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Metaverse integration in higher education curriculum: A systematic literature review

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ABSTRACT

The Metaverse, a fusion of the online and physical worlds, creates an unlimited 3D environment through virtual reality headsets and augmented reality applications. These tools enable users to explore an immersive new reality, free from the physical constraints of the everyday world. This article investigates the transformative potential of the Metaverse in higher education curriculum development using the Systematic Literature Review (SLR) research methodology. Exploring virtual and augmented reality, the research aims to integrate Metaverse technology to enhance curriculum responsiveness seamlessly. The literature review covers various types of Metaverse, emphasizing enriching aspects such as improved learning experiences and global collaboration. Despite facing challenges like initial investments and access disparities, findings indicate a positive impact on curriculum development, facilitating interactive and in-depth learning. Long-term benefits involve career readiness, educational innovation, and paradigm shifts, highlighting the potential of the Metaverse to revolutionize education. This article encourages further exploration and broader-scale implementation of Metaverse in education, both now and in the future.

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ABSTRAK

Metaverse pada dasarnya adalah gabungan antara dunia online dan fisik, menciptakan lingkungan 3D tanpa batas melalui perangkat seperti headset realitas virtual dan aplikasi realitas tertambah yang memungkinkan pengguna menjelajahi realitas baru yang imersif, bebas dari batasan fisik dunia normal. Artikel ini menyelidiki potensi transformatif Metaverse dalam pengembangan kurikulum pendidikan tinggi dengan metodologi penelitian Systematic Literature Review (SLR). Mengeksplorasi realitas virtual dan realitas tambahan, penelitian bertujuan untuk mengintegrasikan teknologi Metaverse secara mulus guna meningkatkan responsivitas kurikulum. Tinjauan literatur mencakup berbagai jenis Metaverse, menekankan aspek yang memperkaya seperti pengalaman belajar yang ditingkatkan dan kolaborasi global. Meskipun dihadapkan pada tantangan seperti investasi awal dan disparitas akses, temuan menunjukkan dampak positif pada pengembangan kurikulum, memfasilitasi pembelajaran interaktif dan mendalam. Manfaat jangka panjang melibatkan kesiapan karier, inovasi pendidikan, dan perubahan paradigma, menyoroti potensi Metaverse untuk merevolusi pendidikan. Artikel ini mendorong eksplorasi lebih lanjut dan implementasi skala lebih luas mengenai Metaverse dalam dunia pendidikan baik di masa sekarang maupun masa yang akan datang.

Kata Kunci: *pengembangan kurikulum; pendidikan tinggi; metaverse*

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INTRODUCTION

Higher education serves as the most fundamental foundation in shaping competent future generations who are capable of adapting to contemporary developments. In the digital era, technology is advancing rapidly, creating both new opportunities and challenges for the education sector. Educators' understanding and proficiency in technology, as well as the high associated costs, are critical considerations. One technological innovation currently attracting significant attention is the Metaverse, a virtual environment that enables social interaction and learning through digital avatars (Noegroho & Sihotong, 2023). The Metaverse itself represents an interactive virtual world that allows users to access diverse content, collaborate, and engage within a cohesive virtual environment. This concept offers a more immersive digital experience and holds potential to transform the way education is delivered and received (Suparyati *et al.*, 2024). It also presents revolutionary possibilities for the development of higher education curricula and their potential implementation in Indonesia's educational landscape (Rewara *et al.,* 2024). As a platform encompassing Virtual Reality (VR), Augmented Reality (AR), and other elements, the Metaverse can be integrated into the learning process to enhance learning experiences (Hew & Cheung, 2019). Learning through the Metaverse has demonstrated a significant improvement in comprehension throughout the educational process. Additionally, social interaction can still occur even when learners are engaging from different locations (Riyanto, 2023).

