Augmented Reality Development Opportunities in Geometry Learning for Elementary Students

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Abstrak

Lembaga Pendidikan pada dasarnya akan memperoleh banyak manfaat dari penggunaan Teknologi, seperti misalnya teknologi augmented reality yang dirancang untuk menunjang proses pembelajaran di kelas, ditambah lagi teknologi augmented reality dapat dioperasikan pada smartphone. Penelitian ini memiliki tujuan untuk menganalisis peluang pemanfaatan smartphone dalam rangka inovasi pengembangan media pembelajaran dengan format augmented reality. Pendekatan kualitatif digunakan pada penelitian ini dengan metode survey. Populasi yang digunakan pada adalah siswa Madrasah Ibtidaiyah dengan total sampel 127 siswa. Teknik pengumpulan data pada penelitian ini adalah teknik non-tes, dengan instrument pengumpulan datanya adalah angket. Hasil penelitian ini menunjukkan bahwa smartphone menjadi teknologi yang cukup familiar bagi siswa, mengingat hampir sebagian besar siswa memilikinya, siswa juga menyukai aktivitas belajar yang memanfatkan smartphone karena memuat beberapa komponen seperti teks, grafis, narasi, video bahkan animasi. Hasil penelitian ini tentu dapat menjadi landasan dalam pengembangan suatu produk media pembelajaran berbasis augmented reality mengingat komponen yang membuat siswa termotivasi untuk belajar termuat didalamnya. Melalui penelitian ini diharapkan dapat muncul inovasi sumber belajar baru dengan harapan siswa dapat terfasilitasi dalam mempelajari materi dan menguasai berbagai kompetensi yang mereka butuhkan.

Kata Kunci: Augmented Reality, Sekolah Dasar, Bangun Ruang, Matematika

Abstract

Educational institutions will basically get many benefits from using technology, such as augmented reality technology which is designed to support the learning process in the classroom, plus augmented reality technology can be operated on smartphones. This study aims to analyze the opportunities for the use of smartphones in the context of innovation in the development of learning media with augmented reality formats. A qualitative approach was used in this study with a survey method. The population used is Madrasah Ibtidaiyah students with a sample was 127 students. The data collection technique in this study was a non-test technique, with the data collection instrument being a questionnaire. The results of this study indicate that smartphones are a technology that is quite familiar to students, considering that most students have them, students also like learning activities that utilize smartphones because they contain several components such as text, graphics, narration, video and even animation. The results of this study can certainly be the basis for developing an augmented reality-based learning media product considering the components that make students motivated to learn are contained in it. Through this research, it is hoped that new learning resource innovations will emerge with the hope that students can be facilitated in learning the material and mastering the various competencies they need.

Keywords: Augmented Reality, Elementary School, Geometry, Mathematics

1. INTRODUCTION

The presence of virtual-based technology will allow visualization activities of learning materials that are more real through the use of ICT. Without realizing it, educational institutions will basically benefit from better accessibility through the use of virtual technologies, such as virtual reality and augmented reality (Liou et al., 2017; Shin, 2017). Currently, the presence of virtual technology has exceeded the educational limits outlined in the Education format, so it can be easily utilized and adopted (Martín-Gutiérrez et al., 2017; Scavarelli et al., 2021).

Augmented reality has developed to date, especially on mobile applications, many games and applications reflect the use of Augmented Reality features (Jang et al., 2021; Khan et al., 2019). Augmented Reality (AR) technology has begun to be used in a new function, which is used as a learning medium at various levels of education, without exception for basic education (Aripin & Suryaningsih, 2019; Syawaludin, A. et al., n.d.; Zulfarina et al., 2021). In line with this, education was always developing like in 21st century education was processes that integrate knowledge, skills, attitudes, and mastery of information technology. The student skills needed in the 21st century are higher order thinking skills (Laar et al., 2020; Tyan et al., 2020). The ability to think analytically is one of the life skills in the 21st century that must be possessed by students as a provision for life in order to be able to compete in the global world (Diah Rusmala Dewi, 2019; S. F. Pamungkas et al., 2020).

