Metaverse Technologies in Education: A Systematic Literature Review Using PRISMA

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Abstract—Metaverse technology is emerging as a global trend, offering virtual activities with real-world experiences. This paper presents a systematic review of research trends from 2012–2022 to determine the prevalence and current conditions of metaverse technology in education. The PRISMA framework (selected reporting items for systematic review and meta-analysis) guided this systematic review. 42 studies were selected from the Scopus database, with more than 70 studies or references from Google Scholar kept as supporting data after quality assessment. The results indicate that research interest in metaverse technology has significantly increased in the last ten years, peaking in 2022. Augmentation and simulation are the most prominent uses of metaverse technology in the learning process. C. Moro (2017) is the most cited author on this topic, with 313 citations, followed by P. Wang (2022) with 264 citations and P. Pelargos (2022) with 163 citations. AR and VR are the most widely used types of metaverse technology. Hopefully, this review will be useful for researchers, educators, and future research on the metaverse and education.

Keywords—metaverse technologies, education, systematic review, PRISMA

1 Introduction

The main aim of this article is to review, analyze and classify numerous research results and literature associated with metaverse technologies in education. This systematic review probes the development pattern of metaverse technologies and its application to learning in the education sphere. Furthermore, it recognizes the type of metaverse technology used and the influence of deploying these technologies. Lastly, this article will give an overview of how the challenges and opportunities of this technology will

affect the educational world in the present and future. To be more precise, Table 1 exhibits the research questions (RQ) as follows:

Table 1. Research questions (RQ)

No.	Research Questions (RQ)
1	How has the metaverse trend evolved in education over the last ten years (2012–2022)?
2	What types of metaverse technologies have been applied in education?
3	What are the challenges of using metaverse technologies in education?
4	What are the problems that occur if the metaverse is applied?
5	How are metaverse technologies for education evolving in Indonesia?

1.1 Metaverse

In the last two years, the term 'Metaverse' has been widely discussed, due to Mark Zuckerberg's decision to rebrand his company to Meta [1]. Zuckerberg's goal is to create a virtual world that would act as a bridge between people, which he referred to as the Metaverse [2]. He made it evident that the future of the internet lies in the Metaverse or virtual world [3], where people could live, work, and study [4]. Although still an immature concept, the tech giant Facebook has invested billions in the development of the Metaverse [5]. The term was initially introduced by Neal Stephenson in his 1992 novel "Snow Crash" [6].

Stephenson's book introduces the metaverse as a structure of code that can only be understood by computers [7]. This code is used to create a virtual reality on the internet, where users are represented by avatars that can interact with each other through software [8]. The metaverse thus blends the physical world with the digital one [9], and was a concept only known and understood by tech companies and gamers before Facebook announced its transition into the metaverse, rebranding as 'Meta' in late 2021 [10].

Put simply, the metaverse is a digital world developed by programmers that can be accessed by anyone through a virtual environment. We may be familiar with popular games such as Pokémon, PUBG Mobile, Genshin Impact, Free Fire, Mobile Legends, and Fortnite [11], or even PC games like DOTA2 and Valorant. This concept is essentially the same as the virtual world featured in video games. Presently, the virtual world is most often experienced through a smartphone screen; however, the metaverse offers a more realistic experience through virtual reality with the help of specific tools [12]. Entering this digital world looks even more realistic and fantastic with the current metaverse concept, which focuses on real-life aspects [13], [14]. It is a platform that combines different technologies such as artificial intelligence (AI), mixed reality (MR or AR/VR), immersive digital space, and real-time communication, enabling social and economic activities between the virtual and physical worlds [15] (see Figure 1). For a truly immersive experience, the metaverse must also fulfill the three P's: presence, persistence, and portability [16], [17].

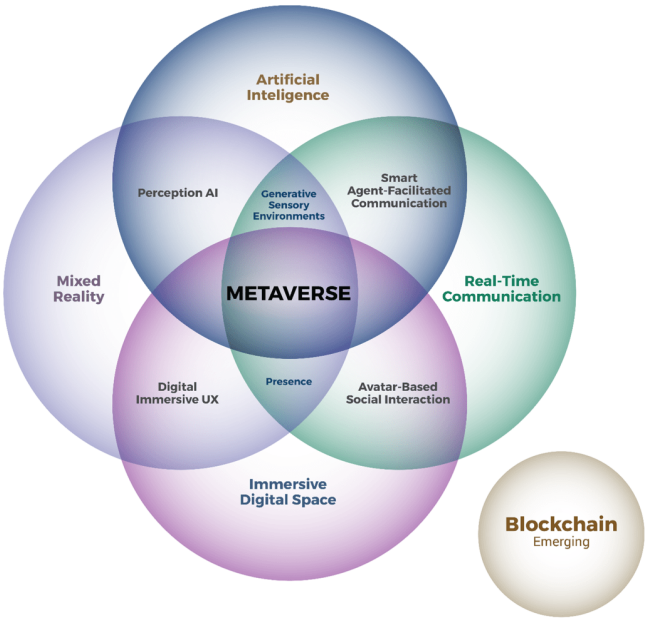

Fig. 1. The Metaverse is a technological convergence

1.2 The 7 layers of the metaverse

According to Jon Radoff's "Building the Metaverse," constructing a complex metaverse to replace the real world is no easy feat. It requires a great deal of research, work, and resources to complete the seven components necessary for such a feat: infrastructure (1), human interface (2), decentralization (3), spatial computing (4), creator economy (5), discovery (6) and experiences (7) (references [18], [19], [20]). An example of such a creation can be seen in Figure 2.

