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Web 3.0 and the Metaverse: Transformative Impacts on Education

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Abstract
This study aims to explore Web 3.0 technology, a transformative internet evolution that has just begun impacting our lives and is expected to play a pivotal role in shaping the future, alongside the Metaverse and its potential applications in education. Through insights gathered from five field experts via semi-structured interviews, this study also aims to clarify how these advancements might influence educational practices. For this purpose, semi-structured interviews were conducted with five experts in the relevant fields using a validated and reliable interview form. In this phenomenological study, data obtained from participants were analyzed using descriptive analysis techniques. The analysis identified the main themes of "Transformation to Web 3.0," "The Metaverse World," "Education in the Metaverse Environment," and "Requirements for Education through the Metaverse," each with several important sub-themes. The findings suggest that the transition from Web 1.0 to Web 2.0 brought about significant changes, and even greater transformations are expected in the transition from Web 2.0 to Web 3.0. Web 3.0, also known as the Semantic Web, is expected to create a digital environment where web technologies become more secure, decentralized, and integrated within immersive virtual worlds. Findings also indicate that while current virtual learning environments offer experiences similar to those in the Metaverse, the widespread adoption of Web 3.0 is expected to bring a vastly different and more immersive experience. Additionally, the implementation of Web 3.0 and Metaverse will likely require robust technical knowledge, infrastructure, user training, and high-speed internet connectivity.

Keywords: Web 3.0, Metaverse, Education, Virtual reality, Technology, Phenomenological research

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Introduction

The concept of the "Metaverse," which has attracted increasing attention in recent years, gained even more prominence following Mark Zuckerberg's announcement of Facebook's rebranding to Meta. According to Lee et al. (2021), the Metaverse—originating from the words "meta" (beyond) and "universe" —is characterized as a "digital big bang," representing a virtual universe where users engage and interact via avatars. The Metaverse encompasses various sectors integral to daily life, such as finance, business, art, law, fashion, social networking, shopping, gaming, and entertainment, attracting significant interest and progressing rapidly through both individual and collective contributions. Its decentralized structure allows for the development of distinct experiences tailored to each sector's foundational principles and operational frameworks, further enhancing its unique and adaptive nature (Yılmaz & Ceranoğlu, 2022).

The transfer of numerous daily activities from the physical world to the virtual universe suggests that the Metaverse will significantly find its place in individuals' real lives. For instance, in the Second Life Metaverse, permanent digital museums and art galleries have been established within the context of cultural activities (Tasa, 2009). In the Decentraland Metaverse, users have been able to purchase NFTs (Non-Fungible Tokens) and participate in experiences similar to real-world festivals (Decentraland, 2022). Furthermore, brands such as Channel, Louis Vuitton, Nike, Adidas, and Gucci have launched digital products like NFT clothing and shoes for Metaverse avatars (Thompson, 2021). Additionally, the capital of South Korea, Seoul, has begun developing content to establish "Metaverse Seoul," a pioneering virtual city worldwide, offering various opportunities such as festivals, historical and tourist excursions, and public services (Gaubert, 2021). These developments within the Metaverse have also led to the emergence of new professions, such as virtual real estate specialists, risk management experts, blockchain developers, digital detectives, and cybersecurity specialists, while also prompting revisions in the job descriptions of some existing professions (Sözcü, 2022). To better understand the structure of the Metaverse, it is essential to examine the concept of Web 3.0, which forms its foundation.

Web 3.0 (Semantic Web)

The internet, initially developed in the 1950s for the purpose of military communication during potential wartime, has evolved through various developmental phases to arrive at its current Web 3.0 version. During the era of Web 1.0, known as the introductory phase of the internet, users could not interact with websites; information was merely distributed from a server computer to numerous client computers. With the advent of Web 2.0, it became possible for users to interact with each other as well as with websites. Platforms such as Facebook, Twitter, YouTube, and Blogger enabled users to share their information and thoughts and engage with other users without requiring any programming skills.

Thus, Web 2.0 marked a significant advancement in the evolution of the internet by allowing users to manipulate content on server computers and share it through those servers, distinguishing it from Web 1.0. Subsequently, as societal needs changed, Web 2.0 made way for the emergence of Web 3.0 (Bektaş, 2012; Yalın, 2001). The following table presents the differences between Web 1.0, Web 2.0, and Web 3.0, as given in Grayscale Research's 2021 report on Metaverse Web 3.0 Virtual Cloud Economies:

Table 1. Comparative analysis of Web (Grayscale Research, 2021)

	Web 1.0	**Web 2.0**	**Web 3.0**
Interaction	Read	Read– Write	Read-Write-Own
Medium	Static text	Interactive Content	Virtual Economies
Organization	Companies	Platforms	Networks
Infrastructure	Personal Computers	Cloud & Mobile	Block Chain Cloud
Control	Decentralized	Centralized	Decentralized

However, with Web 3.0, which was created with the completion of the development of Web 2.0 and carries some of the effects of Web 1.0, and is a decentralized technology that is not permanently connected to a certain center, it is possible to automatically find and process data in accordance with the standards determined within the data pool in question. The ongoing evolution of the internet positions it as a significant data reservoir that delivers information and documents to users. However, due to its centralized structure, which is not aligned with the current era, it is designed as a closed system, limiting its data acquisition to specific and fixed sources. However, with the completion of Web 2.0 development, Web 3.0 has emerged as a decentralized technology that retains some influences from Web 1.0. This new iteration enables the automatic discovery and processing of data according to established standards within the data reservoir. The initial manifestations of this transformation can be observed in social media platforms, advertising, and the creation of dynamic web pages (Bektaş, 2012).

