WHAT DO TEACHERS SAY ABOUT METAVERSE IN EDUCATION?

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ABSTRACT

The metaverse, which has a history of about thirty years in written literature, became the agenda of humanity again in the first quarter of the twenty-first century. Although it seems almost impossible today to draw the boundaries of the experience that this technology, which arouses great excitement, will offer, it is possible to say that humanity is on the verge of going beyond reality. Similarly, for the metaverse, which is expected to offer new generation solutions in terms of educational applications, teachers' opinions and expectations on the subject constitute an important reference when planning the near future. Considering this situation, 333 teachers were asked about their opinions, expectations, and suggestions regarding the use of metaverse in education. The responses of the teachers participating in the research indicate that teachers are optimistic about the advantages to be gained in the educational context with the metaverse, but the education system is not yet ready for this.

Keywords: Metaverse, augmented reality, virtual reality, three-dimentional virtual world, distance education.

INTRODUCTION

Many technologies that increase the quality of life of individuals and save speed and time are first described in science fiction books or films. For this reason, science fictional outputs can be defined as one of the important proofs of what people can achieve if they follow their dreams. It can be said that a similar situation is the case with the metaverse, in which large technology companies invest and are the subject of research today. The metaverse, which found its place only in science fiction books in the nineties, was introduced to Second Life in 2003, followed by Roblox in 2006, Pokemon Go in 2015, and finally Fortnite in 2016. The metaverse, which has reached millions of users in this process, has recently started to lead the investment, and working areas of technology companies such as Facebook and Microsoft.

The ability to collaborate, experience a scenario firsthand, or closely inspect an object makes the metaverse stand out when examining current research and applications. Because of this, the metaverse enables students to interact practically with difficult ideas. For example, students can engage in simulations of scientific investigations or digitally tour ancient civilizations rather than only reading about historical events (Eschenbrenner, Nah, & Sau, 2008). Additionally, teachers can customize learning experiences to meet the

requirements and preferences of each individual student thanks to the flexibility of metaverse environments. Because students may work at their own pace and get guidance that is appropriate to their needs, this personalization can result in more effective learning results (Onu, Pradhan, & Mbohwa, 2024; Tinmaz & Fanea-Ivanovici, 2024). Beyond all of these advantages, the metaverse offers a risk-free environment for honing abilities that could be hazardous or unfeasible in the actual world, including performing laboratory tests or medical treatments. In disciplines like engineering and medicine, where students can learn through simulations with no real-world repercussions, this characteristic is very helpful (Hwang & Chien, 2022; Onu et. al., 2024)

On the other hand, metaverse has some limitations in terms of pedagogical use. For example, although it is possible to observe and experience the situation from a first-person perspective with metaverse, it becomes difficult for the teacher to monitor the students in this situation (Eschenbrenner et al., 2008). However, simulations enriched with augmented reality require more mental effort and effort from the user (Xi, Chen, Gama, Riar, & Hamari, 2022). Similarly, although virtual reality applications offer users a more entertaining and highly present learning experience compared to traditional media, they do not create a significant difference in terms of learning (Makransky, Andreasen, Baceviciute, & Mayer, 2021). Similar requirements apply to the usage of the metaverse in education: dependable platforms, high-quality network connectivity, and device accessibility (Onu et., al., 2024). It is also necessary to provide educators with training, both before and during their careers, in order to enable them to utilise metaverse tools effectively in their teaching practices (Tinmaz& Fanea-Ivanovici, 2024). In consideration of the aforementioned results, it is evident that the metaverse will not serve as a straightforward replacement for the conventional learning environment. (Sharma, Devreaux, Scribner, Grynovicki, & Grazaitis, 2017). Metaverse indicates that it promises great changes and transformations in terms of education. Therefore, there is a need for research on metaverse applications in educational context. In this context, first of all, there is a need to determine the opinions and readiness of teachers as the implementer of the system. The objective of this research is to ascertain the potential of metaverse integration in the field of education and to identify the requirements for its implementation.To this end, the study will investigate the extent of teachers' knowledge about the use of metaverse in education, their perceptions of its advantages and disadvantages and their views on its areas of application. Furthermore, the following are the sub-objectives of this study:

- to find out how much instructors know about using the metaverse in the classroom.
- to find out how educators view the benefits and drawbacks of the metaverse in the classroom.
- to ascertain which educational domains, in the perspective of educators, are more suited for the metaverse.
- to ascertain when it would be best to incorporate Metaverse applications into classroom settings.
- to discuss the possible obstacles to integrating the Metaverse into the classroom and the recommendations made by educators.

Theoretical Background

The metaverse is a bi-located virtual universe that allows individuals to be both "here" and "there" at the same time through their own avatar (Diaz, 2020; Schlemmer & Backes, 2015). From another perspective, as the end product of the development of artificial intelligence, robots, and intelligent systems, the metaverse is defined as a hybrid platform where technologies such as gaming, social media, and digital communities come together at the center of web 3.0, which offers the opportunity to create three-dimensional virtual worlds through the internet (Crespo, Escobar, Aguilar, Velazco, & Sanz, 2013; Schlemmer & Backes, 2015). Therefore, the metaverse is a technology built on the two axes illustrated in Figure 1, which is beyond the many platforms known today (Smart, Cascio, & Paffendorf, 2007).

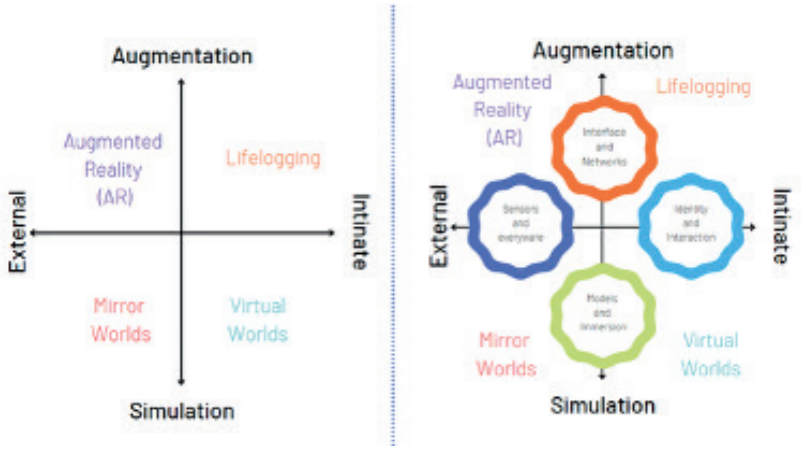

Figure 1. Metaverse types (Smart, Cascio and Paffendorf, 2007).

Considering Figure 1, it is classified that there are four metaverses that offer different experiences to users as (1) augmented reality, (2) lifelogging, (3) mirror world, and (4) virtual reality metaverse (Kye, Han, Kim, Park, & Jo, 2021). While augmented reality metaverses are smart environments networked with location-based technologies, life diary metaverses are platforms where people share information and experience (Lee, 2020; Smart et al., 2017). Mirror world metaverses are environments where real life is imitated (Lee, 2020; Smart et al., 2017). In this context, while the life diary metaverse is more focused on personal experience and is an environment where the individual shares, the mirror world metaverse is a platform where information about the external environment is integrated and shared. Finally, the virtual reality metaverse is a three-dimensional virtual world created using digital data (Lee, 2020; Smart et al., 2017).

