Implementing Instruction with Metaverse: Insights from the TRINGO Concept

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Abstract: Implementing Instruction with Metaverse: Insights from the TRINGO Concept.
Objective: The purpose of this study is to investigate the implementation of learning using the metaverse, and to link it to the TRINGO approach. **Methods:** Through a combined meta-synthesis and narrative approach, the results show the positive impact of the metaverse in learning. **Findings:** The "Ngerti" process with Metaverse creates a holistic learning experience, illustrated by Gemiverse. The "Ngrasa" process shows positive sentiments about the potential of the metaverse to improve the quality of learning. Concrete steps in the "Nglakoni" process, such as addressing privacy and increasing technological accessibility, require positive action and awareness of digital literacy. **Conclusion:** Overall, this process forms the basis for optimizing the metaverse to enhance understanding, emotional experience, and learning effectiveness. Recommendations for using the metaverse with the TRINGO concept can enrich the educational process in a sustainable way for educators and researchers.

Keywords: instructional process, metaverse, tringo, education.

Abstrak: Implementing Instruction with Metaverse: Insights from the TRINGO Concept. Tujuan: Studi ini bertujuan mengkaji implementasi pembelajaran menggunakan metaverse dan mengaitkannya dengan pendekatan TRINGO. Metode: Melalui pendekatan kombinasi meta-sintesis dan naratif, temuan menunjukkan dampak positif metaverse dalam pembelajaran. Temuan: Proses "Ngerti" dengan Metaverse menciptakan pengalaman belajar holistik, diilustrasikan oleh Gemiverse. Proses "Ngrasa" menunjukkan sentimen positif terhadap potensi Metaverse dalam meningkatkan kualitas pembelajaran. Langkah-langkah konkrit dalam proses "Nglakoni," seperti atasi privasi dan tingkatkan aksesibilitas teknologi, memerlukan tindakan positif dan kesadaran literasi digital. Kesimpulan: Keseluruhan, proses ini membentuk dasar untuk mengoptimalkan Metaverse dalam meningkatkan pemahaman, pengalaman emosional, dan efektivitas pembelajaran. Rekomendasi untuk menggunakan metaverse dengan konsep TRINGO dapat memperkaya proses pendidikan secara berkelanjutan bagi pendidik dan peneliti.

Kata kunci: proses pembelajaran, metaverse, tringo, pendidikan.

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■ **INTRODUCTION**

The Metaverse, a virtual reality universe, has increased in popularity in recent years due to technological advancements and integration into various aspects of our lives, including education. The potential for the Metaverse in teaching is enormous, as it offers an immersive and interactive learning experience that goes beyond the limits of the conventional classroom. Utilizing this technology enables educators to establish virtual classrooms, enabling students to learn and collaborate in a 3D environment, resulting in enhanced engagement and improved knowledge retention. Metaverse should be regarded as a valuable tool for transforming instruction, empowering students to explore, learn, and grow in unprecedented ways.

The Metaverse is a continuous, persistent, and post-reality multi-user space that integrates physical reality and digital virtuality. It relies on technology convergence to facilitate multisensory interactions between virtual environments, digital objects, and individuals through virtual reality (VR) and augmented reality (AR). The Metaverse encompasses an interconnected platform of immersive social and networked environments. Seamless embodied user communication in real-time and dynamic interaction with digital artifacts are enabled by (Mystakidis, 2022). This novel interface is poised to facilitate all kinds of human-computer interactions. It represents a new paradigm underpinned by modern technologies including augmented reality, mirror worlds, virtual worlds, and life logging. However, it has not gained widespread adoption and lacks standards adapted to common digital practices in the workplace, learning, commerce, or entertainment (Prieto, Lacasa, & Martínez-Borda, 2022).
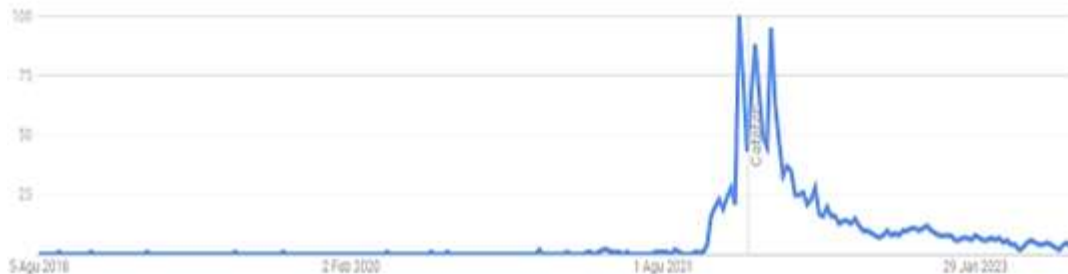

