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Can Augmented Reality Support Science Learning in the Era of Education 5.0?: A Review

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Abstract: Many teachers find it difficult to create science learning media and do not have enough time to develop them. Many complain about the difficulty in understanding material involving formulas and unfamiliar terms. These abstract concepts in science are what make students tend to stay away from learning. The purpose of this study is to explain Can Augmented reality support science learning in the era of education 5.0?; Review. This review was conducted based on the review method. The results of this study explain about science literacy in society (learning in schools and universities) 5.0, namely the society 5.0 era is present as an answer to the problem of justice and equality of shared prosperity; advantages and disadvantages of augmented reality in science learning: the advantages of AR are: More interactive; Effective in use; Can be widely distributed on various media; Simple object modeling because it only displays a few objects; Manufacturers do not spend too much money;. Easy-to-use AR media also has disadvantages, namely: Sensitive to changes in perspective. There are not many manufacturers; Requires a lot of memory on the installed device; Requires AR-enabled hardware.

Keywords: Education 5.0; Science learning; Virtual reality

Introduction

Society 5.0 is a new phase in which technology becomes a major component in human life. The beginning of this era was presented as a refinement of the industrial era 4.0, which is currently seen as disrupting the order of human life. In the era of the industrial revolution 4.0, education must be able to develop essential skills for the digital era, including information and communication skills (ICT), creativity, critical thinking, collaboration, and the ability to solve problems (Haleem et al., 2022). Along with the advancement of increasingly integrated technology (Sánchez-García et al., 2024), expertise in aesthetic and innovative digital media is needed to support the application of technology in the digital field (Verhoef et al., 2021). One important innovation in teaching and learning is the use of digital teaching materials. Science learning is a field that really needs digital teaching materials, because the goal of science education is to create students who act scientifically, can solve problems, and are able to assess information logically and prove it (Al Shloul et al., 2024). In general, science education often encounters difficulties in understanding abstract concepts contained in the material. Science learning supported by technology, including the use of visual elements, has been shown to be more effective than traditional teaching methods. This can increase students' interest in science learning and enrich real and concrete understanding (Sahin & Yilmaz, 2020; Fatmawaty, 2023).

According to Darling-Hammond et al. (2024) and Abdulrahaman et al. (2020), science learning in schools in Bekasi, West Java, still relies heavily on traditional media such as blackboards and printed books, with little use for digital media. Many teachers find it difficult to create science learning media and do not have enough time to develop them. The study also showed that

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science material at the elementary school level contains many concepts related to natural science, so it requires a lot of memorization. Thus, it is important to consider the learning media used. Current learning media still have limitations in implementing developing digital technology. Technological advances in modern times require teachers to innovate in the media used in teaching. Changes in the use of learning media have taken place from its initial physical form, now there are many online learning media available (Dhawan, 2020; Dwivedi et al., 2021). Digital technology has had a major impact on science education, both in terms of learning methods, content, and infrastructure used. The use of digital technology provides opportunities for students to learn independently and continuously, encourages interaction between students and teachers, and provides easier access to various learning resources.

The purpose of this study the skills required include digital literacy which is very important to synergize with technological advances. In addition, communication skills, emotional intelligence, entrepreneurship, global citizenship, problem solving, and teamwork also play an important role. The question that arises is whether our education is ready to face the development of Society 5.0? This era creates a new structure of life, where it is hoped that humans can live more comfortably and sustainably (Shrivastava et al., 2020; Jain, 2024). Society will be easier in various aspects, including the availability of products and services with fast response times. Currently, education in Indonesia is adapting to the 4.0 era, with online learning trends that allow teachers and students to interact even though they are in different locations, connected via mobile devices and the internet. However, if examined more deeply, technological advances offer great opportunities for online-based education. Science learning includes various materials such as physics, chemistry, and biology that are interconnected (Indriati, 2023; Supriadi et al., 2020; Krauss, 2024). Science itself is one of the subjects that is considered difficult by most students. Many complain about the difficulty in understanding material that involves formulas and unfamiliar terms. These abstract concepts in science are what make students tend to stay away from learning. Learning should be linked to everyday life so that students can feel the benefits in real life.

The purpose of science learning is to develop the concept of science learning by linking it to students' daily lives, increasing curiosity about the environment, identifying existing problems, and finding the right solutions, and increasing students' awareness in protecting the surrounding environment. Although research on virtual reality in education has been widely conducted such as Analyzing augmented reality (AR) and virtual reality (VR) recent development in education (Al-Ansi et al., 2023), Impact of virtual reality use on the teaching and learning of vectors, (Campos et al., 2022), there has been no research that specifically examines Can Augmented Reality Support Science Learning in the Era of Education 5.0?: A Review. Therefore, this study aims to examine Can Augmented Reality Support Science Learning in the Era of Education 5.0?: A Review. This paper aims to explain Can Augmented Reality Support Science Learning in the Era of Education 5.0?: A Review.

Method

This study uses a review method. The framework is designed to classify data sources and general information studied in the study. The author attempts to collect information from previous studies related to the variables. The full article is published in the 2015-2023 international journal, indexed in the database, and themed the Can Augmented Reality Support Science Learning in the Era of Education 5.0?: A Review.

