

Application of Augmented Reality in Geometry Learning in Increasing Student Learning Motivation

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Abstract

ICT-based learning media is urgently needed to increase student motivation in learning, especially learning mathematics in flat material. The learning media used is Augmented Reality. Augmented Reality is defined as a technology that combines the real world with the virtual world, is interactive in real time, and is in the form of three-dimensional animation. This type of research is research design research type validation study qualitatively. Students' interest in learning that utilizes technology directly can be seen from their enthusiasm when explained about the barcode which contains augmented reality in the form of the Musi 6 Palembang bridge. Based on the research process that was carried out both during the pilot experiment and teaching experiment, the researchers saw that the enthusiasm of the students was not much different. In addition to increasing the enthusiasm of students, it turns out that there is a barcode containing augmented reality in the form of the Palembang 6 musu bridge about the activities students will be working on, which also helps students understand what they are doing. With the help of explanations from these videos the teacher makes it easier and saves more time because students are not confused when carrying out the activities given.

Keywords : Augmented Reality, Instructional Media

INTRODUCTION

Mathematics is formed as a result of human thought related to ideas, processes, and reasoning. The importance of the role of mathematics in everyday life, both in the realm of life and in the realm of education, therefore learning mathematics is very important at every level of school (Aisyah, et al, 2018).

One important part of mathematics is geometry. In some materials geometry is always an interesting discussion. Geometry is also a part of mathematics material that has a close relationship with other parts of mathematics (Sholihah, S. Z, 2017). Geometry as a field of study in school mathematics material gets a large portion to be studied at school, and the distribution of competency standard distribution for

junior high school occupation units, geometry material gets the largest proportion (41%) compared to other material and is a weak part of mathematics absorbed and limited knowledge and experience possessed by students is geometry (Supriadi, N., 2015). Nonetheless, evidence in the field shows that learning outcomes of geometry are still low and need to be improved, even among branches of mathematics, geometry places the most concern (Sudarman, 2000).

Some of the factors that cause students' difficulties with flat geometric material, especially triangles, are the way the teacher conveys material that is difficult for students to understand, the teacher's limited use of concrete media, and the learning process that is less meaningful (Novita, et al, 2018). The teacher is one of the determining factors for achieving learning objectives in education, especially in learning geometry. One important factor in achieving learning objectives is the teacher's teaching methods in class (Nursyahidah, F., Saputro, A. B., Albab, U. I, 2020). 3D geometric and 3D geometrical learning is still conventional, schools and teaching staff find it difficult to procure visual aids as a means of media for geometrical and 3D geometrical learning because without teaching aids they are only able to imagine or imagine the 3D geometric objects themselves. Therefore the teacher must make updates in learning, namely changing the conventional way of learning to digits (Hanan, A. R, et al. 2018).

At the beginning of this century, teachers or teaching staff must be prepared to face the technological era. This readiness is shown by the teacher's ability to use ICT in learning. This need is based on the consideration that learning using real or concrete media will increase students' interest in learning, because it will make it easier for students to understand the material being taught (Dewi, Ressi Kartika, 2020). It is important for teachers to design triangular learning that is more meaningful by using context and ICT-based media, the use of context and ICT-based media in learning mathematics can make mathematical concepts more meaningful because it can make it easier for students to understand the representational form of abstract mathematical concepts (Haris & Putri, 2011).

Along with the development of science and technology, currently available various forms of technology-based learning media. The use of 2-dimensional (2D) and 3-dimensional (3D) media in education is very useful in increasing student interest and learning outcomes. This is proven by previous research, namely by (Sari, Pudjawan & Suarjana, 2016; Prabowo & Wulandari, 2018, Supriatno, Bukhori & Saragih, 2017; Nopitasari & Saefudin, 2017). It turns out that the use of 3D media is not used at the primary and secondary school level but also at the PAUD level.

One form of technology learning media for learning media is Augmented

Reality. Augmented Reality is a technology that combines two-dimensional or three-dimensional virtual objects and then projects these virtual objects in real time. Augmented Reality is defined as a technology that combines the real world with the virtual world, is interactive in real time, and is in the form of three-dimensional animation. Augmented Reality can be defined as a technology capable of incorporating virtual objects in two dimensions into a real environment and then displaying or projecting them in real time (Mustaqim, Ilmawan, 2016).

The AR concept itself was first introduced by Thomas P. Caudell in 1990 in The Term 'Augmented Reality'. There are three characteristics that state a technology implements the AR concept:

1. It is able to combine the real world and the virtual world.
2. It is able to provide information interactively and realtime.
3. It is able to display in three dimensions.

