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Use of metaverse as innovation into educational technology to drive curriculum progress

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ABSTRACT

Metaverse introduces significant innovation in education by enabling engaging three-dimensional learning experiences. Educational institutions are actively preparing for metaverse integration in the curriculum, enriching students' creativity and critical thinking. This research aims to investigate and identify how the use of the metaverse can be integrated as an innovation in educational technology. This research uses a qualitative approach by collecting data through literature study and data analysis techniques using content analysis methods to highlight the potential of the metaverse as an innovative tool in developing educational technology curricula. Metaverse as a technology that is not only popular in the field of technology but also in the field of education has brought new changes. In the world of education, metaverse allows teachers and students to interact with each other in a virtual room where there is no direct interaction. Overall, the influence of the Metaverse on curriculum design can create significant opportunities to improve the quality of learning. However, the implementation of metaverse in the education sector faces many obstacles and challenges that must be overcome in order to achieve optimal results, one of the main obstacles is limited technological infrastructure.

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ABSTRAK

Metaverse memperkenalkan inovasi signifikan dalam pendidikan dengan memungkinkan pengalaman belajar tiga dimensi yang menarik. Institusi pendidikan aktif mempersiapkan integrasi metaverse dalam kurikulum, memperkaya kreativitas dan pemikiran kritis siswa. Penelitian ini bertujuan untuk menyelidiki dan mengidentifikasi bagaimana penggunaan metaverse dapat diintegrasikan sebagai inovasi dalam teknologi pendidikan. Penelitian ini menggunakan pendekatan kualitatif dengan pengumpulan data melalui studi pustaka dan teknik analisis data menggunakan metode analisis isi untuk menyoroti potensi metaverse sebagai alat inovatif dalam pengembangan kurikulum teknologi pendidikan. Metaverse sebagai teknologi yang tidak hanya populer di bidang teknologi namun juga bidang pendidikan telah membawa perubahan baru. Dalam dunia pendidikan, metaverse memungkinkan guru dan siswa berinteraksi satu sama lain dalam sebuah ruangan virtual di mana tidak ada interaksi langsung. Secara keseluruhan, pengaruh Metaverse pada desain kurikulum dapat menciptakan peluang yang signifikan untuk meningkatkan kualitas pembelajaran. Namun, implementasi metaverse dalam bidang pendidikan menghadapi banyak hambatan dan tantangan yang harus diatasi supaya dapat mencapai hasil yang optimal, salah satu hambatan utama adalah keterbatasan infrastruktur teknologi.

Kata Kunci: *Inovasi Pendidikan; Kurikulum; Metaverse*

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INTRODUCTION

The metaverse is a term that has become increasingly popular in the world of technology. Conceptually, the metaverse refers to a post-reality universe that many users can access by combining digital virtuality and reality. In fact, the term "Metaverse" is not new. However, when Mark Zuckerberg, the owner of Facebook, announced that the company would change its name to "Meta" and make significant investments in advancing technology within the "Metaverse," the term gained more popularity among the general public (Kim, 2021). In this rapidly evolving era, information technology has played a crucial role in transforming various aspects of life, including education. The use of the metaverse, initially known as a virtual environment concept, has brought a major shift in education by offering more interactive and immersive learning experiences. It is a technological evolution emerging with revolutionary potential (Hwang, 2022).

The metaverse offers more than just a virtual experience, alongside drastic changes in how we interact with the digital world. It is a dynamic virtual space where users can interact with one another and with computer-generated objects or environments. The metaverse has the potential to transform the way we learn by introducing new dimensions into education, including elements such as Virtual Reality (VR), Augmented Reality (AR), and more intensive online collaboration (Narin, 2021). The implementation of the metaverse in education not only offers solutions to improve student engagement but also expands the scope of learning by leveraging its interactive potential. The experience of playing and interacting in the metaverse can enhance students' motivation and engagement in learning. The readiness of students to implement the metaverse in the educational landscape, especially in Indonesia, can indeed be realized. Students' interest in using technology can no longer be prohibited or restrained; therefore, the metaverse can serve as a medium for channeling students' interest in technology. This research suggests that applying basic metaverse principles in education is no longer unfamiliar to students and is highly beneficial for teachers in enhancing learning strategies as well as improving students' technological skills (Bakhri, 2022).