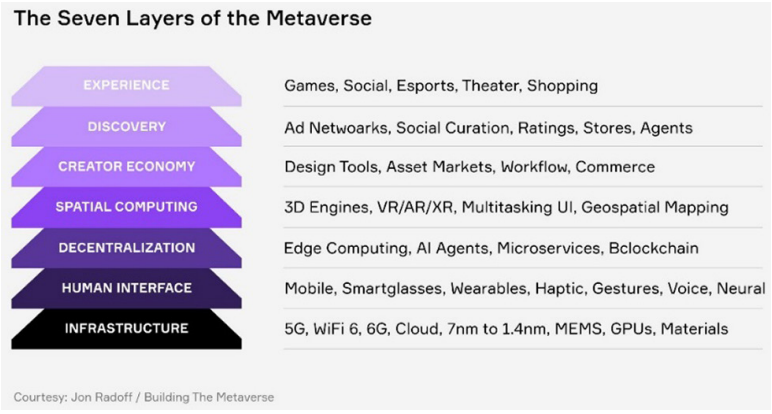

Fig. 2. The seven layers of the metaverse

Mark Zuckerberg has previously stated that the metaverse will not be created by a single company, but by "creators and developers making new experiences and digital items that are compatible and unlock a much larger creative economy than what is currently restricted by existing platforms and their guidelines." So why has the concept of the metaverse become so popular now that Facebook has announced its development? Several reasons can be attributed to this. The widespread adoption of AR/VR technology, the advent of 5G, and the shift to remote work due to the Covid-19 pandemic have made the idea of the metaverse more comprehensible to people. All of this, coupled with the fact that tech giants like Facebook are now beginning to build a metaverse, has gained the attention of investors and ordinary Internet users around the world, adding the metaverse to the list of trending topics for this year.

1.3 Metaverse for education

The COVID-19 pandemic has accelerated digital transformation in various aspects of human life [13], [21]. This has resulted in the emergence of the metaverse era, which has now entered the commercial period and is continuing to increase in terms of digital needs and utilization. Examples of such utilization include e-commerce, video conferencing, video on demand, video streaming, and more. Society is now facing the metaverse era, in which everything is made virtual through the use of Augmented Reality (AR) and Virtual Reality (VR). AR technology allows us to embed virtual objects into the real physical world, while VR involves using 3D computer modeling to immerse ourselves in a 3D virtual environment [22]. Even though the metaverse does not necessarily require us to wear a VR headset or any other accessories, experts believe that virtual reality technology will become an essential part of the new ecosystem. VR/AR technology is playing a key role in the formation of the metaverse; thus, we can expect active market growth in the near future. If the metaverse is a virtual space, then VR is the way to get there.

Education and technology are inextricably linked, with a pattern of cause and effect between the two. Education has the power to drive the advancement of technology [23]. Moreover vice versa, technology will also affect the education system. The world is slowly experiencing high-speed development, especially in education and technology. Human civilization also changes in each period. while technology also has a great impact on the education system. The world is witnessing rapid progress in education and technology, with human civilization constantly evolving. To remain up-to-date, the educational system must keep pace with the growth of technology. Humankind is progressing technologically, and with it comes the challenge of keeping up with the more advanced life transitions. Regardless of personal feelings on the matter, it is essential for people to be prepared for the results of technological advances. This necessitates having life programs in place, particularly in the area of education [24].

Education is the essential capital for developing people's lives. It offers students the opportunity to research and develop advanced, beneficial innovations for civilization, such as technology. Curiosity should never be underestimated, as technology is not impossible for those who have it [25]. Education should aim to guide, direct and lead its students, as it has a strong essence. Ki Hadjar Dewantara said, "*Education is the place where the seeds of culture live in a national society*" [26]. Education and culture are inseparable, as education is needed to cultivate the culture of the nation we hope to become. It is not just academic success, but also success as a human being, that makes

up the pillar of civilization. The rapid development of technology has caused a loss of value and cultural heritage in humans. It is a big challenge for the world of education to embrace the metaverse era, while exploring and owning the importance of knowledge, so students are prepared to welcome it without forgetting the essence of education.

1.4 Types of metaverse

The Acceleration Studies Foundation (ASF) has compiled a metaverse roadmap based on two intersecting lines which represent the four types of metaverses used in education: augmentation and simulation technologies and intimate and external technologies [27].

Augmentation, also known as AR (Augmented Reality), is a technology that inserts virtual objects into the real world. This technology has been widely adopted for educational purposes, such as improving the experience of learning about anatomy. With the help of 3D visualizations, teachers and students can learn in a much more exciting and engaging way than simply looking through a microscope. AR also makes studying chemistry, computer networks, geometry, and even the Earth and outer space much more interesting than simply studying from atlases and globes. This new technology has become a hope in the educational world to continue developing quickly and efficiently.