Figure 1. Trends of metaverse (*source: google tren*ds)

The development of the Metaverse began in the early 2000s; however, noteworthy progress did not occur until 2019. The worldwide outbreak of COVID-19 during the last quarter of 2019 led to a global lockdown, which had a profound impact on students and their education. Thus, humanity is compelled to reevaluate current learning methods and consider leveraging the metaverse as a feasible and crucial implementation (Azoury, Hajj, Azoury, & Hajj, 2023). The metaverse is experiencing transformative changes and trends that are shaping its future. These trends, such as immersive technologies, social interaction, and commerce, are driving the development and adoption of the metaverse. With advances in technology, we can anticipate the metaverse to become an increasingly integral aspect of our lives, providing novel experiences and business prospects for connection, creativity, and commerce.

In education, the Metaverse is a topic that has been previously discussed by various researchers and educators for its potential impact on learning (Tlili et al., 2022). For instance, Kemp & Livingstone (2006) conducted a study in which they explored the possibility of integrating the

Metaverse, specifically through a virtual world platform known as "Second Life," with a learning management system to improve the learning experience. Collins (2008), argues that the Metaverse could be the next frontier for social interaction in a virtual space, particularly in higher education for teaching and learning purposes. Eliane (2014) supports this claim, adding that 3D digital virtual worlds provide avatars that enhance

a sense of presence and allow for interaction and communication. In 2006, Stanford Research Institute International hosted a meeting to create a roadmap for the future of Metaverse technology. The event welcomed academics from numerous fields, technology architects, entrepreneurs, and futurists to envision and forecast plans for the internet's future over the next decade (Elon University, 2006).
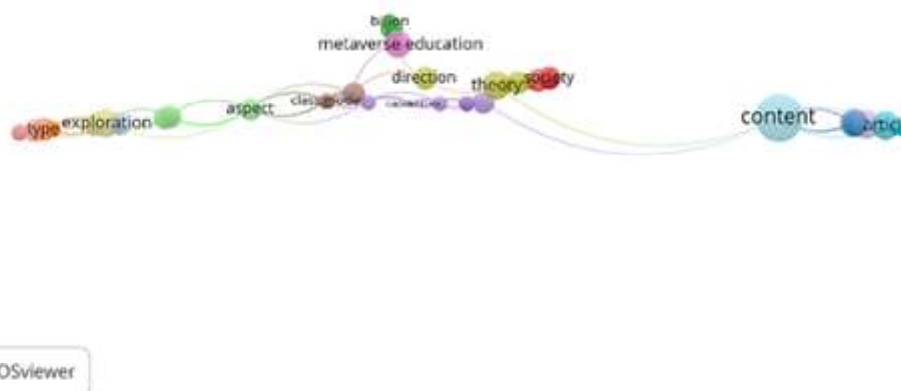

Figure 2. The metaverse trend in education (source: vos viewer)

Compared to prior iterations of the Metaverse, access is currently achievable at all times and locations thanks to rapid advances in mobile technology and deep learning (Kaddoura & Husseiny, 2023). Moreover, it has enhanced the precision of visual and language recognition, leading to a more immersive milieu (Park & Kim, 2022). Additionally, there have been various literature reviews examining Metaverse generally (e.g. Narin, 2021), graphics, interaction, and visualization studies related to Metaverse (Zhao et al., 2022), and reflections on virtual commerce regarding application design and consumer behavior in Metaverse (Shen, Tan, Guo, Zhao, & Qin, 2021), with limited literature available regarding the application of Metaver in education.

The technical assertions made about the Metaverse converge various enduring concerns (Andrew McStay, 2022). The advancements of virtual environments involve photorealistic spaces,

intricate in-world physics, simulations of existing worlds, wearable sensors enhancing immersion, language and interaction abilities, brain-computer interfaces that enable new forms of interaction and perception (such as through taste and smell stimulation), crypto-economic underpinnings, and unprecedented challenges, particularly regarding mental integrity (A. McStay, 2023). Unfortunately, the insufficient implementation of the metaverse in education obstructs the realization of the goal of inclusivity. This obstacle poses a substantial challenge that must be tackled. However, by closing this gap, the full potential of the metaverse can be realized to enhance learning, ensure equal opportunities, and revolutionize the education system. It is crucial for educational institutions and policymakers to acknowledge the significance of adopting these technologies and implementing the essential measures to integrate the metaverse into the educational experience.