The semantic web enables inference and interpretation of information found on websites. This type of web facilitates the development of software systems known as intelligent agents (Bektaş, 2012; Yiğit et al., 2000). This

facilitates the creation of ontologies, an abstract model frequently used in education, to present knowledge within a semantic structure (Antoniou & Van Harmelen, 2008; Choe, 2006).
The aim of Web 3.0 technology is to structure content on websites so that it can be easily understood and processed not only by people but also by computers. When considered from an educational perspective, Web 3.0 provides all the tools necessary for remote learning systems, including the design phase. Additionally, Web 3.0 shapes remote learning systems by enabling customization of teaching based on user needs and preferences, allowing for learning content to be reused across various e-learning platforms, creating universal content resources, and ensuring standardization. In other words, Web 3.0 in education focuses on interoperability, shareability, and reusability. Thus, remote learning systems built on this foundation will be able to provide educators and learners with more flexible and effective content, thereby accelerating, simplifying, and personalizing the educational experience (Aroyo & Dicheva, 2004; Lassila et al., 2001; Priya et al., 2012). Another concept closely related to Web 3.0 and its impacts on education is the Metaverse, which is grounded in Web 3.0 technology and is explored in this study for its educational applications.

Metaverse

The concept of the Metaverse, which has recently gained significant attention as leading technology companies describe it as the future of the internet, was first introduced by author Neal Stephenson in his 1992 novel Snow Crash. In this novel, the Metaverse is defined as a three-dimensional virtual world where people interact with each other and their surroundings, unrestricted by the physical boundaries of the real world (Lee et al., 2021). Then following CitySpace, the first Metaverse, which was active between 1993 and 1996, numerous other Metaverses emerged. One of the most popular of them is Second Life developed in 2003. Second Life provided users with a second world where they could create and customize their own avatars according to their preferences. In this virtual world, many universities, cities, artists, and individuals established virtual entities, enabling various interactions such as socializing, purchasing real estate, designing, and even receiving university education. Remarkably, Second Life even developed its own economy with the Linden Dollar currency (Narin, 2021).
Today, the concept of the Metaverse has gained even more prominence following Mark Zuckerberg's announcement that Facebook would rebrand as Meta. Google Trends reports from October 2021 show a significant increase in searches related to the Metaverse on both Google's search engine and YouTube. Similarly, although the number of academic publications on the topic has fluctuated over the years, there has been a noticeable rise in recent years in publications focused on the Metaverse (Narin, 2021).
Lee et al. (2021) define the Metaverse as a three-dimensional virtual universe and refer to the period from 2011 to 2017, marked by the presence of smartphones and smart wearable technologies in virtual worlds, as the era of immersive virtual environments in smartphones and wearable devices. During this period, augmented reality and virtual reality technologies such as Pokémon Go, VR Chat, and Super Mario AR emerged, drawing attention to the technologies related to the Metaverse.
In recent years, the concept of bitcoin, which has been frequently encountered particularly due to financial developments, is also related to the blockchain concept that can be examined under the elements of the Metaverse. Blockchain is a database that enables secure and consistent transactions made by numerous participants in a decentralized network (Beck, 2018). In other words, each transaction conducted in this database is recorded and shared by other participants in the network, creating a decentralized, distributed data structure (Tanrıverdi et al., 2019). The first currency of this structure was named Bitcoin. Another concept often encountered that is related to blockchain and cloud systems in the Metaverse is NFT. An NFT is a unique digital asset that can be bought and sold but cannot be replicated.
Lee et al. (2021), describing the period from 2017 onwards as the new era of the Metaverse, have articulated the Metaverse based on ecosystem and technological elements as follows:

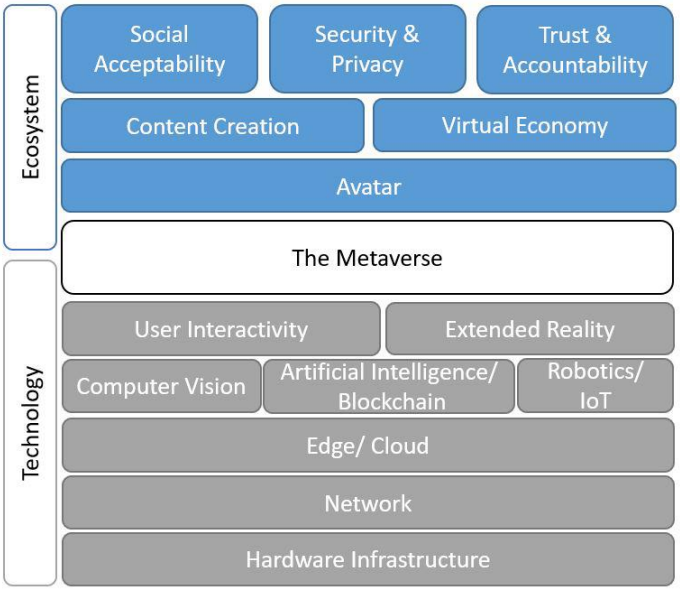


Figure 1. Metaverse ecosystem and technology elements (Lee et al., 2021)

As indicated in the Figure 1, the important technologies for the Metaverse are user interaction, extended reality technology (a concept that includes the concepts of Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR)), computer vision, artificial intelligence/blockchain, robotics/Internet of things, edge/cloud computing, computer networks and hardware infrastructure. The elements of the Metaverse ecosystem are stated as social acceptability, security and privacy, trust and accountability, content creation, virtual economy and avatar.

