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Is education possible in the metaverse especially in Indonesia?

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ABSTRACT

Metaverse in education is one of the innovations in learning media based on three-dimensional virtual space technology whose implementation is currently being widely used. This article aims to determine the development and use of metaverses in education by reviewing the literature on using metaverses in learning. This research uses a systematic literature review method, namely reviewing literature in the form of relevant books and articles. Data collection was summarized from international journal articles, accredited and non-accredited national journals, proceedings, theses, and theses. From the results of the literature study, it is known that the metaverse in the world of education began to be effectively used during the COVID-19 pandemic, where the metaverse was able to overcome the limitations of distance and time to enter class and the acceleration of metaverse technology in the world of education has been seen with the existence of digital-based learning media applications: Augmented reality and virtual reality. With the virtual world concept, online learning can be done more interactively and innovatively, such as the formation of classrooms even though they do not meet in person, virtual practicums, and so on. This flexible learning is an interesting and innovative learning method concept.

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ABSTRAK

Metaverse dalam dunia pendidikan merupakan salah satu inovasi media pembelajaran berbasis teknologi ruang virtual tiga dimensi yang saat ini implementasinya mulai banyak digunakan. Artikel ini bertujuan untuk mengetahui perkembangan dan penggunaan metaverse dalam dunia pendidikan dengan meninjau literatur yang berkaitan dengan penggunaan metaverse dalam pembelajaran. Penelitian ini menggunakan metode systematic literature review,yaitu meninjau literatur, berupa buku dan artikel yang relevan. Pengumpulan data dirangkum dari artikel jurnal internasional, jurnal nasional terakreditasi dan non akreditasi, prosiding, tesis dan skripsi. Dari hasil literature review, diketahui bahwa metaverse dalam dunia pendidikan mulai efektif digunakan pada saat terjadinya pandemik COVID-19, dimana metaverse mampu untuk mengatasi keterbatasan jarak dan waktu untuk masuk kelas dan akselerasi teknologi metaverse di dunia pendidikan sudah terlihat dengan adanya aplikasi media pembelajaran digital berbasis augmented reality dan virtual reality. Dengan konsep dunia virtual, pembelajaran secara online dapat dilakukan dengan lebih interaktif dan inovatif, seperti terbentuknya ruang kelas meskipun tidak bertemu secara langsung, praktikum secara virtual, dan lain-lain. Pembelajaran yang bersifat fleksibel ini menjadi konsep metode pembelajaran menarik dan inovatif

Kata Kunci: *metaverse; perkembangan metaverse; pendidikan*

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INTRODUCTION

The rapid development of the times has led to a transformation in everyday life activities. In this era of 4.0, society cannot avoid technological advancements, which have made human activities easier and more efficient. Nearly all fields of work and daily life now utilize technology, including education. This became especially evident when we faced a global issue such as the COVID-19 pandemic, which restricted and disrupted human activities (Anas, 2023).

Amid complex political and economic situations, along with the emergence of a global pandemic, individual activities and production methods have encountered increasing challenges. For instance, lectures have shifted to online modes through various media devices (Windhiyana, 2020; Ameli et al., 2020). However, current online learning content is still primarily based on 2D displays, which lack the immersion and engagement that traditional face-to-face classroom instruction offers. Students often struggle to stay focused during remote learning sessions (Andiarna & Kusumawati, 2020). In this context, the metaverse emerges as a meaningful solution by integrating advanced technologies, such as Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), and cloud computing, to make learning activities more engaging.

Currently, teachers and educational stakeholders are required to develop innovative, diverse learning content and contexts that can enhance learning motivation. Unfortunately, existing teaching tools and facilities do not offer such features. Therefore, the emergence of technologies such as the metaverse and AR in education presents both opportunities and potential as innovative learning media (Endarto & Martadi, 2022). Essentially, education must integrate with and adapt to existing technological developments.

