understanding, particularly in complex topics like geometry.

These findings suggest that integrating AR into the mathematics curriculum can address common challenges in teaching three-dimensional material, such as difficulties in spatial visualization and lack of student engagement. By making learning more interactive and enjoyable, AR not only improves cognitive outcomes but also fosters a positive attitude towards mathematics. The results of this study highlight the importance of adopting innovative teaching tools like AR to enhance both the cognitive and affective aspects of learning. Furthermore, the study provides valuable insights for educators looking to improve student engagement and interest in mathematics through the use of technology.

CONCLUSION

The results of this study indicate that the use of Augmented Reality (AR) features in the GeoGebra application significantly enhances students' interest in learning three-dimensional material. The average level of student interest reached 80.19%, with the highest scores in pleasure (86.34%) and interest (82.38%), demonstrating that AR creates a more enjoyable and interactive learning environment. Students also showed improvements in attention (77.86%) and involvement (74.18%), proving that AR helps students stay focused and actively engaged in the learning process.

However, this study has several limitations. The research was conducted with a relatively small sample of 61 students from SMAIT Raudhatul Jannah Cilegon. Additionally, the study only examined the immediate effects of AR on students' learning interest without exploring its long-term impact on academic performance or conceptual mastery. The use of self-reported questionnaires may also introduce bias, as students' responses could be influenced by their subjective perceptions.

Despite these limitations, the findings of this study provide important implications for both educational practice and future research. Integrating AR into the mathematics curriculum can be an effective strategy to enhance student engagement and learning outcomes, especially in topics that require strong spatial visualization skills, such as three-dimensional geometry. Teachers are encouraged to utilize AR as a learning tool that can make abstract concepts more tangible and easier to understand.

For future research, it is recommended to expand the sample size and involve diverse educational contexts to validate these findings. Longitudinal studies could also be conducted to explore the sustained impact of AR on students' academic achievements. Furthermore, future research may investigate how combining AR with other innovative teaching methods can enhance learning experiences in mathematics and STEM fields as a whole.

ACKNOWLEDGEMENT

The researcher expresses his sincere thanks to Mr. Dr. Denny Hardiana, M.Si who has provided guidance and direction for the research conducted, Mrs. Kiki Maulidina, S.Pd as the Head of SMAIT Raudhatul Jannah Cilegon who has provided support for this research, and Mr. and Mrs. Mathematics Teachers who are members of the SMAIT Raudhatul Jannah Mathematics KKG who

have completed this research. This research is supported by Hibah Pengabdian Kepada Masyarakat Universitas Pendidikan Indonesia 2024.