Education and Metaverse

Metaverse has emerged as a significant factor not only in finance, gaming, and social networking but also in the education sector. In addition to the augmented reality and virtual reality technologies that are currently being widely used in education, it is now possible to create a virtual education system, or a metaversal education, that incorporates various next-generation technologies such as artificial intelligence, blockchain technology, and 5G/6G internet speeds (Akpınar & Akyıldız, 2022; Damar, 2021). Various applications of this concept already exist today. In the Metaverse environment, rich and effective learning experiences based on experiential learning, course content, and scenarios, allowing for user interaction, simulation, and trial-and-error method. By conducting education in the Metaverse, it becomes possible to build learning environments in the digital world instead of the physical one, which can enhance learners' motivation through real experiences. Metaverse environments offer a wealth of reusable and customizable content. These environments can save time, space, and budget in education (Damar, 2021). Moreover, the accessibility, diversity, and equity provided by metaversal education, along with its more humane characteristics, can lead to many positive pedagogical outcomes (Duan et al., 2021).

Considering that informatics and game-based simulator applications are suitable, enjoyable, and motivating for 21st-century students, referred to as Generation Z or digital citizens (Tokel & Topu, 2017; Gennett, 2010), well-structured theoretical and pedagogical foundations of metaversal education can transfer Generation Z students into the learning environments of the Digital Age (Ünlü, 2019). In this context, metaversal education, which combines play and education, can create a new pedagogical field, potentially reducing the tension between school, family, and social media, making school more engaging for Generation Z (Akpınar & Akyıldız, 2022).

Kye et al. (2021) stated that education can be provided by overcoming spatial and physical boundaries through mirror worlds (Choi & Kim, 2017) where the real world can be reproduced when the subjects are suitable, and that learning and education processes can be improved with life diary records where learning-related data can be collected from online learning tools, provided that the security of personal data is ensured. With 3D virtual games, learners can develop strategic thinking, comprehensive thinking and problem-solving skills and acquire the skills needed for the physical world. In education carried out in the Metaverse environment with technologies such as augmented reality, avatar, mirror world, etc., active and effective learning can be achieved by supporting learning processes in a holistic way visually, auditorily and kinesthetically (Göçen, 2022; Lee & Hwang, 2022). Educational trips, life and industry practices in metaversal educational environments also offer students a rich life experience (Hazneci, 2019). The most important feature that distinguishes metaversal education from educational processes where other three-dimensional virtual environments or augmented reality etc. technologies are used is that it allows students to create a virtual community where they can socially interact with each other (Lee, 2021).

Metaversal educational environments can meet the teaching and learning needs of teachers and students in both the physical and virtual worlds at the same time and provide immersive and interactive learning that also supports individual learning (Guo & Gao, 2022; Kye et al., 2021). In metaversal educational environments where the teacher is the learning environment manager (Akpınar & Akyıldız, 2022), students will not only be in the role of an observer but also an active participant in the process through the avatar that can be used. Additionally, for the first time in education, students will have the opportunity for significant individualization, as they can freely choose their physical characteristics such as eye color, hair color, body image, and the clothes they wear (Salmon & Edirisingha, 2010). In metaversal education, activities are reusable and editable, and the student can reproduce the activity (Akpınar & Akyıldız, 2022; Damar, 2021). The student can take responsibility in the personal learning process, supporting his/her self-efficacy and self-learning. Therefore, since the senses of vision, hearing and touch are included in the educational processes, metaversal education turns into a "human-centered informatics application" (Duan et al., 2021).

It is believed that the Metaverse environment, which enables the creation of realistic learning environments, will greatly contribute to education. However, for education to be successful within this framework, collaboration between qualified education specialists and engineers is essential (Göçen, 2022). The gaps and uncertainties in the theoretical, psychological, pedagogical, and sociological foundations of metaversal education, as well as ethical issues such as copyright for the digital course content to be created, can hinder success (Akpınar & Akyıldız, 2022). Additionally, practical challenges that may be categorized as implementation issues, such as technical requirements, access to information, internet connectivity, differences between collaboration in real and virtual environments, and the extra workload placed on teachers, should not be overlooked (Koçak et al., 2018; Papapanagiotou & Devetsikiotis, 2008).

