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Utilization of the metaverse in the context of interactive learning

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ABSTRACT

In the rapidly developing digital era, the metaverse is increasingly becoming an integral part of human life, including in the world of education. Metaverse, as a three-dimensional virtual world, has great potential to change the learning paradigm into immersive and engaging interactive experiences. The use of the metaverse in interactive learning has become an interesting focus of exploration, along with advances in virtual reality and augmented reality technology. This opens the door to the exploration of new concepts through simulations, educational games, and global collaboration, freeing learning from the limitations of the conventional classroom. Engaging learning experiences, hands-on simulations in virtual environments, and global collaboration are the advantages of interactive learning through the metaverse. The literature review covers various types of metaverses, their potential in learning, their implementation in economic education, and interactive learning media based on Articulate Storyline 3. Although metaverses have a positive impact in improving the learning experience, ethical challenges such as accessibility, data security, and inclusivity need to be considered. The research results show that, although the metaverse opens a dynamic and exciting new era in digital education, certain limitations must be carefully addressed to ensure that the use of the metaverse in education provides maximum benefits for all students.

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ABSTRAK

Dalam era digital yang berkembang pesat, metaverse semakin menjadi bagian integral dari kehidupan manusia, termasuk dalam dunia pendidikan. Metaverse, sebagai dunia maya tiga dimensi, memiliki potensi besar untuk mengubah paradigma pembelajaran menjadi pengalaman interaktif yang mendalam dan menarik. Pemanfaatan metaverse dalam pembelajaran interaktif menjadi fokus eksplorasi yang menarik, seiring dengan kemajuan teknologi virtual reality dan augmented reality. Ini membuka pintu untuk eksplorasi konsep baru melalui simulasi, permainan edukatif, dan kolaborasi global, membebaskan pembelajaran dari keterbatasan ruang kelas konvensional. Pengalaman pembelajaran yang menarik, simulasi praktik langsung dalam lingkungan virtual, dan kolaborasi global menjadi keuntungan pembelajaran interaktif melalui metaverse. Tinjauan literatur mencakup berbagai jenis metaverse, potensinya dalam pembelajaran, implementasinya dalam pendidikan ekonomi, dan media pembelajaran interaktif berbasis Articulate Storyline 3. Meskipun metaverse memberikan dampak positif dalam meningkatkan pengalaman belajar, tantangan etika seperti aksesibilitas, keamanan data, dan inklusivitas perlu diperhatikan. Hasil penelitian menunjukkan bahwa, meskipun metaverse membuka era baru dalam pendidikan digital yang dinamis dan menarik, keterbatasan tertentu harus diatasi dengan cermat untuk memastikan bahwa penggunaan metaverse dalam pendidikan memberikan manfaat yang maksimal bagi seluruh peserta didik.

Kata Kunci: *media pembelajaran interaktif; metaverse; pembelajaran interaktif; transformasi pendidikan*

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INTRODUCTION

In the continuously evolving digital era, the concept of the Metaverse is becoming increasingly prevalent and is playing a significant role in various aspects of human life. One field undergoing continuous transformation via the Metaverse is the educational sphere. The Metaverse, essentially a virtual world comprised of three-dimensional digital spaces (Firmansyah et al., 2024; Pristiwanto et al., 2023), offers substantial potential to transform the learning paradigm into a more profound and engaging interactive experience. The utilization of the Metaverse within the context of interactive learning has become a compelling topic for exploration. Concurrently with advances in Virtual Reality (VR) and Augmented Reality (AR) technologies, new pedagogical approaches are emerging, creating environments that enable students to engage directly in realistic and interactive learning experiences, with all the associated advantages and disadvantages for both teachers and students (Chua & Yu, 2023).

