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Literature Study: Development of Augmented Reality- Based Early Childhood Education Learning Media

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ABSTRACT

In the era of the Industrial Revolution 4.0, technology plays an important role in various aspects of life, including education. One technological innovation that can be applied in early childhood education is Augmented Reality (AR). This study aims to (1) determine the urgency of using AR technology in early childhood learning media; (2) explain the process of integrating AR technology into learning media; and (3) identify the effects of AR-based learning media on early childhood development. The research method used is a literature study by collecting, analyzing, and concluding findings from previous studies related to AR in education. The results show that (1) the use of AR is essential to introduce children to technology from an early age, preparing them to adapt and compete in the Industrial 4.0 era; (2) AR integration can be implemented through various learning materials, such as introducing numbers, letters, and creating interactive "Magic Book" media; and (3) the use of AR-based learning media has been proven to increase children's learning motivation, curiosity, and activeness. Therefore, it is recommended that early childhood education institutions in Indonesia begin adopting AR technology to make learning more interactive, engaging, and relevant to current technological developments.

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1. INTRODUCTION

The development of technology is growing rapidly and uncontrollably. The industrial era 4.0 constantly connects various aspects of life with technology. The education sector is no exception. In the era of the Industrial Revolution 4.0, the use of technology is often integrated with various aspects of life, including education. One of them is by integrating AR technology in learning media in early childhood education. Entering the industrial era 4.0 teachers should be creative and innovative by following the demands of the times to be literate in the latest technology. It cannot be denied that in this industrial era 4.0 children are so familiar with technology, as a teacher should be able to utilize technology as a learning medium (Oktaviana & Yudha, 2022).

Early childhood education is an educational process aimed at ages 0-8 years. In a study said that early childhood is a golden age. Of course, the role of the teacher is to stimulate children's development as well as possible so that children grow and develop optimally. However, a reality is that there are still many teachers who provide monotonous learning to children. As in previous research by Wiyanda et al. (2023), this institution still uses classical learning methods which are centered on a teacher. So it makes children become bored and bored because of less interesting learning. In another study conducted by Rahma teachers still use the lecture method which makes children bored and less enthusiastic about participating in learning activities (Rahma & Simamora, 2022).

The problem is caused by ineffective learning media. Integrating AR in learning media allows students to be more enthusiastic in participating in classroom learning. Learning in early childhood education must be more interesting and enthusiastic, one of which is by integrating augmented reality in learning (Cahyaningtyas, 2020). Augmented reality is media or applications that represent imaginary objects into real objects and with the resulting visualization can create learner interaction (Nasution et al., 2022).

The use of augmented reality as a learning media has been widely used by educational levels such as kindergarten, elementary school, junior high school, high school, and college level. Unfortunately, the use of augmented reality at the early childhood education level is still very integrated into learning media. AR is mostly applied in the college environment with a percentage of 23.64%, then SMP at 18.18% and SD at 16.36%. The study reviewed only about 5% of AR applications in early childhood education (Chen et al., 2017). Related to these problems, the author wants to know how the urgency, integration process, and the impact of augmented reality as a learning media in early childhood education.

2. METHODS

The research method used in this research is the literature study research method. According to Nazir (2014), the literature study research method means that researchers conduct various literature studies needed for research. This research is carried out by looking for theoretical references that are relevant to the topics and problems under study (Nazir, 2014).

Theoretical references found through literature study research are used as the basis for research discussion. The data sources that become references in this research are relevant literature sources as primary data sources (research results data, research reports, scientific journals, even previous literature study research, and so on.), and secondary data sources (basic government legal regulations, books, etc.).

After obtaining data sources as references, researchers analyzed the literature review data using content analysis. Content analysis is a process in which the researcher examines

the text objectively to gain an understanding of the content as a whole, without the intervention of the researcher (Ahmad, 2018). In this case, the researcher will thoroughly discuss the information contained in the data source, which requires setting time to read and study the information to achieve results. These results are expected to answer the problem and be considered in early childhood education.

3. RESULTS AND DISCUSSION

3.1. Augmented Reality-Based Learning Media

Multimedia is known to be more interactive to improve children's ability to recognize the elements of images and colors (Handayani, 2018). Augmented reality is a media or application that is a representation of an imaginary object into a real object and can create student interaction with the resulting visualization. Augmented reality (AR) is a learning environment that best supports children's visualization for rapid concept understanding. Plus, AR can make it easier for teachers to prepare learning materials and teaching to children becomes more interesting and attractive (Lee et al., 2019). Augmented reality (AR) can attract children's attention because the material is presented in virtual three dimensions and real time interactively so that children understand more about the material presented.