Introducing Metaverse technology into higher education curricula opens the door to more dynamic, interactive, and responsive learning approaches that align with the continuously evolving demands of the labor market (Johnson & Smith, 2023). The utilization of virtual spaces in learning processes bridges the gap in professional learning experiences by providing adequate tools and resources (Laksito & Wibowo, 2022). The concept of the Metaverse can also be applied in the preservation of cultural heritage objects through replication. Such replication may occur on a virtual scale, ranging from regions to buildings or monuments, thereby creating a realistic atmosphere and fostering community engagement (Hamka *et al.*, 2022). VR, in particular, is a suitable approach to addressing the challenges of the Fourth Industrial Revolution (Industry 4.0) in education. Its implementation enhances direct engagement and can improve academic outcomes during the learning process (Safar *et al.*, 2021).

The successful implementation of Metaverse technology in higher education contexts requires not only tracking technological trends but also a deep understanding of its impact on educational quality. The Metaverse integrates elements such as simulations, virtual collaboration, and personalized learning experiences to create a challenging and relevant learning environment that prepares students to face real-world challenges (Watson *et al.*, 2017). This study aims to examine how the application of Metaverse technology can enhance curriculum development in higher education, including the challenges, benefits, and paradigms it presents in the educational sphere. A detailed analysis of the Metaverse's impact on learning experiences provides a deeper understanding of how curricula can be adapted to meet the evolving needs of society. This research is expected to make a significant contribution to understanding the potential of the Metaverse in higher education and to motivate academics and educators to explore and implement this innovation on a larger scale. In doing so, higher education can continue to serve as a platform for producing graduates who not only possess academic knowledge but also practical skills relevant to industry and societal needs.

LITERATURE REVIEW

Metaverse

The term “Metaverse” originates from a combination of the words “meta,” meaning beyond, and “universe,” referring to the world. The Metaverse refers to a hypothetical, synthetic environment that is associated with the physical world (Barlian *et al.*, 2022). Essentially, the Metaverse is about merging the online and physical worlds to create something novel. Devices such as virtual reality headsets and augmented reality applications allow users to explore this new reality as an immersive, unlimited 3D environment. The Metaverse is boundless and free from the physical constraints inherent in the everyday world, implying that it can appear and function in ways that are markedly different from conventional expectations.

The Metaverse enables humans to express a world in which daily life, economic activities, and education are integrated (Watson *et al.*, 2017). Several Metaverse applications have been adopted in education due to their rapid integration into contemporary life. However, alongside these developments, an understanding of the Metaverse’s concepts and types, as well as examples of its applications in education, is necessary. Once these aspects are comprehended, the benefits of utilizing digital technology or the Metaverse can be realized, as has been observed in recent years. Understanding the Metaverse can be facilitated through workshops conducted at both school and higher education levels to introduce how this technology operates as a learning medium (Sulistiani, 2023).

Metaverse Simulation

Within the digital realm, including the Metaverse, the term simulation is commonly used. Simulation can be defined as a form of training that demonstrates scenarios in a manner that closely resembles real-life conditions. Therefore, simulations in the digital world constitute imitations or enactments of events that mirror reality. Four types of Metaverse simulations work in collaboration with each other. Through this collaboration, the Metaverse creates a world in which users can experience activities or conditions that feel as real as those in the physical world (Mulati, 2022). In general, the four types of Metaverse simulations are illustrated in **Figure 1** below (Iswanto *et al.,* 2022).