This study hypothesizes that the utilization of the Metaverse in interactive learning will contribute positively to student learning motivation and the overall effectiveness of the learning process. By enabling direct simulations and practice within a virtual environment, as well as global collaboration unrestricted by geographical boundaries, the Metaverse is expected to create learning experiences that are more engaging, inspiring, and relevant to contemporary demands. However, the research is also expected to identify and address the limitations that arise with the use of the Metaverse in education. The utilization of the Metaverse in interactive learning opens the door to a new era of digital education that is more dynamic and engaging. With this approach, we can create learning experiences that are more personal, inspiring, and relevant to the demands of the era. The integration of Metaverse technology into the learning process offers students opportunities to engage with subject matter within a virtual environment. By providing realistic and interactive simulations, the Metaverse enables students to actively explore, experiment, and comprehend complex concepts across various disciplines.

Concurrently with this advancement, there is a corresponding responsibility to ensure that the Metaverse is used judiciously and ethically to ensure sustainability and inclusivity in education. Educators, technology developers, and other stakeholders must collaborate to develop guidelines and policies that support the safe, ethical, and beneficial use of the Metaverse for all. By integrating principles of digital ethics into the design and implementation of the Metaverse in education, we can create a holistic and sustainable learning environment for all students. In this regard, it is important to emphasize that the utilization of the Metaverse in interactive learning is not merely about technology adoption, but also about a transformation in the pedagogical approach. By incorporating elements such as interactivity, personalization, and content relevance, education can become more engaging, inspiring, and aligned with individual student needs. As a result, we can expand accessibility to education, address learning disparities, and open the door to sustainable lifelong learning opportunities for everyone.

Although several previous studies and experiments on the utilization of the Metaverse in education exist, few studies have explicitly detailed prior literature reviews. For instance, research highlights the Metaverse's potential in creating social communication spaces, providing flexible settings for creativity and sharing, and enhancing virtual learning experiences (Laksito & Wibowo, 2022). These findings underscore the importance of an interactive approach to utilizing the Metaverse within an educational context. Another study relevant to the interactive approach in learning concerns interactive learning media based on Articulate Storyline 3, validated for material on social and cultural diversity in Indonesia for IPAS (Natural and Social Sciences) subjects (Hidayat & Mulyawati, 2022). This learning medium was designed to capture student attention, facilitate teachers in delivering the material, and aid students in understanding the lesson. Employing a research and development approach with the 4D development model, this study

involved the definition, design, and development stages of the interactive learning media. Data collection methods included interviews and questionnaires, to which qualitative descriptive analysis was applied.

Therefore, this article aims to contribute to the context of interactive learning by introducing a literature review on the use of the Metaverse in education. By conducting a meticulous literature search, this article will provide a more detailed statement of scientific novelty and identify research areas that still require further exploration. Thus, this article is expected to serve as a foundation for future, more in-depth research on the utilization of the Metaverse within the educational context.

LITERATURE REVIEW

In an era characterized by digital advancement, the educational landscape has undergone a significant shift with the emergence of the Metaverse concept. The Metaverse, an evolving three-dimensional virtual world, has garnered attention across various aspects of human life. Notably, the utilization of the Metaverse within the context of interactive learning has become a primary focus for researchers and educational practitioners. The Metaverse's potential to provide profound and engaging learning experiences, coupled with its integration of Virtual Reality (VR) and Augmented Reality (AR) technologies, establishes a new foundation for education (Humaira et al., 2024). This literature review aims to explore the understanding and key findings related to the utilization of the Metaverse in the context of interactive learning. It delves into how this technology permeates various facets of education, including simulation, gamification, and global collaboration, while also identifying the associated challenges and ethical considerations. The concept of interactivity in learning, as supported by constructivist learning theory, serves as a cornerstone for the application of the Metaverse in education. This theory emphasizes the importance of active interaction between learners and learning materials, as well as among learners themselves, in the process of knowledge construction (Ariandini & Hidayati, 2023). In the Metaverse context, interactivity is key to creating profound and meaningful learning experiences, wherein students are not merely passive observers but relatively active participants in the learning process.

Implementation of the Metaverse in Education: Types, Potential, and Limitations

This research outlines the various types of the Metaverse, its potential, and the limitations of its application within the educational context. Four categories of the Metaverse highlight different functions, types, and technologies, supported by findings in relevant literature. The two primary categories within the Metaverse are augmentation, where virtual elements are added to the real world, and simulation, where users are immersed in a virtual environment that simulates specific situations or experiences. Examples of Metaverse applications in health education, such as the use of virtual garments for anatomy laboratory simulations and virtual spinal surgeries, demonstrate the flexibility of this technology in providing profound and realistic learning experiences (Pensieri & Pennacchini, 2014).