Table 1. Types of Metaverse (Lee, 2020)

	Augmented Reality	Life Diary	Mirror World	Virtual Reality
Description	Creating smart systems with location- based and internet technology	Technology for storing and sharing everyday experiences and information about objects or people	A reflection of the real world	A virtual world in the light of digital data
Features	Intelligent systems Location based	Saving information	Modelling virtual maps and GPS technologies	Interaction through avatars
Assistive Technologies	Smartphones Head up display	Wearable technologies	Map services	Multi-user online games
Example of Metaverse Applications	Pokeman Go	Facebook, Instagram, Apple Watch	Google Earth, Yandex Navigation	Second Life, Minecraf, Roblox, Zepeto

When Table 1 is considered, it is seen that the virtual worlds expressed as the metaverse are not a brand new technology for humankind. However, when the recent search engine statistics are analyzed, it is possible to say that the metaverse has become a technology that attracts the attention of much wider masses (Google, 2022). In addition, although metaverse-focused studies in Web of Science and Scopus have existed since 2007, it is seen that the interest has increased, especially in recent years (Tlili et al., 2022). However, it is seen that not only the investments in this field but also the rapid remote working with pandemic conditions and the recognition of online platforms is an important factor supporting the interest in the metaverse (Tlili et al., 2022).

On the other hand, studies focusing on the metaverse have so far found a wide range of applications ranging from art (Romero, Viana, & Angel, 2016), media (Brennen, & Dela Cerna, 2010), education (Quintana & Fernandez, 2015), architecture and design (Jovanovic & Milosavljevic, 2022) to cultural events (Choi & Kim, 2017). Therefore, it is possible to say that metaverse is "a technology that will go beyond being a

means of entertainment and socialization" for the near future. However, from a philosophical point of view, especially from a constructivist perspective, the learning process is defined as the process that individuals realize together by sharing and in harmony (Steffe & Gale, 1995). The learner is not the object in education, but the leading role of the process itself, that is, the subject (Freire, 2015). Therefore, it is clear that it is essential to make the learning experience more flexible rather than confining it only within the school walls (Schlemme & Backes, 2015). In addition, with the developments in the field of artificial intelligence, programming, and intelligent systems, the need for studies in the field of technology, especially in these fields, is increasing day by day. For this reason, new generations need to follow technological developments and even provide them with learning opportunities where they can lead these developments (Giarratano & Ricley, 1998). From this point of view, it is possible to say that digital technologies in the learning environment are as natural as pen and paper for today's generation compared to previous generations.

Although metaverse is a new technology, there are studies showing that it is as effective in terms of academic achievement as traditional methods in the learning-teaching process, as well as providing learners with digital competence, as well as providing the opportunity to practice more safely with less cost (Heo & Kim, 2021). For example, Siyav and Jo (2021) found in their research that metaverse-based nursing education encourages experiential learning for nursing students and that the learning experience becomes more efficient. In addition, the results indicated that students showed much more participation in the metaverse learning environment than in traditional learning environments and also attracted attention (Estudante & Dietrich, 2020). Metaverse has been used not only at university but also at many different levels up to secondary school level (Heo & Kim, 202; Lopes & Gonalves, 2021). Similarly, it is seen that metaverse is used in the teaching of disciplines such as mathematics, and history as well as in direct application areas such as piloting (Choi & Kim, 2017; van der Stappen, Liu, Xu, Yu, Li, & van der Spek, 2019; Wangid, Rudyanto, & Gunartati, 2020). In addition to providing the opportunity to experience a situation as it really is, metaverse can also be used as a support system in the development of learning skills, especially in special education. In this context, Stichter, Laffey, Galyen, and Herzog (2013) state that it is useful to use this technology to help students with autism spectrum disorder gain social communication and interaction competencies.

Providing a freer learning experience to an individual has also become possible with the metaverse (Lopes & Gonalves, 2021). In addition, the cooperation and collaborative learning environment required to build knowledge together without the necessity of physically coming together becomes possible with the metaverse (Schlemme & Backes, 2015). Therefore, the metaverse has the potential to be an important aid in overcoming the transactional distance in distance education. At this point, it can be said that the fact that many virtual world universes, especially Second Life, can be integrated into the learning management system will contribute to the effective use of this potential (Warburton, 2009).