Simulation is another technology that models reality, such as VR (Virtual Reality). This technology can be used as an interactive environment, such as for soldering and welding simulations, shooting simulations, or medical operations simulations. Intimate technology is a type of technology that brings the physical into the virtual world, represented by an avatar. Lastly, metaverse technology is used to display information about the world from all users, which is what forms the basis of the future metaverse (Figure 3). This metaverse consists of four key components: (1) Augmented Reality; (2) Lifelogging; (3) Mirror Worlds; and (4) Virtual Worlds.

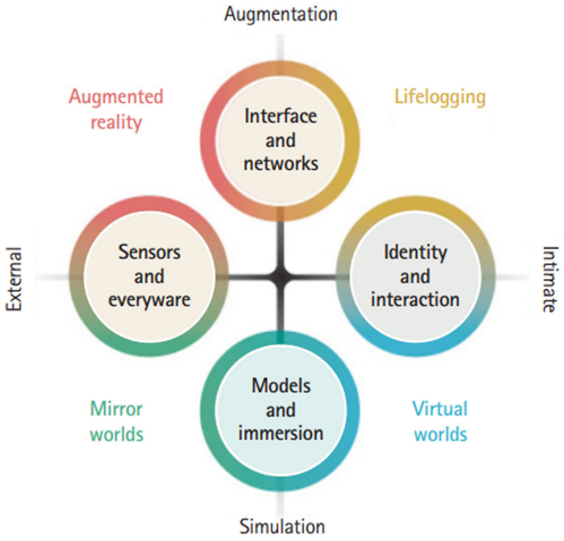

Fig. 3. Diagram of 4 types of the metaverse [28]

Augmented Reality (AR) (external-augmentation) is a form of technology that expands the reality of the physical world by adding virtual information, as illustrated in Figure 4. The first introduction of QR technology, GPS, and Google Glass technology marked the beginning of a state in which the virtual world is unified with the real world in real-time.

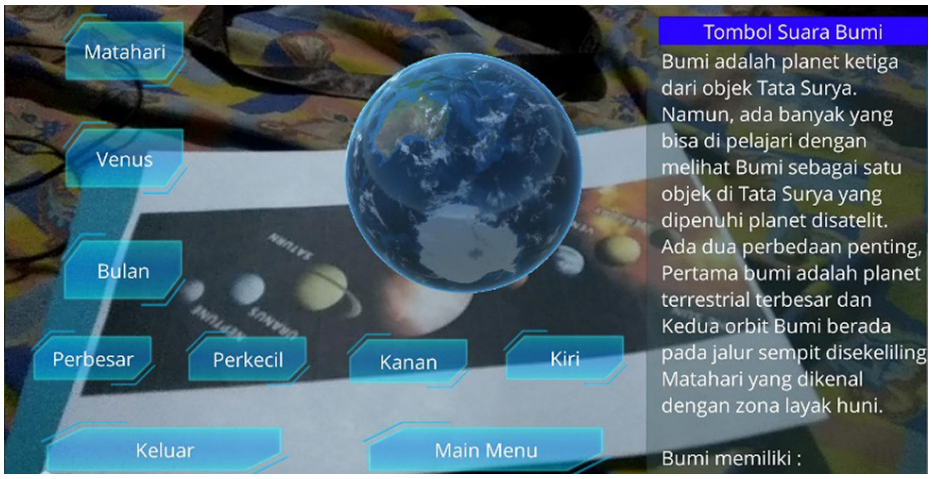

Fig. 4. Augmented reality

Lifelogging, sometimes referred to as intimate-augmentation, is a web 3.0 technology used to collect user information, objects, or communication data in the metaverse. This technology has enabled the concept of M2E [28], allowing people to be rewarded with crypto tokens for actively moving or transitioning between locations. Examples of this technology include STEPN, MetaGym (see Figure 5), OliveX, Genopets, and more.