The use of the Metaverse in education offers significant potential for creating new social communication spaces among students and teachers, providing flexible settings for creativity and sharing, and enhancing virtual learning experiences (Iswanto et al., 2022). The Metaverse's capability to simulate practical and interactive experiences can also assist students in comprehending complex concepts (Rewara et al., 2024). The Metaverse in interactive learning brings significant benefits to the student learning experience. First, the Metaverse provides a highly immersive and realistic learning experience through the integration of VR and AR technologies (Putri et al., 2024). By entering the virtual environment, students can experience the sensation of being immersed in various learning situations, ranging from scientific simulations to historical reconstructions. Student engagement in the learning process is also significantly

enhanced, as they do not merely act as passive observers but as active participants in exploration and experimentation within the virtual environment. The utility of the Metaverse in education supports project-based learning more effectively (Anyan, 2023). Students can work together in teams to complete complex tasks or challenging projects, while collaborating and interacting directly in a realistic virtual environment. This allows them to hone collaborative, problem-solving, and communication skills.

Another benefit of utilizing the Metaverse is the facilitation of global collaboration. Students and educators from around the world can join in the virtual environment without geographical boundaries, facilitating the exchange of ideas, cultures, and learning experiences (Nego & Setiaji, 2022). Thus, the Metaverse opens the door to rich cross-cultural learning and broader knowledge discovery. Ultimately, the utilization of the Metaverse facilitates the development of students' digital skills. They learn to interact with advanced technologies, understand concepts such as virtual and augmented reality, and confidently use specialized applications and software (Kurdi, 2021). Consequently, the Metaverse not only brings direct benefits to learning but also helps prepare students for a future increasingly dominated by digital technology.

The use of the Metaverse also presents several limitations and challenges. One of these is the potential weakness in social relationships that can occur in a virtual environment, as well as potential identity issues for Metaverse users, particularly for students whose identities are still in development. Furthermore, adapting learning experiences from the Metaverse to the real world is also a challenge that requires educators' attention (Salim et al., 2023).

The Utilization of Augmented Reality in Economics Education: Innovation for Enhancing Engagement and Understanding

The integration of Augmented Reality (AR) technology in economics learning not only introduces innovation but also offers a more interactive and engaging pedagogical approach. This article explains the benefits of using AR in economics learning, as well as the underlying theories, to provide a more profound understanding. The use of AR in economics learning can be linked to several relevant learning theories. One of these is project-based learning theory, wherein students engage in practical projects, such as business simulations or financial planning, within a virtual environment. The fundamental concept of this theory is that learning is more effective when students are involved in authentic activities relevant to their learning context (Kamaruddin et al., 2023).

Furthermore, the use of AR also aligns with engaged learning experience theory, which emphasizes the importance of direct experience and interaction in the learning process (Musyafak & Subhi, 2023). By leveraging AR, students can actively participate in the learning process, simulate real economic situations, and experience profound learning through interaction with virtual elements. The advantages of using AR in economics learning include interactive experiences that allow students to explore abstract concepts visually, data visualization that facilitates comprehension, and project-based learning that prepares students to face future economic challenges.

The Implementation of Technology in Learning in the Digital Era: Challenges and Opportunities for Education in Indonesia

Building on the previous discussion on the utilization of technology in education, it is essential to highlight the challenges and opportunities faced within the Indonesian educational context. To provide a stronger theoretical foundation, we can deepen our understanding by integrating several statements that support the use of technology in the educational context. By understanding this, educators can design learning experiences that effectively leverage technology to achieve desired learning objectives. Furthermore, technology can be used to facilitate active, collaborative, and student-centered learning (Hadiapurwa et

al., 2023; Rosyiddin et al., 2023; Syafi'i, 2024). By understanding the principles of technology-based learning, educators can integrate technology more effectively into their teaching practices. Thus, an understanding of the challenges and opportunities associated with technology implementation in Indonesian education becomes relevant within the context of discussions about utilizing technology, including the Metaverse and augmented reality, to enhance the learning experience.