The ability to think analytically is the ability to identify the correct conclusion relationship between questions, statements, images, concepts or other forms that represent so as to provide a belief, information, or opinion on a problem. The thinking process is emphasized on convergent thinking, so that based on the facts, the available data is analyzed to narrow down the existing alternative solutions so that the right decision can be taken (Kartikawati et al., 2020; Manurung & Panggabean, 2020). Students' analytical thinking skills can be trained as early as possible. This means that children at that age have been able to use their thinking skills to identify concrete things, but have not been able to fully understand abstract things (Baruno, 2021; Suparjono et al., 2020). Based on the documentation data of grades in one of the State Islamic Madrasahs, the ability to analyze the material for building a fifth grade children's room is still low. Of the 4 classes in the school, the average evaluation scores on the material of spatial construction ranged from 50.49 to 67.89 for each class. So we need media that can improve the analytical thinking skills of the 5th graders.

The impact of online learning due to the Covid-19 virus is that the use of smartphones among elementary school level children has increased. According to a survey from BPS, children 5 years and over who access the internet to access social media reach 88.99% (Al Salman et al., 2021). Meanwhile, referring to the results of observations made at MIN 3 Karanganyar, it shows that all students have smartphones, however, their use is still not optimal but only used to accommodate hobbies, entertainment and student communication. This is of course very unfortunate, because there are still few children who use smartphones for the purposes of the learning process (Harris et al., 2020; Tanil & Yong, 2020).

The implementation of learning should be carried out interactively, inspiring, and can motivate students to be able to play an active role. So, teachers must choose learning media that can attract students' interest in learning. It is also very unfortunate, in fact there are still many teachers who have not used existing facilities such as smartphones for learning purposes. One of the uses of smartphones in education is as a learning medium (Buchari, 2018; Nisa et al., 2020; Zaheer et al., 2018), considering that conceptually learning media is a tool in the learning process. Learning media are everything that is used to encourage the learning process (Hendi et al., 2020; Martín-Gutiérrez et al., 2017). Many technologies develop learning media using smartphones. One of them is Augmented Reality (AR) technology. The ability to connect multimedia into the real world by using a smartphone is able to provide information to students anytime and anywhere. This helps teachers to teach students in a different way. The use of AR in education has great potential.

AR applications are currently developing very fast. Experts predict AR will become a new computing platform, because AR media allows students to interact with virtual or real world objects to learn through experimentation, participation and interactivity to increase learner attention and motivation (Muñoz-Saavedra et al., 2020; Sidhu & Ying, 2017). Students can know abstract concepts or complex phenomena, thanks to the possibility of

visualizing and realizing concepts that are accessible to students by technology, and AR media can also improve understanding of mathematical concepts (Khan et al., 2019; Yip et al., 2019). In this generation AR began to develop rapidly. The third generation (2019 – present) is characterized by the use of AR with smart glasses, web-based AR, and AI (Artificial Intelligence). In the field of education, many studies have proven the effectiveness of using AR in learning (Elmunsyah et al., 2019; Sugiyarto et al., 2018).

By using AR learning will be more interesting and fun. From the explanation above, one of the uses of AR is in mathematics. In mathematics, many students, especially elementary school students, find it difficult. This is because mathematics lessons are still abstract, while the way of thinking of elementary school-aged children is still concrete. In order for mathematics to be interesting and concrete, Augmented Reality (AR)-based mathematics learning media was developed. With AR, students can project virtual objects to become real in front of their eyes (Godoy Jr., 2020; T. D. Pamungkas, 2020). The advantage of Augmented Reality is an attractive visual display, because it can display 3D objects and their animations as if they exist in a real environment and juxtaposed with information about 3D objects in the form of sound, it is hoped that it can be used as an alternative learning media to make students interested in learning it (Arslan, R., Kofoğlu, M., & Dargut, 2020; Godoy Jr., 2020).