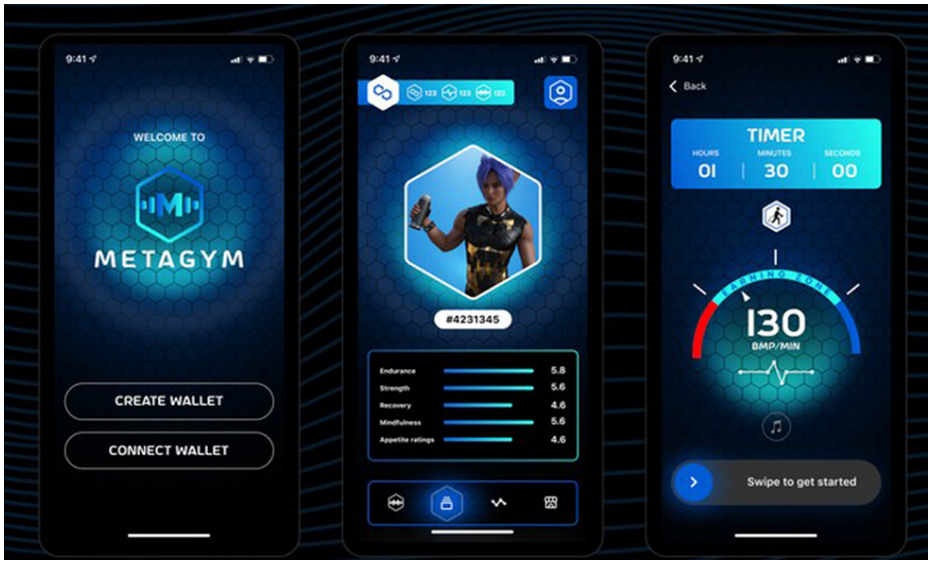

Fig. 5. MetaGym

Mirror worlds are virtual models that reflect the real world in a virtual form (e.g. representative mirror worlds, web-based virtual tours as depicted in Figure 6, virtual laboratories, and virtual classes). Numerous platforms facilitate virtual learning, such as Google Street View, Zoom, and Google Meet.

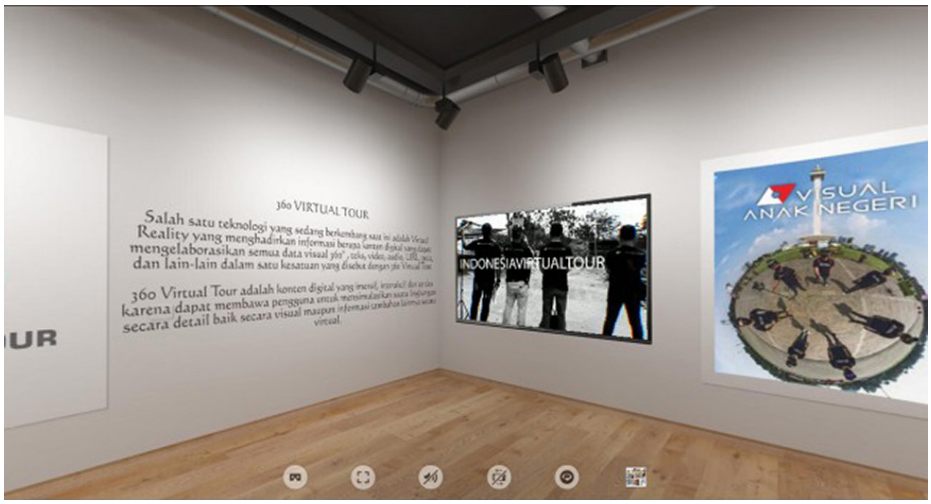

Fig. 6. Virtual tour

The virtual world is a 3D environment in which avatars are used to represent the players or characters, allowing for interactions within the world [29]. This concept is often seen in popular MMORPGs such as PUBG, DOTA2 and The Sims (Figure 7), as well as in social media platforms such as ZEPETO and Roblox.

Fig. 7. The sims

Based on the types described in the previous section, the metaverse is seen to be far more complex, as discussed in the seven layers of the metaverse section, where everything is interrelated and has a more elaborate structure [30], [31]. With the progression of technology, the metaverse offers numerous advantages to its users, like a more consumer-friendly, cost-effective, accessible and economical approach.

2 Review methodology

2.1 Data collecting

Data was collected using a systematic research method which identified the steps necessary to conduct a literature review with the PRISMA approach. PRISMA is the accepted standard for presenting evidence in systematic reviews and meta-analyses. Only peer-reviewed journals were taken into account for this study. Reports, conference proceedings, books and theses were not considered. 42 articles indexed by Scopus were analysed in order to answer the research questions stated earlier. These articles were chosen based on five criteria: 1) Refereed academic journals (to ensure the highest quality of refereeing); 2) Published in the last ten years (2012–2022); 3) Indexed by Scopus; and 4) Discussion of metaverse for education (with five predetermined subthemes in Table 2). Figure 8 shows the PRISMA Flow Diagram visually depicts the flow of studies through each phase of the review process.

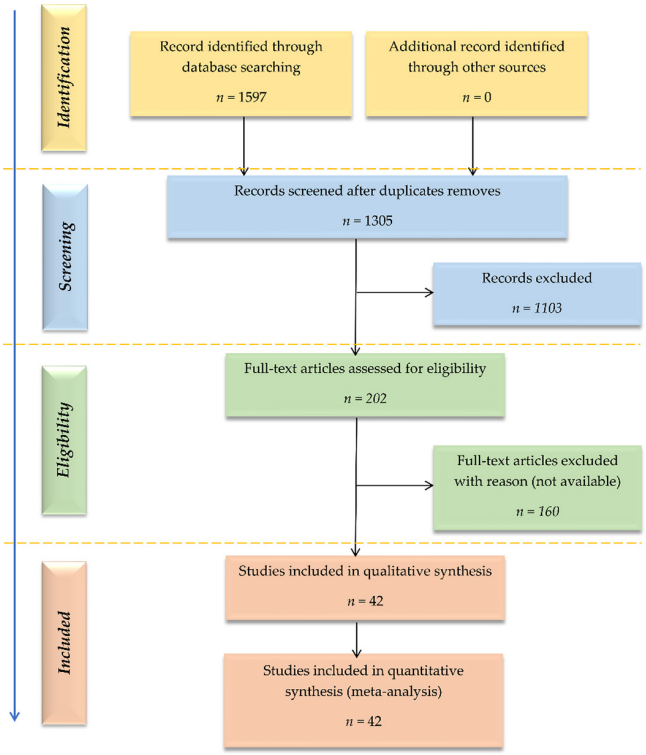

Fig. 8. PRISMA flow diagram

To guarantee the scientific integrity of our research, we excluded sources such as conference proceedings, books, book reviews, magazines, short surveys, short communications, correspondences, newsletters, discussions, product reviews, editorials, publisher's notes, and erratum from our analysis (42 articles in total). Subsequently, we conducted a thematic analysis of the remaining articles in order to identify the themes related to our research patterns and trends. This resulted in five sub-themes, which supplied us with the required data to answer our research questions (Table 2).

