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Research Article

Metaverse and Music Education

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Metaverse and Music Education
Metaverse is one of the latest terms emerging technologies have introduced to us. This rapidly developing technology is becoming an indispensable part of our lives, just like today's smartphones. This three-dimensional virtual universe, accessed through various devices, offers unlimited opportunities such as socializing, e-commerce, gaming, and, most importantly, education. It provides an affordable and safe environment in teaching methods that are expensive and dangerous to teach. This study, which is a literature review, discusses Metaverse, virtual reality, augmented reality, and simulations. It is aimed to reveal the current situation in using Metaverse in education, examinations have been made in the field, and relevant studies have been reviewed. The focus of the examined studies is the advantages and disadvantages of Metaverse in education and social life. The positive aspects of using Metaverse in education are interactive learning, learning with fun, and increased motivation. Various evaluations have been made by examining the conducted studies, and a perspective has been developed regarding the use of Metaverse in music education. It was suggested as a result of the study regarding how Metaverse, already being used in many educational disciplines and continuously developed for integration into educational programs, can be utilized in music education. It can be said that music education with Metaverse will become a more interactive, funnier, and student-centered experience and will enhance students' musical abilities while also fostering their creativity and self-confidence.

Keywords: Music Education, Metaverse, Virtual Reality (VR), Augmented Reality (AR), Simulation,

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Introduction

New concepts are being added to our everyday vocabulary with the influence of developing technologies. The terms virtual reality, augmented reality, and simulation are increasingly emerging and making ground in our lives today. Another concept that can be considered as the next stage of virtual reality, augmented reality, and simulation, which have become widespread and integrated into our lives with the advancement of technology, is Metaverse. In this virtual and three-dimensional universe, accessed through various devices, people can experience various things such as socializing, e-commerce, gaming, education, etc. This new world, receiving significant investment from developing corporations and major companies like Meta (Facebook), Microsoft, Google, and Nvidia, is advancing day by day to offer realistic experiences to people. Metaverse, generally associated with gaming, e-commerce, entertainment, and education, has been the subject of several studies regarding how education can be conducted in this three-dimensional virtual world. Various studies cited below indicate that the Metaverse is being recognized as a new force in the field of education and that internet-based learning is further enhanced through its integration. These studies also demonstrate the Metaverse's potential to provide multifaceted and effective educational experiences by offering innovative learning environments. Therefore, Metaverse promises significant potential in education. It is thought that when the Metaverse

project reaches its intended level, it will enable individuals to experience a simulated-real life and make it possible to create learning experiences grounded in the framework of social-cognitive learning theory in education (Muştu Yıldız & Kurubacak, 2022).

This study proposes suggestions on how Metaverse, currently being used in many fields and continuing to be developed for educational programs, can be utilized in music education. The current situation regarding the use of Metaverse in education will be presented, and relevant investigations in the field will be conducted by examining scientific studies in this field. The reviewed studies have focused on the advantages and disadvantages of Metaverse in education and social life. A limited number of studies on music education and Metaverse were listed in searches conducted using the keywords "music education" and "Metaverse" on the Web of Science, Scopus, and Google Scholar platforms. While one of these studies focuses on music education, the others primarily revolve around music activities and creating recording environments using Metaverse. No studies related to Metaverse in the context of music education have been found in Turkey. Therefore, it is believed that this study will contribute to the field of music education. In this regard, the following questions have been addressed:

1. What is the role of Metaverse in education?
2. What are the advantages and disadvantages of using Metaverse in education?
3. What is the use of Metaverse in music education?
4. What can be done to enhance the use of Metaverse in music education?