Online learning supported by internet-based technology has indirectly accelerated the trend of virtual learning and highlighted the role of technology in education (Rodriguez, 2022). The basic concept of the metaverse, a virtual world, has already been actualized in the educational field in several cases. This includes the use of platforms that support virtual learning, such as e-learning, Google Classroom, and other online media (Nurfalah, 2019). The presence of online learning marks the first step toward a virtual world that will usher in the true era of the Metaverse in the years to come. Indeed, technological advancements in education are inevitable; therefore, individuals today must be able to utilize and leverage technological developments for beneficial purposes.

Research related to the utilization of the metaverse has been widely conducted, especially in the field of education. One such study, conducted by Wahyudin et al. (2023), examined the application of the metaverse in digital literacy learning for Early Childhood Education (PAUD) students. In their study, Wahyudin et al. (2023) found that integrating the metaverse into learning activities can spark imagination in PAUD students, and teaching can be carried out effectively and efficiently. Another study by Herlim (2023) analyzed the impact of the metaverse on Christian religious education, finding that the metaverse offers opportunities for meaningful religious learning experiences, provided that students' spirituality is maintained.

The topic of metaverse research in the field of education has gained significant attention, particularly during and after the COVID-19 pandemic, when academics have strived to develop innovations that meet learning needs in today's technological era. Unlike previous studies, this research aims to review the development of metaverse technology in education and its application in educational settings by examining relevant literature. Therefore, this study focuses on identifying the development and enhancement of metaverse use in learning.

LITERATURE REVIEW

Metaverse

The term "Metaverse" is a combination of two words: “meta” (Greek), meaning beyond, and “universe,” referring to a hypothetical synthetic environment connected to the physical or real world (Putri, 2022). The term "Metaverse" was first used in literature by Neal Stephenson in his dystopian novel, Snow Crash, in 1992 (Alfaridzi et al., 2023). The Metaverse refers to the integration of current and future digital platforms with a focus on virtual reality, where virtual interactions can directly influence the real world. The Metaverse is a virtual world space that contains visual avatars, digital social interactions, and games. It is a permanent and continuous multi-user environment, a post-reality universe that combines digital virtuality with the real world (Mystakidis, 2022).

The Metaverse integrates internet technology with Extended Reality (XR). Extended Reality (XR) refers to a combined environment of real and virtual space, created through human and computer collaboration to form an interactive environment, consisting of several types such as augmented reality (AR), mixed reality (MR), and virtual reality (VR) (Morimoto et al., 2022). Kaplan et al. (2021) explain the differences among them: AR allows users to see the real world while overlaying virtual elements, VR refers to the use of technology (usually headsets) to block out real-world stimuli with virtual experiences, and MR is a combination of both, involving aspects of both physical and virtual worlds. These technologies are now widely used in various fields, including surgical procedures (Sugimoto, 2022).

Song et al. (2023) outlines six main characteristics of the Metaverse: (1) digitalization of assets, where all assets in the Metaverse are always “digital,” and activities within it also require digital assets; (2) application scenario-based, where the Metaverse offers new scenario-based experiences to users; (3) scope of economics, enabling the growth of a unique economy, namely the digital economy; (4) industry universality, providing the potential for industries to adopt the Metaverse fully; (5) integrated innovation, where the Metaverse has an energy supply mechanism capable of integrating existing innovations; and (6) platform ecosystem, where the Metaverse ecosystem can be designed in various ways and become a new ecosystem. In this context, the Metaverse offers users an experience that seamlessly blends virtuality and reality. Hence, the “world” or ecosystem created in the Metaverse is constructed entirely in a “virtual” manner.

Education

In a broad sense, education means “life,” implying that it encompasses the entirety of knowledge found in life, which gives positive meaning to an individual (Pristiwanti et al., 2022). In a narrower sense, education refers to the education system or schools. The broad explanation of education can be found in the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, which states that education is a conscious and planned effort to create a learning environment and process where students actively develop their potential to possess religious values, self-control, personality, intelligence, noble character, and skills needed by themselves and society. Therefore, education can be defined as a human effort to grow and develop their physical and spiritual potential in accordance with the values present in their society and culture. In this context, according to Tarigan et al. (2022), education serves as a medium that plays a crucial role in shaping one's life.