■ METHODS

Research Design

This study employed a literature review approach utilizing a combined construction of meta-synthesis and narrative. Meta-synthesis is a synthesized interpretation of primary data's interpretation by constituent study's original authors. Unlike meta-analysis of quantitative data, which aggregates and reduces the data to a single entity, qualitative meta-synthesis differs (Zimmer, 2006). Many meta-synthesis studies translate qualitative findings into research, theory, and practice (Leary & Walker, 2018). However, narrative reviews of the same studies often reach varying conclusions, highlighting the challenges of using them to draw definitive conclusions on a particular topic. As a result, while narrative reviews can serve as evidence-based resources, they are not particularly useful as scientific evidence (Pae, 2015). Thus, combining meta-synthesis with narrative reviews is a potent approach that integrates the benefits of both methodologies. This method permits researchers to examine existing literature, detect common themes, patterns, or inconsistencies, and surmount the limitations of individual studies. Through conducting a thorough analysis, researchers can make significant contributions to the progress of knowledge in their specific field and provide vital for future research and practice.

Search Strategy

We utilized Google Scholar as our primary database, selecting articles based on specific criteria. Google Scholar is a thorough and user-friendly search engine, containing an extensive collection of academic resources, including scholarly articles, conference papers, and theses. After carefully selecting, we obtained two qualitative research articles that we deemed review-worthy. Figure 3 presents an illustration of our findings.

Inclusion and Exclusion

The meta-synthesis study included multiple qualitative studies. The use of a qualitative approach was selected to describe objects and phenomena related to learning using metaverse. The selection criteria for articles can be found in Table 1.

Table 1. Article selection criteria

Inclusion Criteria	Exclusion Criteria
The selected articles encompass a time frame spanning from 2020 to 2023 (2020-2023)	Beyond the temporal scope of the preceding three-year period (2020-2023)
Qualitative research article	Outside qualitative research article
Within the scope of the metaverse topic in education	Not in the scope of metaverse topics in education
Accessible	Inaccessible

The inclusion criteria for article selection include a specific time frame, requiring articles published between 2020 and 2023, with a focus on qualitative research in the area of metaverse topics in education. The selected articles should explore virtual environments, augmented reality, or immersive technologies in educational settings.

In addition, accessibility is a key criterion to ensure that the selected articles are readily available for review. Conversely, exclusion criteria will apply to articles that fall outside the specified time frame, do not qualify as qualitative research, lack relevance to metaverse topics in education, or are inaccessible for review. By applying these

criteria, the goal is to compile a comprehensive and relevant collection of articles that contribute to the understanding of metaverse applications in educational contexts from 2020 to 2023.