Theoretical Framework

Metaverse

The concept of Metaverse first emerged in Neal Stephenson's novel "Snow Crash" published in 1992. In the book, Metaverse refers to a vast virtual environment that combines virtual reality and the internet (Duan, Li, Fan, Lin, Wu & Cai, 2021; Lee, Braud, Zhou, Wang, Xu, Lin, Kumar, Bermejo & Hui, 2021). A similar example of Metaverse can be found in the 2018 film adaptation of the novel "Ready Player One" which aired in 2011. Lee et al. (2021) stated that the three-dimensional virtual era of Metaverse began with the advancement of augmented reality, virtual reality, and control tools between 2011 and 2017, and the period from 2017 to the present is considered the new era of Metaverse. Metaverse refers to immersive three-dimensional virtual worlds where individuals interact with each other and software agents as avatars, using the real-world metaphor but without physical limitations (Davis, Murphy, Owens, Khazanchi & Zigurs, 2009). Mark Zuckerberg, who named his company after the term Metaverse, defines it as a tangible space where we can view internet-connected content and live within it (Zuckerberg, 2021). In short, Metaverse is not just a standalone technology but an interconnected virtual space that combines virtual reality, augmented reality, the internet as a whole, and the actual reality itself.

By establishing an economic system using blockchain technology, Metaverse integrates the virtual and real worlds into the economic system. It would be accurate to define Metaverse as a virtual world with socio-economic possibilities, as various Metaverses (such as Decentraland-MANA, The Sandbox-SAND, etc.) create and utilize their own cryptocurrency based on blockchain technology. For instance, on February 9, 2022, Samsung conducted its Unpacked event in the Metaverse called Decentraland, specifically in their virtual store named Samsung 837X, a replica of the physical Samsung store in New York. The event was live-streamed, and users attending the virtual store were greeted by an AI-powered character named Samantha, who provided important information and engaged in various dialogues with the users (Samsung, 2022). Similar examples can be found in this context. For example, in April 2020, Epic Games collaborated with Travis Scott to organize a concert in the game Fortnite, developed using the Unreal Engine. The concert attracted 27.7 million unique viewers. Moreover, Fortnite hosted concerts by Marshmello and Ariana Grande, where numerous avatars participated. Apart from Fortnite, other platforms hosted virtual concerts, such as Soccer Mommy and David Guetta on Roblox, Post Malone on Horizon World, and Foo Fighters on Meta. These concerts attracted millions of attendees, and renowned brands sponsored these events (Tien-Dana, 2023).

It is, for sure, observed that Metaverse has advanced not only in the realm of entertainment and gaming but also in education and other fields. When we examine the Insight series produced by Anima Res, a company focused on healthcare and aimed at medical education, it is seen that they have ventured into the Metaverse using virtual reality, augmented reality, mixed reality, and 3D animations. They have meticulously created detailed human organs such as the heart, kidney, and lungs. Through these applications, medical students can experience and simulate various organ movements and diseases that are typically difficult to observe with the naked eye (Anima Res, 2023).

Many studies show that the best way to learn something is through practice. According to recent studies in the field of "Cognitive Learning" based on Gestalt Psychology by Gkintoni and Dimakos (2022), it is stated that designing learning environments with visual stimuli that activate visual areas plays a significant role in enhancing the learning process, and the diversity of stimuli promotes adaptation to sensory inputs in the brain, facilitates the development of a more flexible structure, and contributes to the reinforcement of the learning process through neural connections, thus improving the learning process. Research indicates that 83% of what people learn is acquired through sight, 11% through hearing, 3.5% through smell, 1.5% through touch, and 1% through taste (Kağızmanlı, Özgüler, Kaya & Aydın, 2017). Dale's Cone of Experience further illustrates that, assuming time is constant, people tend to remember:

- %10 what they read,
- %20 what they hear,
- %30 what they see,
- %50 what they see and hear,
- %70 what they say,
- %90 what they do and say (Davis & Summers, 2015).