In the field of education, metaverse innovation is considered capable of driving curriculum development by providing engaging and compelling learning experiences. The metaverse offers students the opportunity to learn in a three-dimensional virtual space, providing enjoyable learning experiences and detailed explanations of the subject matter. With the support of a flexible curriculum integrated with metaverse technology, students are expected to have the opportunity to learn freely and explore their potential truly. Many educational institutions, including Universitas Nasional, have prepared for the use of the metaverse in their curriculum by training teachers and developing learning materials (Alfaisal, 2022). The use of the metaverse as an educational technology innovation is crucial, as societal needs and expectations for the education system continue to change. Traditional curricula, although often rigid and static, are no longer sufficient to prepare future generations to face the increasing global demands. Therefore, the implementation of the metaverse in schools is not merely the adoption of new technology but a significant step toward aligning education with the dynamics of the changing times (Kye, 2021).

In the study by Barlian (2022), published in the *Journal of Educational Technology*, the implementation of the metaverse in education can help students develop skills such as teamwork, creativity, and problem-solving. This research also demonstrates that the metaverse is not only a learning tool but also a learning environment that fosters students' creativity and critical thinking. In other words, the metaverse serves as a community that provides users with a broader experience than just a technology. The integration of the metaverse promises significant changes in teaching methods, learning experiences, and curriculum development within the education sector. Recent survey results conducted by the Center for Education

and Technology Research indicate that approximately 78% of educators expressed a desire to integrate the metaverse into their curriculum. The study found that the use of the metaverse enables more adaptive and interactive learning, in addition to improving students' absorption of learning materials (Wang, 2022).

Another study written by Indrabayu (2022) titled "Learning Strategies Using the Metaverse for Teachers at Madrasah Aliyah Al Hidayah" addresses the issue currently faced by schools—enhancing learning strategies. To address this issue, the metaverse has emerged as a technology that can help teachers develop more engaging learning strategies compared to conventional methods. Another study by Indarta (2022) also notes that the use of the metaverse in education has opened up new opportunities to support the better implementation of the learning process. In Indarta's (2022) study, the advantages and challenges of using the metaverse in education are also explained. The advantage is experience-based learning, where students not only see and read but also feel, making learning more meaningful. However, the disadvantage lies in the socio-economic conditions of society, where not everyone can access the metaverse due to the need for digital devices. Digital crime also presents challenges related to student privacy and security.

The role of the metaverse in education serves as a promising strategy to enhance the learning process. The use of new learning media and changes in learning strategies certainly require thorough preparation from the initial planning stage. Curriculum development is a planning phase in the entire educational process that can be carried out to prepare for the use of the metaverse in the learning process. Based on research findings, the metaverse and curriculum—especially the *Kurikulum Merdeka*—can indeed be implemented and have great potential; however, among the numerous studies, only a few have discussed their relation to educational technology (Zhang, 2022).

Based on recent studies, the metaverse is becoming increasingly popular and widely used. Although many studies focus on curriculum, they do not directly relate to educational technology. The difference between this research and existing studies lies in its more specific focus and approach toward integrating the metaverse within the context of educational technology to drive curriculum advancement. Most existing research focuses on classroom-based studies using basic metaverse principles, or merely on metaverse usage and training for teachers. Therefore, to address the gaps in previous studies, this research discusses the use of the metaverse as an innovation within the context of educational technology to advance curriculum development. The purpose of this study is to investigate and identify how the use of the metaverse can be integrated as an innovation in educational technology to enhance curriculum development and progress. The focus of this study is to explore how the use of the metaverse can serve as an innovation to support curriculum advancement.