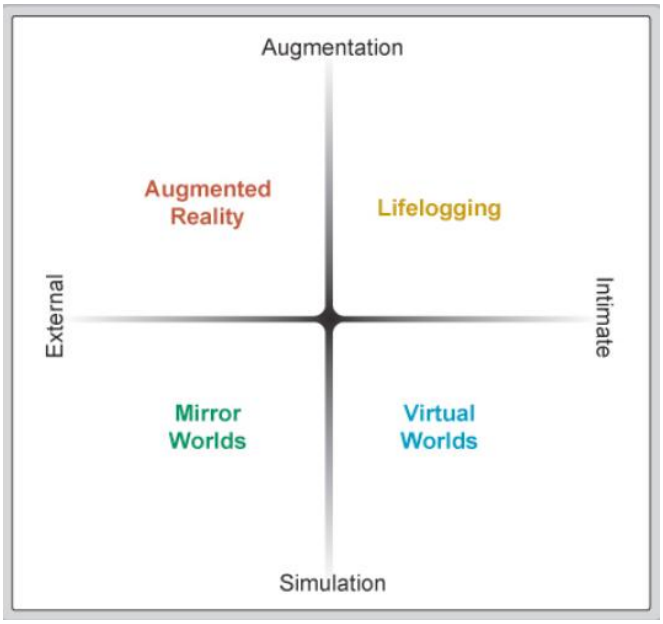

Figure 1. Four Types of Metaverse Simulations
Source: Smart, J, 2007

1. Augmented Reality (AR)
   Augmented Reality (AR) represents a form of augmentation of the external world. AR utilizes global positioning systems and Wi-Fi integrated into mobile devices to provide location-appropriate shortcut information or detect markers in quick response (QR) codes, linking or complementing existing information. Additionally, real and virtual graphics can be seamlessly blended and viewed in real-time through glasses or lenses. AR has been recognized as effective for learning materials that are difficult to observe directly or explain textually. It is particularly suitable in fields that require continuous practice and experience, as well as in high-cost or high-risk domains.

   AR refers to a technology that expands the physical world through a location-aware interface system, connecting with information networks in everyday environments. Real-world and virtual graphics can typically be viewed in real time through glasses or lenses. AR enables the teaching of learning materials that are difficult to convey through text, subjects that require continuous practice and experience, and high-cost educational content to students.

2. Lifelogging Scenario
   The lifelogging scenario in the Metaverse refers to the recording or collection of informational and communicational data for users and objects within the Metaverse. This type of Metaverse collects significant amounts of sensitive information. Educational applications fall under the lifelogging Metaverse scenario. Other examples of lifelogs include user information on social media platforms such as Facebook, Twitter, and Instagram. In the medical field, services utilize biometric information stored on wearable devices such as STEPN, which follows the move-to-earn (M2E) concept. STEPN is an application that rewards users with tokens of monetary value for walking, running, or standing. This also constitutes a form of lifelogging..

3. Mirror World
   The mirror world is a type of external world simulation that refers to a virtual model enriched with information or a “reflection” of the real world. A mirror world is a Metaverse in which the appearances, information, and structures of the real world are transferred into a virtual reality, akin to a mirror. All activities in the physical world can be performed via the internet or mobile applications, and the metaverse facilitates a more convenient and efficient real-world life.

4. Virtual Reality (VR)
   VR is a type of Metaverse that simulates an internal or immersive world. Virtual reality technology encompasses advanced 3D graphics, avatars, and instant communication tools. VR represents a world in which users feel fully immersed in a virtual reality. Virtual reality is often described as the opposite end of a spectrum that includes mixed reality and augmented reality. However, VR allows us to perceive flat images in three dimensions based on the principles of human vision. It is also characterized as an internet-based 3D space accessible to multiple users simultaneously, enabling participation through avatars representing the users.

   Within virtual reality Metaverse environments, elements such as space, cultural backgrounds, characters, and institutions are designed differently from the real world. Users interact through avatars controlled by AI-driven characters, communicate with other participants, and pursue various objectives. The Metaverse also encompasses virtual realities that involve physical interactions, such as body movements, touch, and daily or economic activities occurring within these spaces. Examples of such phenomena include Zepeto and Roblox. Zepeto is a recently emerging interactive service that utilizes 3D avatars. At the same time, Roblox is a platform where users can create their own virtual worlds and participate in diverse creative experiences with friends.

Higher Education Curriculum Development

Curriculum development is an important and complex process within the field of education. In higher education, curriculum development represents a strategic process aimed at ensuring that educational programs reflect the latest advancements in knowledge, technology, and labor market needs. The following are several key aspects or principles in curriculum development, particularly in higher education (Ayudia *et al.,* 2023; Dewi & Hamami, 2019; Fatimah *et al.,* 2021; Sobari *et al.,* 2023).

1. Alignment with Current Developments
   The curriculum must be continuously updated to reflect the latest developments within the relevant field of study. This may involve periodic reviews of courses and learning materials, as well as the integration of current technologies and teaching methodologies. Activities that challenge students to think critically in problem-solving, encourage collaboration, and foster effective communication are essential components that should be incorporated into the curriculum or lesson plans.