The Metaverse has also brought along some negative characteristics. Individuals representing themselves with avatars in the virtual world can choose to display "a character they wish to be" rather than their "true self." The virtual identity provided by the Metaverse can lead to "disembodiment" (Erkılıç & Dönmez, 2020) in students, causing them to distance themselves from their "real identity" (Göker, 2017) or perceive their identity differently. The interaction of "space without distance" (Göker, 2017) and uninterrupted time in the Metaverse can result in the erosion of perceptions, feelings, and meanings associated with the sense of presence provided by the interaction between space and people, leading to illusory consciousness (Akpınar & Akyıldız, 2022). These situations, along with the potential for the Metaverse virtual environment to foster a contactless society (Göker, 2017), the possibility of creating an unlawful environment due to its decentralized structure, and the risk of personal data becoming exposed (Kye et al., 2021), can pose problems for metaversal education on both theoretical and practical levels. The implications of these issues can be concerning from philosophical, pedagogical, psychological, and sociological perspectives.

The Aim and the Significance of the Study

The Metaverse is a developing technology with undefined boundaries and applications. While this technology is being utilized in various sectors, its integration into education has also begun. Academically, the Metaverse has been researched most extensively in the field of education, following computer science and engineering (Narin, 2021). When these studies are examined, it is generally seen that either a Metaverse educational environment has been created or existing Metaverses have been analyzed in terms of certain variables. However, as Duan et al. (2021) pointed out, the studies conducted in the academic field regarding the Metaverse are limited. To effectively benefit from the Metaverse, which is gaining more attention daily and showing different applications in education, and to avoid falling behind as a developing country like Türkiye, more research is needed, as noted by Damar et al. (2018).

Unlike the review studies conducted in Türkiye, this study seeks the opinions of experts in the field of Web 3.0 and the Metaverse on how to effectively benefit from the Metaverse in education. The aim of this study is to examine the views of academicians and educators who are experts in Web 3.0 and the Metaverse, as well as the reflections of the Metaverse in education. This study is significant as it serves as a guide for the practical use of the Metaverse in education by addressing how the results obtained can be evaluated from various perspectives and with the opinions of different field experts.

Method

Research Design

The research is designed using a phenomenological approach. In phenomenological studies, due to the nature of this design, the focus is on subjects and phenomena that are known to exist but about which there is no in-depth

knowledge. Qualitative research aims to examine the experiences of individuals who have expertise in specific subjects while avoiding generalizations and the pursuit of absolute truth. In this context, phenomenology is widely preferred in qualitative research. Through this design, researchers strive to obtain detailed information by deeply investigating phenomena related to topics that have not been fully clarified or explored (Creswell, 2015). Web 3.0 and Metaverse are concepts that have not yet been fully utilized, clearly defined, and are newly entering our lives. This research aims to uncover the phenomena and concepts related to Web 3.0, the Metaverse, and the potential reflections of the Metaverse on education. It is assumed that the identified field experts are sufficient in number and quality to reveal these phenomena.

Study Group

In phenomenological studies, individuals who know, recognize, live the phenomena, and can convey this knowledge and experience are selected as data sources. In the application process of this design, the data source is people (Çapar & Ceylan 2022). In the study, educators who conduct studies and research on Web 3.0 and Metaverse were preferred as participants. While selecting the participants, scientific studies in the literature were examined and researchers working in this field were reached by e-mail and invited to participate by mentioning the research. 2 participants were selected in this way. The other 3 participants are researchers known for their research and experience on Web 3.0 and Metaverse in the close circle of the authors. These participants were also reached verbally and invited to the study. The study was limited to 5 participants whose demographic characteristics are given in the table below. The participants were coded and described with the abbreviations P1, P2,… throughout the study.

Table 3. Demographic characteristics of the participants

Participant	Title	Position	Field
P1	Assoc. Prof.	Faculty Member	Geomatics
P2	Assoc. Prof.	Faculty Member	Computer and Instructional Technologies Education
P3	Asst. Prof. Dr.	Faculty Member	Computer and Instructional Technologies Education
P4	Dr.	Faculty Member	Computer and Instructional Technologies Education
P5	Expert	Teacher	Information Technologies

Data Collection and Data Collection Tool

The data were collected using a semi-structured interview form, which is a qualitative data collection method. In the data collection tool, interview questions were prepared in advance, and interviews were conducted with participants based on these questions. The data were obtained through one-on-one online video conferencing using the Zoom software. The online interviews lasted between 40 and 65 minutes. During the interview, the researcher recorded important statements of the participants by taking written notes. The researcher utilized these notes both to identify subsequent questions and to obtain qualitative data. Based on the course of the interview, follow-up questions were used to gather more detailed information from the interviewees. In this research, the aim was to clarify the research problem by utilizing the experiences of the participants, and in-depth textual data were sought from a small number of participants.

The primary data collection tool in phenomenological research is interview forms. In interviews, deeper information can be obtained to identify phenomena (Baker et al., 1992). Since phenomenological research aims to deeply understand the knowledge and experiences of people with life experiences related to the topic and to uncover phenomena (Morse & Field, 2013), the interview form was considered an appropriate data collection tool. Before preparing the interview questions, a literature review was conducted on the topics of Web 3.0 and the Metaverse, and studies related to these subjects were examined. This provided a foundation for the preparation of the interview questions. Initially, 12 questions were designed for the interview phase. Three faculty members with expertise in the field of information technologies and active in a public university were considered as subject experts. The draft interview questions were sent to these three faculty members for expert feedback. They were asked to review the questions based on the criteria of "clarity and comprehensibility," "relevance and adequacy for the purpose of the research," "removal of any unnecessary questions," and "whether there were additional questions to be included." Based on the feedback received from the experts, four questions were removed—two because they were roughly similar in meaning to other questions, and two because they were deemed outside the scope of the research. Additionally, adjustments were made to four questions. After being revised according to the expert opinions, the interview form was finalized to consist of eight questions. The interview form was then reviewed one last time by the researchers to assess its suitability for the interview. While creating the interview form, it started with questions about the basic structure of Web 3.0, continued with questions about the Metaverse and was completed with questions about the use of the Metaverse in education, thus trying to create a hierarchical and logical structure.