LITERATURE REVIEW

Basic Concept of the Metaverse

The term *"metaverse" has recently gained popularity, particularly* among academics in the field of technology. However, the concept of the metaverse is not something new; it existed even before Mark Zuckerberg, the owner of Facebook, made a significant investment in advancing technology called the "Metaverse." The term was first introduced in a science fiction novel written by Neal Stephenson titled *Snow Crash* in 1992. In the novel, the metaverse was not yet fully explained, as it was still conceptual and lacked real-world evidence at the time (Endarto & Martadi, 2022). The metaverse is described as an extension of the real world, a three-dimensional environment that allows people to enter and engage with

it. In addition, the metaverse consists of immersive technologies and digital environments where data is projected and represented, such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR).

The terms Extended Reality (XR) or Cross Reality are also used to describe this type of technology. The post-reality universe, or metaverse, is an environment used by many people that combines physical reality with digital virtuality. This universe is based on technological developments that enable multisensory interaction with virtual environments, digital objects, and other people, such as through VR and AR. Furthermore, Hollensen (2022) explains that the metaverse is a digital replica of the physical world. In this three-dimensional digital space, users can gather as avatars resembling themselves. From these definitions, the metaverse can be understood as a virtual world that replicates the real world, where individuals can communicate and engage in activities just as they would in real life. Metaverse users can customize their avatars' appearance because it is a virtual space. Additionally, to access the metaverse, one must use supporting technological tools such as VR and AR (Weinberger, 2022).

Ideally, several supporting components must exist within the metaverse, particularly AR and VR. Augmented Reality (AR) is a technology that integrates virtual objects into the real world, either in 2D or 3D form, using digital devices such as smartphones. This technology is already widely used in games, advertising, and even education. Although it sounds futuristic, AR is neither expensive nor difficult to access, as it can be used via smartphones. Meanwhile, Virtual Reality (VR) is a technology that creates a realistic 3D virtual world. VR also allows users to interact with one another freely in the virtual world, just as they would in the real world. While in the virtual environment, users may experience *telepresence*, where they feel as if they are physically present and integrated into the virtual world, interacting with objects within it (Saurik et al., 2019). Like AR, VR technology can also be easily accessed using smartphones, although it generally requires additional tools, such as special goggles, for example, Google Cardboard, developed by Google. AR and VR are essential to the basic concept of the metaverse because today's immersive digital spaces can be accessed through these technologies (Chairunissa, 2022).

Definition of Metaverse in Education

The metaverse in education is generally associated with learning systems, strategies, or media used by teachers or educational institutions to enhance learning activities. The metaverse in education can connect teachers and students in a virtual space, eliminating the need for face-to-face interaction (Setiawan, 2022). It is a space where students can meet and interact virtually with their classmates and educators. This enables students from anywhere and at any time to participate in learning and to transcend the limitations of physical classrooms. The use of the metaverse has proven to be productive, mainly as this virtual space enables students to conduct scientific experiments, create prototypes, and watch learning videos in a more immersive manner (De Felice, 2023).

The metaverse offers teachers the opportunity to overcome learning barriers among subjects by allowing them to create learning environments tailored to the needs of learners. Students can engage in independent learning, enabling them to explore their unlimited questions, refer to ideas from people all around the world, and take the initiative to find the correct answers. According to Iswanto (2022), in the context of education, the metaverse has several characteristics, including:

1. Virtual learning spaces, where the metaverse can provide virtual learning environments that are more communicative, enjoyable, and engaging by integrating the virtual world with the real world.
2. Collaborative learning, where the metaverse allows students to work together and learn with people from all over the world, thus creating a learning environment rich in social interaction.

3. Overcoming barriers, where the metaverse offers teachers the opportunity to overcome barriers between subjects and learning by allowing them to combine traditional subjects with modern learning.

Metaverse-based education can open up new opportunities to enhance teaching and learning activities, facilitate greater innovation, and provide engaging and enjoyable learning experiences.