Result and Discussion

One of the important reasons for scientific literacy is that understanding science offers the fulfillment of personal needs and joy, knowledge of students' scientific literacy is very important to know students' understanding of the scientific concepts they have learned. One of the good approaches used in scientific literacy is the scientific approach (scientific approach) consisting of 5 activities (5M), namely observing, asking, collecting data, associating, and communicating. Students have the opportunity to explore knowledge from various sources, including information and communication technology ande-learning to we-learning, need to be developed for students' social abilities through technological implications such as the development of interactive media (multimedia). Interactive multimedia in physics learning can also make it easier for teachers to deliver material with abstract concepts that are difficult for students to understand (Rahim et al., 2022; Oktaweri et al., 2019). Before discussing Augmented Reality, we will first discuss Leteasi Science 5.0.

Science Learning in Society 5.0

The realization of the society 5.0 era aims to create human capabilities to answer social challenges as an innovation of the industrial revolution 4.0 (Ghobakhloo et al., 2024; Narvaez Rojas et al., 2021). The concept of society 5.0 is present in the midst of people's lives to answer the challenges of economic growth and

technology that are not yet in line with a growing and developing society. Therefore, the society 5.0 era is present as an answer to the problem of justice and equality of shared prosperity. To increase global competitiveness in the society 5.0 era, Indonesian education must improve, namely by analyzing learning methods and the readiness of Indonesian human resources (Nurviani & Abdullah, 2022). The advancement of communication and information technology in the society 5.0 era has changed people's lifestyles in working, socializing, playing and learning (Tavares et al., 2022; Poláková et al., 2023). In the era of society 5.0, technological advances, especially in the field of education, require students and teachers to have skills in using technology to answer the opportunities and challenges of life in the era of society 5.0 (Alayda et al., 2022). Today, science education is directed at preparing students for success in the era of society 5.0. One of the skills needed in the era of society 5.0 is scientific literacy skills. Scientific literacy is the skill to think scientifically and critically and use scientific knowledge in solving challenges and making decisions. There are two views on scientific literacy, namely, scientific literacy is an understanding of scientific content, namely basic scientific concepts and scientific literacy is the ability to reason in a social context. Between the era of society 5.0 and scientific literacy have the same goal in answering all challenges of community life and improving decision-making skills (Rohayati & Abdillah, 2024; Walter, 2024). The role of science learning to face the era of society 5.0, namely by conducting learning using Augmented Reality. The function of Augmented Reality is therefore discussed first, the function of using Augmented Reality in science learning:

Advantages and Disadvantages of Augmented Reality

Augmented reality (AR) can be defined as a technology that is able to combine two-dimensional or three-dimensional virtual objects into a real environment and then display or project them in real time (Koparan et al., 2023; Rauschnabel, 2021; Xiong et al., 2021; Cipresso et al., 2018). In other words, augmented reality (AR) is a technology that enables the merging of the real world with the digital virtual world, including... displaying 3D three-dimensional objects in the real world through camera support so that the camera feels like the 3D object is in the real world and AR can do the same. Can display illustrations that are difficult to achieve in reality. In simple terms, the augmented reality system works using a camera, Pradana explained. From the smartphone will then detect the existing marker or marker object, then the camera will scan the marker pattern and compare it with the existing database. If the database matches, the marked information will appear as a three-dimensional object according to the animation created by Zhang, (2022), Li et al. (2021), Kuett et al. (2021), and Liu et al. (2023). Currently, augmented reality used in Augmented Reality is a technology that summarizes digital information about objects or the real world in the intended place to improve the user experience.

In Learning, augmented reality allows students to see scientific objects in interactive 3D so that it can improve students' understanding of AR technology (Mansour et al., 2024), which has the potential to provide positive benefits. can be applied to the world of education (Nazar et al., 2024; Tzima et al., 2019; Ghazali et al., 2024). However, AR is still rarely used in education in Indonesia. The use of AR in learning provides benefits for students including making learning fun, increasing motivation and interest in learning, increasing opportunities to ask questions, increasing interaction between students and other students (Khan et al., 2019; Koti, 2023). The advantage of AR is that it can directly visualize an object and provide a clear picture of its meaning which will certainly support and facilitate students in encouraging understanding of the material (Yang et al., 2024; Kim et al., 2019; Wibowo, 2023). In addition, the advantages of AR are (Ramadhani & Rosy, 2023; Tan et al., 2022; Oke et al., 2022): More interactive; Effective in use; Can be widely distributed on various media; Simple object modeling because it only displays a few objects; Manufacturers do not spend too much money;. Easy-to-use AR media also has disadvantages (Buchner et al., 2022; Smink et al., 2022; Gabriel et al., 2023), namely: Sensitive to changes in perspective. There are not many manufacturers; Requires a lot of memory on the installed device; Requires hardware that supports AR.

Conclusion

The application of augmented reality in science learning not only makes it easier for students to understand difficult material but also brings important innovations to education in the digital era, although its success requires teacher readiness and adequate technological infrastructure support in the 5.0 era.

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Author Contributions

Conceptualization, methodology, validation, .; formal analysis, investigation,; resources, data curation, A. W. P writing—original draft preparation, writing—review and editing, visualization, Z. A. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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