The word media comes from Latin and is the plural form of the word medium which literally means intermediary or introducer. According to Gegne (in Bart and Wong, 1974) states that media are various types of components in the student's environment that can stimulate him to learn. The National Education Association (NEA) has a different understanding. Media are forms of communication both printed and audio-visual and their equipment. Media should be manipulable, can be seen, heard and read. Whatever the limitation is, namely that the media is everything that can be used to channel messages from the sender to the recipient so that it can stimulate thoughts, feelings, attention, and attention. Can stimulate students' thoughts, feelings, attention, and interests and attention in such a way that the learning process occurs. Learning is a translation of the word "instruction" which in Greek is called *instructus* or "*intruere*" which means conveying thoughts, thus the meaning of instruction is to convey thoughts or ideas that have been processed meaningfully through learning. The word learning contains a more proactive meaning in carrying out learning activities, because in it not only educators or instructors are active, but students are active subjects in learning. So learning is a process of interaction between educators and students as well as learning resources and media used, in an effort to make changes in cognitive, affective, and motor aspects (Setiawati et al., 2020).

Learning media is any form of communication tool that can be used to convey information from sources to learners in a planned manner so as to create a conducive learning environment where the recipient can carry out the learning process efficiently and effectively (Mustaqim & Kurniawan, 2017). Learning media is a messenger technology that can be used for learning purposes, learning media is a physical means of delivering subject matter.

3.2. The Urgency of Developing AR-Based Learning Media

Today, where technological development is growing rapidly, various fields in the industrial world 4.0 are flocking to develop their aspects in order to achieve success in the future. In the world of education, especially early childhood, there are still difficulties and lack of adjustment in this digital era, despite the excellent schools in the capital city that have implemented a digital-based learning system. Yet as we know in the current digital era,

education that will stimulate early childhood development will have a huge impact in the future. In the industrial era 4.0, technology has dominated economic activities and changes in people's lifestyles, resulting in increased use of technology (Agit et al., 2023).

According to previous research, technology drives international investment and trade as well as increasingly efficient production processes (Lucya & Anis, 2019). Everyone today can live a life that meets expectations with the help of technology (Wahyuni et al., 2021). Therefore, in order for children to survive and compete in the digital era and even the future, it is important for them to learn technology from an early age. Using a science-themed curriculum and applying augmented reality technology, can be the answer to improving the quality of education in the era of the industrial revolution 4.0 which is characterized by the use of technology, digital, and IoT. This is evidenced by the increase in students' learning outcomes and the increasing pattern of students' ability to construct knowledge based on their learning experience after using augmented reality media (Dewi and Sahrina, 2021).

3.3. Examples of AR Utilization in Learning Media

Given the importance of using augmented reality in early childhood education, it is appropriate for a teacher to integrate it in learning media. As a teacher who lives in industry 4.0 must be creative and innovative to be able to balance the times. In the literature study AR can be integrated in learning media. For example, the introduction of numbers and letters formed with 3D animation using AR. Khoerunnisa, in her research, revealed that the use of AR for learning the recognition of numbers and letters is very effective because it makes children interested and not bored (Khoerunnisa, 2025).

In addition, AR can be implemented as learning media in the form of a mobile AR magical game book (Tomi & Rambli, 2013). In the concept of this book prototype, it has a story page design and a bookmark page. The story page has a storyline that is supported by illustrations on the current page. While the bookmark page contains the marker of each 3D character supported by animation on the current page. This book prototype uses a handheld display (mobile device) to view the book augmentation, as this display helps users experience the AR concept while maintaining the context of reading a normal book. Moreover, the computing power of mobile devices is advanced and also in 3D graphics processing with the introduction of embedded Graphic Processing Units (GPUs).

The concept of mobile AR books is the same as other physical books, so users can reduce the complexity of learning between mobile AR books and physical books. This AR book aims to perfect traditional books, where the natural interaction between book users remains, that natural interaction is pointing. Tangible User Interface (TUI) in AR is an interaction that uses the physical environment to be real when interacting with the AR system. In this prototype, the finger is used to interact with the book.