Education is an effort to improve a person’s attitude by absorbing positive values. This aligns with the function of education as explained by Suwartini (2018), who states that education is an effort to shape and develop abilities, character, personality, and civilization in a better direction. Sujana (2019) also explains that one of the functions of education is to eliminate inequality. Referring to the Indonesian education

system, education serves as a medium for developing abilities and shaping the character of society. Therefore, education is currently becoming a central aspect in reducing knowledge disparities that may arise within society.

Amid the rapid development of technology, education is also one of the fields that requires adaptation to such advancements (Arliman, 2020; Junaidi et al., 2023). Hence, technology is increasingly being implemented in the education or learning process (Firmansyah, 2019; Maghfiroh, 2022; Suminar, 2019). One technology frequently utilized in education is the Metaverse. According to Erturk and Reynold (2020), some of the benefits of the Metaverse include: (1) expanding traditional learning practices by engaging students in different ways; and (2) increasing students' motivation to learn. In addition, Mystakidis (2022) explains that the application of virtual technology in education can improve learners' academic performance, perspectives, and satisfaction in learning, as well as enhance motivation and collaboration among students.

METHODS

The method used in this article is a literature study. A literature study is a term used to refer to a specific research methodology or development carried out to collect and evaluate research related to a particular focus topic (Lusiana & Suryani, 2014), by gathering various journals, reading articles, and comparing the content of each journal related to the article title. The literature used includes national and international journal articles obtained through Google Scholar, Sinta, and the Directory of Open Access Journals (DOAJ). The scientific articles selected focus on the topic of the Metaverse and education. In this case, the collected articles were reviewed and synthesized, resulting in conclusions and an overview of the required topic: the development of the Metaverse in education.

RESULTS AND DISCUSSION

The results of the literature study conducted show that the development and use of the Metaverse are becoming increasingly widespread and can be integrated into various fields of education. Some people still consider the Metaverse as merely a new term for VR and AR; however, the Metaverse is more than just AR or VR. This reinforces the belief that education must continually evolve in response to the times, particularly in the current technological era (Arliman, 2020). Therefore, the use of technology in education has become a necessity.

Park & Kim (2022) present the framework of the Metaverse. Three key features distinguish the Metaverse from conventional platforms, namely shared, persistent, and decentralized. It also requires Artificial Intelligence technology to ensure that the Metaverse world operates according to the rules set by its creators, allowing AR or VR to become part of the Metaverse in delivering virtual content. Through the shared and persistent features, learners who study with VR can interact with other users and create within the Metaverse world. Furthermore, the decentralized feature in the Metaverse ensures that individual control, power, or virtual ownership rights are fairly distributed among users, helping to create a more inclusive environment.

Development of the Metaverse in the Field of Education

In 2021, the concept of the Metaverse drew significant attention, marked by Facebook's rebranding to Meta, with the promise of providing a more immersive online experience (Ioannidis & Kontis, 2023). However, a deeper review of previous literature reveals that the Metaverse has been evolving for at least 24 years, dating back to before the year 2000. Today, the Metaverse can be considered a relatively mature "technology".

The Metaverse is not a new phenomenon; rather, it is a concept that has evolved, dating back to 1905, and can be classified into four dynamic periods, known as Epochs (Ioannidis & Kontis, 2023). Duan et al. (2021) further state that the development of Metaverse technologies can be categorized into four periods. The first period, "Text-Based Interactive Games," spans from 1974 to the mid-1990s and can be divided into two phases: before and after the advent of the World Wide Web. The second period, from 1994 to the early 2000s, is categorized as "Open Virtual Worlds." The third period, from 2003 with the emergence of "Second Life" to 2018 with the rise of "Massively Multiplayer Online Games," is followed by the fourth period, which began in 2018 with the integration of blockchain into virtual worlds and continues to the present.

The global pandemic significantly impacted the education sector, restricting access to schools and laboratories for both teachers and students. Initially, online conferencing was used as a solution to facilitate virtual learning (Wang et al., 2022), which then evolved into the use of VR/AR to provide immersive visual stimuli and real-time tracking, positioning the Metaverse as a new social platform for learners and educators worldwide.

