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Metaverse as transformation and innovation in education in the digital era

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ABSTRACT

In overcoming a learning process that students are less interested in, it is necessary to have learning media that attracts students' interest through existing developments, one of which is the Metaverse. The development of the Metaverse has contributed a lot to the progress of information and communication technology in the educational context, so this indirectly directly encourages transformation and adaptation of more exciting and innovative learning. This research aims to identify the use of the Metaverse as innovation and transformation in education. The method used in this research is a systematic literature review to identify, evaluate, and interpret studies related to the Metaverse, such as educational transformation and innovation in the digital era. The manuscripts reviewed in this research were 11 studies that focused on the Metaverse in learning. Based on the literature review, the research results show several positive implications of implementing the Metaverse in a learning context. Overall, the use of the Metaverse in education has had consequences for the development process of students, from increasing understanding to developing skills, as well as stimulating motivation and social interaction.

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ABSTRAK

Dalam mengatasi proses pembelajaran yang kurang diminati peserta didik, diperlukan adanya media pembelajaran yang menarik minat peserta didik dan sesuai dengan perkembangan yang ada, salah satunya adalah Metaverse. Perkembangan Metaverse telah banyak memberikan kontribusi terhadap kemajuan teknologi informasi dan komunikasi pada konteks pendidikan, sehingga hal ini secara tidak langsung mendorong untuk melakukan transformasi dan adaptasi pembelajaran yang lebih menarik dan inovatif. Tujuan penelitian ini adalah mengidentifikasi penggunaan Metaverse sebagai inovasi dan transformasi dalam pendidikan. Adapun metode yang digunakan dalam penelitian ini adalah Systematic Literature Review untuk mengenali, mengevaluasi, dan menginterpretasikan studi yang terkait dengan Metaverse sebagai transformasi dan inovasi pendidikan di era digital. Naskah yang ditelaah dalam penelitian ini adalah 11 studi yang mana berfokus pada Metaverse dalam pembelajaran. Berdasarkan kajian literatur yang telah dilakukan, hasil penelitian menunjukkan beberapa implikasi positif dari penerapan Metaverse dalam konteks pembelajaran. Secara keseluruhan, penggunaan Metaverse dalam pendidikan telah memberikan implikasi proses perkembangan peserta didik, mulai dari peningkatan pemahaman hingga pengembangan keterampilan, serta merangsang motivasi dan interaksi sosial.

Kata Kunci: *era digital; inovasi pendidikan; metaverse; transformasi digital*

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INTRODUCTION

Education is not merely the process of transferring knowledge from educators to students. Moreover, education plays a role in shaping individuals into better human beings so they can live life fully in three main aspects: cognitive, affective, and psychomotor (Buchari, 2018). Providing knowledge and skills is the objective of the training and teaching processes in education. Educators have an obligation to educate, starting from physical development, health, skills, thoughts, and feelings. If learning is not engaging, it will significantly impact the final learning outcomes (Hasriadi, 2022). In fact, many students do not yet participate actively in the learning process because they feel the implemented learning still fails to arouse their enthusiasm for learning. The selection of appropriate methods can be an alternative solution to this problem, ensuring that education continuously experiences improvement (Iriansyah, 2020).

In Undang-Undang Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional, it is explained that, “Education is a conscious and planned effort to create a learning atmosphere and process so that students actively develop their potential to possess religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, the nation, and the state”. Education is inseparable from the learning process that occurs in schools. The success of learning fundamentally depends on the factors influencing it, one of which is the learning model and process itself (Yulia et al., 2020). Therefore, educators must be able to prepare learning materials optimally before commencing teaching activities. This aims to achieve learning that aligns with the established educational goals.

Educational challenges arise from the perspective of educational quality, which has become a primary demand in the digital era, as it prepares human resources capable of competing globally. The responsibilities and roles of an educator are substantial and not as straightforward as they may seem, as educators must be prepared to face future educational challenges. The standards for 21st-century or digital-age schooling, for both teachers and students, are intrinsically linked to the application of technology in learning (Kauchak & Eggen, 2012). Educators must be able to prepare their students for life in the digital age. A practical solution to this issue is the adaptation of learning content to align with contemporary developments, including instructional models, learning approaches, and media, as well as the strengthening of the teacher's role in instruction.