In face-to-face education, individuals engage in multi-layered learning that involves movement, sound, and visual perception. The more sense is involved in the learning, the more the learning becomes permanent and durable. Indeed, learning conducted in the Metaverse environment can provide effective learning experiences by incorporating visual, auditory, and kinesthetic

support (Kress & Van Leeuwen, 2001; Lee & Hwang, 2022, as cited in Göçen, 2022). Considering all these, it demonstrates the significance of Metaverse in offering learners an experiential learning approach, where they can learn by doing and experiencing.

Virtual Reality VR

Virtual reality is commonly and popularly used to define the imaginary worlds in computers and our minds (Merriam-Webster, 2023). Virtual reality is an artificial environment experienced through sensory stimuli provided by a computer, such as images and sounds, in which a person's actions partially determine what happens in the environment. An ideal VR system allows the users to move around the objects physically and touch them as if they were real (Jerald, 2016). Lessick and Kraft (2017) define virtual reality as an experience in which the user, using a computer or mobile device, is present in a virtual world while physically in the real world. Nowadays, virtual reality enables users to have real experiences and interact with different people, simulating various environments. With the evolution of virtual reality into the Metaverse, we are transitioning into a new dimension.

Augmented Reality AR

Augmented reality (AR) is defined as a more sophisticated version of reality created with the use of technology to overlay digital information onto the image of what is being viewed through a device (such as a smartphone camera) (Merriam-Webster, 2023). Cai, Chiang, and Wang (2013) define augmented reality as an extension of virtual reality in the form of integrating two and three-dimensional virtual data produced by computers with various devices into the environment of users, together with sensing and multimedia techniques through a camera using three-dimensional graphics technology.

Simulations

Simulations offer a learning experience that minimizes environmental risks, provides each student with learning opportunities, provides an equalitarian learning environment, adheres to adult learning principles, and accommodates different learning styles. They also allow students to learn by doing and experiencing, facilitating the development of their psychomotor skills. In addition, they support the acquisition of decision-making, evaluation, teamwork, and management skills through feedback mechanisms. Simulations are stated to offer students opportunities for continuous repetition, leading to increased performance and self-confidence and supporting their motivation. Therefore, simulations can be considered an important learning tool (Baudrillard, 2018, as cited in Özdemir & Gıynaş, 2022).

Apple Vision Pro

At the time of this research, Apple had released its Vision Pro product, pushing the boundaries of virtual reality and Metaverse concepts to a more advanced level. This device, which facilitates the integration of digital content into the physical world, offers users spatial experiences across various domains, thereby easing the integration of the Metaverse into daily life. With Vision Pro, users can perform tasks as if using multiple monitors simultaneously, watch films in a cinema-like atmosphere, play games, and interact with others. In addition, the device provides opportunities for creative activities such as drawing and painting using hand gestures and allows users to explore music applications in various ways.

The functions offered by Vision Pro are categorized into a wide range of fields, including education, entertainment, tool development, daily life assistant applications, music, finance, graphics and design, production, games, and sports. For instance, the Djay application, which enables artists to compose their own music, won the Apple Design Award in 2024 (Apple, 2024). Vision Pro not only transforms the home environment into a studio, allowing users to compose music, but also includes applications that guide users while playing a real piano. These applications provide visual aids that show the correct timing and note positions on the keys, facilitating the performance or learning of a piece. This enables users to play complex musical pieces without the need to turn pages and enhances the learning process.

In this context, the spatial experiences provided by Vision Pro allow users to achieve higher levels of interaction and efficiency in education, creativity, and daily life practices.

Metaverse in Education

When reviewing the studies on Metaverse and education, it is seen that there has been an increase in the number of studies, particularly since 2020. As of March 2022, in industries investing in the Metaverse, the information and computer businesses rank first (17%), followed by educational institutions in second place (12%) (Statista, 2022; as cited in Göçen, 2022). Bakır (2022) suggests that social-mixed reality in the Metaverse and blended active pedagogies can provide more profound and enduring knowledge and, more importantly, become a democratizing factor in education, enabling equal participation on a global scale.