Data Analysis

Because meta-synthesis is a purely qualitative research design, no statistical techniques or analyses were used in this study (Cabanilla & Pogoy, 2023). We used descriptive data analysis. Descriptive analysis in literature review refers to the process of analyzing and synthesizing data from multiple sources to describe the characteristics, trends, and patterns of a particular research area or topic (Dias, Carvalho, & Sampaio, 2022; Haneem, Ali, Kama, & Basri, 2017; Phoong, Phoong, & Khek, 2022). The primary goal of descriptive analysis is to provide an overview of the current state of knowledge, identify gaps in research, and highlight key themes or findings that can inform future research or policy development.
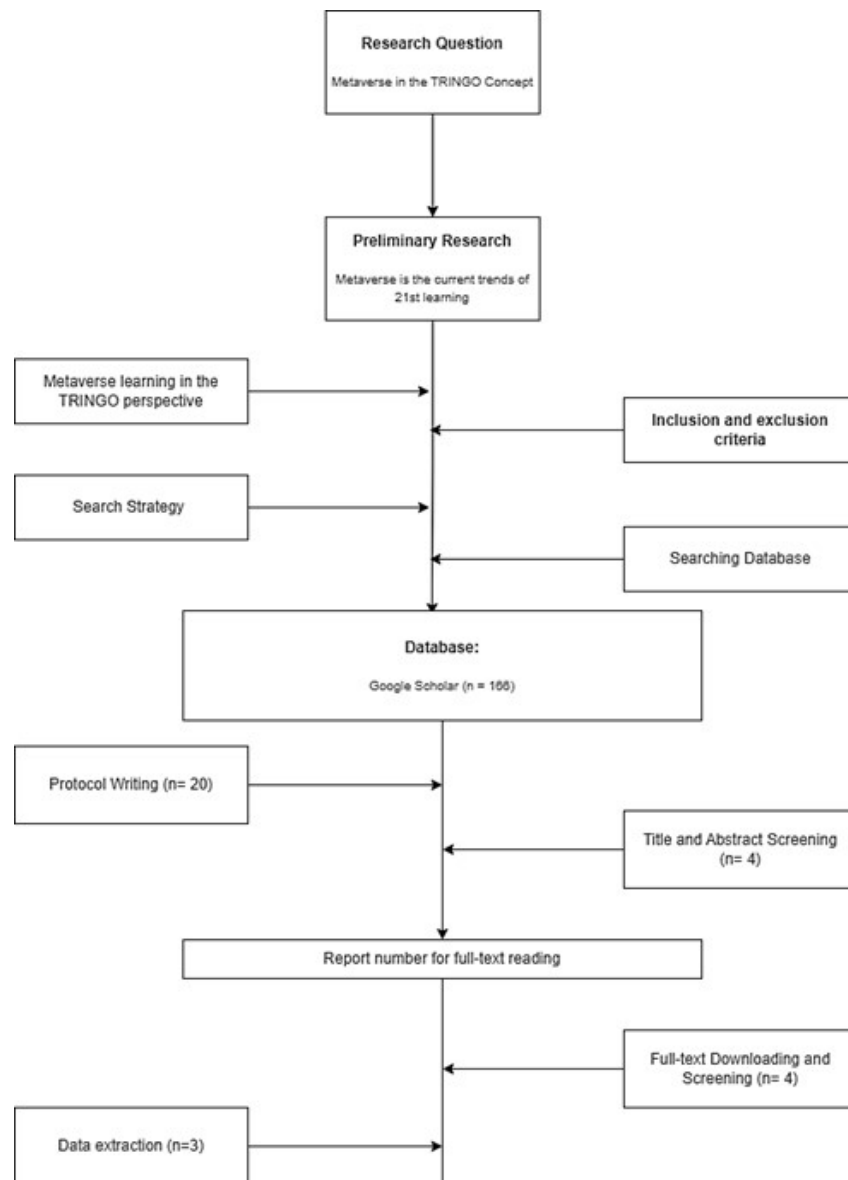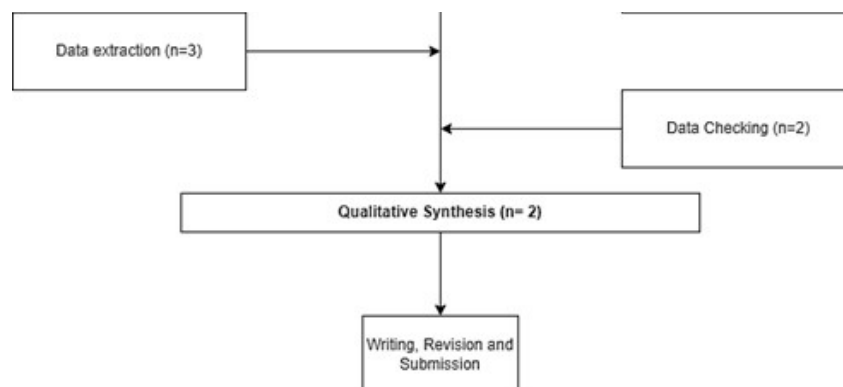
Figure 3. Review steps (adapted from tawfik et al., 2019)

After conducting a meta-synthesis, we created the TRINGO concept utilizing a narrative study supported by credible references. We integrated the current meta-synthesis results with this study and depicted them through the TRINGO approach. Consequently, the anticipated outcome of this article is the instructional efficacy of utilizing the metaverse with the TRINGO methodology. Consequently, the anticipated outcome of this article is the instructional efficacy of utilizing the metaverse with the TRINGO methodology.

■ RESULTS AND DISCUSSION

The Concept of Metaverse and TRINGO Approach

The idea of the metaverse originated from Neal Stephenson's science fiction book "Snow Crash" in 1992. The characters in the book transformed into avatars to work in a 3D virtual environment, known as the metaverse (Kye, Han, Kim, Park, & Jo, 2021). The metaverse is a term used to describe a virtual reality that transcends reality. The word "meta" denotes transcendence and virtuality, while "universe" refers to the world and the universe. The term "metaverse" refers to a digital world expressed through media like smartphones and the internet (Kim, 2020). Initially, the metaverse was designed for consumption-oriented economic activities like

trading goods. However, today metaverse technologies are increasingly being used to enhance the relationship between production and consumption in the real economy. For instance, users develop and produce items and games. This principle is applicable not only to the general field but also to practical education (Yu, 2022).