REFERENCES

- Andriyani, A., & Buliali, J. L. (2021). Pengembangan media pembelajaran lingkaran menggunakan augmented reality berbasis android bagi siswa tunarungu. *Math Didactic: Jurnal Pendidikan Matematika*, 7(2), 170-185. <https://doi.org/10.33654/math.v7i2.1353>
- Arifin, A. M., Pujiastuti, H., & Sudiana, R. (2020). Pengembangan media pembelajaran STEM dengan augmented reality untuk meningkatkan kemampuan spasial matematis siswa. *Jurnal Riset Pendidikan Matematika*, 7(1), 59-73. <https://doi.org/10.21831/jrpm.v7i1.32135>
- Baharuddin. (2010). Psikologi Pendidikan. Yogyakarta: Ar-Ruzz Media.
- Duval, R. (1998). Geometry from a cognitive point of view. In C. Mammana & V. Villani (Eds.), Perspectives on the teaching of geometry for the 21st century: An ICMI study. Dordrecht: Kluwer.
- Fraenkel, J., Wallen, N., & Hyun, H. (1993). *How to Design and Evaluate Research in Education 10th ed.* McGraw-Hill Education.
- Francis, K., & Whiteley, W. (2015). Interactions between three dimensions and two dimensions. In *Spatial Reasoning in the Early Years* (pp. 121-136). Routledge.
- Fujita, T., Kondo, Y., Kumakura, H., Kunimune, S., & Jones, K. (2020). Spatial reasoning skills about 2D representations of 3D geometrical shapes in grades 4 to 9. *Mathematics Education Research Journal*, 32, 235-255. <https://doi.org/10.1007/s13394-020-00335-w>
- Hadi, A. A., Sarifah, A., Maftuhah, T., & Putri, W. D. (2023). Rendahnya Minat Baca Anak Sekolah Dasar. *Renjana Pendidikan Dasar*, 3(1), 22–30. Retrieved from <https://prospek.unram.ac.id/index.php/renjana/article/view/303>
- Hardani, Andriani, H., Ustiawaty, J., Utami, E. F., Istiqomah, R. R., Fardani, R.A., Sukmana, D. J., Auliya, N. H. (2022). Metode Penelitian Kualitatif & Kuantitatif. Yogyakarta: Pustaka Ilmu.
- Herrera, L.M., Pérez, J.C., & Ordóñez, S.J. (2019). Developing spatial mathematical skills through 3D tools: augmented reality, virtual environments and 3D printing. *International Journal on Interactive Design and Manufacturing*, 13, 1385-1399. <https://doi.org/10.1007/s12008-019-00595-2>
- İbili, E., Çat, M., Resnyansky, D., Şahin, S., & Billinghamurst, M. (2020). An assessment of geometry teaching supported with augmented reality teaching materials to enhance students' 3D geometry thinking skills. *International Journal of Mathematical Education in Science and Technology*, 51(2), 224-246. <https://doi.org/10.1080/0020739X.2019.1583382>
- Komariyah, S., Afifah, D. S. N., & Resbiantoro, G. (2018). Analisis pemahaman konsep dalam memecahkan masalah Matematika ditinjau dari minat belajar siswa. *SOSIOHUMANIORA: Jurnal Ilmiah Ilmu Sosial Dan Humaniora*, 4(1). <https://doi.org/10.30738/sosio.v4i1.1477>
- Osyopova, N., Kokhanovska, O., Yuzbasheva, G., and Kravtsov, H. (2020). "Implementation of Immersive Technologies in Professional Training of Teachers." In *International Conference on Information and Communication Technologies in Education, Research, and Industrial Applications*; October 06, 2020; 1308, 68–90.
- Parzys, B. (1988). "Knowing" vs "seeing". problems of the plane representation of space geometry figures. *Educational Studies in Mathematics*, 19(1), 79–92. <https://doi.org/10.1007/BF00428386>
- Pittalis, M., & Christou, C. (2010). Types of reasoning in 3D geometry thinking and their relation with spatial ability. *Educational Studies in mathematics*, 75, 191-212. <https://doi.org/10.1007/s10649-010-9251-8>
- Putrawangsa, S., & Hasanah, U. (2018). Integrasi teknologi digital dalam pembelajaran di era industri 4.0: Kajian dari perspektif pembelajaran matematika. *Jurnal Tatsqif*, 16(1), 42-54. DOI: [10.20414/jtg.v16i1.203](https://doi.org/10.20414/jtg.v16i1.203)
- Retnawati, H. (2017). Teknik Pengambilan Sampel. Yogyakarta: STIKES Surya Global Yogyakarta.
- Safari. (2003). Indikator Minat Belajar. Jakarta: Rineka Cipta.
- Sara, J. A., & Danawak, Y. (2021). Kajian media pembelajaran augmented reality (AR) dalam pembelajaran bangun ruang. In *Prosiding Seminar Nasional Matematika Dan Sains* (pp. 240-247).
- Soesana, A., Subakti, H., Karwanto, Fitri A., Kuswandi, S., Sastri, L., Falani, I., Aswan, N., Hasibuan, F. A., Lestari, H. (2023). Metodologi Penelitian Kuantitatif. Medan: Yayasan Kita Menulis.

Su, Y. S., Cheng, H. W., & Lai, C. F. (2022). Study of virtual reality immersive technology enhanced mathematics geometry learning. *Frontiers in Psychology*, 13, 760418. <https://doi.org/10.3389/fpsyg.2022.760418>