Teachers' perspectives on the metaverse can provide valuable insights into its potential to enhance student engagement and learning outcomes. Research indicates that the metaverse can facilitate interactive and immersive learning experiences, which are essential for fostering student engagement. For instance, Pahmi highlights that teachers recognize the metaverse's ability to enhance interaction, visualization, and accessibility, which can revolutionize student engagement, particularly for those who struggle with traditional teaching methods (Pahmi, 2023). This aligns with findings from Chen et al., who assert that the metaverse supports student-centered education and cultivates positive learning attitudes, thereby enhancing educational outcomes (Chen et al., 2023). Teachers' opinions on these aspects are vital for understanding how to leverage the metaverse effectively in their classrooms.

Moreover, teachers' attitudes towards the metaverse can influence their willingness to adopt and integrate this technology into their teaching practices. Jafari's study reveals that the majority of teachers hold a positive attitude towards using the metaverse in science classes, believing it can simulate real-life activities and enhance social communication (Jafari, 2023). Such positive perceptions are crucial, as they can lead to increased adoption rates of metaverse technologies in educational settings. Conversely, negative perceptions or concerns about the metaverse's effectiveness could hinder its integration. Therefore, understanding teachers' opinions is essential for addressing potential barriers to adoption. Additionally, exploring teachers' views on the metaverse can shed light on the necessary support and training required for effective implementation. Research by Yilmaz and Simsek emphasizes the need for well-informed individuals, including teachers and students, to facilitate the effective use of virtual reality and metaverse technologies in education (Yilmaz

& Simsek, 2023). This indicates that teachers may require professional development and training to feel confident in utilizing these technologies. By gathering teachers' opinions, educational institutions can better tailor their training programs to meet the specific needs and concerns of educators, ensuring a smoother transition to metaverse-based learning environments.

Furthermore, teachers' insights can help identify the challenges and limitations associated with the use of the metaverse in education. Gurkan and Bayer note that while metaverse platforms can enhance the quality of education, there are various factors to consider, such as infrastructure and accessibility issues (Gurkan & Bayer, 2023). Teachers can provide firsthand accounts of the challenges they face when integrating new technologies, which can inform policymakers and educational leaders about the necessary resources and support systems required for successful implementation. Understanding these challenges is crucial for developing strategies to overcome them and maximize the potential of the metaverse in education.

Lastly, exploring teachers' opinions on the metaverse can contribute to the broader discourse on educational technology and its implications for future teaching and learning practices. Research by Rahman emphasizes the need for educators to understand how metaverse technology can impact student engagement and academic performance (Rahman, 2023). By incorporating teachers' insights into the conversation, stakeholders can develop a more comprehensive understanding of the metaverse's role in education and its potential to reshape traditional pedagogical approaches.

METHOD

In this section, research design, sampling, data collection tool and analysis process will be discussed.

Research Design

This research, which aims to reveal the potential use of metaverse in education, its advantages and disadvantages, stakeholders' knowledge of the metaverse, the appropriate areas for its applications, the suitable timing for its implementation, and awareness of the stakeholders of the education system regarding metaverse practices in education, was designed as a survey study. Survey studies are studies that aim to objectively reveal the views of a large group of people on a specific topic based on questions such as "What is it?", "How is it?" or "What is it about?" (Buyukozturk, Ozturk, Kilic, Akgun, Karadeniz, & Demirel, 2016). From this point of view, it is possible to characterize survey studies as studies that explain the current situation in the light of the statistics obtained from the participants.

Within the scope of the research, 333 teachers from Turkiye were reached. Most of the participants were teachers working in private schools (N=171) or public/public schools (N=146). However, there are also those who continue their studies in different fields of the education sector (N=4) and those who are not actively teaching (N=12). However, among the participants; primary school teachers (18.6 %), English teachers (17.4 %) and computer and instructional technology teachers (14.7 %) stand out.