METHODS

This study employs a literature review approach to analyze relevant articles that focus on the utilization of the Metaverse within the context of interactive learning. The literature review approach was selected because it facilitates the collection and synthesis of existing knowledge on the topic from various available sources. The article search process was conducted using Google Scholar, with relevant keywords such as "metaverse," "learning," and "interactive learning." The selected articles fall within a publication time frame of the last 10 years, specifically between 2014 and 2023. Inclusion criteria for the articles comprised those that specifically discuss the utilization of the Metaverse in the context of interactive learning.

After the relevant articles were gathered, a Quality Assessment was performed to ensure the validity and reliability of the information presented. The quality assessment criteria included verifying whether the article was a scientific journal that had undergone a peer-review process, whether the article specifically addressed the use of the metaverse for learning, and whether an experiment regarding the use of the metaverse in learning had been conducted. This procedure helped ensure that the articles used in the literature review were of high quality and relevant to the research focus. Data analysis was conducted by synthesizing the findings from the quality-assessed articles to formulate answers to the research questions.

RESULTS AND DISCUSSION

Based on the literature review conducted in this study, the Metaverse can be utilized in learning activities. The Metaverse enables students to interact and collaborate with peers or teachers within a virtual environment. This can enhance collaboration, communication, and problem-solving skills through interactive experiences. Simulations provided in economics education, as well as those related to the natural sciences, demonstrate the possibility of new types of learning. With this new learning concept, educators must focus on providing instruction that is not only novel but also interactive.

Educators must be able to maintain relationships and communication with their students, even when they are not in the same physical room. In multimedia communication, "interactive" refers to the two-way relationship between a human and a computer. Therefore, the teacher's role is to make this student communication feel like a two-way interaction between humans, rather than between a human and their device (Putri, 2019). The Metaverse can also be used to involve parents in their children's learning process. They can observe or participate in learning activities virtually (Agustini et al., 2023; Xu et al., 2024).

The Concept of the Metaverse and Its Implications in Education

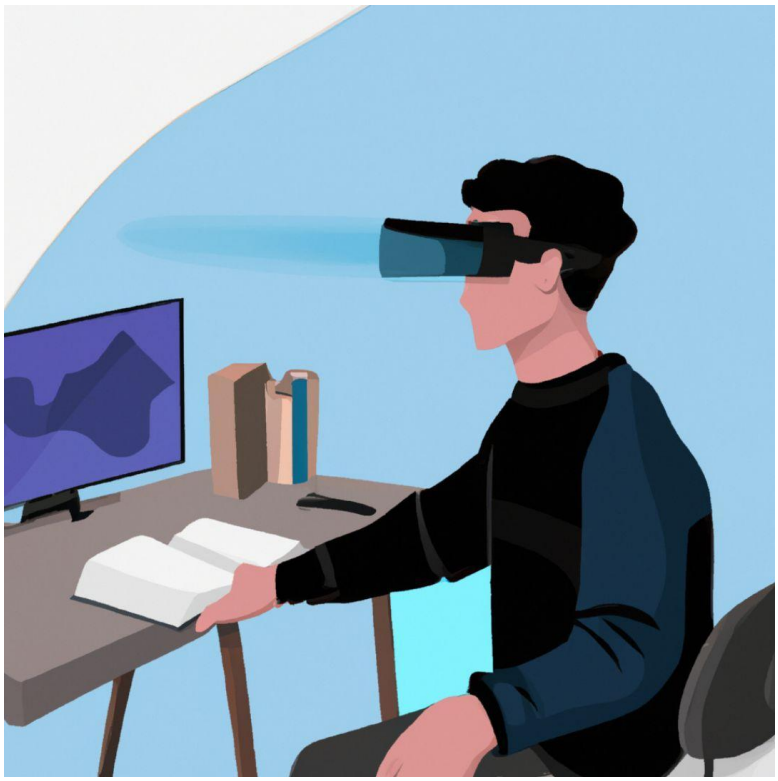

Figure 1. Illustration of the Metaverse in Use
Source: Author's Documentation (2023)