In their study, Tepe, Kaleci, and Tüzün (2016) stated that virtual reality applications are increasingly used in entertainment, tourism, medicine, defense, construction, manufacturing, and education. With these applications, students can go on field trips, experience a sense of presence in the places they visit, and hear the sounds in the environment. It was also stated that medical students could work on virtual cadavers and experience realistic scenarios. It was stated that laboratory experiments which can be costly and dangerous in real life can be carried out more cheaply and safely in virtual environments. In addition, virtual reality can be used in many subjects, such as mathematics, language, history, etc. (p.553).

The positive aspects of conducting education using Metaverse include interactive learning, enjoyable learning experiences, and enhanced motivation. For example, individuals can explore and discover historical periods by embodying avatars within the context and society of that era, enabling them to engage in experiential learning, which is considered one of the most effective learning methods, leading to a more lasting learning experience. Another example is the ability to conduct hardware-based training that can be expensive and prone to damage in the physical world through the Metaverse. By utilizing the Metaverse, individuals can engage in these activities without the hassle of sourcing components and, at the same time, gain unlimited experience. They will have the opportunity to perform these tasks without the need to find parts and benefit from an

unlimited learning experience facilitated by the Metaverse. ODTÜ (Middle East Technical University) established the first virtual campus in Turkey. The study conducted by Siyaev and Jo (2021) stated that practical training using virtual reality could be conveyed more easily to individuals. Some studies demonstrate the effective teaching of technical subjects such as aircraft maintenance in the Metaverse environment. Falah et al. (2014) stated that simulation-like learning environments prepared with Metaverse can enable experiential and higher-level learning rather than lower-level learning. Many higher education institutions worldwide, including Stanford University, have started offering language and medical education in the Metaverse world (Ogles, 2021; Andrews et al., 2019, p. 6, as cited in Kaya, 2023).

Advantages and Disadvantages

We can list the potential advantages of education with Metaverse as follows:

- It can increase motivation.
- It can enable us to experience places and experiences we would not be able to visit or see under normal circumstances.
- Individuals can learn at their own pace with Metaverse.
- Multiple practice opportunities can be provided.
- It can reduce costs.
- It can reduce hazards and risks.
- It requires interaction and active participation, which makes learners more active rather than passive.
- Learners can learn by doing and experiencing.
- It eliminates the concept of distance for collaborating team members. (Tepe, Kaleci & Tüzün, 2016).
- With Metaverse, young people can prevent loneliness in their social lives, enhance social self-efficacy, and develop supportive interactions, fostering social relationships. (Oh et al., 2022; Bakır, 2022).
- It can create new job opportunities.
- It makes learning enjoyable and enduring, engages students actively, and allows for adjusting individual learning paces. (Bayram, 1999, p.52).
- It allows teachers and students to simultaneously meet their learning and teaching needs in the physical and virtual worlds, creating an interactive and immersive learning environment. (Guo & Gao, 2022, p.1; Diaz et al., 2020; Kaya, 2023).
- In the Metaverse, connected with avatars, it is believed that exclusion due to factors such as gender, race, social class, and disability, which can cause discrimination in the physical world, will be reduced. (Duan, Li, Wu & Cai, 2021).
- It eliminates the distances to physical locations that need to be visited for education, thus saving time.
- Damar (2021) has listed the following advantages: providing experiential education, learning environments based on content and scenarios, richness and efficiency, interactive learning opportunities for users, application of acquired knowledge in the field and the opportunity for trial and error, motivation created by working in a real-life scenario, ability to work with various possible scenarios based on digital content, and the advantages of time, space, and budget that it brings.

We can list the potential disadvantages of education with Metaverse as follows:

- It is currently underdeveloped.
- The possibility of causing health problems such as headaches and eye strain due to the size and weight of the equipment during long-term use.
- The high cost of equipment makes it difficult for global adoption currently.
- Equipment users may inadvertently engage in actions that could harm themselves in the physical world if they are not careful.
- Temporary health issues such as nausea and dizziness can occur while using the equipment.
- Using the equipment for long periods is challenging due to factors such as weight.
- It requires high-tech software and hardware and high-speed internet like uninterrupted 5G.
- Poorly developed and low-quality content may not serve its purpose.
- The legal issues present in the current internet and social media platforms still need to be fully clear in the context of the Metaverse.