Since the COVID-19 pandemic, various new technologies have been applied, especially in the education sector, alongside increased interest in the Metaverse. Similar conditions were found in countries like South Korea, where most elementary school students are familiar with the Metaverse and consider it closely connected to their daily lives (Suh & Ahn, 2022). As a result, the Metaverse has rapidly developed and been effectively utilized during the pandemic.

Today, the use of the Metaverse in education can enhance learning through blended learning approaches, including the redesign of curriculum resources, teaching methods, and even certification mechanisms. This is supported by research conducted by Yuefan et al. (2022), which demonstrates that learning spaces that integrate both offline and online elements based on the Metaverse can connect structural conditions with multimodal content storage systems and provide deeply immersive learning experiences.

The Use of the Metaverse in Education

A considerable amount of research has examined the application of the Metaverse in education. This reflects the growing interest among academics and educators in integrating Metaverse concepts into the learning process. It has been noted that the use of the Metaverse for educational purposes is still in its early experimental stages (Qiu et al., 2023).

As an innovative breakthrough in education, the Metaverse offers various benefits that facilitate the learning process, such as overcoming spatial limitations, enabling more flexible learning, and making online education more efficient and interactive. This is supported by Wang et al. (2022), who stated that the increasingly advanced VR/AR devices serve as efficient tools for teaching and learning. The Metaverse can also support specific learning models. For example, in English language instruction, Shu & Gu (2023) found that the Metaverse provides highly immersive experiences, multimodal interaction, and creative freedom, which help students achieve deep learning, develop their abilities, enhance Higher Order Thinking Skills, and become more intelligent individuals within virtual learning environments.

Furthermore, the Metaverse provides learners with more opportunities to experience, explore, study, and teach in new worlds, as well as to work and interact with others (Hwang & Chien, 2022). In fact, the Metaverse enables students to learn or practice in contexts that are not possible in the real world—for example, practicing how to fly an airplane. This is provided that the Metaverse is designed to deliver meaningful learning experiences or opportunities to its users. Additionally, research by Salloum et al. (2023) indicated that creativity and innovation play a key role in determining the effectiveness of Metaverse systems. Thus, innovative implementations of the Metaverse are crucial, as they contribute to enhancing and expanding users' perceptions of adopting new technologies.

Furthermore, the implementation of the Metaverse through augmented reality and virtual reality can meet the needs of the Society 5.0 era in enhancing the quality of education in Indonesia (Pangestu & Rahmi, 2022). This is especially beneficial when applied to skill-based learning processes. In Indonesia, the use of the Metaverse is most commonly found in learning at the upper secondary and university levels. With such potential, the Metaverse can serve as a tool to elevate education on a global scale.

Hwang and Chien (2022) developed a framework related to the application of the Metaverse in teaching and learning. In this context, they emphasize the role of artificial intelligence (AI) in supporting educational activities through the Metaverse, which includes three functions: (1) Arbitration, referring to the Metaverse acting as a third party that helps resolve problems; (2) Simulation, where the Metaverse provides virtual simulations that resemble real-life conditions—as demonstrated in the study by Xu et al. (2023), which utilized the Metaverse for driving practice and simulation; and (3) Decision-making, in which the Metaverse offers solutions to problems, allowing users to make informed decisions.