To make the learning process more engaging for students, it is necessary to use instructional media that can stimulate their interest. One of the popular trends in instructional media today is metaverse technology. The metaverse is a platform where physical and digital realities merge (Mystakidis, 2022). It creates a multi-user environment that emerges through technological convergence, enabling multisensory interactions within a virtual world. In other words, the Metaverse can be regarded as a perpetually connected social network, serving as a robust platform for user participation in authentic and dynamic digital communication. This vast virtual universe also provides space for development within the context of learning and education.

The objective of implementing Metaverse technology in education is to engage students in active and enjoyable learning experiences, thereby creating a more stimulating learning environment. This enables students to interact directly with peers and teachers digitally. Furthermore, the use of this technology provides a more interactive learning experience, wherein students can engage in realistic simulations and confront challenges that are difficult or even impossible in the real world. Therefore, the application of the Metaverse in education can serve as a democratizing factor, enabling equitable participation worldwide, unrestricted by geographical boundaries (Girvan, 2018).

Educators need to make adaptations and changes in their perspectives regarding their roles as educators and the learning process (Afrianto, 2018). They can engage in adaptive measures, including adjusting the

curriculum context and content, which will prepare students to meet the demands of 21st-century competencies. Furthermore, they are also expected to select and implement various contemporary instructional models that are appropriate for the needs of the current generation of students.

A considerable amount of research has been conducted on innovations in education that incorporate technology into the learning process. One such study concerns the development of an Android application as an instructional medium for pneumatics (Setiadi et al., 2018). In this context, the Android application represents a form of learning innovation focused on technology, enabling a more interactive learning process that keeps pace with rapid advancements in science and technology (IPTEK). Moreover, current technologies, such as Artificial Intelligence (AI) and the Metaverse, have become significant topics of interest to researchers in the education field, including the use of AI in early childhood learning (Yang, 2022). Such research focuses on developing frameworks and technology-based learning media that can be utilized for both current and future instruction.

From the analysis of the previously described problems, it is evident that the competencies required in this digital era pose a significant challenge. Direct learning applications are deemed insufficient for achieving 21st-century skills. With the advent of increasingly sophisticated technologies, such as the Metaverse, it is hoped that these issues can be addressed, leading to improvements in education. Therefore, the researcher is interested in exploring this topic further and conducting research to understand the Metaverse as a transformative and innovative force in education in the digital era. This study aims to review and analyze the use and implementation of Metaverse technology in education and learning. In this regard, a systematic literature review will be conducted to identify alternatives and forms of application or operational uses of the Metaverse in education.

LITERATURE REVIEW

The Concept of the Metaverse

The Metaverse is a concept that refers to a virtual world that integrates elements from the real and digital worlds, forming a unified entity. The Metaverse serves as a digital representation of human activities in the physical world. In this 3D digital space, users can convene through avatars that resemble them (Hollensen et al., 2022). Other research also suggests that the Metaverse is a digital technology capable of creating a 3D virtual world by utilizing Augmented Reality (AR) and Virtual Reality (VR) technologies, allowing users to interact authentically within the virtual world (Endarto & Martadi, 2022; Hwang & Chien, 2022). Thus, it can be understood that the Metaverse is a technology offering the concept of a digital space in 3D form. This concept originates from the idea of creating a virtual world that resembles the real world, allowing individuals to communicate and interact with each other and their surroundings through specially designed avatars.