Data Analysis

In qualitative data analysis, the researcher seeks to discover and reveal the hidden information within the qualitative data obtained (Özdemir, 2010) and to derive meanings from the raw data (Corbin & Strauss, 2015). The data obtained from the interviews were read in detail to select significant and meaningful expressions, and the selected expressions were evaluated as data sources for direct quotations in their original form. In phenomenological studies, direct quotations are often used to obtain in-depth information (Baker et al., 1992).

Miles and Huberman (1984) propose a hierarchical classification consisting of stages for analyzing qualitative data, which includes data reduction, data visualization, and drawing conclusions. Accordingly, the following processes have been carried out:

Data Reduction: Raw qualitative data were read in detail, and texts that were not relevant to the topic were not considered for evaluation and were excluded from the research.

Data Visualization: After unnecessary elements within the qualitative data were filtered out, analyses were conducted on the remaining texts, leading to the creation of visualizations such as tables, word clouds, word networks, and AI-assisted original content visuals related to themes and sub-themes. This approach ensures that the visualized information captures readers' attention more than textual information. The memorability of visuals is higher than that of texts, enhancing their educational value.

Drawing Conclusions: Following the analysis of qualitative data, the discovered information was revealed and presented in a meaningful way.

Interviews conducted with participants via Zoom were recorded with the consent of each participant, resulting in separate video files for each individual. During the data analysis phase, the audio from these videos was transcribed by both researchers into text documents. The textual expressions in the Word document were analyzed using content analysis techniques. In this context, all documents were read individually, and meaningful codes were compiled to reach categories. Themes and sub-themes were then developed using these categories. Frequencies related to each sub-theme were tabulated. Since the themes were not predetermined in this research, the content analysis technique was preferred. Silverman (2006) defines content analysis as the most used technique in qualitative data analysis.

Ethical Approval (only for necessary papers)

Ethical permission (5/12/2024 – 12/09) was obtained from Hatay Mustafa Kemal University Ethics Committee for this research.

Findings

In direct quotes, participants' opinions are expressed using codes such as "P1, P2, P3, P4, P5." After analyzing the qualitative data obtained from the participants, the themes of "*Transformation to Web 3.0," "The Metaverse World," "Education in the Metaverse Environment,"* and *"Requirements for Education through the Metaverse,"*, along with their corresponding sub-themes, were identified. The frequencies for each sub-theme are presented in Table 4

Table 4. Themes and subthemes obtained from the interviews

Themes	f
Transformation to Web 3.0	
Web 3.0 is still a very new, incomplete web technology.	3
There is an extraordinary change with Web 3.0.	5
The concept of decentralization is dominant in Web 3.0.	3
There is a semantic structure in Web 3.0.	2
The web transformation is based on blockchain and distributed ledger technology.	3
This transformation involves a large amount of data.	4
The Internet of Things is related to Web 3.0.	2
Virtual worlds are also a type of Web 3.0 tool.	2
Online shopping holds an important place in Web 3.0.	3
Web 3.0 applications have started to be partially used.	4
Artificial intelligence and/or deep learning applications are being used within the scope of Web 3.0	3
The Metaverse World	
Environments similar to the Metaverse were used in the past.	4

There are many scientific concepts related to the Metaverse.	3
The Metaverse environment will require significant costs.	3
Significant innovations have been achieved with the Metaverse.	4
Education in the Metaverse Environment	
Digital environments like the Metaverse increase students' intrinsic motivation.	3
Many of the applications in education in the Metaverse have their counterparts.	3
The Metaverse has significant effects on education.	5
Students feel more comfortable while learning in the Metaverse environment.	
No technology ensures learning directly.	2
Extraordinary education is possible in the Metaverse environment.	3
Requirements for Education through the Metaverse	
There will be important requirements for education in the Metaverse environment.	4
Technical knowledge is required to conduct education in these environments.	4
Prior training is necessary for education in the Metaverse environment.	2
Very high-speed internet connections are needed.	2

Participant Opinions on the Theme of *"Transformation to Web 3.0"*

Participants generally focused on the transition from Web 2.0 to Web 3.0 regarding this theme. They expressed their opinions on how Web 3.0 evolved and the innovations that came with Web 3.0. Participants used the definition of third-generation internet services used in the infrastructure of applications and sites for Web 3.0. They interpreted the fundamental difference between Web 2.0 and Web 3.0 as the presence of more personalized content for users with artificial intelligence and machine learning in Web 3.0. Participants made the following comments about the theme:

P5: *"Web 3.0 is developing very fast, but I think Web 3.0 has not been fully discovered yet. Maybe teachers can learn the features of these tools in 5-10 years. People have a certain amount of knowledge because of Web 2.0. When people need Web 3.0 tools, they will learn how to use them. There are individuals in society who are interested in technology, follow technology, and learn and improve themselves in advance. However, these are a small segment of society."*