Furthermore, Metaverse enables students to incorporate their personalized virtual objects, which can be either self-created or sourced from open repositories. Such objects add an extra layer of digital content, including 3D imagery, to the physical environment. Moreover, students can program individual coding blocks for expanded functionality, and these blocks can be shared with others via the Metaverse repository. Making the source of experiences public allows students to observe and use it as a model for their own code (Parsons, 2019). According to Huang et al (2019), experiences are democratic constructions of learning with profound meaning.

TRINGO is an acronym for understanding (*ngerti*), feeling (*ngrasa*), and implementing (*nglakoni*), which was introduced by the Father of Indonesian Education, Ki Hadjar Dewantara. This teaching concept emphasizes students' awareness of comprehending what they learn, internalizing the knowledge and skills into their hearts as learning outcomes, and finally, applying
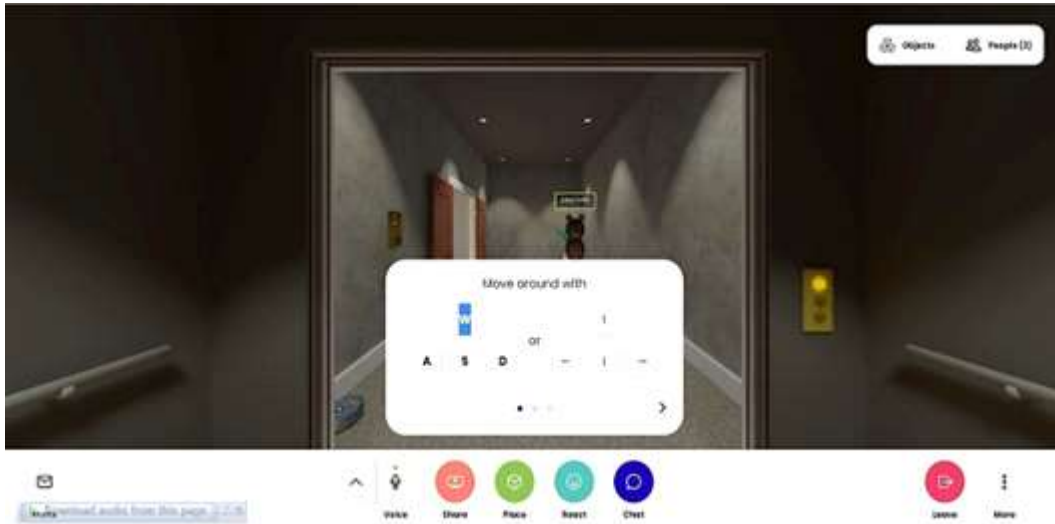
Figure 4. An example of the metaverse

the learning outcomes in real-life situations (Diana, 2019). According to Thaariq et al (2021), TRINGO is connected to metaphorical activities that enable creativity to be a conscious process.Through exchanging positions, metaphors form comparative connections between various ideas and objects. In this systematic approach, students are granted the freedom to examine their peer's work. This system facilitates a creative process that links familiar and unfamiliar concepts and generates novel ideas from common ones, such as other students' assignments (Kuswandi, Praherdiono, & Toenlioe, 2017).
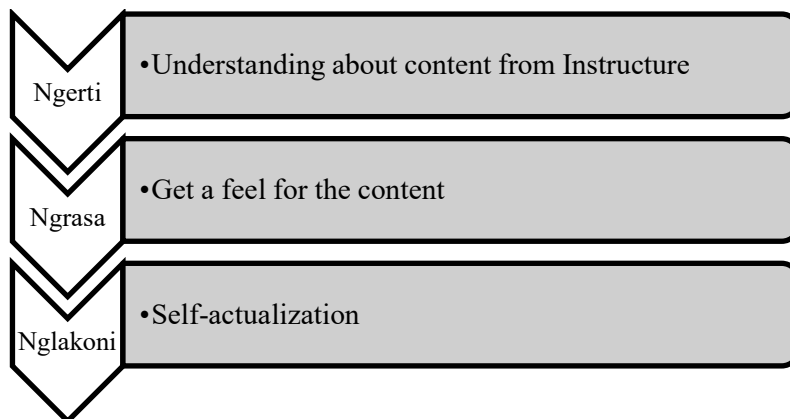
Figure 5 TRINGO Concept in Learning (Kuswandi et al., 2020)

TRINGO serves as the fundamental basis for developing educational tools that cater to diverse education requirements. Consequently, education personnel, including teachers and non-teaching facilitators, can execute the TRINGO concept through various models, learning resources, and other viable means (Diana, Kuswandi, & Ulfa, 2019). This article focuses on pertinent and reviewed research that is relevant to the TRINGO concept.

