Jurnal MATHOLOGI: Jurnal Pendidikan dan Riset Matematika
Volume 1, No. 1, Januari 2026 – Juni 2026, pp. 12 – 18

IMPLEMENTATION OF AUGMENTED REALITY-BASED LEARNING MEDIA USING THE AGAR (AMAZING GEOMETRY AUGMENTED REALITY) APPLICATION IN GEOMETRY

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Submitted : *27-01-2026* *Accepted* : *05-05-2026*
Revised : *11-03-2026* *Published* : *15-05-2026*

ABSTRACT

This study aims to determine the effectiveness of using AGAR (Amazing Geometry Augmented Reality) media in mathematics learning, specifically in teaching spatial figures at a junior high school in Malang. This study uses a pre-experimental design. The sample size in this study was 24 students. The instruments used were pretest, posttest, and student response questionnaires. The data analysis techniques used were descriptive data analysis and inferential data analysis using SPSS software. The results showed that the average pretest score of the students was 73.85 and the average posttest score was 81.5. The students' learning outcomes before the learning process were still relatively low because no students obtained a score above the minimum passing grade, while the students' learning outcomes after the learning process were relatively high because 21 students obtained a score above the minimum passing grade. The students' learning outcomes before the learning process were not satisfactory because no students achieved the minimum passing grade, while after the learning process, 21 students achieved the minimum passing grade. Thus, the students' learning outcomes after the learning process met the classical mastery criteria. The students' response to the use of AGAR media was that 93.5% of students chose the "yes" category and 6.5% of students chose "no," so it can be said that the students' response was positive. Thus, it can be concluded that the application of AGAR media is effective on students' mathematics learning outcomes.

Keywords: Augmented reality, geometry, effectiveness, learning outcomes.

INTRODUCTION

Everything that moves must change, as is the case with the current situation with revolutions in various fields. The social sector has entered the 5.0 society revolution, while the technology sector has entered the 4.0 industrial revolution. All of this has had an impact on every aspect of life, and those who are able to take advantage of these changes will certainly benefit. Therefore, the impact of this revolution poses a challenge for all countries in the world (Neumman, W et al., 2020).

In this case, it is necessary to prepare to respond to all the challenges posed by the social and industrial revolutions. This preparation can be carried out by encouraging intensive change in various sectors of life, especially in the education sector. This is because the education sector will produce competent individuals, whose competencies will enable all resources to be utilized to the maximum, so that this revolution will have a beneficial impact (Ramdani et al., 2019).

Education is a conscious effort to develop children's abilities and potential so that they can benefit from it in their lives as citizens. Education aims to develop human potential so that individuals can become leaders on earth and to nurture their potential, talents, and interests (Ahmadi, 2016). The learning process in schools is constantly undergoing renewal, especially in the use of technology to deliver learning materials. This is in line with the development of science and technology, which is advancing day by day. The role of teachers in learning is to provide, demonstrate, guide, and motivate students to interact with the various learning resources available. Student interaction can be carried out through methods and multimedia. With all the potential that students have, they will naturally interact actively in the learning process (Wati, 2016).

Mathematics learning is a means of developing thinking, therefore mathematics has an important role. In everyday life, mathematics is used to solve problems and for the advancement of science and technology (Fauzan et al., 2022). This proves that learning mathematics encourages students to use mathematical thinking in learning other sciences.

According to Sundayana (2014), mathematics is one of a set of learning materials that plays an important role in education, influencing the development of science and technology. In parallel with this, according to Fauzan (2024), mathematics is a fundamental part of education that shapes the way individuals think and solve problems. One of the most important subjects in mathematics education is geometry. Geometry is taught to students starting in elementary school. According to Walle (2001), the reasons for the importance of learning geometry are (1) geometry is closely related to everyday life, (2) geometry can develop problem-solving skills, (3) geometry plays an important role in learning other branches of mathematics, (4) geometry can be applied in everyday life, and (5) learning geometry is very enjoyable. In line with this opinion, according to Budiarto (2000), the objectives of learning geometry are to develop logical thinking skills, develop spatial intuition, instill knowledge to support other subjects, and be able to read and interpret mathematical arguments. Logically, geometry should have a greater chance of being understood by students than other branches of mathematics.