AR can be used to help visualize abstract concepts for the understanding and structure of an object model. Currently AR is widely used in the fields of games, medicine, and image processing, while in education it is still rarely used (Mustaqim, Scientist, 2016).

So, from the problems above, the reason for choosing the title of this research is expected to provide a solution to the problem above. Utilization of media using

2D and 3D technology-based ICT is very useful in improving the teaching and learning process because 2D and 3D technology has entertainment aspects that can increase students' interest in understanding concretely in learning media. Having an attractive appearance will make the teaching and learning process more interesting and you will not feel bored.

On this basis, it is hoped that learning using augmented reality can create new learning methods in understanding formulas that are more interactive and interesting and can help convey information on learning mathematics, especially triangular flat material. researchers want to see how students respond after implementing learning using augmented reality from a lesson.

METHOD

Researchers realize that there is a lack of articles discussing Augmented Reality (AR) technology that can be implemented in the field of education in Indonesia, especially in mathematics, so this study aims to explain how AR is used, and its impact on increasing student motivation. This type of research is research design research type validation study qualitatively.

RESULT AND DISCUSSION

1. Learning Media

Learning media supports the learning process to increase student learning motivation. The use of learning media can help in the learning process according to Sanaky (2013:5):

- a. Increase student enthusiasm for learning because of learning media.
- b. Learning methods that can use various learning media.
- c. Learners have reciprocal interaction in teaching and learning process activities.

The function of learning media is to facilitate and enhance the process of learning and teaching. Learning media refers to any tools, resources, or materials that are used to convey information, engage learners, and support the learning objectives. The main function of learning media is to promote effective communication and knowledge transfer between educators and learners. According to Midun (2012: 40-41) learning media can have several benefits, namely:

- a. Learning materials that use a variety of learning media can broaden the knowledge of students.
- b. Students get a variety of experiences when the teaching and learning

process is taking place using various types of learning media

- c. Students gain real and direct learning skills.
- d. Accurate and up-to-date information can be obtained by using learning media.
- e. The display of learning media is expected to motivate students' learning.
- f. Increase the efficiency of the learning process.
- g. Adding new ways in the teaching and learning process.

There are several relevant researches about the Augmented Reality:

- a) Mochamad Zulfahmi, 2020 : The Potential of Utilizing Augmented Reality as a Learning Media for Learning Motivation and Student Response. Discussion : This study aims to prove that augmented reality as a learning medium can be enjoyed by students in the form of learning motivators and student responses using augmented reality as a learning medium. Result : The results of this study are increased student motivation and positive responses to the use of augmented reality as a learning medium to obtain positive responses from

- students and increased student learning motivation.
- b) Septian & Yeni, 2020 : Literature Study of the Effect of Markerless Augmented Reality Based Learning Media on Student Learning Motivation. Discussion : Learning media in this method in each region have their own uniqueness and advantages in a more lively learning process. Result : There are many positive effects of increasing learning motivation from the application of this media so that students can produce creative traits, their emotional intelligence becomes measurable, and students are more competitive and collaborative with their peers.
- c) Afifah & Yuli : The Effect of Mobile Augmented Reality on Intrinsic Motivation and Geometry Learning Achievement in Online Learning in Class 8 Junior High School Students. Discussion : This study aims to see the effect of implementing mobile augmented reality (MAR)-based learning media and compare it with Powerpoint media on intrinsic motivation and student achievement in online

learning build a room using a virtual class. Result : The results show that there is no significant difference in the average intrinsic motivation and learning achievement of students in online learning using a virtual class. The self-report results show that the use of MAR learning media presents a fun learning experience and makes learning content easier to understand

Based on the research above, it is concluded that augmented reality learning media has the potential to increase student learning motivation. The function of augmented reality (AR) in learning is to provide an interactive and immersive learning experience by overlaying virtual elements onto the real-world environment. AR technology enhances traditional educational methods by integrating digital information and virtual objects into the learner's perception of the physical world.

2. Augmented Reality (AR)

a. Definition of Augmented Reality

Augmented Reality is a combination of real and virtual objects in a real environment, running interactively in real time, and there is integration between objects in three dimensions, that is, real and virtual objects are made possible

with appropriate display technology, interactivity is possible with appropriate display technology, interactivity is possible through certain input devices, and good integration requires effective tracking (Yudhastara, B. 2012).

Augmented Reality technology was first implemented by Ivan Sutherland in 1962. Augmented Reality as a methodology has also been developed by many parties so that it can be implemented on various devices. AR deployments also do not require any special additional devices which generally take a lot of time and funds for the purchase and installation process. Based on the two reasons that have been described, AR technology has been developed by many developers on mobile platforms such as Android or IOS (Amir, I., 2017).