Table 2. Branches of the teachers participating in the study

Branch	Frequency (f)	Percentage (%)
ICT (Computer & Instructional Technologies)	49	14.7 %
Science	15	4.5 %
English Language	58	17.4 %
Mathematics	39	11.7 %
Pre-school	18	5.4 %
Counselling	11	3.3 %
Primary school teacher	62	18.6 %
Turkish Language	14	4.2 %
Other	67	20.1 %
Total	333	100%

While a great majority of the participants (59.5 %) had a bachelor's degree, the other big majority (37.8 %) of teachers consisted of teachers who had a master's degree.

Table 3. Educational background of the teachers participating in the study

Educational status	Frequency (f)	Percentage (%)
Associate degree	2	0.6 %
Bachelor's (Undergraduate) Degree	198	59.5 %
Master's (Graduate) Degree	126	37.8 %
Doctorate (PhD)	7	2.1 %
Total	333	100%

It was found that most of the teachers participating in the study had 6-10 years of experience (29.1%), but also 11-15 years (24%), 16-20 years (21%), 1-5 years (17.4%), 21 and over years (8.4%).

Table 4. Experience (years) of the teachers participating in the study

Teaching experience (years)	n	%
1-5	58	17,4
6-10	97	29,1
11-15	80	24,0
16-20	70	21,0
21+	28	8,4
Total	333	100%

Data Collection Tool

A questionnaire was devised by the researchers in accordance with the research objectives. In addition to demographic information, including age, employment status, and institution, the questionnaire comprises multiple-choice and open-ended questions exploring the metaverse in education from the perspective of teachers.

To guarantee the content validity and reliability of the questionnaire, a number of measures were implemented. Three experts in the field of educational technology were consulted during the development phase to refine the questions and ensure their alignment with the research objectives. The questions deemed appropriate for the research purposes by the three experts were incorporated into the questionnaire. The questionnaire comprises a total of 28 questions.

Data Collection Process

The questionnaire prepared by the researchers was shared online through social media and digital communication tools. In the online questionnaire, participants were informed that their data would only be used within the scope of the research and their data was processed after their approval. The data obtained from the questionnaire was analyzed using thematic analysis method. The questionnaire, which was available to to join for one week, were compiled by the researchers. In the following process, the researchers categorised the participants' responses in line with the research questions and descriptive statistics were obtained.

FINDINGS

When the responses of the teachers participating in the study to various questions on a 9-point Likert-type questionnaire were analyzed and according to the findings obtained by simple statistical calculation; the teachers' knowledge of the concept of metaverse was calculated as 5.25 points on average. Similarly, more than three out of four teachers (N=260), 78.1% of them stated that they had experienced the metaverse

environment before. When the details of these experiences were examined, it was found that teachers generally responded positively due to experiences in virtual reality or three-dimensional virtual worlds rather than the current concept of "metaverse". For example, P13 said "I can say that it makes you feel both happy and uneasy. I had a short-term space station experience. I can say that it was inspiring to experience a situation that is normally impossible to experience, even if it was "as if". Also, VR goggles felt a little heavy, causing neck pain and headache in long-term use". Similarly, P9 said "My experience started with the Second Life application." It is seen that very few users talk about an experience suitable for the metaverse in the current sense. For example, P93 is one of them and the details of this experience are as follows; "We met with teachers from different cities of Turkiye in a virtual environment in the conference hall with my avatar through the link given in a training introducing Web 3.0 tools.". Therefore, it is possible to say that teachers have limited metaverse experience but are familiar with three-dimensional virtual world and virtual reality applications.