2. Relevance to Industry Needs
   Kurikulum harus dirancang agar lulusan dapat memenuhi kebutuhan industri dan pasar kerja. Keterlibatan industri dalam proses pengembangan kurikulum dapat membantu memastikan bahwa mahasiswa dilengkapi dengan keterampilan yang sesuai dengan tuntutan pekerjaan. Kebutuhan dunia kerja dan industri akan tenaga kerja yang berkualitas di masing-masing bidang profesi telah berkembang secara dinamis menjadi tantangan yang jelas bagi kurikulum di Indonesia.

3. Competency-Based Learning
   The focus should be on developing skills and competencies required in the professional world. A curriculum should not only be oriented toward the delivery of knowledge but also toward fostering practical and analytical skills that can be applied in real-world contexts. Educational institutions must cultivate graduates who possess strong character, practical skills, innovation, creativity, domain-specific competencies, and sensitivity to both local and global environments.

4. Integration of Technology and Innovation

The utilization of technology in the learning process is increasingly critical. Integrating technologies such as the Metaverse, simulations, and online platforms can enhance students' learning experiences and prepare them for challenges in the digital era.

5. Collaboration and Partnerships
   Engaging external stakeholders, including companies, research institutions, and communities, can enrich the curriculum and ensure that educational programs are contextualized within a broader societal framework.
6. Periodic Evaluation and Assessment
   Establishing mechanisms for regular evaluation and assessment is crucial for measuring the effectiveness of the curriculum. Feedback from students, alums, and other stakeholders can facilitate continuous improvement.
7. Student Engagement
   Involving students in the curriculum development process can provide valuable perspectives. Student participation in discussions, surveys, and evaluations can help align the curriculum with their needs and expectations.
8. Sustainability and Flexibility
   Curricula should be designed to evolve and remain relevant in the face of changes in the educational and societal environment. Such flexibility allows educational institutions to respond rapidly to unforeseen developments.

Effective curriculum development requires a combination of deep understanding of labor market demands, academic advancements, and the impact of emerging technologies. The ultimate aim is to produce graduates who are not only academically proficient but also prepared to navigate the complexities of the real world (Smith & Turner, 2024). This capability is particularly essential in the current era.

METHODS

The Systematic Literature Review (SLR) is a critical research method for constructing a detailed overview of literature relevant to a specific research topic. SLR is a method that identifies, evaluates, and interprets the findings of a given research topic to address other research questions. This method is applied in accordance with established steps to avoid subjective interpretation or bias (Dinter *et al.*, 2021). The SLR process begins with formulating specific research questions and designing a research protocol that guides the steps for searching, including the selection and exclusion of literature, as well as the evaluation criteria. At this stage, information sources, such as journal databases, conference proceedings, books, and other academic sources, are identified for access.

Following source identification, a systematic literature search is conducted using relevant keywords, complemented by the application of predetermined filters and inclusion and exclusion criteria. The next step is literature selection, which involves choosing literature based on the inclusion and exclusion criteria established in the protocol. It is important to note that this selection process may involve more than one researcher working independently to enhance validity and reliability.

Subsequently, data are extracted from the selected literature using pre-designed forms or assessment tables. Evaluating the methodological quality of each literature source is also a crucial aspect of SLR, and appropriate evaluation tools corresponding to the type of research are employed to provide a more accurate representation.

After data extraction and quality evaluation, analysis and synthesis of the literature findings are conducted to identify trends, similarities, or differences within the relevant literature. The final SLR report includes essential components such as the introduction, methods, findings, and conclusions. Before publication, feedback from peers or the research team is reviewed, and the report is revised based on the received feedback. Through these steps, SLR provides in-depth insights into existing literature on a research topic, enabling readers to understand the broader context and formulate well-informed perspectives and robust conclusions (Andriani, 2021).

RESULTS AND DISCUSSION

Implementation of Metaverse Technology in Higher Education Curriculum Development

The implementation of Metaverse technology in higher education curriculum development has demonstrated a significant positive impact. The following are the outcomes of applying Metaverse technology in curriculum development (Endarto & Martadi, 2022; Fadilah, 2023; Laksito & Wibowo, 2022; Safitri *et al.,* 2024).