Prior Research Findings

Several recent studies have explored the use of Metaverse technology in an educational

context, examining its potential applications, challenges, and opportunities. In the following discussion, we will explore the findings of some key studies that address different aspects of the use of the Metaverse in education. From the applications of the Metaverse in designing learning environments to the challenges that need to be overcome, these studies provide deep insights into the role of the Metaverse in changing the paradigm of modern education.

Table 2. 7 Articles reviewed

No	Author	Year	Title	Publication
1	Chen, Z.	2022	Exploring the application scenarios and issues facing Metaverse technology in education	Interactive Learning Environments
2	Lin, H., Wan, S., Gan, W., Chen, J., & Chao, H.-C.	2022	Metaverse in Education: Vision, Opportunities, and Challenges	IEEE International Conference on Big Data (Big Data)
3	Hwang, G.-J., & Chien, S.-Y.	2022	Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective.	Computers and Education: Artificial Intelligence
4	Qiu, Y., Isusi-Fagoaga, R., & García-Aracil, A.	2023	Perceptions and use of metaverse in higher education: A descriptive study in China and Spain.	Computers and Education: Artificial Intelligence
5	Fokides, E.	2023	Development and testing of a scale for examining factors affecting the learning experience in the Metaverse.	Computers & Education: X Reality
6	Wei, D.	2022	Gemiverse: The blockchain-based professional certification and tourism platform with its own ecosystem in the metaverse.	International Journal of Geoheritage and Parks
7	Zallio, M., & Clarkson, P. J.	2022	Designing the metaverse: A study on inclusion, diversity, equity, accessibility and safety for digital immersive environments.	Telematics and Informatics

Chen's (2022) research delves into the use of Metaverse technology for education, exploring its application scenarios and the challenges it faces. The article highlights how the 3D virtual world of Metaverse, based on VR and AR, offers interactive learning and practical skills training, thereby enhancing the learning experience. Clarifying technical term abbreviations when first used and adhering to consistent technical language and standard sentence structure, this improved text maintains formal language, correct grammar, and is free from filler words or bias. However, several issues must be resolved, including guaranteeing user data security, ensuring technology accessibility, and integration of the Metaverse into educational curricula. While Metaverse-based education displays great potential, addressing these concerns is crucial in enhancing its effectiveness and inclusivity in supporting education in the future.

Research by Lin et al (2022) explores the implementation of the Metaverse in education, examining the challenges and opportunities it presents. The Metaverse refers to a real-time digital environment that enables communication and interaction within a 3D virtual world. The article explains how implementing Metaverse can improve the learning experience through interactive learning and practical skill training in a virtual environment. Although, the author acknowledges certain challenges that must be resolved, including issues concerning user data security, technology accessibility, and the integration of Metaverse in the educational curriculum. Overcoming these obstacles can facilitate Metaverse becoming an effective and inclusive tool to support education in the future.

Hwang & Chien (2022) discussed the potential of the metaverse and the features that need to be considered to implement ideal metaverse applications, such as "shared", "persistent", and "decentralized". To implement a metaverse, it is important to consider applications related to the metaverse, such as those in computer games and social networks. The metaverse can be fully or partially virtual, such as virtual reality (VR) systems or the use of augmented reality (AR) in a real-world context. In the metaverse, people can engage in various social activities, collaborate on projects, play games, and learn from experiences or solve problems. In the metaverse, real people and virtual characters can be partners or friends. Various activities and events, such as economic activities, political events, and natural disasters, can occur in the metaverse. AI technology plays an important role in ensuring that the metaverse operates according to the rules defined by its creators. Overall, the implementation of the metaverse involves considering its characteristics, exploring applications, creating virtual environments, enabling social interactions, and using AI technologies.

Qiu, Isusi-Fagoaga, & García-Aracil (2023) analyzed teachers' perceptions of the use of the metaverse in educational practice and its contribution to local development. The study focused on China and Spain as reference countries in the metaverse, but with limited cooperation in this area. Metaverse integration involves various technologies such as high-speed communication networks, augmented reality, virtual reality, mixed reality, cloud computing, edge computing, Internet of Things (IoT), blockchain, artificial intelligence (AI), and other technologies. Metaverse can provide highly immersive and interactive virtual-real learning environments and experiences for educational participants. Implementing a meta-learning system based on digital technologies such as mixed reality, augmented reality, and virtual reality can develop students' self-awareness and self-learning habits. Metaverse can bring several benefits to higher education, such as promoting self-awareness, self-directed learning, and providing an immersive teaching environment. Metaverse has the potential to enhance collaboration and internationalization between countries in higher education, such as China and Spain, to promote local development.