Although their metaverse experiences are limited, in the light of the findings of the research, there are clues that teachers closely follow the studies in this field. The continuation of the studies in the field of metaverse was calculated as 4.80 out of 9, and it was determined that the teachers had a positive attitude towards the use of metaverse in education (6.23 points). Similarly, the teachers' score was calculated as 6.19 for the advantageous use of metaverse. In this context, teachers listed the advantages of using metaverse in education as producing materials that will attract students' interest (N=258), providing the opportunity to apply knowledge (N=250), creating learning by doing and experiencing (N=229) experience for students much more easily (N=229), providing the opportunity to get to know new technologies closely (N=229) and eliminating the boundaries in education (N=200). The advantages of the use of metaverse in education are presented in Table 5.

Table 5. Educational advantages of using Metaverse

Advantages	Frequency (f)	Percentage (%)
Real-world-like environments to enable practice	250	74
To be able to provide experiences that can attract students' interest	258	76.3
Learning by doing and experiencing environment	229	67.8
Experiencing new technologies closely	229	67.8
Elimination of limitations in education	200	59.2
Making the impossible possible	200	59.2
Digital competence	195	57.7
Personalized learning experience	186	55
Obtaining more data about the student's learning experience	150	44.4
Increasing engagement	146	43.2
Time and cost savings	135	39.9
Cooperative learning environment	113	39.3
Accessibility	78	23.1
Safe learning experience	69	20.4
Students' readiness	67	19.8
Equal opportunities	47	13.9

There are also teachers who think in the opposite direction. The scores of the teachers who have concerns about the use of metaverse in education were calculated as 5.38. This situation indicates that although teachers have a positive attitude towards metaverse in education, they still have a view that it should be approached cautiously. At this point, teachers are most concerned about technical problems (n=260), psychological problems, especially addiction (n=235), inequality of opportunity (n=229), data security (n=193) and teachers' readiness (n=189). The challenges and perils anticipated/foreseen/projected by the teachers regarding the use of metadata in education are summarised in Table 6.

Table 6. Challenges and perils anticipated/foreseen/projected by the teachers

Challenges and perils anticipated/foreseen/projected by the teachers	Frequency (f)	Percentage (%)
Technical problems (internet connection loss, freeze, etc.)	260	76.9
Psychological problems (such as addiction)	235	69.5
Inequality of opportunity	229	67.8
Data Security	193	57.1
Teachers' readiness	189	55.9
Difficulty in preparation / expert requirement	183	54.1
Physical problems (such as eye pain, nausea)	173	52.7
Cost	160	47.3
classroom management problems	143	42.3
Can't find suitable content	136	40.2
Inability to develop content	123	36.4
estrangement from real life	117	52.4
Material not found	117	34.6
Students' readiness	116	34.3
Relevance of content (age-appropriate content)	113	33.4
Parent complaints	95	28.1
Dissatisfaction of school administration	59	17.5
Not taking students' attention	29	8.6

Although teachers have concerns about the use of metaverse, it can be stated that the participants in the study are willing to use metaverse in their lessons. While the score of the teachers participating in the study regarding the willingness to use metaverse in their lessons was 6.37, the score for the suitability of their lessons for metaverse was calculated as 6.05. In addition to this situation, teachers' scores for participation in training on metaverse integration in education were found to be 8.08. This situation indicates that teachers are willing to use metaverse in their lessons despite all their concerns.

The teachers who participated in the research stated that information technologies (N=240), physics (N=237), biology (N=229), chemistry (N=228) and mathematics (N=221) courses are more suitable for metaverse. This situation indicates that teachers mostly think that the contents in science and mathematics are suitable for metaverse environment. The disciplines that the teachers participating in the study think are suitable for metaverse are listed in Table 7.