This AR book prototype concept is also equipped with a mobile application, where this mobile application is developed on the android platform. This mobile application features 3D characters and animations (crows) with audio to the bookmark page. In addition, this application also provides a narrator to the user with the aim of being a guide for children while reading the entire storyline. The book also designs highly interactive number learning for children. Users can interact with the book using their fingers to count along with the 3D character animations that are enlarged on the book, thus leaving a natural interaction between the user and the book. From here the concept of engaging students in the learning environment and process is fully implemented. The design of an interactive mobile AR application can create a fun, and motivating teaching and learning tool.

3.4. Benefits of Augmented Reality in Learning Media

Based on the literature study conducted on the benefits of augmented reality in learning media, the results show that the use of augmented reality in learning media has a good effect on students. Children become more motivated and eager to organize the utilization of technology in learning media is an answer to improve the quality of education in Indonesia. This is evidenced by the increasing learning outcomes of students and the increasing pattern of students' ability to construct knowledge based on their learning experience after using augmented reality media (Leliavia, 2023). Utilization of educational media using augmented reality can stimulate the mindset of students in thinking critically about a problem and events that exist in everyday life, so that the utilization of educational media using augmented reality can directly provide learning wherever and whenever students want to carry out the learning process (Mustaqim & Kurniawan, 2017).

In addition, the utilization of AR in learning media also has an effect on teacher TPACK competence. The results of the application of augmented reality applications can improve teacher competence in using digital media and providing digital learning infrastructure. In addition, the process of teaching and learning activities by utilizing digital media becomes more interesting and interactive (Setiawati et al., 2020). By utilizing AR media in learning, it has a positive impact on teachers and students because it can create active and interactive learning. Learning in the classroom becomes not monotonous. The results of the study suggest that the implementation of augmented reality is very easy for teachers to understand because it is user friendly and attracts children's interest (Nasution et al., 2022). In another study, it is said that the results of utilizing AR in learning media improve children's abilities. Children become faster and more responsive when compared to traditional learning media. Using AR makes students more motivated, easier to understand learning, and can learn and play using augmented reality (AR), providing a direct learning experience to young children (Cahyaningtyas, 2020).

The positive effect caused by the use of AR in learning media is because AR has advantages. The following are the advantages of using augmented reality in learning media (Leliavia, 2023).

1. Interesting because it is in accordance with the times and has an animated display that resembles a video game that looks real.
2. Easy to understand because it can display the process.
3. Objects can be displayed in detail and specifically because they are three-dimensional.
4. Abstract material can be visualized into concrete material so that students understand the material more easily.
5. Objects that are too complex, small, large, fast-moving, and too slow can be displayed and observed easily by students.
6. Has the ability to grow and imitate.

Furthermore, augmented reality not only improves learning motivation and cognitive understanding but also enhances collaboration and communication skills among early childhood learners. Through interactive AR applications, children can engage in group exploration, problem-solving, and storytelling activities that foster social-emotional development. In addition, AR provides inclusivity in learning, as it can be adapted for diverse learning styles and needs, supporting both visual and kinesthetic learners. The immersive nature of AR helps create meaningful learning experiences that bridge imagination and real-world understanding, which is essential for holistic early childhood education.

4. CONCLUSION

Based on the literature study conducted on the development of augmented reality in learning media, the results show that the use of augmented reality in learning media is important because augmented reality is part of technology. Early childhood is important to be introduced to technological devices so that they can survive and compete in the future. AR development in learning media can be integrated in early childhood education, for example in the introduction of numbers and letters, and in the learning media "Magic Book". Utilization of educational media using augmented reality can stimulate the mindset of students in critical thinking, creating active learning and because children are very motivated.

Thus it is highly recommended the development of augmented reality in Learning media. Because the integration of AR in learning models, teaching materials, and learning devices is able to encourage the achievement of student abilities effectively and efficiently. In its utilization AR is also more innovative and creative.

In addition, future research and development are expected to focus on how augmented reality can be applied more widely in classroom practice, especially for early childhood learning that integrates play-based and inquiry-based approaches. Collaboration between educators, technology developers, and policymakers will be essential to ensure that AR-based learning media can be used effectively and sustainably. Moreover, training programs for teachers should be continuously improved to enhance their digital competence and creativity in utilizing AR. Thus, the implementation of AR in early childhood education will not only make learning more engaging but also contribute to forming a generation that is adaptive, innovative, and ready to face global technological challenges.

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