Fokides (2023) offers valuable insights into the possibilities of immersive virtual environments for education and provides researchers with tools to scrutinize the factors that shape one's experience in the Metaverse. The Metaverse offers a new dimension in terms of engagement, interaction and experience for students and teachers in education. It describes a network of virtual worlds where users interact with each other and digital objects in a shared environment. The article also mentions that Metaverse encompasses a variety of tools and platforms, including virtual classrooms, laboratories, and field trips, allowing students to attend lectures, conduct experiments, and explore historical sites, scientific laboratories. The article further discusses a scoping review that analyzes eighty-seven

studies on the educational use of immersive VR and the use of VR headsets, on which this research is based. Overall, the article presents Metaverse as a promising tool to enhance learning experiences in various educational environments.

Wei (2022) proposed Gemiverse as a real-world prototype that provides customized solutions and focuses on building immersive experiences. According to the article, the implementation of the metaverse in terms of learning is through the creation of an edutainment platform called Gemiverse. The platform aims to provide a fun and engaging way for millions of players to turn their passion for career learning into real assets. Gemiverse combines career simulation and social gaming to engage players and keep them engaged for years to come. Gemiverse also features learning and earning mechanics that allow players to earn NFTs and tokens as they learn, as well as leaderboards and seasonal awards. The platform is community-driven, engaging and rewarding the community for contributing to the growth of the entire ecosystem. Overall, Gemiverse's application of the metaverse from a learning perspective aims to disrupt the professional skills training industry and build the future of learning and earning.

Zallio & Clarkson (2022) explored the importance of inclusion, diversity, equity, accessibility, and safety in digital immersive environments. According to the article, the metaverse has the potential to create new learning experiences and paradigms. Creating a constructive narrative around the metaverse can bring together academics, enthusiasts, and early adopters to experiment and spark conversations. In addition, it is important to create a set of learning and education activities to ensure that users understand what the metaverse is and its potential for the future. This includes developing digital literacy programs for users of all ages, genders, cultures, and abilities, as well as creating awareness of a safe, inclusive, and accessible metaverse. The article also emphasizes the importance of having different voices talking about the metaverse, bringing people with different backgrounds and ideas to the table, involving them in the design process, letting them try out technologies, and creating support for learning and knowledge about the metaverse. Overall, the implementation of the metaverse in learning requires a focus on accessibility, inclusivity, and security, as well as the development of educational programs and opportunities for experimentation and collaboration.

The Metaverse's TRINGO Process

Based on the two studies conducted, the development of the TRINGO model in its practical implementation is evident. This is further verified through Table 2.

Table 3. Analysis of the study conducted by TRINGO

Source	*Ngerti*	*Ngrasa*	*Nglakoni*
Chen (2022)	Understand the application of the metaverse in education, detailing scenarios for its use and the challenges it faces.	The focus is on enhancing the learning experience through 3D virtual worlds that provide a hands-on and interactive feel.	Provide direction on steps to be taken to improve the effectiveness and inclusiveness of Metaverse-based education, namely addressing privacy issues, improving technology

			accessibility, and integrating Metaverse into the educational curriculum.
Lin et al (2022)	The definition of the metaverse as a real-time digital environment that enables communication and interaction within a 3D virtual world is well described.	Positive sentiment about Metaverse's potential to enhance the learning experience through interactive learning and hands-on skills training in a virtual environment.	Several challenges to overcome were identified, including the security of user data, the accessibility of the technology, and the integration of Metaverse into the educational curriculum.
Hwang & Chien (2022)	Great potential with key characteristics of "shared," "continuous," and "decentralized" applied to games, social networks, and virtual/augmented reality.	Social engagement, collaboration, play and learning.	Provides some guidance on the steps needed to implement Metaverse, such as considering its features, exploring applications, creating virtual environments, enabling social interaction, and using AI technology.
Qiu, Isusi-Fagoaga, & García-Aracil (2023)	Emphasize its contribution to local development.	A positive review of the potential of Metaverse to enhance learning experiences, student self-awareness, and international collaboration in higher education.	Possible positive actions, such as the implementation of a digital technology-based meta-learning system to develop students' self-awareness and independent learning habits.
Fokides (2023)	The concept of the metaverse is well described as a virtual environment where interaction and shared experiences take place.	A positive view of the potential of the Metaverse to enhance student and teacher engagement, interaction, and experience in	Practical insights by mentioning various Metaverse tools and platforms, such as virtual classrooms, labs, and field trips. It provides a real-