Table 7. Metaverse applicable cources

Lesson	Frequency (f)	Percentage (%)
Information Technology	240	72,07
Physics	237	71,17
Biology	229	68,77
Chemistry	228	68,47
Mathematics	211	63,36
Foreign Languages	195	58,56
Painting / Visual Arts	192	57,66
Music	153	45,95
Turkish (Language)	137	41,14
Physical Education	124	37,24
Philosophy Group	104	31,23
Guidance and Counseling	78	23,42
History	15	4,50
Geography	12	3,60
Life Science/social Sciences	4	1,20
Drama	1	0,30
Intelligence and Mind Games	1	0,30

Teachers' responses that they think that metaverse is more suitable for concretising abstract concepts, conducting experiments, collaborative learning and creating real-like learning environments are also noteworthy. However, teachers who think that the education system is almost never ready for metaverse (2.26%) state that the situation is similar for the stakeholders of the system. In the light of the findings of the research, it was determined that teachers think that their colleagues (2.35%), parents (2.05%) and schools (2.35%) are almost never ready, but relatively students (4.59%) are more ready in this regard. However, the teachers participating in the study estimated that they will use metadata effectively in education within five years at the latest. Teachers' predictions about the effective use of metadata in education are presented in Table 8.

Table 8. Projected time for the widespread implementation of Metaverse (years)

Estimated year range	Number of Teachers (n)	Percentage (%)
3-5 years	124	37,24
In 1-2 years	79	23,72
5-10 years	76	22,82
10+	36	10,81
Ever	18	5,41

When Table 8 is analyzed, it is determined that teachers foresee that the education system needs a few years to prepare for the metaverse. At this point, it can be said that it is natural to need time since education is a very large system.

DISCUSSION

The integration of the metaverse into educational has transformative possibilities, including immersive and interactive learning experiences that surpass physical constraints (Onu et. al., 2024). According to research, it can lower cognitive load (Gomez-Rios, Paredes-Velasco, Hernandez-Beleno & Fuentes-Pinargote, 2023), save traditional education expenses like lodging and transportation, and allow for safer and more effective instructional designs (Heo, Kim, Jeong, Kim, & Yoon, 2022). Furthermore, the metaverse represents a cost-effective solution for modern education, particularly in terms of recent literature (Hwang et. al., 2022; Onu et. al., 2024),

Despite these benefits, research have indicated that a virtual reality environment, such as the metaverse, may not necessarily be an optimal learning environment in all contexts (Makransky et. al., 2021). Additionally, recent research has highlighted significant concerns, serious issues, especially with regard to the long-term health effects of virtual reality use, including effects on vision and balance (Guna, Gersak, Humar, Krebl, Orel, & Pogacnik, 2020; Song & Jung, 2017). The teachers involved in this study expressed serious concerns about the physical and mental health implications for students using metaverse technologies. Although teachers generally hold an optimistic view of the metaverse, their concerns about student health are significant and warrant careful consideration by educators and developers alike. Planning must take into account the health status of students, especially as virtual reality technology becomes more integrated with metaverse applications (Guna et al., 2020).

The pedagogical challenges associated with the transition to using the metaverse for educational purposes are significant and multifaceted. These include the need for robust infrastructure, effective integration strategies and teacher involvement in resource design (Lee & Hwang, 2022). Our study's finding that teachers should have the knowledge and expertise to use this new technology efficiently, beginning with pre-service, is consistent with existing literature (Lee & Hwang, 2022; Onu et. al., 2024). The limited metaverse experience among the teachers in the study, coupled with their negative perceptions of the system's readiness, underscores the need for immediate action by relevant authorities (e.g., ministries of education, technology, and infrastructure). These authorities should facilitate the acquisition of metaverse experience and its integration with technological-pedagogical knowledge. This process can be initiated with low-risk, small-scale implementations, allowing teachers and students to gradually adapt to the new approach. For instance, it could focus on interactive simulations or virtual field trips in disciplines such as science and history.