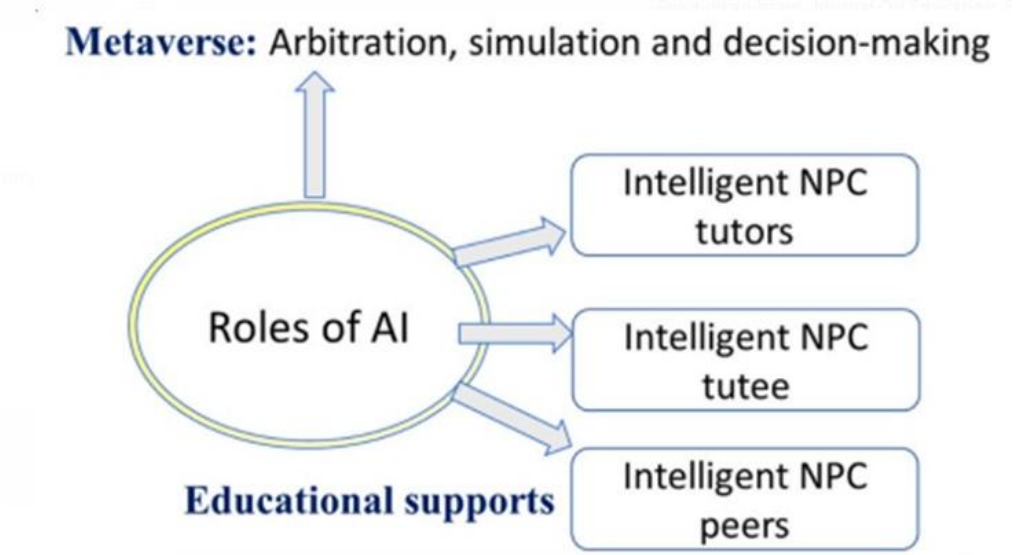

Figure 1. Framework of the role of the Metaverse in education
Source: Hwang & Chein (2022)

The use of the Metaverse in education offers benefits for both educators and students. According to Tlili et al. (2022), the Metaverse offers learners opportunities to explore environments or places that would otherwise be inaccessible due to limitations in space, time, or cost. Through virtual access, learners can, for example, visit museums accurately as part of their learning experience. The Metaverse thus expands students' ability to explore various learning resources with ease.

As previously noted, the Metaverse creates a "virtual space" that mirrors real-world environments or generates entirely new ones. The educational framework developed by Hwang and Chien (2022) focuses

on the role of the Metaverse within the educational context. In contrast, Zhang et al. (2022) designed a framework to illustrate how the Metaverse functions within the broader educational system.

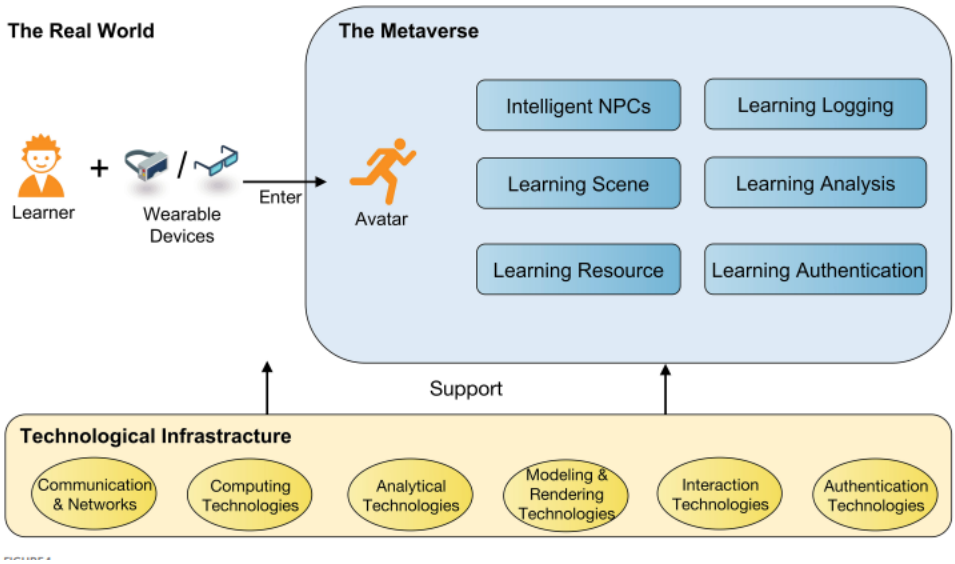

Figure 2. Metaverse in Education
Source: (Zhang et al., 2019)

The framework illustrates how the metaverse can be utilized in education. Learners will use assistive tools and become "avatars" in a developed virtual space. Thus, it can be said that the metaverse requires tools for its implementation, which may include VR glasses, mobile devices, and others. In this virtual space, both learners and educators will conduct learning activities, such as observing scenarios, simulations, or even simply learning in a "virtual classroom."