Research on Metaverse and Education

This section provides an overview of some research conducted on Metaverse and education. Due to the inclusion of findings and various topics related to the study of Metaverse worldwide, specific research studies still need to be addressed under this section.

There is only one single accessible study related to music education. Marlen, Nastiti, Primasari, Wibisono, and Negara (2023) aimed to identify barriers, analyze potentials, and propose solutions regarding Indonesia's Gamelan instruments within the Metaverse. As a result of this study, they stated that Gamelan Metaverse still has limitations in terms of movement and ease of use, and it cannot be effectively utilized as a musical tool. Accordingly, they concluded that usability and mobility factors need to be further developed.

When reviewing the studies conducted in Turkey, it can be seen that the dissertations specifically focused on education in relation to Metaverse are rare; however, in recent years, there has been an increasing number of research articles on this topic. A search using the keyword "Metaverse" in the national thesis center of the Higher Education Council resulted in 17 theses. However, only one of these dissertations is related to education. While numerous dissertations have been written on virtual reality and augmented reality, 11 are related to virtual reality and education, and 3 are related to augmented reality and education. When analyzing Başaran's (2010) dissertation on preservice teachers' views on using virtual reality in education, preservice teachers stated that virtual reality is appealing and encourages teachers to be more active. It was also found that it enables teachers to implement the knowledge into practice, facilitating comprehension and accelerating learning.

Arıcı (2013) conducted a study in which virtual reality technology was utilized in the science and technology lessons to teach astronomy, and it was concluded that the experimental group achieved higher academic success compared to the control group.

In their comprehensive review titled "Metaverse Studies," Güler and Savaş (2022) stated that based on the results of various studies they examined, students were more successful compared

to traditional methods, and it contributed to achieving the goal of permanent learning in education.

Methodology

The method of this study is a literature review. In a literature review, previously published works such as books, articles, theses, conference papers, historical records, and reports related to the research topic are searched, located, and examined, and thereby, information that would contribute to the study is obtained (Karasar, 2009). Köroğlu (2015) defines a literature review not only as examining academic publications but also as exploring innovative fields, gathering information about them, providing information, developing a perspective, and using them to introduce concepts. Using this method, various indexes were reviewed to conduct a literature review by focusing on the concept of the Metaverse, and the current information about the Metaverse was presented, investigating its relationship with education. The current state of using Metaverse in education has been explored, and relevant studies in the field have been examined. These studies focused on the advantages and disadvantages of Metaverse in education and social life. Various evaluations were made through the analysis of these studies, aiming to develop a perspective on using Metaverse in music education.

Findings

Metaverse and Music Education

Over time, the responsibilities of teachers, who have significant roles and responsibilities in societies, have continuously evolved due to the changing society, diverse student profiles, emerging approaches in educational sciences, international developments, and scientific and technological advancements throughout history (Sönmez, 2019, p. 237). In today's rapidly advancing scientific and technological developments, teachers are increasingly required to be involved in adapting to these changes. Computer and various software training are provided to improve the technological infrastructure of teachers trained in modern faculties. Therefore, it can be said that teachers with high technological knowledge and the ability to adapt to changes are required to educate a generation that can quickly adapt to new technologies and constantly keep up with innovations.