Based on the results of field observations and analytical studies of several relevant researches, it is important to initiate the emergence of learning media in the augmented reality format. Learning generally still uses conventional methods, namely lectures and exercises from the Student Worksheet book, so that learning becomes boring and students find it difficult to understand the material being taught. One of the mathematics materials taught in the fifth grade of Madrasah Ibtidaiyah is spatial construction. Students are still not able to analyze the shapes, determine the volume of the shapes, and find the nets of the shapes. This research has a novelty with other studies, namely the use of research subjects that focus on students who sit in elementary education and the use of augmented reality media which has not been developed by other researchers in the same research population.

Therefore, this study aimed to analyze the opportunities for using augmented reality-based learning media for elementary school students. Considering that this research and several previous studies have differences, namely related to the type of technology developed, many similar studies have examined the opportunities of a technology in the learning process, but only a few have tried to examine the opportunities for implementing augmented reality technology for elementary school students. Thus, this research is very important to know the results as an initial effort to develop and apply learning media that are not only technology-based, but also according to the needs and characteristics of students.

2. METHODS

The type of research used is descriptive quantitative research, with the approach was survey (Fadli, 2021; Salim, 2019). The use of this approach is in line with the research objective, namely to describe opportunities in the presentation of data in the form of numbers. The population of this study were students of Madrasah Ibtidaiyah Negeri 3 Karanganyar, with a subject of the reasearch was consist of 127 students who were selected by adopting a random sampling technique.

The data in this study were collected through a non-test technique, followed by a data collection instrument, namely a questionnaire (Oducado, 2021). This questionnaire will contain questions in order to answer the formulation of the problem and research objectives, the questionnaire in this study adopts from several studies that have been carried out. This needs analysis questionnaire consists of 3 indicators, starting from smartphone ownership, the

types of applications that are frequently used, and how students view the use of smartphones for the learning process, with a total of 5 questions. The questionnaire was adopted from several studies from (Alowayr & Al-Azawei, 2021; Hanif et al., 2018).

Before being distributed, the questionnaire was first consulted with teachers and lecturers who are considered experts in the field of learning and utilization of learning resources in order to maintain the quality and validity of data collection tools (Elangovan & Sundaravel, 2021). The results of student responses will later be analyzed descriptively packaged in percentage figures (Qodr et al., 2021), in order to describe opportunities for using augmented reality for learning activities.

This research procedure starts from a questionnaire that has been assessed or consulted first with the lecturer as an expert, then distributed to students during the learning process. The results of the questionnaire from the filling process were then analyzed and described the categories of student responses so that the percentage of students' responses to the questions could be known (I. Prasetyo, 2014), briefly the research procedure is illustrated in Figure 1.
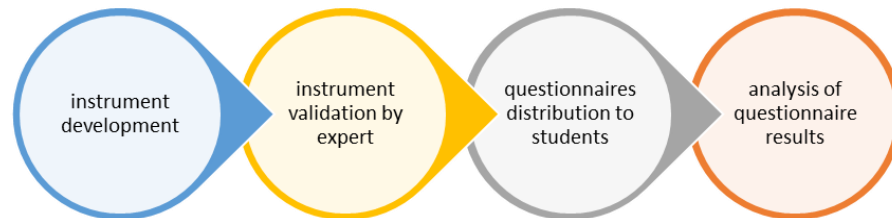

Figure 1. Research Procedure

3. RESULTS AND DISCUSSION

Result

In this section, we will present the results of identifying opportunities for using augmented reality learning media as one of the first steps (needs analysis) before entering the development and utilization stage. The description of the results of student responses to the distributed questionnaires will be explained both in narrative and with the support of the following graph or table.

The results of the first response are regarding smartphone ownership, even though they are still in basic education, but the fact that the student brings his smartphone to the school environment can certainly be indicated as an opportunity to use smartphones to support the learning process. The results of student responses show that if the smartphone they are carrying belongs to their parents (46% or a total of 58 students), students bring the smartphone under the supervision of their parents so that when parents contact students they can immediately connect when class time is over. In addition, there were also students who stated that the smartphone they brought was their own (48% or a total of 61 students), as well as several students who did not have a smartphone (6% or a total of 8 students). From these results, it can be seen that students basically already have smartphones, both personal property that they get from their parents' gifts, as well as parents' smartphones that they use to bring to school.