Curriculum in Learning

The curriculum encompasses all learning activities prepared and guided by the school, whether conducted in groups or individually, inside or outside the school, and based on students' experiences (Aprima, 2022). The curriculum also serves as a reference for assessing student learning outcomes. As an educational plan, the curriculum consists of three main components: objectives, learning materials, the development of the learning process, and the development of evaluation content. These curriculum components require foundations to create a new curriculum or revise an existing one. According to Mubarok (2021), the curriculum has six foundations, as follows:

1. Problem Identification and General Needs Assessment, a crucial step in revising the curriculum;
2. Targeted Needs Assessment, gathering information related to students' learning interests;
3. Goals and Objectives, determining the aims and targets of the curriculum to ensure it is well-directed;
4. Educational Strategies, considering teaching strategies to support the implementation of the curriculum;
5. Implementation; and
6. Evaluation and Feedback, as any program must evaluate in order to make necessary improvements.

According to Hasan (2022), the curriculum as a learning plan for students is divided into three forms, as follows:

1. The ideal curriculum or document curriculum is written text that serves as a guideline for educational activities.
2. The actual or functional curriculum is the learning plan implemented in the classroom.
3. The hidden curriculum refers to the social relationships that arise from learning activities.

Table 1. Differences between the ideal, actual, and hidden curriculum

Aspect	Ideal Curriculum	Actual Curriculum	Hidden Curriculum
Form	Written	Learning process in the classroom	Social relationships between teachers and students
Example	Syllabus, lesson plans (RPP)	Learning materials, such as modules	Classroom discussions

Source: Hasan (2022)

METHODS

This research is a qualitative study in which the data consist of narratives or written words. According to Bogdan and Taylor in Ulandari (2023), qualitative research is also a methodology used for research procedures that yield descriptive data. Within the qualitative framework, this study aims to gain a deep

understanding of the phenomenon under investigation. Data collection was conducted through a literature study method, which involves the theoretical exploration of various scientific references relevant to the research topic. The literature study (library research) method involves collecting data by understanding and studying theories from various sources related to the research.

According to Zed in Adlini (2022), the literature study method consists of four stages: preparing the necessary tools, compiling a working bibliography, organizing time, and reading or taking notes on research materials. The study began by compiling research sources, including books, journals, and previous studies. The collected literature was then reviewed to identify ideas relevant to the research. Subsequently, the reading materials were analyzed using content analysis techniques by rechecking and rereading the sources to prevent misinformation. The results of this analysis were then organized systematically into a coherent written work.

RESULTS AND DISCUSSION

Results

The Role of the Metaverse in Educational Transformation

The Metaverse is a three-dimensional virtual world that combines elements such as online gaming, social media, virtual reality (VR), and augmented reality (AR), and has a significant positive impact on educational transformation. Its presence allows users to interact online, creating interactive and collaborative learning spaces. One of its key advantages is the ability to provide realistic simulations and learning experiences, enabling students to navigate challenging or even dangerous situations within a safe environment. For instance, a history class could utilize the Metaverse to visit reconstructed historical sites virtually. In contrast, a physics class could conduct experiments that would be impossible to perform in the real world. This not only enhances student understanding but also strengthens their problem-solving skills (Pamungkas, 2022).

As a technology that has gained popularity not only in the technological field but also in education, the Metaverse has brought about significant change. Conceptually, the Metaverse refers to a post-reality universe that combines two worlds: the virtual or digital world and the physical world. In education, the Metaverse enables teachers and students to interact within a virtual space where physical face-to-face interaction is not required (Herlambang, 2023). This virtual space allows students to meet and interact with teachers and peers from anywhere. Moreover, the Metaverse facilitates virtual collaboration between students and teachers. This environment enables learners to engage with others from around the globe, allowing them to learn from diverse perspectives and broaden their understanding of different cultures and languages. Collaborative projects in the Metaverse also develop essential social and teamwork skills applicable in the real world (Tlili, 2022).