Augmented reality (AR) is a technology that combines the real-world environment with virtual elements, enhancing the user's perception and interaction with their surroundings. It overlays computer-generated content, such as visuals, sounds, or 3D objects, onto the user's view of the physical world, typically through the use of a

mobile device, smart glasses, or a heads-up display.

Unlike virtual reality (VR), which creates a fully immersive virtual environment, AR enriches the real world by adding virtual elements that appear to coexist with the physical environment. This blending of virtual and real-world elements allows users to interact with both simultaneously.

b. The function of Augmented Reality

According to Lee, Augmented Reality has the potential to attract, inspire, and motivate students to explore and control from a variety of different perspectives, which previously had not been considered in the world of education. Augmented Reality (AR) is a combination of virtual objects (text, images, and animation) in the real world (Wahyudi, A. K., 2014). The various potentials and advantages of applying augmented reality technology to education include having the power to attract students in a way that was previously not possible and giving students freedom to carry out the discovery process in their own way (Amir, I., 2017).

c. The benefits and drawbacks of Augmented Reality

The benefit of Augmented Reality

According to Raviraj, et al (2013), the advantages of a system that uses the AR method are as follows: Interaksi terasa begitu nyata

1. Because virtual objects are displayed in real terms on the user's device screen, users can interact with these virtual objects directly
2. Implementation is cheaper
3. AR does not require a special device which of course makes implementing an AR system much cheaper
4. The possibility of system hiccups is displayed less

The drawback of Augmented Reality

Augmented Reality (AR) also has drawbacks, namely:

1. Users do not see the mixing between virtual objects and the real world, users will certainly feel that the entire environment that is generated virtually feels more real than just an object positioned in the real world
2. Does not support production facilities to the

overall environmental design.

3. AR does not describe the environment as a whole. Overall environmental design is not very supportive of the implementation of AR-based systems.

3. The Preparation of Augmented Reality

Augmented Reality is presented using a barcode on student activity sheets based on the results of discussions with the team and supervisors presented in a very simple manner which includes pictures, videos, and questions in the form of geogebra. In the process of making augmented reality, researchers go through six stages, namely: material preparation, context preparation, video and photo capture, editing process, process of creating AR in the assemblr application, uploading and creating barcodes or QR codes.

Making augmented reality on student activity sheets by researchers is done using a laptop, for taking photos and videos taken through recordings in context then the video is edited using a video editing application

a. Assemblr

The reason researchers use the assemblr application is because assemblr can be used using the website or chrome so there is

no need to download the application, and the way to use it is easy, just enter an account then enter an image and edit the image as you wish then save it in the project, after that then download the barcode to be placed on the Student Activity Sheet, besides this site it also allows us to make QR Codes for free without any usage time limits.

b. Editing Video

Apart from using augmented reality, the researchers also added a video to further clarify the flat shapes on the Musi 6 Palembang bridge. The first step is that the researcher prepares a video and then updates it using a video editing application.

c. Barcode

Making augmented reality on student activity sheets by researchers using cellphone cameras to take photos or videos and then edit them using a video editing application. Making barcodes in this study was carried out by researchers through an online site, namely QR Code Monkey. The reason researchers use the QR Code Monkey site is because this site allows us to create QR Codes for free without a usage time limit. In addition, the features available on this site can also be

said to be complete, starting from URLs, text, email, phone, SMS, and so on.

4. Student Responses to Augmented Reality

Based on the facts the researchers found during the research conducted at SMP Al-Azhar 33 Palembang, during their learning they had never applied augmented reality technology, so that when the research took place they were very interested in the results of augmented reality that they saw through their tablets, because they could learn while using technology that is closely related to everyday life.

Students' interest in learning that utilizes technology directly can be seen from their enthusiasm when explained about the barcode which contains augmented reality in the form of the Musi 6 Palembang bridge. Based on the research process that was carried out both during the pilot experiment and teaching experiment, the researchers saw that the enthusiasm of the students was not much different. Below is student documentation when running the barcode which contains the augmented reality Palembang 6 musu bridge which is on the Student Activity Sheet.



Figure 1. Student documentation when using barcodes

In addition to increasing the enthusiasm of students, it turns out that there is a barcode containing augmented reality in the form of the Palembang 6 mus bridge about the activities students will be working on, which also helps students understand what they are doing. With the help of explanations from these videos the teacher makes it easier and saves more time because students are not confused when carrying out the activities given.