There are several factors that make geometry easier to understand than other subjects. Among them is the fact that students are already familiar with geometric ideas before they start school. From an early age, students are exposed to geometry in their surroundings, such as blackboards, drums, balls, cardboard boxes, and many other objects. However, evidence in the field shows that students' learning outcomes in geometry are still low. One factor that causes low learning

outcomes in geometry is the existence of initial misconceptions and the assumption that the material is difficult, especially in the subject of spatial figures. Students consider spatial figures to be difficult, and when children consider a subject to be difficult, they will easily get bored of learning, so it becomes a challenge for teachers to be motivated to create more interesting and enjoyable learning experiences. Creating enjoyable learning can be done through learning that is tailored to the characteristics of the students. As is well known, learning is a process of interaction between students and educators and learning resources in a learning environment. Learning resources can take the form of learning media. A medium can be said to be a learning medium if it is able to transmit learning information from the source of information to the recipients of that learning information (Bairdm, D & Fisher, 2005).

Effective learning media will determine whether learning information is conveyed well or not to students, which will later affect their learning achievements. Students' knowledge will become more abstract if learning uses media with verbal language, which will later cause differences in perception between students and educators. Knowledge will become more concrete if learning uses media that provides direct experience in learning, because it involves all human senses (Arsyad, 2019).

Effective learning media will also encourage students to learn independently, thereby forming student-centered learning. To that end, the use of technology is necessary to create effective learning media. One such technology is virtual technology, which is a product of the 4.0 industrial revolution. This was chosen because virtual technology is capable of accurately representing real objects in providing information. One example of virtual technology is Augmented Reality (AR) (Hammer et al., 2021).

Augmented Reality (AR) is a concept that combines digital information (images, videos, audio, text) into a virtual environment and displays it in real time. Augmented reality technology uses objects as markers to display images, videos, audio, text, and 3D visuals, enabling this technology to display virtual 3D tools and materials, and even simulation videos in learning. The markers required for augmented reality technology can be in the form of cards or paper, so they can be embedded into existing objects. This capability will play a significant role in learning media (Mubai et al., 2020).

Many learning media have been developed using AR technology, one of which is AGAR (Amazing Geometry Augmented Reality). This media was developed as learning media for spatial geometry material. It consists of marker paper and an application that can be downloaded for free from the Google Play Store.

The AGAR media application uses smartphone devices, making this media highly mobile. Furthermore, this learning media application also uses the Android operating system, resulting in excellent media interactivity. This application is also capable of presenting attractive displays, making it possible to use it for independent learning, and this learning media also has good independence.

Therefore, this study will analyze learning outcomes, mastery, and student responses in the application of AGAR (Amazing Geometry Augmented Reality) media in spatial geometry material.

METHOD

The type of research used in this study was pre-experimental. The research involved only one class as the experimental class. The aim was to determine the effectiveness of spatial learning through the use of AGAR (Amazing Geometry Augmented Reality) media in a junior high school in Malang City. The research design used to measure the effectiveness of using AGAR media in spatial learning is One-Group-pretest-posttest. In the trial, no control class was used. This research design was carried out by comparing the pretest and posttest results in the trial class. The instruments used to determine student learning outcomes were pre-tests and post-tests, which were conducted to determine students' abilities before and after being taught using AGAR media. Individual student learning completeness was achieved when students' absorption reached 75% of the subject matter through test assessments, while classical student completeness reached 80% of the number of students who met the completeness criteria. Then, to measure the effectiveness of the AGAR learning media, an effectiveness instrument was used, which was taken from a student response questionnaire. The questionnaire was given after the learning activities were carried out. Several statements related to the media used were prepared on the response sheet. This was aimed at seeing the extent of students' interest in the AGAR media.

RESULTS AND DISCUSSION

After implementing AGAR learning media and calculating the research results data, we arrived at the discussion of the research results. The AGAR learning media implementation research was carried out with appropriate and measurable objectives, designs, and research subjects. The first research result was the students' learning outcomes before and after the implementation of AGAR media.