		education.	world picture of how Metaverse can be implemented in an educational context.
Wei (2023)	Gemiverse is described as a real-world prototype designed to provide an immersive and engaging career learning experience.	A positive feeling about Gemiverse as a potential solution to change the career learning paradigm and motivate players to engage in learning.	Explore the features of Gemiverse, including career simulators, social games, NFT and token-based learning and rewards, and community engagement, which are driving the growth of the ecosystem.
Zallio & Clarkson (2022)	Inclusive, Diverse, Equitable, Accessible, and Secure, and their potential for transforming learning.	Positive feelings about the potential of the metaverse to create new learning experiences and constructive narratives. This feeling creates a sense of optimism about the future of the metaverse.	Create learning and educational opportunities, develop digital literacy, and raise awareness of a safe and inclusive metaverse.

Thus, the concept of the metaverse must be integrated into meaningful learning through the use of TRINGO as the basis for its instructional design. Practical implementation could include:

Ngerti (Understanding): The process of "ngerti" (understanding) can be achieved through the application of the metaverse in education. By sharing experiences in a 3D virtual environment, as demonstrated by Gemiverse, students can better understand the material through direct interaction and shared experiences. The sustainability, diversity, accessibility, and security built into the metaverse create an inclusive learning environment that allows a wide range of students to understand and participate. Although there are challenges in infrastructure and data security, improvements in the use of the metaverse can stimulate the process of understanding by providing a more holistic and engaged learning experience.

Ngrasa (Sense): The application of the Metaverse in education, particularly through learning experiences in 3D virtual worlds, received positive responses in the Ngrasa (feeling) process. This positive feeling stems from the recognition of the potential of the Metaverse to enhance the interactivity of learning and provide hands-on experiences that can be felt. The appreciation of the social, collaborative, gaming, and learning aspects of the Metaverse creates a positive feeling

toward the use of this technology. In the context of higher education, positive feelings about the Metaverse also include increased student engagement, self-awareness, and international collaboration, providing a positive dimension that can be deeply felt. Gemiverse, as a concrete example, is perceived as a solution that can trigger a change in the professional learning paradigm, creating a sense of motivation that can be felt by participants. Overall, these positive feelings created a palpable atmosphere of optimism about the future of Metaverse in improving the quality of learning experiences.

Nglakoni (Doing): Improving the effectiveness of Metaverse-based education requires concrete steps associated with the Nglakoni (doing) process. These include addressing privacy concerns, improving technology accessibility, and integrating the Metaverse into the curriculum. Understanding functions, exploring applications, and using artificial intelligence are steps that need to be taken in this process. Positive actions, such as the use of digital meta-learning systems, should be implemented. Gemiverse provides concrete examples through career simulators, social games, and NFT awards that illustrate the real-world application of the concept. Awareness of digital literacy and efforts to create a safe and inclusive metaverse are steps to optimize the potential of the metaverse in education.

The TRINGO concept's application in the Metaverse highlights the significance of virtual education and social values in the virtual world encounter. Users can utilize the potential and advantages of the ever-expanding virtual environment by comprehending, experiencing, and executing experiences in the Metaverse.

■ **CONCLUSIONS**

This research concludes that Ki Hadjar Dewantara's TRINGO concept can be implemented in the classroom using Metaverse.

The "Ngerti" process in Metaverse education creates a holistic and engaging learning experience as depicted in Gemiverse, allowing students to understand the material through direct interaction and shared experience. The positive sentiment in the "Ngrasa" process towards the Metaverse, especially through the learning experience in the 3D virtual world, creates an atmosphere of optimism about its potential to improve the quality of learning. Meanwhile, concrete steps in the "Nglakoni" process to improve the educational effectiveness of the Metaverse, such as addressing privacy concerns, improving technological accessibility, and integrating the Metaverse into the curriculum, require positive action and awareness of digital literacy. Nevertheless, this study has certain limitations, such as expanding the scope and context of Metaverse use, that need to be considered. Overall, this research provides a solid foundation for optimizing the potential of the Metaverse to enhance understanding, emotional experience, and learning effectiveness.

Meanwhile, the results of this study strongly recommend that educators harness the power of the metaverse to shape and enhance students' learning skills. By leveraging the immersive and interactive nature of the Metaverse, educators can provide students with a holistic learning experience. The positive results observed in the research highlight the potential of the Metaverse to shape a deeper understanding of educational material.

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