The identification results continue to how students use the smartphones they use, the survey results show that accessing Youtube dominates the use of smartphones by students, this of course cannot be separated from data sources or various data on Youtube and can be watched by all groups including elementary school students. Followed by the use of smartphones for communication purposes either via WhatsApp or Telegram. For elementary

school students, when they have a smartphone, they certainly cannot be released to play games, almost 25.2% of students use their smartphones to play games. As well as utilization in other matters which are quite low, such as accessing learning applications, accessing Tiktok, Social Media, and others, as shown in Table 1.

Table 1. Student-Accessed Apps

No	Response	Total students	Percentage
1	Learning applications (teacher room, zenius, etc.)	6	4.7%
2	Games	32	25.2%
3	Entertainment (Tiktok, Rheso, etc)	16	12.6%
4	Communication (WA, Telegram, etc.)	21	16.5%
5	Youtube	39	30.7%
6	Social media	2	1.6%
7	Etc	11	8.7%
	Total	**127**	**100%**

Base on Table 1, the identification results are in line with the results of student responses in the next item where almost quite a number of students state that they have learned to use their smartphones (96,6%), however the learning platform they access is Youtube, this certainly indicates that students are interested in audio shows. visuals, both in the type of general information, entertainment, as well as information supporting learning materials. However, most people use Google to search for information in the form of text, graphics or other information.

Table 2. Types of Learning Applications that Students Do with Smartphones

No	Response	Total students	Percentage
1	Learn through Google	80	63%
2	Learn through the Ruangguru Application	5	3.9%
3	Learn through Youtube	30	23.6%
4	Etc	12	9.4%
	Total	**127**	**100%**

Base on Table 2, smartphones are often used by most students to do the assignments they get after participating in learning activities in class, a total of 66,1% of students stated that when they get assignments or homework that must be completed, they sometimes use smartphones to do work. the house, either to seek information from Google, Youtube, or information from classmates. This can certainly indicate that smartphones are used quite often by students but there has been no media innovation - digital learning media developed by teachers to then be used specifically for the subjects they teach in class.

Discussion

The development of technology in the digital era occurs so quickly, so that opportunities to take advantage of it need momentum and a good analytical process because it will greatly impact the sustainability of the activities of its users. As is data regarding the identification of the use of smartphones as one of the technological devices that are often used for learning activities (Kearney & Maher, 2019; H. Prasetyo et al., 2019; Uther, 2019). Student responses have been described in the results of the first study regarding smartphone ownership, basically the results of the study show that smartphones have become familiar

items for students, so most of them have owned them both privately and by their parents. These results certainly provide an illustration that technology has entered various lines of human life regardless of age and psychological abilities (Abdul Talib et al., 2019; Saikat et al., 2021), even in some studies also showing that the role of smartphones is almost impossible. replaced for millennials and some students, without exception elementary school students (Amin et al., 2021; Matzavela & Alepis, 2021; Pedaste et al., 2020).

However, from the results of the study, it is also known that most students use smartphones not for learning activities, but to access Youtube and play games, this certainly shows that the use of smartphones is not optimal to support the learning process. In fact, several studies have shown that smartphone use can be integrated with media such as augmented reality (Danaei et al., 2020; Dinayusadewi et al., 2020; Ibáñez & Delgado-Kloos, 2018), as well as smartphone-based learning media or mobile learning (Agustini et al., 2020; Chiappe-Laverde & Paz-Balanta, 2021; Ngabekti et al., 2019), as well as smartphone-based learning media or mobile learning where students can access course materials as their supplement to add insight or master the material they are learning (Chiappe-Laverde & Paz-Balanta, 2021; Uther, 2019). Of course, it is necessary to optimize the use of smartphones to support the learning process, considering that there are many types of digital learning media that can be packaged and accessed via smartphones (Hasyim et al., 2020; Saputri et al., 2020; Sugiyarto et al., 2018).