There is a limited number of studies on the use of Metaverse in music education, which is increasingly being used in various disciplines in education. When analyzing the few applications that can be used in music education, it is seen that there are applications like Virtuoso, Instrument Studio VR, Volotic, Lyra VR, Jam Session VR, and Percussive VR. These applications allow users to create music using various instruments and loops. However, when examined in detail, it is seen that these applications have some limitations. These software programs use hardware such as goggles and devices that use the movements of the user's hands, specifically the left and right hands. In these applications, which allow using the right and left hands as individual fingers or using a drumstick-like device, it is seen that the hardware capabilities for playing instruments that require the simultaneous use of multiple fingers, such as guitar and piano, are not yet sufficiently developed. The prerequisite for using Metaverse in music education, particularly in practical lessons, would be producing appropriate hardware tools.

Conducting music education through the Metaverse will provide various opportunities in music education. The findings below highlight ways to enhance the usability of Metaverse in music education:

In their study, Demitriadou, Stavroulia, and Lanitis (2020) investigated the impact of mathematics teaching through virtual reality and augmented reality on primary school students. The results indicated that the use of VR and AR technologies resulted in an increase in students' performance. Furthermore, it was determined that student's interest and motivation to learn mathematics also increased as a result. Similarly, music theory topics that involve mathematical elements can also be conducted through Metaverse.

Heo and Kim (2021) conducted a study that successfully provided climbing training using Metaverse and Augmented Reality technology to teach motor skills that require time, effort, experience, and practice. The instructor pre-created climbing techniques, postures, and movements in this training. Students were able to repeat these movements without the presence of an instructor until they mastered them. The study concluded that this climbing training was as effective as traditional face-to-face climbing training. Similarly, instrument education, which also requires time, effort, experience, and practice, can be delivered to students through Metaverse, allowing them to receive training on different instruments.

Virtual music libraries and instrument experiences can be offered on the Metaverse. Students can play virtual versions of different instruments, explore various music genres, and expand their musical experiences. This way, students can gain musical diversity and versatility.

Quintana and Fernandez (2015) conducted a study on developing a model in the virtual world for the pedagogical training of preservice teachers and its impact on teacher education. The study's findings showed positive implications for students through learning systems that enable them to enhance their teaching skills based on collaborative learning experiences. It was observed that virtual environments provided motivating, intellectual, and technological challenges for preservice teachers, and the technical and usability challenges encountered during use were resolved to a degree that strengthened the spaces and working methods (as cited in Güler and Savaş, 2022). The Metaverse can enable music students to come together and form virtual orchestras or groups. In this way, students playing different instruments can come together to learn how to play together and create a harmonious musical performance. The Metaverse can also facilitate students' participation in collaborative music projects by allowing them to join in a virtual environment with friends who play different instruments or sing. They can collaborate and make music together. This way, musical collaboration, teamwork, and communication skills can be developed.

Virtual music studios and recording rooms can be created in the Metaverse. Students can create their own compositions, record them, and edit them. In this environment, they can experiment with different sound effects and virtual versions of instruments to enhance their music production skills.

The Metaverse enables students to organize virtual concerts and performances. They can take the stage through their avatars and

interact with the audience. This allows students to showcase their performance skills and gain stage experience. People from different regions who are unable to meet physically can perform concerts simultaneously as part of the same music group. There is a musician and software developer named Mehmet Ünal in our country who is closely interested in Metaverse and has succeeded. Mehmet Ünal, who met the audience on the same stage despite being in different countries, can be cited as an example.

Instead of using ready-made Metaverses like Second Life, Getchell, Miller, Nicoll, Sweetman, and Allison (2010) developed their own three-dimensional virtual environment for archeology education. In this environment, they conducted teaching by assigning tasks to the users. As a result, it facilitated the easy experience of performing challenging and costly tasks in the field of archaeology for students, promoting collaborative learning. Metaverse can also provides students with the opportunity to experience music history firsthand. Students can rediscover historical music events, famous musicians, and compositions in a virtual environment, enabling them to understand music history through these immersive experiences better.

Metaverse can assist students in enhancing their musical skills in a fun way through musical games and interactive activities. For instance, interactive applications such as rhythm games, note recognition activities, or musical puzzles can contribute to students' sense of rhythm, note identification, and musical understanding. These engaging experiences can help students develop their musical abilities while enjoying the process.