1. Enrichment of Learning Experiences
   Metaverse technology enables more interactive and immersive learning. Students can access 3D simulations, virtual explorations, and profound learning experiences. This enhances the curriculum's appeal and motivates students to engage more actively in their learning. This statement aligns with the research conducted by Fadilah in 2023, which indicated that learning through the Metaverse (in this case, using Spatial.io) can provide enjoyable educational experiences and serve as an effective means of campus promotion.

2. Global Collaboration
   The Metaverse allows students from various parts of the world to collaborate within virtual environments. Group projects can be carried out efficiently without geographical limitations. This opens opportunities for students to gain global perspectives and develop the collaborative skills required in the era of globalization. The Metaverse can enhance engagement and enable practical learning within realistic virtual settings, providing unrestricted global access to educational resources. Effective global collaboration depends on robust technological infrastructure and continuous monitoring of security considerations.

3. Practical Simulations
   Through the Metaverse, higher education institutions can offer realistic and practical simulations within virtual environments. This helps students refine their practical skills without the risks and costs associated with direct practice. For instance, medical students can perform virtual surgeries, or architecture students can design buildings within a 3D environment. Simulations serve as a significant tool because they help maximize learning across diverse educational settings. Simulation-based education promotes diligent and focused student learning, offering opportunities to expand skills so that students can apply their knowledge and competencies in more realistic scenarios.

4. Personalized Learning
   Metaverse technology enables enhanced personalized learning. Learning systems can be tailored to individual students' learning styles, providing more effective and efficient learning experiences. Personalization can be further enhanced through artificial intelligence, allowing the system to adjust learning according to the curriculum, provide individualized feedback, and create more efficient learning experiences. With no limitations of space and time, learning can be globally accessible through online platforms.

Challenges in Implementing the Metaverse in Higher Education

The implementation of Metaverse technology requires significant initial investment in infrastructure and training. Such investment may include foundational education aimed at raising public awareness. Schools, community centers, or specialized training programs are suitable venues for this education. Instruction on the use of software, internet navigation, tools such as Microsoft Office, online security, or basic programming skills can significantly assist the community in becoming proficient in technology across various contexts, including educational settings (Awaliyah *et al.*, 2024).

Other studies have shown that some students may not have equal access to Metaverse technology, leading to disparities in their learning experiences. This access inequality refers to limitations that individuals or groups may face in obtaining hardware, software, or technological infrastructure, such as smartphones, computers, internet connectivity, or digital resources. Such limitations can hinder individuals' ability to seek employment or develop small businesses. Consequently, they may miss opportunities for online work or positions requiring technological skills (Awaliyah *et al.*, 2024).

Furthermore, data security and student privacy must be prioritized, given the involvement of advanced technologies. Digital security is a critical concern for all members of society, including those in educational contexts. Digital security threats should be addressed collectively and mitigated through proper education and understanding. Efforts to enhance awareness and knowledge regarding digital security will help protect privacy and safety in virtual environments (Awaliyah *et al*, 2024). Additionally, security and privacy issues can be addressed through collaboration among government, educational institutions, and technology industries in establishing infrastructure that supports the integration of the Metaverse into the learning process (Yuda *et al.*, 2024).

Benefits of Implementing the Metaverse in Higher Education

Students engaged in Metaverse-based learning can gain a competitive advantage in an increasingly digital labor market. The competition currently emerging in the workforce is fundamentally related to understanding market mechanisms, the speed and accuracy of product delivery, and the ability to create added value. All of these outcomes can be achieved effectively when organizations have creative human resources with high capacities, including knowledge of the technologies used to perform their work (Nugraha & Puspita, 2023).

The application of the Metaverse promotes innovation in higher education, enabling institutions to update their curricula in line with technological advancements continually. The Metaverse has the potential to surpass or reach the peak of growth in the learning domain because it has created digital educational platforms based on AR and VR. Moreover, audiovisual education has currently shaped the most popular Metaverse applications, which have been widely utilized in various educational contexts (Setiawan, 2022).