A study by Kanber (2023), published in the *International Journal of Emerging Technologies in Learning*, revealed that the use of the Metaverse enhances student motivation, strengthens problem-solving and critical thinking skills, and improves language learning, particularly in speaking and writing. However, to fully harness the potential of the Metaverse in education, teachers must provide clear explanations and guidance to students. This helps learners understand Metaverse concepts and prepares them to navigate trends, daily practices, and its role as a learning tool. By enabling interactive and collaborative learning while supporting a wide range of subjects, the Metaverse actively contributes to accelerating educational transformation and improving overall learning quality (Putri, 2022).

The Impact of the Metaverse on Curriculum Design

The impact of the Metaverse on curriculum design is a complex phenomenon that involves integrating new technologies into formal learning structures. The virtual world accessible to users can significantly influence the design of educational curricula. Key influences include increased interactivity, more immersive learning experiences, and the implementation of game-based learning models. The Metaverse also enables curricula to incorporate augmented reality and virtual reality technologies, which can enhance learner engagement and promote more effective and enjoyable learning (Sulistiani, 2023).

However, the use of the Metaverse in curriculum design also introduces new challenges, such as the need for educators to gain a deeper understanding of technology and to develop learning content suitable for Metaverse environments. This shift may also impact the technological infrastructure required within learning environments and necessitate changes in methods for evaluating and assessing learning outcomes. The integration of the Metaverse into curriculum design can help learners develop strategic thinking, creativity, and collaboration skills among peers. Nevertheless, special attention must be given to the ethics and safety of using this technology, as well as a deeper understanding of the psychological and social effects of its implementation in education (Gusteti, 2023).

Overall, the influence of the Metaverse on curriculum design presents significant opportunities to improve the quality of education but also demands comprehensive changes in teaching approaches, content development, and educational infrastructure. A thorough understanding of the technical, pedagogical, and social implications of using the Metaverse in educational contexts is needed to ensure its optimal use (Rasyida, 2023).

Challenges and Obstacles in Implementing the Metaverse

The implementation of the Metaverse in education faces numerous obstacles and challenges that must be addressed to achieve optimal results. One of the primary challenges is the limitation of technological infrastructure, resulting in unequal internet access in many regions. Inadequate infrastructure can hinder the use of the Metaverse, especially for educational institutions located in remote areas or with limited access. Additionally, security and privacy are crucial, as the Metaverse involves the collection and use of personal data from each learner (Syahrul, 2023). Strong policies and robust security systems are necessary to protect student privacy and mitigate cyber threats. Another key challenge lies in integrating the Metaverse into the school curriculum. To understand and incorporate the Metaverse into daily learning, teachers and other education staff require extensive professional development. A poorly integrated curriculum can hinder the use of the Metaverse in providing richer and more immersive learning experiences. Solutions that combine virtual and physical worlds are also necessary to strike a balance between the two (Buana, 2023).

The lack of equal access to hardware and connectivity among students is also a significant barrier to learning. Therefore, subsidy or aid programs must be implemented to ensure that all learners can access the Metaverse without limitations. Additionally, cultural and ethical considerations must be carefully taken into account. Differences in cultural and moral beliefs may affect how the Metaverse is used in education. Thus, discussions with various stakeholders are needed to understand diverse perspectives (Saputri, 2024). Within the Metaverse, learners and teachers may encounter challenges in collaborating and interacting with one another. Therefore, platforms that support effective collaboration and interaction,

along with training programs to help learners develop teamwork skills, are essential. Despite this, the costs associated with infrastructure, training, and content development for implementing the Metaverse can pose significant challenges. Solutions to address these costs may include alternative funding models such as grants or private sector partnerships (Tari, 2023).

Furthermore, unsupportive policies and regulations may hinder the application of the Metaverse in educational institutions. Creating an environment conducive to the development of the Metaverse in the education sector—through advocacy, government engagement, and supportive policy development—will be a crucial step in advancing this initiative. To address these issues, regular evaluations of Metaverse implementation are necessary to identify areas for improvement. Continuous research and innovation are crucial for developing more efficient approaches, as the field of education is continually evolving (Salim, 2023).