By creating virtual music exhibitions and musicology research on the Metaverse, students can explore and learn about different styles of music, musicians, or musical works. They can make presentations at these virtual exhibitions or research. Thus, students can increase their musical knowledge and have the opportunity to develop their research skills.

Metaverse can also help students develop their music analysis and composition skills. Students can analyze music compositions, examine musical notation, and understand musical structures. Additionally, they can have the opportunity to compose and arrange their own musical pieces within the virtual environment.

Students can examine certain musical topics in depth by creating virtual music workshops on the Metaverse. For example, virtual workshops covering different topics such as songwriting, vocal technique, or instrument mastery can be organized.

Metaverse can also provide students with experience in sound engineering and production. In the virtual environment, students can enhance their skills in sound recording, adding sound effects, and learning microphone techniques. They can also practice song arrangement and mixing skills by understanding the production process and experimenting with virtual devices.

Metaverse can be a platform that encourages musical creativity and improvisation. Students can experiment with different musical tools in the virtual environment, explore different rhythm and melody combinations, and improve their musical expression abilities. This way, it can enable them to uncover their original musical ideas.

Metaverse can combine music with storytelling to offer interactive storytelling experiences. Students can explore a musical story in a virtual environment, interact with music-related characters, and contribute to the story's development. This allows them to make sense of music and develop storytelling skills.

Metaverse can serve as an interactive platform for organizing music events and festivals. Students can host virtual concerts, music festivals, or musical performances. In this way, students not only have the opportunity to experience music on stage but also develop organizational skills.

Metaverse can make music education a more interactive, enjoyable, and student-centered experience. It can enhance students' musical abilities and boost their creativity and self-confidence. Virtual environments provide students with a broader musical experience and creative space. Offering an innovative and interactive approach to music education, Metaverse can enable students to deepen their understanding of music, improve their musical skills, and explore their creativity. However, it is important to balance these applications with real-world music education and support them with teacher guidance. Key elements of music education, such as real-time interaction, teacher guidance, and hands-on practice, should also be considered.

Discussion, Conclusion, and Implications

Discussion

The most important contribution of the Metaverse to education is its ability to enhance permanent learning through experience. While the technology used to be a supplementary tool in teaching, today, it is becoming a phenomenon that gradually covers and starts to change education. When examining studies conducted in education, it is seen that educational activities conducted in virtual worlds increase student motivation, attract their attention, and increase their academic achievements.

Conclusion

Financial resources should be allocated to use Metaverse in schools in the future, technological infrastructure should be provided comprehensively, and well-equipped teachers should be trained in this field. In this regard, the engineers and companies who will design these Metaverses and the teachers who will guide students using these Metaverses have important roles. In particular, teachers should constantly improve themselves and master the subtleties of education and training with Metaverse. The prerequisite for this is to integrate Metaverse-related topics into the curricula of institutions that train teachers. Seeing and limiting the Metaverse as just a means of entertainment as it is today, thinking of it as a three-dimensional video game is to ignore the great potential of a world with unlimited possibilities (Guo & Gao, 2022).

Implications

When examining Metaverse's positive and negative aspects, the positive aspects outweigh the negative ones. Instead of focusing on its potential drawbacks, it is necessary to focus on eliminating the negatives and making the most of its positive aspects. In addition to integrating Metaverse into the curricula of faculties as a necessity for the future, Metaverse training can be given to current teachers already practicing their profession through in-service training. This way, our teachers can become competent guides in Metaverse and positively use technology. Soylu (2019) stated that one of the first shortcomings felt in the

education world regarding Metaverse in Turkey is insufficient software with Turkish language support. By addressing such shortcomings and having a young and dynamic population capable of creating their own Metaverse software, the Republic of Turkey should stay caught up in this field and open its doors to this world, which will provide positive effects in terms of time and cost.

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