P3: *"In Web 3.0, there is a wallet consisting of 16 digits. Everything happens through this. Thanks to Blockchain technology, for example, a person will buy a car using credit. He/she does not need to go to the bank for this. He/she does not need to go to a notary for purchase and sale. The necessary information is recorded, and no one can delete this record. This is why people care about Blockchain technology. For example, normally a person with power and authority can issue a fake diploma, but this is not possible with the distributed ledger structure. The distributed structure provides immutability. When someone tries to commit fraud, the distributed structure prevents this."*

P5: "*People worldwide are aiming to earn large amounts of money through projects focused on decentralized finance based on Web 3.0."*

P1: "*I personally prefer defining Web 3.0 more through Semantic Web and Ontological Web technology. The inclusion of blockchain doesn't really change this definition. I view blockchain as a different computing technology. What did we use before blockchain technology? We used Cloud Computing technology. The issue with Cloud Computing was its centralized approach. Now, I see this as an evolution of that centralized approach in Cloud Computing into a distributed structure. In essence, I view it as a change in computing architecture. I classify the blockchain base separately and see it as an evolution from the Client-Server Architecture of Cloud Computing to a Peer-to-Peer structure."*

P4: *"Thanks to Web 3.0, a user, for instance, can sell a video or documentary they created on YouTube to someone on the other side of the world using NFT technology."*

P3: *"Web 3.0 will bring significant contributions. It is already evident that some of its features have started to be used to some extent."*

P4: *"Open-source code runs in the background of Web 3.0. There is no central structure; instead, data transfer occurs from person to person. For instance, in a Web 2.0 application like Facebook, all user data is stored centrally. If Facebook were to shut down, everything would be lost because all the data is under Facebook's control. However, in systems operating on Web 3.0, there isn't just one main server—you are the server. Moreover, there are millions of servers like you. It's the same with NFTs. An NFT generates a unique code for your digital asset, a code that is specific to that item. Without that code, it can't be sold elsewhere. I believe it's an ethical and fairer environment. Right now, I don't think a complete Metaverse exists globally. When you look worldwide, you see many Metaverses..."*

P3: *"Although the internet has been referenced by names like Web 1.0 and Web 2.0, these distinctions aren't very clear-cut, but Web 3.0 should be considered separately."*

P5: *"When you make a transaction with a credit card, your personal information goes to the other party, but in Blockchain and Public Key Cryptography, neither the sender nor the recipient can see each other's information during transfers."*
P5: *"In terms of Web 3.0's use in education, we teach programming in schools. Building on that, we will move on to teaching software development in areas like programmable money, smart contracts, and autonomous systems."*
P4: *"We call Web 3.0 a semantic structure, a meaningful structure. This structure eliminates centralization, and with Blockchain, there won't be a need for a central authority."*
P2: *"The increasing load of information required a web concept that could process it. As this has surpassed what can be done with human power alone, Web 3.0 was developed based on the logic of machines communicating with each other. When we look at the purpose of Web 3.0, it's fundamentally about allowing computers and the applications running on them to communicate, use each other's data, and understand each other. This is the core logic behind Web 3.0 and thus the Semantic Web."*
P1: "*The Big Data project is still ongoing and continues to grow. However, it's not enough to just establish a common language that these machines can use to communicate. In the logic of the Semantic Web, yes, machines will use a common language to understand each other, but they will also interpret that language. For example, when we speak Turkish, we both understand the structure and nuances of the language, so we create meaning in our minds based on the meanings we assign to words. The main expectation with the Semantic Web is that machines can also perform this kind of information structuring. Technologically, this is called inference—machines need to not only receive information but also make deductions from it. At present, it seems as though the Semantic Web stage has been completed."*
P2: *"We can observe machine-to-machine communication in our household devices as well. For example, you can connect to your smart TV from your phone or control your cleaning robot. The basic connection and the shared language among these machines have already been resolved."*
P3: *"The Semantic Web is currently in the transition phase following Web 2.0. While searching for answers to questions like how machines should be represented, how a common communication language can be established, and how to include machines in this process, a concept called Ontology emerged, and all Web languages were created based on ontologies. Ontology is actually a topic that linguists have worked on. It is a structuring schema used to make sense of knowledge. This is difficult to implement in any field, but it is especially challenging in the field of education. This is because there are at least 8-10 factors that make up a learning environment. Among these 8-10 factors, when we look at the 3 main factors, we see the teacher, the student, and instructional tools and materials, in other words, the teaching materials and content."*
P5: *"There are currently decentralized finance, distributed structure, and blockchain-based projects related to Web 3.0. If Web 3.0 is mentioned, the basis of this work is the blockchain structure and the distributed ledger structure. I consider the distributed ledger structure as the democratization of money and computing power and its transfer to the public. For example, while companies such as Facebook and Google host their own servers, UBER is in the taxi sector despite not having its own taxis. Drivers use their own taxis but they use them in connection with UBER. With Web 3.0, information storage, processor power, and especially the processing power of video cards in the blockchain are being used a lot. With Web 3.0, a company will do the computing and IP part of the project itself without having any servers or even a building. As far as I can see, when people call Web 3.0 the semantic web, the issue of trust and money comes into play. This is understood as the completely transparent, auditable, and retroactively unchangeable structure of the blockchain due to its structure."*
P4: *"With Web 3.0, data mining emerges here. When we look at the systems that form the semantic structure, data mining and learning analytics are working in the background."*
P2: "Since Web 2.0 was developed with the purpose of content creation and the concept that every user connected to the Web can contribute to the content, the amount of data and information on the Web increased significantly along with social network applications. This rapid increase in the amount of information has led to a vast expansion of the data sets that could previously be scanned or interpreted using simple HTML tags or by extracting data based on the structure of HTML tags."
P4: *"The structure we refer to as the Internet of Things today enables billions of pieces of information to interact and connect with each other. This data exchange among objects operates within a certain systematic framework. Communication between objects forms a pattern, and it is learning analytics that detects this pattern and transforms it into behavior. On the other hand, intelligent systems are in operation—namely, artificial intelligence. Intelligent learning systems are at work. All of these are associated with Web 3.0."*
P2: *"What Web 3.0 has aimed to achieve is to establish a common language structure that allows machines to understand each other. When we look at current applications, we can see that machines are indeed able to communicate, understand each other, and retrieve data from one another by using these languages. You can also see this in social network applications. For instance, you can connect to Facebook with your Google account—though they are separate applications and platforms, even if they operate under different companies, you can still*