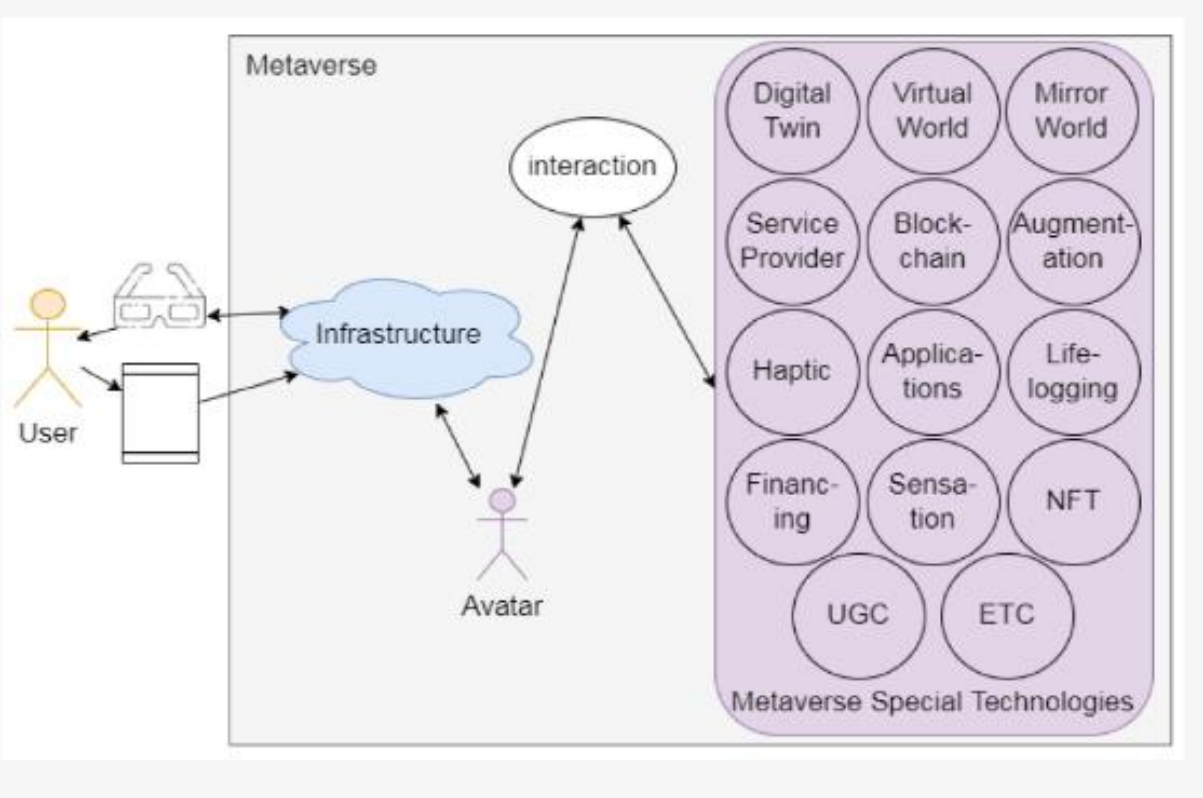

Figure. The Concept of the Metaverse
Source: Dahan *et al.* (2022)

The conceptual framework of the Metaverse is illustrated in **Figure 1** (Dahan et al., 2020). In this context, there are at least four primary components in the utilization of the Metaverse: 1) the user, defined as the individual operating within the Metaverse; 2) infrastructure, which encompasses the devices required to access the virtual world; 3) the Avatar, serving as the user's virtual representation; and 4) interaction, which in this case can occur between the "avatar" and the "system," or among "avatars." Based on this conceptual framework, it can be understood that the Metaverse essentially offers a virtual existence by leveraging an individual's "virtual" persona or avatar for interaction and activities.

The Development of the Metaverse in an Educational Context

The Metaverse is essentially a long-standing term; however, it has gained frequent usage in recent times. The term "Metaverse" was initially coined by the author Neal Stephenson in his 1992 novel, "Snow Crash." The Metaverse is defined as a virtual universe where users can access avatars, connect with their groups, and engage in experiential activities, exploring the virtual space across various desired locations (Sutopo, 2022). This aligns with the previously explained definition of the Metaverse, namely, the concept of the Metaverse as a "digital space" or, in this context, a "visual space."

Over time, the Metaverse concept has expanded its role within the realm of education, particularly in the effort to create an innovative and inclusive educational system. In line with its origins (as proposed by the aforementioned author from Washington), the development of the Metaverse also influences the dynamics and paradigms of education. Consequently, this presents significant opportunities for various sectors, ranging from business to education (Nugraha & Purwati, 2023). Educational institutions are, in turn, integrating the Metaverse concept into the learning systems they design.