Table 2. Five sub-themes

No.	Themes
1	Metaverse for education
2	Types of metaverse technology in education
3	Metaverse opportunities
4	Metaverse challenges
5	The future of the metaverse and education

3 Results

3.1 Summary of findings

A search was performed on the Scopus database, resulting in 1597 journal articles being found based on the Title-Keywords search: "Metaverse Education" AND "Metaverse" OR "Education" OR "Metaverse Technology" OR "AR/VR". Upon the application of inclusion criteria, duplication was removed, and 1305 articles remained. Further screening (title and abstract) was done manually, leaving 1103 articles. Then, these articles were evaluated for their relevance in answering research questions, with 202 meeting the criteria. Out of these 202 articles, 42 were accessible (Table 3). Finally, the articles were thoroughly read in order to extract the relevant data that would support answering our research questions.

Table 3. List of 42 articles by year (2012–2022)

Year	Title	Total
2012	[32]	1
2013	[33]	1
2017	[34], [35], [36], [37], [38], [39]	6
2018	[40], [41], [42], [43]	4
2019	[44], [45], [46], [47], [13], [48], [49], [50]	8
2020	[51], [52], [53], [54], [55]	5
2021	[56], [57], [58], [59], [60]	5
2022	[61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72]	12
Total		**42**

3.2 Trends of metaverse technologies in education

RQ1: *How has the metaverse trend evolved in education over the last ten years (2012–2022)?*

Figure 9 shows the trends of publication from 2012 to 2022 from Scopus-indexed journals, with as many as 202 articles. A marked increase in article numbers can be seen from 2019 to 2022, likely due to the Covid-19 pandemic. Since the beginning of 2019, many changes have been made to human life patterns, one of which is the implementation of policies to limit mobility and interaction between people. As social beings, we rely on interaction to fulfill our needs, and this need has been met by the emergence of the term "metaverse" since the publication of Neal Stephson's novel Snow Crash in 1992. This AR/VR technology allows us to interact with other individuals virtually.

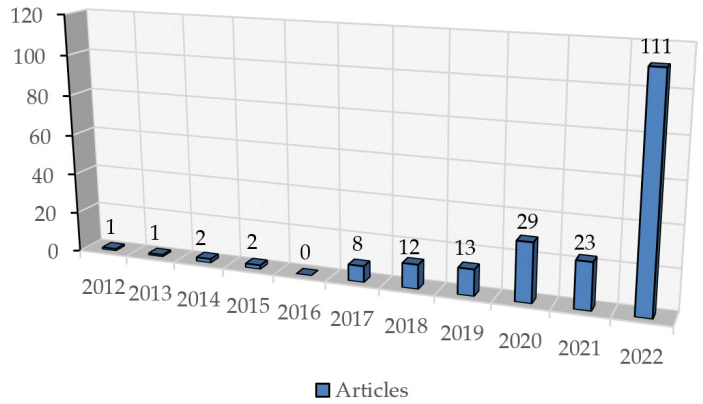

Fig. 9. Trends of metaverse technologies in education (2012–2022)

Metaverse technologies such as Augmented Reality (AR) and Virtual Reality (VR) have been a part of our lives for a while now. However, the change to the name of a major technology company, Facebook, to "Meta" in 2021 has sparked a much broader discussion about the metaverse among the general public. The following is a list of 42 reviewed articles, as shown in Table 4.

Table 4. List of 42 articles by most citations

No	Authors	Articles	Year	Cites
1	C. Moro	[34]	2017	313
2	P. Wang	[61]	2022	264
3	P. Pelargos	[62]	2022	163
4	T.K. Huang	[56]	2021	94
5	T. Joda	[63]	2022	80
6	H.H. Liou	[35]	2017	77

(Continued)