The concerns raised by the teachers who participated in the study are pertinent to the current state of the education system. The initial step in this process involves educators, technology developers, policymakers, and researchers establishing cooperative relationships with the aim of working together to create metaverse tools and resources that support educational goal (Camilleri, 2024). The availability of a strong technological infrastructure is essential for the successful implementation of metaverse education. This includes the supply of powerful hardware, quick internet access, and gadgets that can create immersive experiences (Hwang & Chien, 2022). Currently, many educational institutions may find it difficult to adopt virtual reality (VR) and augmented reality (AR) technologies due to their high cost and technical complexity, which calls for a large investment in these resources. It would be beneficial to invest in the creation of a diverse range of metaverse-compatible content, catering to a variety of subjects and age groups. For this purpose, it is recommended to include interactive and gamified elements to increase engagement and adapt to different learning styles. Additionally, supporting the gradual enhancement of metaverse tools and to enable the timely resolution of any new problems, a mechanism for the regular gathering of user feedback—including that of students and educators—must be put in place. Such an approach would foster respectful and constructive interaction between participants. It is recommended that clear rules and expectations for behaviour in the metaverse be established to facilitate process management. This would encourage participants to interact politely and constructively.

In summary, it is encouraging that the metaverse may be incorporated into educational environments. Nonetheless, it's clear that a lot of teachers are still wary of creating secure and effective learning environments in metaverse. This cautious enthusiasm should drive the adoption of systemic improvements and changes. It is imperative that the entire educational system be prepared to embrace the metaverse, addressing pedagogical challenges, infrastructure needs, and health issues in order to create a comprehensive and dynamic learning experience.

CONCLUSION

Recent studies indicate an increasing trend in which students are engaging with metaverse environments such as Minecraft and incorporating these experiences into their social and leisure activities (Dean, 2021; Suh & Ahn, 2022). Remarkably, research suggests that students are keen to extend their gmae experiences into the school environment to socialise, have fun and spend time with friends (Samur & Ozkan, 2019). This shift suggests that metaverse games are replacing traditional group activities such as football, basketball, and other social games (Comert & Akgun, 2021; Kerdvibulvech, 2022).

The metaverse's potential for immersive learning is widely supported in the literature (Estudante, & Dietrich, 2020; Heo, Kim, Jeong, Kim, & Yoon, 2022; Lee, Yi, Moon, & Yeo, 2023). This emerging technology has the potential to be integrated into educational settings to match students' interests and experiences results (Onu et. al, 2024; Tinmaz & Fanea-Ivanovici, 2024). Similarly, paricipansts recognise the metaverse as an inevitable tool for creating engaging and realistic learning environments, despite the current lack of preparedness. Nevertheless, for the utilisation of the metaverse in an educational context to yield optimal outcomes, a number of prerequisites must be met. For instance, it is essential to ensure that schools have access to high-quality network connectivity and that the necessary devices are available (Onu et. al., 2024). It is similarly imperative to furnish educators with training, both prior to and throughout the course of their careers, in order to utilise metaverse tools in an efficacious manner within their pedagogical practices (Tinmaz & Fanea-Ivanovici, 2024).

Furthermore, compared to traditional approaches, our results show that the metaverse presents a significant potential for providing distinctive learning experiences. For example, using the metaverse, students could virtually experience historical events like Leonardo da Vinci's painting of the Mona Lisa or the conquest of Istanbul. This finding corroborates the work of Estudante and Dietrich (2020), which emphasises how immersive experiences facilitate more profound comprehension and engagement. Also, metaverse's deployment in high-risk or resource-intensive domains, such as aviation or medical training, aligns with the safety and accessibility benefits outlined (Lee et al., 2023).

In summary, our research supports the metaverse's transformative potential in education, echoing previous research (Heo et. al., 2022; Hwang & Chien, 2022; Lee et. al., 2023; Onu et. al., 2024; Tinmaz & Ivanovici, 2024) while offering fresh perspectives on how it might be used in practical learning situations. The metaverse provides dynamic, interactive, and secure learning environments that have the potential to completely transform education by bridging the gap between virtual and real-world experiences (Onu et. al., 2024). To overcome present constraints and realize its full potential, future study and investment in this field are essential to making the metaverse a vital resource for creative and inclusive education.

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