Furthermore, the application of the Metaverse in education serves as a resolution to the challenges of remote learning (PJJ), thereby providing an optimal solution for conveying information retention to participants without distance limitations. In the Metaverse, learners can access educational resources from around the globe and interact with peers and instructors irrespective of geographical boundaries. Thus, the development of the Metaverse in education not only fosters more advanced learning but also stimulates reflection on how we provide utility or benefits to education in the current digital era.

The Potential of the Metaverse in Educational Transformation

The development of the Metaverse has significantly contributed to the advancement of information and communication technology within the educational context. This, in turn, indirectly compels the transformation and adaptation of learning to be more engaging and innovative. With the emergence of the Metaverse, various institutions or educational bodies can easily leverage this opportunity to present learning experiences using new, high-quality methods that meet the ever-evolving demands of the times.

The Metaverse can be regarded as a platform that effectively directs or channels the learning process for students in the current era of digital development, where it assists their learning activities or processes within the context of virtual-based learning (Rachmadtullah et al., 2022). Consequently, students can engage more deeply with the subject matter, enrich their learning experiences, and explore their potential for collaboration with peers.

The Metaverse not only enables students to access information but also delivers a more interactive and immersive learning experience. Through the use of avatars and 3D simulations, students can be directly involved in virtual-based learning, which can enhance their engagement with the subject matter. Utilizing avatars and virtual identities, students can create representations of themselves within the Metaverse. These virtual identities facilitate social interaction and the personalization of the learning experience (Riyanto, 2023).

The potential held by the Metaverse facilitates a pedagogical approach that can be personalized according to the individual needs of each student. Metaverse-based learning can help in assessing individual learning progress, encompassing feedback and adjustments to relevant learning content, thereby creating a more meaningful learning experience. Thus, the Metaverse effectively opens doors to various opportunities in the educational sphere, better preparing future generations to face the demands of the future.

METHODS

This study employs the Systematic Literature Review (SLR) method. SLR is a research methodology used to systematically review literature and map specific phases (Larasati et al., 2021). In this context, the SLR will identify, evaluate, and interpret studies related to specific research questions, particular topics, or designated phenomena. This approach concentrates on comprehensive data collection to construct an in-depth understanding of the subject under investigation.

SLR also refers to a specific research or development method aimed at gathering and evaluating studies relevant to a particular topic focus. Essentially, the principle of the SLR method is to summarize primary research findings in a research approach that presents more balanced and comprehensive facts (Siswanto, 2010). Based on this, this study will review literature relevant to the research problem. The study utilizes journal articles pertinent to the topic of "the use of the metaverse" as a "transformation" and "innovation" in education in the digital era. Based on the results of the collected data processing, eleven articles will be the focus of the research.

RESULTS AND DISCUSSION

Following data collection, the eleven selected articles will be analyzed. In this context, the research focuses on a review of the instructional design and the research results from the collected literature. 'Instructional design' refers to the overarching theme of these articles, which may encompass the potential, form, and/or method of Metaverse implementation in learning. Meanwhile, the 'research results' column constitutes the conclusions or findings from the literature under review. The details of the literature review are presented in **Table 1.**