Table 4. List of 42 articles by most citations *(Continued)*

No	Authors	Articles	Year	Cites
7	G. Papanastasiou	[44]	2019	65
8	A. Nayyar	[40]	2018	62
9	H.s. Choi	[36]	2017	50
10	J.H. Steffen	[45]	2019	45
11	K. Abhari	[64]	2022	42
12	J. Jeong	[33]	2013	40
13	P. Rau	[65]	2022	38
14	D. Anton	[41]	2018	32
15	G. Bozzelli	[46]	2019	31
16	K. McMillan	[51]	2020	30
17	M. Garcia-Bonete	[66]	2022	30
18	P. Wozniak	[60]	2021	29
19	J. Jang	[57]	2021	26
20	R. Bucea-Manea-Ţoniş	[67]	2022	24
21	A. Borrel	[37]	2017	21
22	S.C. Mallam	[47]	2019	21
23	J.K. Aw	[52]	2020	21
24	S. Sheik-Ali	[72]	2022	20
25	Y.A. Sekhavat	[68]	2022	20
26	M. Ma	[38]	2017	17
27	J.C.G. Vargas	[53]	2020	16
28	B. Falchuk	[42]	2018	15
29	N. Xi	[13]	2019	15
30	A. Siyaev	[58]	2021	15
31	K. Jung	[69]	2022	15
32	H. Kim-Berman	[48]	2019	14
33	V. Nguyen	[70]	2022	14
34	H. Kanematsu	[32]	2012	13
35	I. Navarro Delgado	[39]	2017	13
36	A. Tarabasz	[43]	2018	13
37	D. Rath	[49]	2019	13
38	Y.M. Tang	[50]	2019	13
39	F. Calabuig-Moreno	[54]	2020	13
40	P. Zikas	[55]	2020	13
41	S. Keaveney	[71]	2022	13
42	S.O. Semerikov	[59]	2021	12

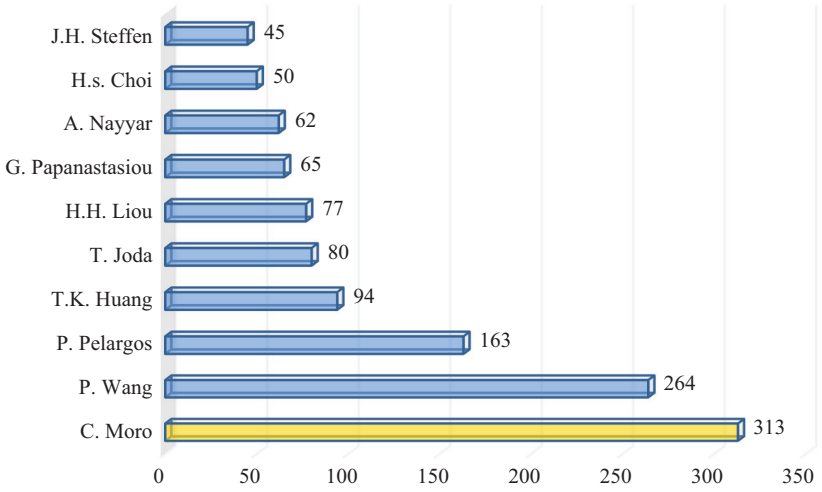

Fig. 10. Top 10 articles by most citations

The 2017 study "The Effectiveness of Virtual and Augmented Reality in Health Sciences and Medical Anatomy" by Moro (c=313) received the highest citation (see Figure 10). This article examines the use of metaverse technologies, including AR/VR, in the teaching of human anatomy. It was found that learning, engagement and performance of students improved due to this educational method. However, the use of VR devices for extended periods of time generated side effects such as headaches, dizziness and blurred vision.

3.3 Type of metaverse technologies in education

RQ2: *What types of metaverse technologies have been applied in education?*

Based on the existing literature, a comparison of metaverse technologies can be summarized as shown in Table 5.

Table 5. Types of metaverse technology comparison

Aspect	Type	Description
Definition	AR	The technology and methods that allow overlaying of real-world objects and environments with 3D virtual objects
	Lifelogging	The technology used for tracking, recording and sharing user activity data
	Mirror World	Reflection of the real world in virtual environments
	Virtual World	A computer-simulated environment with personal avatars, interactivity, and data.

(Continued)

Table 5. Types of metaverse technology comparison *(Continued)*

Aspect	Type	Description
Features	AR	An interactive experience that combines the real world and computer-generated content (augmentation or simulation)
	Lifelogging	In the metaverse concept, lifelogging can strengthen the connectivity of everyone digitally.
	Mirror World	Representation of the real world in digital, ex: google earth
	Virtual World	User avatar interactions and activities
Apps & Devices	AR	Smartphones
	Lifelogging	Wearable Devices, Blackbox's
	Mirror World	Map-based services, virtual conferences apps, virtual tour
	Virtual World	MMORPG, VR Headset
Examples	AR	Pokémon Go, Digital Book, Realistic Content.
	Lifelogging	Facebook, Instagram, STEPN, Smartwatch.
	Mirror World	Google Street View, Google Maps, ZOOM, Google Meet.
	Virtual World	Roblox, PUBG, Zepeto.

Table 6 shows the classification of the 42 articles based on the type of metaverse technology adopted.

Table 6. Type of metaverse technologies adopted by

No	Type	Articles [Ref.]	Total
1	Augmented reality	[35], [52], [68], [53], [71], [61], [47], [58], [34], [62], [56], [63], [44], [40], [45], [64], [33], [65], [51], [60], [57], [37], [72], [38], [48], [39], [43], [50], [54],	29
4	Lifelogging	[59], [66]	2
5	Mirror world	[36], [41], [46], [69], [70], [32], [49]	7
6	Virtual world	[67], [42], [13], [55]	4

Analysis of the reviewed articles showed that the use of metaverse technologies such as AR/VR is the most popular in education, particularly for learning. Figures 11–13 indicate that AR/VR is more often used for augmentation and simulation. It is believed that this technology can help students learn topics that would be hard to present directly (high risk), such as the solar system, anatomy, astronomy, etc. Through this immersive teaching and learning experience, students have the opportunity to visualize objects. It is hoped that this technology can serve as a major breakthrough in teaching and learning activities and provide a solution to improving the quality of education in the future.