The Metaverse is also beneficial for students with diverse learning styles, as they can derive maximum advantage from a more diversified learning approach. The Metaverse can overcome spatial and temporal limitations for class participation, thereby accelerating the integration of Metaverse technologies in education (Hasannah *et al.,* 2024). Through the Metaverse or other educational technologies, students can access a wide range of information via various digital or online platforms. Furthermore, the systems employed can be adapted to the prevailing curriculum (Safitri *et al.*, 2024).

Learning Paradigms Using the Metaverse

The paradigm shift associated with Metaverse-based learning also warrants attention. The Metaverse enables a lifelong learning approach, allowing students to continue developing their skills after graduation. Essentially, the Metaverse has transformed conventional learning paradigms. Students no longer learn at fixed times but can engage in learning at any time and from anywhere (Yuda *et al.*, 2024).

The integration of online and offline learning within the Metaverse also opens the door to a more flexible hybrid education model (Wankel & Bessinger, 2013). Through the Metaverse, learning that was previously conducted traditionally and constrained by spatial and temporal limitations can now occur in hybrid or unrestricted physical settings. This supports cross-cultural learning, as students from different regions can participate together on the same platform (Yuda *et al.*, 2024; Chen & Wang, 2023).

The implementation of Metaverse technology in higher education contexts undoubtedly presents several challenges that need to be addressed. However, its long-term benefits are auspicious and have the potential to fundamentally transform educational paradigms, guiding us toward more inclusive, interactive, and future-relevant learning experiences (Anderson & Brown, 2022). One of the primary challenges is the availability of sufficient technological infrastructure to support the use of the Metaverse in educational environments. This includes sufficient hardware, fast and stable internet access, and human resources capable of managing and effectively utilizing the technology in the learning process. Furthermore, a deep understanding of the potential and limitations of Metaverse technology is necessary to optimize its use in accordance with educational needs. Despite these challenges, the long-term benefits remain extensive (Brown & Taylor, 2023).

The use of the Metaverse can enhance educational accessibility for individuals from diverse backgrounds, overcoming geographical and mobility barriers, and facilitating more in-depth collaborative and experiential learning. By leveraging the interactive features offered by the Metaverse, educational institutions can create learning environments that are more engaging, captivating, and relevant for students, thereby increasing their motivation and involvement in the learning process (Chen & Wang, 2023). Moreover, the Metaverse can serve as a platform for developing new skills aligned with the demands of the digital-era labor market, such as collaboration, problem-solving, and creativity. Consequently, although challenges in implementing Metaverse technology in higher education cannot be overlooked, its substantial long-term benefits provide a strong impetus to continue developing and integrating this technology within our educational systems.

CONCLUSION

Higher education plays a crucial role in shaping a competent and adaptable future generation, aligning with the evolving demands of the modern era. In the digital age, the Metaverse has emerged as an intriguing innovation with revolutionary potential for higher education curriculum development. By incorporating technologies such as VR and AR, the Metaverse can be integrated to create dynamic learning experiences that are responsive to labor market needs.

The literature review elaborates on the concept of the Metaverse, including its types such as AR and VR, highlighting its ability to enrich learning experiences, foster global collaboration, provide practical simulations, and enable personalized learning. This study focuses on higher education curriculum development, emphasizing adaptation to current developments, industry relevance, competency-based learning, technology integration, partnerships, regular evaluation, student engagement, and sustainability. Utilizing SLR as the research method, the results and discussion demonstrate the positive impact of the Metaverse on curriculum development, while also acknowledging challenges such as initial investment, access disparities, and data security and privacy concerns that need to be addressed.

Long-term benefits include enhanced career readiness, educational innovation, diversified learning, and paradigm shifts. Despite the challenges, the implementation of the Metaverse has the potential to transform educational paradigms into more inclusive, interactive, and future-relevant models, with the expectation of making a significant contribution to understanding and exploring the role of the Metaverse in higher education.

AUTHOR'S NOTE

The author declares that there are no conflicts of interest regarding the publication of this article. The author affirms that the data and content presented in this article are free from plagiarism.

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