The existence of activities in learning that involve students directly also has a good influence. With these activities the learning process becomes more enjoyable for students. This is in accordance with previous research which states that students will be more enthusiastic when directly involved in carrying out activities in real learning. Besides that, learning activities that are adapted to learning material can also train students to hone problem-solving skills and easily understand material (Mauleto, 2021).

Most schools do not provide adequate geometry media/visual

aids/adequate geometric teaching aids so teachers only rely on blackboards to draw (Titisari, 2017, p.116). in fact, there are lecturers/teachers who draw manually. Curves that are drawn manually have drawbacks and don't even match the concepts in mathematics. Drawing manually requires more time than using software. Geogebra applications can be used as learning media with various facilities (fitriaasari, 2017, p. 68). Deficiencies in drawing this curve have an impact on students who will feel confused. Facilities in learning can be a factor of differences in student learning outcomes (Abadi et al., 2018, p. 1).

CONCLUSION

Augmented Reality is a technology that combines two-dimensional or three-dimensional virtual objects and then projects these virtual objects in real time. Augmented Reality is defined as a technology that combines the real world with the virtual world, is interactive in real time, and is in the form of three-dimensional animation. Augmented Reality has the potential to attract, inspire, and motivate students to explore and control from a variety of different perspectives, which was not previously considered in the world of education. Augmented Reality (AR) is a combination of virtual objects (text, images, and animation) in the real world. Various potentials and advantages of applying augmented reality technology for education, among others, one of

which is having the power to attract students in a way that was previously not possible and giving students the freedom to carry out the discovery process in their own way. Students' interest in learning that utilizes technology directly can be seen from their enthusiasm when explained about the barcode which contains augmented reality in the form of the Musi 6 Palembang bridge. Based on the research process that was carried out both during the pilot experiment and teaching experiment, the researchers saw that the enthusiasm of the students was not much different. In addition to increasing the enthusiasm of students, it turns out that there is a barcode containing augmented reality in the form of the Palembang 6 musu bridge about the activities students will be working on, which also helps students understand what they are doing. With the help of explanations from these videos the teacher makes it easier and saves more time because students are not confused when carrying out the activities given.

REFERENCES

- Aisyah, P. N., Khasanah, S. U. N., &, Anik Yuliani, E. E. R. (2018). Analisis Kemampuan Pemecahan Masalah matematis Siswa Pada Materi Segiempat Dan Segitiga. *JPMI : Jurnal Pembelajaran Matematika Inovatif*, 1(5), 1025-1036
- Mustaqim, Ilmawan. 2016. Pemanfaatan Augmented Reality Sebagai Media Pembelajaran. *JPTK : Jurnal Pendidikan Teknologi dan Kejuruan*, 13 (2)
- Sholihah. S. Z & Afriansyah. E. A. (2017). Students Difficulties Analysis In Problem Solving Of Geometry Based On Van Hiele Thingking Stages. *Mosharafa: Jurnal Pendidikan Matematika*. 6 (1) hal 288
- Sudarman. 2000. Pengembangan Paket Pembelajaran Berbantuan Komputer Materi Luas dan Keliling Segitiga untuk Kelas V Sekolah Dasar. Tesis tidak diterbitkan. Malang: PPS UM.
- Suprihady, D (2015). Aplikasi Geogebra dalam pembelajaran Geometri Bidang. Makalah IF2123 Aljabar Geometri-Informatika ITB.
- Hanan, A. R., Fajar, I, Pramuditya, A. S. (2018). “Desain Bahan Ajar Berbasis Augmented Reality Pada Materi Bangun Ruang Bidang Datar”. *Prosiding SNMPM II, Pendidikan Matematika*, 2 (1),288
- Haris, D., & Putri, R. I.I. (2011). The role of context in third graders learning of area measurement. *Journal on Mathematics Education*, 2(1)
- Nursyahidah, F. Saputro., A. B, Albab. U. I. (2021). “Desain

Pembelajaran Kerucut
Berkonteks Tradisi Megono
Gunungan”. Jurnal Elemen. 7
(1)

- Yudhastara, B. (2012). “Teknologi Augmented Reality Untuk Buku Pembelajaran Pengenalan Hewan Pada Anak Usia Dini Secara Virtual”. Skripsi. Yogyakarta: Sekolah Tinggi Manajemen Informatika Dan Komputer Amikom Yogyakarta.
- Raviraj, S., Patkar, S., Singh, P., & Brj. S., V. (2013). Marker Based Augmented Reality Using Android OS. India: Pune University.
- Amir, I. (2017). “Pengembangan Buku Ajar Dan Augmented Reality (AR) Pada Konsep Sistem Pencernaan Di Sekolah Menengah Atas”. Skripsi. Pogram Pasca Sarjana. Makasar : Universitas Negeri Malang.