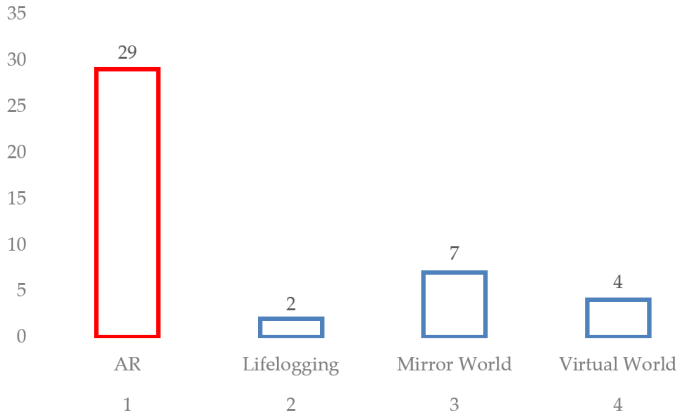

Fig. 11. The use of metaverse technology in education

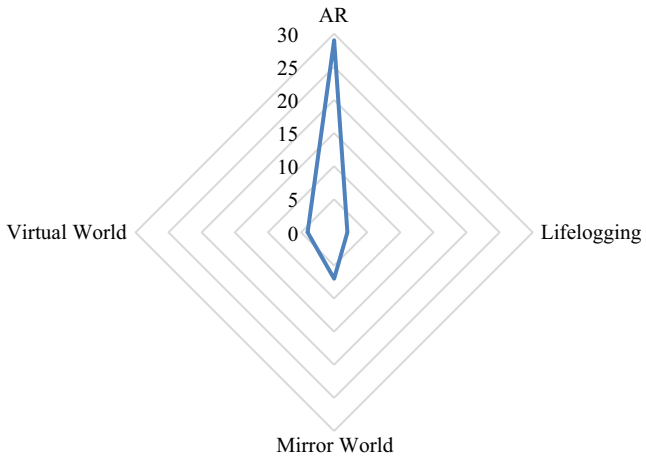

Fig. 12. The use of metaverse technology in education (cont.)

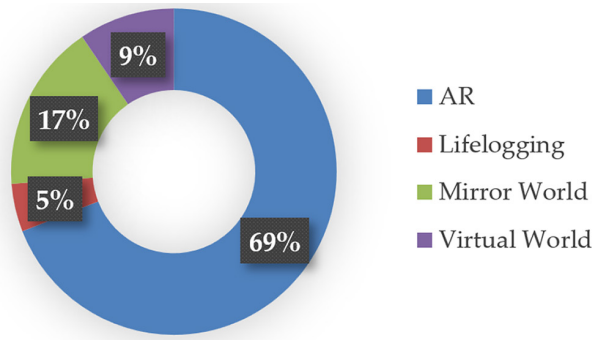

Fig. 13. The most used type of metaverse technology (%)

The use of metaverse technology has various implications for the world of education, especially in the learning process. Augmented reality technology, for example, which can visualize real objects in 3D, can be highly motivating for students. Additionally, social media can be an alternative for social-based learning media, with teachers and students being able to learn and connect through apps such as WhatsApp and Instagram. Distance learning has become especially relevant during the COVID-19 pandemic, with the mirror world or virtual face being an alternative in the world of education to keep it running. Virtual learning is also being developed by various universities, such as virtual laboratories or practicum activities that can be supported by various simulations or virtual environments, which may be safer and more cost-effective than their real-life counterparts. Such simulations include shooting training, firefighting exercises, air-craft steering, welding, operation simulations and more. Furthermore, these virtual environments can provide students with a better understanding of such phenomena, which are impossible to visualize in actual conditions, such as volcanic eruptions, outer space, and galaxies. Hence, metaverse technology has been shown to provide users with new and immersive experiences through virtual sensations without the limitations of space and time.

4 Discussion

4.1 Metaverse for education: challenges & opportunities

RQ3: *What are the challenges of using metaverse technologies in education?*
RQ4: *What are the problems that occur if the metaverse is applied?*

Over the last two years, the learning process utilizing various metaverse technologies has proven to have a great many positive impacts. This does not, however, result in a more complex virtual university, which could be imagined as an interactive virtual environment with all its activities. Thankfully, the metaverse has been integrated into many areas of life, including education, which is the focus of this research. Well-known applications like Zoom and Google Meet have become staples in the modern learning environment, but new technologies such as mesh platforms and Somnium rooms will provide even more immersive experiences. Ultimately, the use of these technologies could lead to the creation of a virtual university, providing a highly active and collaborative environment for learning [45–47].