The development of the Metaverse concept has led to a higher degree of freedom for sharing and creation (Hasannah et al., 2024; Kye et al., 2021). This enables the design of independent learning activities, providing students with new, unlimited experiences. The Metaverse has four types: augmented reality, lifelogging, mirror world, and virtual worlds (Mulati, 2023). Lifelogging refers to the collection of user information, objects, and communication data within the metaverse during daily interactions, such as when using social media platforms like Instagram, Twitter, and Facebook (Iswanto et al., 2022; Ksibi et al., 2021; Ribeiro et al., 2022). A mirror world is a type of simulation of the external world or a reflection of the real world in a virtual model, which can be utilized for purposes such as learning and its potential development (Leinonen et al., 2021; Wiharjokusumo et al., 2022; Yu, 2022).

Its characteristic of connecting the real and virtual worlds has implications for education by enriching experiences and innovating other learning methods. Its implications in education include allowing students to study phenomena that are difficult to visualize in three dimensions, providing an in-depth understanding of content that is challenging to explain through text, and enabling interactive experiences even during the learning process.

Potential Development of Metaverse Technology in Education

The development of Metaverse technology within the educational context has become a compelling topic in recent years. Beyond its broadening utilization, the potential development of this technology could have an even greater impact on the learning process. A primary aspect of Metaverse technology development is the creation of educational platforms that serve as interactive and immersive learning environments for students. These platforms are designed to provide more enjoyable and compelling learning experiences, leveraging virtual elements within the Metaverse to deepen student understanding of various concepts (Kurdi, 2021). The integration of Artificial Intelligence (AI) also plays a crucial role in the development of Metaverse technology in education. AI can be used to enhance the learning experience by providing content recommendations tailored to the individual needs and preferences of students (Liriwati, 2023). Through continuous data analysis of student interactions, AI can also provide more personalized feedback and help formulate more effective learning strategies.

Furthermore, the development of interactive learning content is a promising area in the development of Metaverse technology. Content such as simulations, educational games, and engaging virtual environments can be designed to help students understand complex concepts more intuitively and practically (Khaira et al., 2023). For example, in natural sciences education, students could explore virtual environments that simulate natural ecosystems or experiment with physics concepts in a controlled virtual setting. Advanced research and innovation can also be a focus in developing Metaverse technology for education. The development of haptic technology, for instance, could open up opportunities to create more realistic learning experiences by allowing students to experience physical sensations in a virtual environment. Moreover, the integration of blockchain technology could enhance the security and integrity of learning data, while also opening doors for new business models in the education industry (Aulia et al., 2023).

Inter-industry collaboration is equally important in the development of Metaverse technology for education. Cooperation between educational institutions, technology companies, and Metaverse platform developers can yield innovative and sustainable solutions. For instance, universities could collaborate with VR/AR technology companies to develop learning programs tailored to specific industry needs, or conduct workshops and training for educators on utilizing Metaverse technology in the learning process.

By exploring the potential applications of Metaverse technology in education, we can identify numerous opportunities to enhance the student learning experience and create learning environments that are more inclusive, adaptive, and engaging. Therefore, it is vital for stakeholders to continuously follow the advancements of this technology and actively participate in developing solutions that meet future educational needs. Thus, the development of Metaverse technology in education will open doors for innovation and transformation in the educational world as a whole.

Limitations and Challenges of Using the Metaverse in Learning

The utilization of the Metaverse in learning appears to yield many positive impacts; however, several limitations must be considered when using the Metaverse for instructional purposes. While the social relationships or social distances provided are expanded, the social connection is not the same as what we typically experience when meeting face-to-face. The persona displayed in the Metaverse world also cannot be called our true self. With the freedom given, we can choose what information and which self we present to others. Consequently, we must be cautious and refrain from quickly judging someone's personality. Another limitation we must consider is data security and privacy, given the option to appear anonymous. Everyone's regard for freedom differs, so it is undeniable that other, more severe crimes may emerge (Putri et al., 2022).