Through technology such as smartphones, students can actually access various information they need to support their learning activities, especially in learning a material. It can be seen from the response of students who turned out to be doing learning activities both from Google, Youtube and other website-based media. These results are certainly in line with the benefits that are automatically seen from the integration and optimization of ICT into learning activities (Lin et al., 2017; Shatri, 2020). From these results it was also identified that students seemed to like information packaged in the form of audio-visual, visual and text which of course can only be obtained by students through the use of ICT devices such as smartphones and computers (Sari et al., 2019; Shamir et al., 2019). In several studies, it is stated that smartphones can be an intermediary to improve the quality of student learning processes and outcomes, such as in the development of learning media products in augmented reality format which in fact contribute to increasing learning motivation, digital literacy, and even students' critical thinking skills (Aurum & Surjono, 2021; Khan et al., 2019; Lin et al., 2017).

The process of developing augmented reality media certainly cannot be separated from several components such as text, graphics, audio, and video. All the components mentioned are in line with the responses of students who like the subject matter which contains these components. In this research, augmented reality has a high enough opportunity to be applied to the learning process, both from the results of research and several studies that show that Augmented reality is proven to be used as a learning medium (Dinayusadewi et al., 2020; Mustami et al., 2019). As some research has done that learning media with augmented reality format according to the results of expert assessments, obtain good results and are included in the category worthy of being used as learning media (Dinayusadewi et al., 2020; Sidhu & Ying, 2017). In addition, the use of smartphones in the learning process has been widely applied at various levels of education (Ilic, 2021; Matzavela & Alepis, 2021).

Research conducted by two researchers related to a review of the use of Augmented Reality in STEM-based learning shows that, during the STEM-based learning process, augmented reality media tends to be used in a simulation format that is supported by exploratory activities carried out by students. However, the presence of augmented reality as a learning media at that time were not equipped with features that fit the needs of students, so only a few students felt accommodated when learning with the help of augmented reality

(Dinayusadewi et al., 2020; Ibáñez & Delgado-Kloos, 2018). In addition, the application during the learning process. Other research also says that smartphone-based augmented reality technology is quite promising to be applied to learning activities in the 21st century, considering that several education providers are interested in adopting this technology into the learning process (Elmqaddem, 2019; Hakim, 2018). The need for optimizing the use of smartphones, one of which is through learning media such as augmented reality will have a positive impact on various improvements in student achievement, both in terms of academics and non-academic aspects (soft skills), this is because in augmented reality students are like being in a life and environment that has resemblance to the original (Hanafi et al., 2017; T. D. Pamungkas, 2020). Through the use of smartphone technology with augmented reality format accompanied by support from teachers, schools and parents, it is hoped that they can create a learning environment that supports one another (Ramadiani et al., 2020; Roy, 2019).

Overall, smartphone-based Augmented Reality can be one of the ideal formats to be used as learning media in the digital era. The presence of an innovation will ultimately make it easier for students to learn various materials that they receive while participating in activities at school. The high potential for using smartphones, especially in the Augmented Reality format for learning activities, cannot be separated from various facts, both theory and practice that have been proven to contribute positively to improving students' academic abilities and achievements. Through this research, it is also seen that the use of smartphones for the learning process plays an important role in creating an interactive and motivating learning climate.

However, with the limitations of this study, which is only able to present a result of the needs analysis related to the use of smartphones for the learning process, it is hoped that researchers can examine the types and forms of learning media that can be used through this smartphone, be it augmented reality which has been discussed. that the media has many benefits, as well as learning media with other formats that of course pay attention to the characteristics and needs of students as users.

4. CONCLUSION

This study succeeded in identifying how the opportunities for using smartphones as a basis for innovation in the development of augmented reality-based learning media are. Through the results of this study, it can be seen that the opportunities for using smartphones are high enough to be integrated into the learning process, not least for students who are at the elementary education level. This opportunity can be seen from the results of successful research showing that students like material that contains text, graphics, audio, and video components. The opportunity to use augmented reality is also inseparable from the many studies that find empirical facts that this media has various benefits for students who use it. Teachers certainly have hope that through this innovation they can be helped in optimizing the achievement of competencies and improving the quality of graduates.

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