As previously mentioned, the metaverse consists of various types, including Augmented Reality and Virtual Reality. In this regard, Kaddoura and Husseiny (2023) reviewed various literature and forms of metaverse implementation in life, resulting in findings on the advantages and/or forms of AR and VR implementation in education. The explanation is presented in Table 1.

Table 1. AR and VR Implementation in Education

Augmented Reality	Virtual Reality
• Solving problems accurately using digital information to teach parts that are not visible graphically. • Deep understanding of the subject.	• Practice can be carried out through virtual simulations. • Learning beyond time constraints. • Enhances strategic and comprehensive problem-solving skills.

Source: (Kaddoura & Husseiny, 2023)

The implementation described by Kaddoura & Husseiny (2023) supports the form of implementation or framework outlined earlier. Essentially, the metaverse provides a new learning medium to enhance the effectiveness of education. Digital information within the metaverse can be used, especially in practice-based learning that emphasizes time efficiency. This is supported by the explanation from Fitria and Simbolon (2022), who state that the metaverse offers flexible learning, where both teachers and students can alter the learning experience—from the structure of the space to the timing of instruction. This creates a virtual learning environment.

Based on the explanation of the use of the metaverse in education, several roles of the metaverse in supporting learning can be described. **First**, the metaverse can serve as an intelligent tutor or learning

companion. In this context, it is referred to as an Intelligent Non-Player Character (NPC) (Hwang & Chein, 2022; Zhang et al., 2019), where the metaverse can provide avatars capable of assisting users in completing learning tasks and solving problems, such as assignments and exercises. **Second**, building an ecosystem and/or environment for the learning process (Alam & Mohanty, 2022; Dahan et al., 2022; Fitria & Simbolon, 2022; Lee et al., 2023). In this case, a virtual space can be designed to become a learning environment that supports and motivates students throughout the learning process. The developed virtual space may even replicate real-life classroom settings, and virtual spaces can become one form of blended learning that is now frequently used (Mitra, 2023). **Third**, simulation and practical learning. Many studies have utilized the metaverse as a tool for simulation or practical training, such as medical classes for surgery or anatomy, driving practice, teaching practice classes (Jeong et al., 2021; Sugimoto, 2022; Xu et al., 2023), and others. The metaverse has the potential to enhance the quality of practical learning, where learners can engage in realistic practice even though the tools and media are virtual, providing new facilities and learning experiences (Kye, 2021; Setiawan, 2022). The use of ever-evolving technology naturally becomes a “new thing,” offering new experiences for learners. This also helps increase student motivation to continue learning.

Considering the advantages and applications of the metaverse, it can be said that the metaverse presents an opportunity for Indonesia to improve the quality and innovation of its education. Indonesia itself has developed several e-learning platforms that create educational environments emphasizing learning flexibility. One example is the Kampus Merdeka program, specifically the Kredensial Mikro Mahasiswa Indonesia (KMMI), which creates a flexible micro-credential learning space (Bhakti et al., 2022). Additionally, numerous studies have developed frameworks and practices from various countries regarding the implementation of the metaverse in education, which can serve as sources or ideas for advancing education integrated with technology. The application of metaverse principles can enhance the quality of education in Indonesia by fostering innovative, efficient, and effective learning (Gusteti et al., 2023).

CONCLUSION

The metaverse can be utilized in Indonesian education, particularly in Senior High Schools and higher education institutions. With this opportunity, the metaverse can be used as a tool to enhance global education. Furthermore, the metaverse provides learners with more opportunities to experience, explore, learn, and teach in a new world, as well as work and interact with others.

The importance of the metaverse lies in its ability to provide immersive and interactive learning experiences, overcoming spatial and physical limitations in the learning process. Nonetheless, there are still limitations in the support facilities provided by faculties and universities that need to be improved to facilitate a wider implementation of the metaverse. Thus, the conclusion regarding the use of the metaverse in higher education is that it has great potential to open new opportunities for developing student skills, contributing to society, and expanding collaboration. However, further investment in facilities and support from educational institutions is needed to maximize the benefits of metaverse implementation in an educational context. Future research may further detail the forms of practice and implementation of the metaverse or other virtual technologies in education in Indonesia.

AUTHOR'S NOTE

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