The analysis of student learning outcomes before the implementation of spatial learning using AGAR media showed that 100% of students did not achieve individual mastery because they scored below 75. In other words, student learning outcomes before the implementation of AGAR media were low and did not meet the criteria for classical mastery. After learning with AGAR media in spatial learning, the average student score was 81.5. Meanwhile, before learning with AGAR media, the average student learning score was 73.85.

In the application of spatial learning using AGAR media, it was found that 21 students or 87.5% of students achieved individual mastery, while 3 students or 12.5% did not achieve mastery. Since 21 students or 87.5% achieved mastery, it can be concluded that the students' learning outcomes

after applying spatial learning media met the indicators of classical learning mastery.

In general, learning using AGAR media motivates students to be more enthusiastic in participating in learning, especially in spatial learning. This is because many teaching and learning activities do not use media and only use textbooks. Students only see examples from books without real media. In fact, students need learning media to make it easier for them to understand the material. AGAR media is learning media with the aim of enabling students to see the actual shapes of these spatial figures. This motivates students to learn mathematics and enables them to achieve good learning outcomes.

Another result of the analysis is the students' response analysis. The results of this analysis show that, in general, students responded positively to learning with AGAR media, where students enjoyed learning mathematics and enjoyed the learning atmosphere using AGAR media. Students also responded that the teaching and learning process and the way teachers taught using AGAR media were interesting. Students found it easier to understand the material, and students said that the use of AGAR media was different from usual.

When the normality test was conducted, the Shapiro-Wilk test showed that the Sig. value for the test results was 0.077. Because this value is greater than 0.05, it can be concluded that the data comes from a normal distribution. The analysis results show that the pretest and posttest data have met the normality test, which is a prerequisite test before conducting a hypothesis test, in this case a t-test. Because the pretest and posttest data are normally distributed, they meet the criteria for using a t-test to test the research hypothesis. The testing in this study used a Paired t-test.

Based on the results of the Paired Sample Test, the Sig. (2-tailed) value is 0.000 < 0.05, so in accordance with the decision-making guidelines, H_0 is rejected and H_1 is accepted. After comparing the significance value with 0.05, a comparison is made between the t-count value and the t-table value. The calculated t-value is negative, namely -14.725. The calculated t-value is negative because the average pretest score is lower than the average posttest score. In this situation, a negative calculated t-value can have a positive meaning. Therefore, the calculated t-value becomes 14.725. Based on the degree of freedom and significance value (α: 2). From the paired t-test results, we obtain a df of 22 and a significance value (0.05:2) equal to 0.025. This value is used as a reference to find the t-table value, which can be seen in the distribution of t-table statistical values. The t-table value is

2.074. Thus, because the t-value of 14.725 > t-table 2.074, in accordance with the decision, it can be concluded that H_0 is rejected and H_1 is accepted.

Several of the above research results show that Augmented Reality technology is practical, effective, and has a positive impact on the learning process of spatial material, especially in the form of learning media. Therefore, based on these research results, the application of augmented reality-based learning media can contribute significantly to fostering interest in learning spatial material in the form of practical and effective learning media.

CONCLUSION

Augmented Reality (AR) has characteristics that are in line with the current era of revolution, where AR application technology is based on technology that is capable of presenting mobile, interactive, and independent media, making AR technology one of the learning media solutions that is relevant to the development of learning in the era of the 5.0 society revolution and the 4.0 industrial revolution. Based on the results of the implementation of Augmented Reality (AR)-based learning media using the AGAR (Amazing Geometry Augmented Reality) application, it was found that the students' learning outcomes had an average score of 81.5, while the students' learning outcomes before using the learning media had an average score of 73.85. The learning outcomes in the pretest showed that 100% of students were not yet proficient. Meanwhile, in the post-test, the mastery of student learning outcomes showed that there were 3 students out of a total of 24 students, or 12.5% of students, who did not achieve individual mastery, and 21 students, or 87.5% of students, who achieved individual mastery. Thus, it can be said that mastery in learning was achieved in a classical manner. Furthermore, the positive response of students can be proven by the average positive response rate of 93.5%, which meets the criteria of above 75%. Thus, the implication of utilizing AR-based learning media can have a positive impact on the learning process in the form of practical and effective learning media.

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