Table 1. Article Review Results

No	Reference Source	Instructional Design	Research Results
1	Herlim (2023)	Christian religious learning using the Metaverse	This study suggests that the Metaverse can address the limitations of 2D online learning and enhance interactivity in the teaching and learning process.
2	Yuniansyah & Handayani (2023)	Learning linear algebra by using Spatial.io as a virtual classroom	This study aimed to evaluate the usability and user experience of the virtual class. In this context, the virtual class had a positive impact on learning, as reviewed from student responses.
3	Hambali et al. (2023)	Learning development uses Gather Twon as a distance learning facility	Gather Town facilitates the learning of practical skills through a more structured, independent learning framework, providing continuous, one-on-one feedback.
4	Fauzan & Priowirjanto (2023)	Use of Metaverse in online business	Building business transactions and communication easily in the form of a virtual world.
5	Riyanto (2023)	Learning uses Metaverse for distance learning	An experiment was conducted to assess the effectiveness of learning using the Metaverse. The experimental group showed a significant improvement in learning outcomes, whereas the control group showed a relatively low improvement.
6	Endarto & Martadi (2022)	The potential of the metaverse as interactive multimedia to support educational progress.	The Metaverse can create a more engaging virtual experience for students by combining AR and VR technologies on a single platform. The use of the Metaverse in education fulfills the demands of dynamic technological developments.
7	Trisnawati (2024)	Interactive learning using Metaverse broadcasting	The utilization of the Metaverse in education represents an innovative approach that can be leveraged, particularly in creating interactive learning experiences. Metaverse technology has a significant impact on student motivation to learn.
8	Hapidz *et al*. (2022)	Metaverse is a learning innovation that allows improving the quality of learning itself	The Metaverse has great potential to support more interactive and immersive online learning.
9	Isnain (2023)	Metaverse technology-based learning in educational practices in schools	The Metaverse enables students to experience life in a virtual world, creating variations in learning and daily digital experiences.
10	Iswanto (2022)	Opportunities for using the metaverse in the world of education	The Metaverse enables teachers to tailor learning experiences to individual student characteristics, providing targeted support. Furthermore, the Metaverse also enables the

No	Reference Source	Instructional Design	Research Results
			expansion of unlimited freedom and experiences for students, allowing them to conduct independent learning, which lets them explore their questions based on their autonomy.
11	Setiawan (2020)	Overview of the opportunities or potential of the metaverse for education in Indonesia	Metaverse technology is feasible for implementation in Indonesian education, as it presents an opportunity for the Metaverse to develop more engaging learning experiences.

Source: Processed Data (2023)

Based on the results of the literature review conducted, the findings indicate several positive implications of implementing the Metaverse in a learning context. In this regard, the majority of studies state that the Metaverse has the potential to enhance the quality of education. Overall, the eleven articles address different topics but are interconnected, particularly in their consideration of the potential of the Metaverse.

The Practice of Using the Metaverse

Three of the eleven articles reviewed explain the practical application of the Metaverse in education (Hambali et al., 2023; Herlim, 2023; Trisnawati, 2024). Overall, the research suggests that the Metaverse has significant potential as a technology that can enhance learning effectiveness and significantly increase the level of interactivity in the teaching and learning process. Students can collaborate more effectively within a Metaverse environment, and its use can help overcome the limitations of the classroom that occur when online learning is conducted solely through e-learning and video conferencing. The Metaverse provides a new dimension to the use of educational technology (Inceoglu & Ciloglugil, 2022).

Other research emphasizes the use of the Metaverse's visual or digital space as a medium for the digital economy, particularly in transactions. Essentially, the Metaverse is already being applied in various fields, such as economics and education. The use of the Metaverse in online business can simplify communication and transaction methods between sellers and buyers in the virtual world (Fauzan & Priowirjanto, 2023). With the use of the Metaverse, space and time are no longer constraints (Syahrul & Baidarus, 2023). Economic development within the Metaverse world thus becomes a feasible possibility (Nugraha & Purwati, 2022). This demonstrates that the Metaverse can advance the digital economy, even enabling "real" transactions within a "virtual space."

Interactivity within the Metaverse encourages active participation from students, creates a dynamic learning environment, and facilitates communication between teachers and students. Furthermore, the "digital space" innovation within the Metaverse allows for increased student motivation and learning outcomes (Fauzian, 2022; Sulistianingsih et al., 2022). This positive impact can serve as a foundation for the development of more innovative learning models in the future.

The Metaverse as a Support for Remote Learning

In this context, the Metaverse offers a 3D digital space that enables its utilization in remote learning (Hambali et al., 2023; Riyanto, 2023). The application of Metaverse technology can create a more immersive and interactive learning experience, as well as stimulate social interaction among students

situated in different locations. The Metaverse emphasizes flexible learning, particularly in terms of the freedom to select the time and place for learning (Yuda et al., 2024). The use of technology in learning can undoubtedly enhance the accessibility, effectiveness, and flexibility of instruction (Said, 2023). Similarly, the use of the Metaverse, which can create a digital space, allows learning to be conducted as it would be in a physical classroom, even without meeting directly (face-to-face).