Learning with various 3D visualizations can be an interesting option for students who rely solely on textbooks or 2D images to understand complex material. For example, in history classes, teachers may no longer need to take students to museums in person but can instead use virtual tour technology. However, from the other side, this metaverse can also have other impacts, even terrifying. For example, if the world of education one day is replaced in the form of a virtual world, the essence of learning will not be achieved; for example, the social warmth that should be felt directly between humans is not better than that provided by the virtual world. Then the real world is where we live as humans, so one cannot live dependent on the virtual world. Then in terms of health, currently, to feel the virtual world's sensation, we must use a VR Headset, which, based

on trials, can cause symptoms of dizziness and eye pain if used for a long time. From a security point of view, cyberspace is a world that is vulnerable to data theft, for example, someone's privacy and data leakage, so the representation of people in cyberspace is not necessarily the same as the original, meaning that someone can use fake avatars in cyberspace so that it can be said that they tend to experience an identity crisis. Moreover, more than 70 studies were retained after quality assessment to strengthen the analysis of how the implementation of metaverse technology in education has been applied (See references).

4.2 Metaverse technologies in Indonesia

RQ5: How are metaverse technologies for education evolving in Indonesia?

The development of the metaverse in Indonesia is quite progressive, as the WIR Group is currently constructing it. At the end of 2022, when the G20 Summit takes place in Indonesia, virtual cities will be presented to travelers. One of the changes that may arise from the metaverse is a shift in work culture; people have already begun to adapt to various virtual activities. With the advancement of the internet, education may transition from the physical world to the virtual world. It is difficult to imagine how, 6–10 years from now, activities such as student orientations, conferences, campus tours, exams, interviews and the internship process, which previously relied on face-to-face interaction, could become part of the virtual metaverse world. In short, the metaverse has a lot of untapped potential that education stakeholders can explore.

Metaverse technology facilitates the broadest access to more flexible learning. The concept of learning anytime and anywhere has captivated many. Technology can reduce time, space and costs constraints. When the Covid 19 pandemic struck, 1.6 billion students were affected by education disruption due to the sudden adoption of technology. But this disruption has enabled students to learn anytime, anywhere, and with anyone. In conclusion, technology has become a core and primary necessity for constructing an educational civilization in the digital era.

Despite the availability of educational technology, learning loss may still be an issue due to the gap in access. As per the Ministry of Education and Culture's data from 2020, 31.8% of people do not have internet access. Kominfo 2020 also reported that there are still 12,548 villages without 4G internet. This is a classic problem in the world of education, and global data shows that 364 million young people lack access to technology. In 2020, around 159,000 Indonesian students dropped out of school due to the lack of access and educational infrastructure, with an inequality of human resources causing a disparity in the quality of education across different regions. To address this infrastructure gap in Indonesia, it is essential to accelerate the development of fundamental infrastructure, such as internet access, as well as to strengthen other digital infrastructures.

The world of education cannot ignore the potential impact of technological advances. Rather, we must use these advances as a means to achieve positive outcomes. With the development of metaverse technologies by major corporations, education must be ready to embrace this technology. Metaverse (if successful) will be reminiscent of the introduction of the internet into education. It has great potential to revolutionize the future of global education, providing wide-reaching access to knowledge and the possibility

of interacting with avatars from all over the world. Educational institutions must take advantage of these benefits and should have already begun developing metaverse technologies. Whether we like it or not, the metaverse phenomenon will eventually become a part of the new educational order.

In the future, metaverse technology will allow history teachers to take students to virtual museums instead of real-world ones. This 3D experience will make lessons that used to be limited to two dimensions far more engaging. Geography classes can even visit volcanic eruptions and interview volcanologists without having to leave the classroom. By bringing learners out of the abstract realm and into virtual reality, the metaverse has the potential to revolutionize education as we know it. While this may be exciting for some, it is certainly a bit intimidating to think about.

5 Conclusions

Technological developments are inevitable, and so we must use them wisely to bring the most benefit to human life, particularly in education. In the early 2000s, the education world was fearful that the internet would destroy it; in those years, smartphones were even banned in schools, with anyone found carrying one facing confiscation. However, now, a decade later, the technology that once seemed so threatening can be used for educational purposes. Education cannot try to halt the progress of the times; instead, it must find ways to use technology in a positive direction. Technology, including the metaverse, is a pathway; it cannot be seen as an end in itself. In the author's opinion, the physical school and all its activities will not be completely supplanted by the metaverse. The metaverse will simply be a tool to make services even better without completely replacing the real world. Education seeks to humanize humans, not virtualize them. The metaverse presents a challenge to the real world of education. With the availability of human resources and infrastructure, the metaverse era in education will continue to evolve and develop. Indonesia has a great opportunity to develop the metaverse; it is the fourth largest country in terms of the number of social media users, with 191.4 million people using social media as of January 2022. This is an impressive statistic that should be taken into account when considering the potential for the metaverse in Indonesia, as it opens up opportunities for new business models and products. The metaverse could drive the digital economy, in which Indonesia has huge potential, with 600,000 digital talents being produced each year. The development of this technology is expected to result in the creation of 23.3 million new jobs by 2030. Therefore, interdisciplinary, comprehensive, and solutive research is needed to discuss this technology in detail and ensure that the metaverse does not simply become a new trend in the virtual world, but also offers solutions to the various problems faced by Indone-sia today.

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