Considering the various points above, the Metaverse still holds a favorable position if leveraged and used for learning. It presents a new challenge for higher education to integrate learning that utilizes various Metaverse technologies, given that human resources must be fully conversant with the technology, and adequate facilities are also required. It should not be limited to specific majors. However, it can also be applied across all disciplines, as the appropriate use of Metaverse technology has been proven to enhance learning effectiveness and interactivity. This technological innovation, a three-dimensional virtual space known as the Metaverse, has also been successfully utilized in early childhood education. Learning activities become more enjoyable and stimulate children's imagination, thereby effectively and efficiently achieving learning objectives (Wahyudin, 2023). Therefore, to overcome these challenges, specific efforts are needed. Educators must be provided with adequate training and professional development to utilize Metaverse technology in learning effectively. This training should include an understanding of Metaverse platform usage, the development of interactive learning content, and the integration of artificial intelligence into the learning experience. Thus, educators will be better prepared and more confident in implementing Metaverse technology in their teaching practices.

This challenge highlights the need for human resources who understand and are skilled in managing Metaverse technology. Adequate facilities are also required to support the use of Metaverse technology in learning. However, the appropriate use of Metaverse technology has been proven capable of enhancing the effectiveness and interactivity of learning at various levels, including in early childhood education. By utilizing this 3D virtual space technological innovation, learning activities become more enjoyable and can spur children's imagination, thus achieving learning objectives more effectively and efficiently.

Research Limitations and Implications of Findings

Although this literature review provides comprehensive insights into the utilization of the Metaverse in learning, several limitations exist. First, because this study focuses on the analysis of available articles, it is possible that some articles were not accessible or not considered in the analysis. Second, there is potential bias in the selection of articles, which may not cover all perspectives or relevant research on this topic. Third, the quality evaluation of articles was conducted based on predetermined criteria; however, some articles may possess varying quality, which may have influenced the overall analysis.

The implication of this literature review's findings is the significant potential for utilizing the Metaverse in a learning context, which can enhance interactivity, engagement, and student understanding. The use of the Metaverse can open doors for innovation in adaptive, interactive, and creative instructional design. However, it is crucial to pay attention to the several limitations and challenges associated with the use of the Metaverse in learning. One primary implication is the need for educators to receive adequate education and training to utilize Metaverse technology in the learning process effectively. Furthermore, a deep understanding of the limitations and risks associated with Metaverse use is necessary, such as data security and privacy issues, as well as the potential negative impacts on social relationships and individual identity.

In a broader context, the use of the Metaverse in education can be one step toward an educational transformation that is more inclusive, interactive, and relevant to the demands of the era (Yuda et al., 2024). However, further research and continuous technological development are necessary to address the limitations and optimize the potential of the Metaverse for learning.

CONCLUSION

The utilization of the Metaverse within the context of interactive learning is the primary focus of this research. With the Metaverse's potential to create profound and engaging learning experiences, coupled with its integration of Virtual Reality (VR) and Augmented Reality (AR) technologies, the Metaverse forms a new foundation for education. The application of the Metaverse in education is based on the concept of interactivity, which is key to creating profound learning experiences. In this context, the Metaverse enables students to interact and collaborate in a virtual environment, enhancing collaboration, communication, and problem-solving skills.

Furthermore, the types of Metaverse, such as augmented reality (AR), lifelogging, mirror worlds, and virtual worlds, offer significant potential in creating new social communication spaces, providing flexible settings for creativity and sharing, and enhancing virtual experiences in learning. Despite its significant benefits, the use of the Metaverse in learning also faces a number of limitations and challenges, such as weaknesses in real-world social relationships, identity issues, and data privacy concerns. Therefore, adequate education and training for educators, as well as a deep understanding of the risks and limitations associated with Metaverse use, are essential.

However, by addressing these challenges and limitations, the use of the Metaverse in education can be a step toward an educational transformation that is more inclusive, interactive, and relevant to the demands of the era. It is imperative to conduct further research and continuous technological development to optimize the potential of Metaverse use in learning in the future.

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