The Potential of the Metaverse in Education

Based on the literature review conducted to gather research data on the topic of the Metaverse as an innovation in education, the findings indicate that, overall, the Metaverse has presented a very positive outlook regarding its use in the educational context. Metaverse-based instructional designs are effective in enhancing students' cognitive abilities, as evidenced in the literature.

Furthermore, the potential of the Metaverse as an interactive multimedia platform, through the use of AR and VR technologies, lies in its ability to create engaging virtual experiences for students by combining these technologies on a single platform. The utilization of the Metaverse as an interactive educational medium is also recognized as key to addressing the demands of progressive technological development. Moreover, AR and VR technologies contribute to an increase in student motivation and innovation in teaching practices, thereby exerting a positive impact on teaching and learning activities (Endarto, 2022). Additionally, the development of the Metaverse can also aid in advancing other domains, such as big data, interaction, artificial intelligence, game design, Internet computing, the Internet of Things, and blockchain (Lin et al., 2022).

The Metaverse is viewed as capable of enhancing student growth and development, while also creating more engaging and contextual learning experiences. The presence of the Metaverse can optimize the technology and educational media used, making learning more effective. The learning experiences students gain with Metaverse technology will better equip them to develop soft skills and foster improved self-perception. One application of the Metaverse in education is the virtual collaboration project, which is considered to offer students the potential for meaningful experiences. Virtual environments can enable students from various locations to interact and collaborate in shared learning experiences (Pustikayasa et al., 2023).

Overall, the use of the Metaverse in education has implications for students' developmental processes, ranging from enhanced understanding to skill development, as well as stimulating motivation and social interaction. Therefore, the implementation of this technology in the educational system becomes increasingly important to consider in meeting the developmental demands of the digitalization era and creating a more relevant and practical learning environment.

Challenges of Using the Metaverse

After reviewing the 11 articles, several studies that discussed the challenges of Metaverse implementation also employed a literature review method, which in turn concluded the potential of Metaverse use. This resulted in significant overlap in the identified challenges and opportunities of Metaverse use. The challenges in using the Metaverse, as identified from reviewing the various articles, are as follows:

1. Complex Equipment**.** Accessing the Metaverse requires adequate electronic devices and signal strength. Therefore, socioeconomic status may become a significant barrier and challenge for both students and educators in implementing Metaverse-based learning (Setiawan, 2023). Furthermore, the use of the Metaverse increases risks associated with digital media, such as visual impairment (myopia)

or even loss of balance due to the discrepancy between the virtual environment and reality (Roy et al., 2023).

2. Data Security and Privacy. The vast virtual environment is an advantage of the Metaverse; on the other hand, there is a lack of protocols or principles governing its practical application, resulting in a high degree of overall freedom (Putri et al., 2023; Roy et al., 2023). While rules and principles govern activities in the real world, such frameworks have yet to be established in the virtual world.aktivitas diatur dengan adanya aturan dan prinsip, maka di dunia virtual belum dibangunnya hal tersebut.
3. Identity and Interaction**.** The virtual world can create the possibility of reputation crises and user identity issues. Furthermore, it allows for data theft and anonymity in the creation of virtual "identities" (Ertado & Martadi, 2020).

These three issues represent the primary challenges in the use of the Metaverse for learning. Therefore, in instruction, teachers must ensure that learning within these virtual classrooms occurs safely. Educators must develop a virtual environment that guarantees students can participate in the class in an orderly and secure manner.

CONCLUSION

Based on the research results and discussion, it can be concluded that the Metaverse has become a transformation and innovation in the world of education in Indonesia. The application of the Metaverse not only creates a more interactive and dynamic learning environment but also opens new opportunities for effective collaboration among students. The positive impacts of this innovation in Metaverse use in education are not limited to cognitive aspects but also include the development of better soft skills and the stimulation of motivation and social interaction. Therefore, the Metaverse can serve as a significant transformation and innovation in education, particularly in the current digital era. Future research can develop operational or conceptual frameworks that can then be applied in learning using the Metaverse.

AUTHOR'S NOTE

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