Discussion

Comprehensive and well-planned solutions are required to address the obstacles and challenges that hinder the implementation of the Metaverse in education. Governments and educational institutions must increase investment in infrastructure—particularly in internet access and hardware—to overcome technological limitations. Additionally, a beneficial strategy is to collaborate with technology companies to provide affordable connectivity and hardware. To ensure equitable access to devices and connectivity, subsidy or assistance programs should be implemented to support low-income individuals. In underdeveloped regions, public technology centers can also help improve community access. The development of collaborative platforms and training programs will enhance learners' abilities in the Metaverse, particularly in overcoming challenges related to collaboration and interaction (López-Belmonte, 2023).

In terms of security and privacy, strict security standards and cybersecurity training are essential for teachers and other educational staff. Technology companies have the capacity to offer innovative and efficient security solutions. Building a strong ethical culture in Metaverse use can be facilitated by creating clear ethical guidelines and engaging parents, teachers, and communities in dialogue. Teacher development and training programs can help improve Metaverse integration with the curriculum. Moreover, creating educational content aligned with Metaverse applications and learning objectives is necessary. Regular curriculum evaluation and adjustment are crucial to ensure that the Metaverse is effectively integrated into the learning process. Additionally, developing platforms that maintain a balance between virtual and physical learning environments must be considered (Ning, 2023).

Public–private partnership approaches and private sector involvement can help address resource constraints. Partnerships with the private sector, grants, and support from charitable organizations are alternative funding options that can help reduce the costs of implementation. To overcome these barriers, effective budget management and prioritization of spending on key elements of Metaverse implementation are essential. Supportive policies and regulations should be strengthened through government involvement, advocacy, and collaboration among multiple stakeholders in the policymaking process. Furthermore, to address these challenges, regular evaluations of Metaverse implementation should be conducted to identify areas requiring improvement or adjustment. Continuous research and innovation must also be encouraged to produce more efficient approaches that align with the evolving landscape of education. Overall, the success of Metaverse implementation in educational transformation will depend on the collaboration among governments, educational institutions, the technology industry, and society (Afifah, 2023).

CONCLUSION

The role of the metaverse has a significant impact on the transformation of education. The classroom, which was once confined to traditional concrete buildings, has evolved into a virtual space. The metaverse, with its three-dimensional (3D) virtual space technology, has opened up various new possibilities for creating interactive and collaborative learning environments. Students can experience simulations more realistically by visiting variously reconstructed historical sites or conducting virtual experiments that would be impossible in the real world. This will undoubtedly enhance students' critical thinking skills, boost their motivation, and refine their problem-solving and collaborative abilities. The potential presented by the metaverse, along with the various responses from teachers regarding it, will undoubtedly impact curriculum design in the future. A virtual world that can be accessed during the learning process can significantly influence the design of educational curricula. Interactive learning that combines two worlds requires teachers to create new learning strategies, and the implementation of game-based learning models may become an aspect to consider in future curriculum design. Curriculum changes certainly have obstacles, especially in relation to metaverse technology. Unequal infrastructure that supports metaverse-based learning, limited internet access, unguaranteed security and privacy, the abilities of teachers and students to use the metaverse, and the limited amount of metaverse learning content are current obstacles in curriculum change.

AUTHOR'S NOTE

As the authors of this article, we acknowledge the complexity and challenges inherent in the implementation of the metaverse in education. This article aims to investigate critical obstacles and describe solutions that can be implemented to improve the application of the metaverse in educational environments. We hope that this in-depth analysis of the issue can stimulate further discussion and action toward creating a more inclusive, innovative, and future-oriented learning environment. The authors realize that this article is still far from perfect; therefore, constructive criticism and suggestions are highly expected to perfect this article. Lastly, thank you to all parties involved in the research process until the completion of this article. We hope this article can be useful for those in need.

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