connect to another social network platform. However, a complete information structure has yet to be established. Can we say that all information on the Web has been converted into a format that machines can understand? No, we cannot say that yet."

P1: *"Another concept related to Web 3.0 is the virtual world. Within virtual worlds, we have virtual reality, augmented reality, mixed reality, and beyond that, X reality, or extended reality. Above all these lies the Metaverse. All of these are interconnected. There are blockchain systems, such as Bitcoin and Ethereum, that control the financial dimension of this. Additionally, NFT technologies are in place to manage the ethical issues within these systems. All of these concepts I mentioned are systems associated with Web 3.0."*

P2: *"In Web 2.0 or earlier systems, which were centralized, if you were an artist who created a painting, the best way to sell it would be to go to a centralized system—a fair or an exhibition—and display it there to sell it, right? That's how you would earn money. Web 3.0 has introduced the concept of decentralization into our lives. What does this mean? The same artist can also sell the digital version of their work. Web 3.0 enables a creator to sell their work in a physical setting as well as its digital version. NFT technologies are essential for securely selling these works and materials in digital environments. When you sell a product, the NFT provides you with a code, ensuring the buyer knows they uniquely own that product. Digital currency, not physical money, underpins NFT technologies."*

P4: *"The language of the Web is JavaScript, and JavaScript continues to be used in Web 3.0 as well, because there is a library developed specifically for Web 3.0. From what I've seen, React Native is the most widely used framework, which is JavaScript-based. For smart contracts, the Solidity programming language is used, particularly for writing smart contracts on the Ethereum network. If you're planning to become a blockchain developer, you might want to learn Go and Rust programming languages. Without writing any code, it's also possible to develop applications like Web 2.0 tools. Content creators don't necessarily need to learn the coding languages I mentioned, but those working within this infrastructure should learn these languages and coding skills."*

P5: *"There is a space station application. When you open this application and put on the Oculus headset, it feels like you are actually on the space station, moving around and being assigned the routine tasks an astronaut would need to perform daily, which you then complete. There is also an element of gamification involved here. The Metaverse can be described as a step beyond what we know as simulation. In the example I gave, we see that the likelihood of someone becoming an astronaut and going into space during their lifetime is extremely low, perhaps even impossible. An astronaut undergoes months or even years of training, completing various tasks on Earth, and if their health is suitable, they can eventually go to the space station. The Metaverse allows us to have this experience easily and economically, without the need for any of that."*

P4: *"I bought a virtual reality headset. It provides amazing experiences across various topics. Using the device, I went on virtual tours to different parts of the world. You really feel as if you're in that location. When you fall from a height in the virtual environment, it feels real, and you get scared. After using these devices for a certain period, side effects like dizziness and headaches can occur. As far as I know, Apple is seriously working on these devices. Google also made an attempt. Over time, I think they will eliminate the negative effects of these devices. In the coming years, I believe lighter, more practical, and side-effect-free devices that can be worn like glasses will be produced."*

P2: *"Research continues on objects truly understanding each other, interpreting information, and making inferences, which leads us to a technology known as Deep Learning. How is that information processed? Deep Learning extracts the most meaningful insights from the information, regardless of which application the user is using. Many algorithms and models are being developed for this, but standardization has not yet been achieved."*

P3: *"Facebook is working on its own Deep Learning algorithms, Google is developing its own, and Apple is focusing on Deep Learning algorithms for applications like Siri. Why are they doing this? Because if they can extract meaning from the data, the Web could become an incredibly powerful force. A software, machine, or application that can interpret this information can be used positively or negatively, depending on the intention."*

Participant Opinions on the Theme of "Metaverse world"

Participants expressed that traditional education encourages students to describe, think about, and conceptualize information, whereas the Metaverse allows students to experience the information and immerse themselves in the learning environment. Most of the interviewed participants focused on gamification and emphasized its importance. The opinions of the participants on this theme are as follows:

P3: *"There will inevitably be a lot of artificial intelligence working within Metaverse systems. In such complex structures, data processing is very intricate, and implementing security measures is challenging. Therefore, data security is crucial in the Metaverse, as there will be a massive flow of data. It will be challenging to monitor, control, and secure such a vast amount of data, especially in the initial stages of Metaverse usage, where data security issues might arise."*

P1: *"In our era, data science is now the profession of the future. Those who work in this field will try to identify meaningful patterns from a person's data coming from millions of different sources. This includes data mining, systems that enable responses based on incoming data, and the Internet of Things that allows different objects to communicate. All of these are new professions based on Web 3.0 systems. Training must be provided to prepare people to manage these tasks."*
P5: *"Currently, we can only transmit our voice and image, but in the Metaverse, we will be able to send our avatars, our three-dimensional representations. This means that I will appear in a different place as my 3D self, even though I am physically here. Tools like Oculus Quest, HP, and HTC Vive enable this experience. For example, we are currently in a 2D environment using Zoom for virtual meetings, but on the other hand, we'll be able to interact in a 3D environment. An example application allows several people to sit and chat together in the same virtual environment."*
P3: *"I can define the Metaverse as a project aiming to achieve a global level of 3D simulation like Second Life, where objects and scenarios are animated realistically in a shared space."*
P2: *"I can't say for sure how successful the Metaverse will be or how far it will advance, but I expect it to attract a significant number of users. If this weren't the case, a company wouldn't have changed its name to Meta. I don't think the considerable investments and focus on the Metaverse would happen without feasibility studies. My expectations aren't extraordinary, but I believe it will be used as an alternative platform."*
P3: *"Is the Metaverse a new concept? No, there was Second Life before it, and even earlier virtual environments. The Metaverse is really an umbrella term, encompassing platforms like Second Life."*
P4: *"When being physically present in a learning environment is costly, time-consuming, or impossible, joining the Metaverse, which gets quite close to reality, could offer convenience in terms of time, cost, and accessibility."*
P3: *"When trying to establish an educational presence on the Metaverse, there will undoubtedly be costs. If you need to purchase services to develop an avatar, there will be a cost. Likewise, if you're an avatar developer selling to others, there will be costs. For all of these, you'll need blockchains, Ethereum, and similar technologies. Although these will certainly be utilized, blockchain is not the primary focus in an educational context."*
P5: *"Today, there are people who design and sell avatars and create Metaverse environments. There will be professions centered around these tasks. Web 3.0 alone could give rise to at least 30 new job types, some of which have already emerged."*
P3: *"The Metaverse offers something unprecedented: a shared space where we can gather together in a virtual world. This is incredibly significant."*

Participant Opinions on the Theme of "Education in the Metaverse"

The participants noted that the Metaverse is not a savior in education but rather an effective tool that facilitates learning. They emphasized that it appeals to multiple senses and allows students to feel as though they are learning in a separate world within the Metaverse. The participants made the following comments regarding the theme:
P3: *"The defining characteristic of Generation Z is not that they are smarter or have better learning abilities than previous generations, but rather that they have more opportunities to use technology and are using it more extensively. Learning requires experiences; learners must be active, engage in hands-on activities, and learn from making mistakes and finding their own solutions."*
P1: *"When a new technology emerges and is integrated into education, we often view it as a magic wand that will transform education and solve all problems. However, this is not the case with any technology. Typically, we adopt a hybrid model. For instance, while we are using Zoom today, we will be using the Metaverse tomorrow. The Metaverse offers us certain advantages, particularly in areas where it can have a significant impact."*
P4: *"A child's motivation is influenced by both intrinsic and extrinsic factors. Intrinsic motivation is far more valuable than extrinsic motivation. If extrinsic motivation takes precedence over intrinsic motivation, it can be dangerous. We want children to be eager to learn on their own. While we can offer external motivational elements like coins or badges in the learning process, if these overshadow intrinsic motivation, students may shift to a mindset where they learn only to receive the reward. If the reward is absent, the student might adopt an attitude of 'I won't learn.'"*
P2: "*Normally, visiting a museum abroad is quite challenging for a person, but with the Metaverse, it becomes much more economical, faster, and easier. Additionally, we can explore interactively with our friends. In this environment, I can touch and use all my senses."*
P3: *"For example, when you're teaching history, experience is crucial for learning. The more experiences you can provide, the more successful the student will be. In face-to-face education, we can use digital materials to the fullest. However, in remote education, even if we conduct assignments, discussion activities, etc., we can't really talk about genuine experiences. In the Metaverse, you place the student directly into a virtual laboratory that we've developed, where they can gain hands-on experience. The student can take on the role of a character in a*

historically reenacted event. For instance, you can make the student an avatar that actively participates in the War of Independence, experiencing it firsthand as if they were a part of the battle. You can enable the student to observe everything, live through it, and even intervene when necessary."

P5: *"In schools with virtual classrooms in the Metaverse, students can join classes from outside and listen to lectures. A student can take a course from any institution and any teacher in the world. They can choose institutions that offer open services, which may require accreditation and enrollment, or they can attend completely free and open-access courses."*

P3: "*You can create a virtual laboratory where children can explore inside a DNA helix in biology. In a medical school, you can place a corpse on the table for students to examine. They can cut, dissect, and practice. This can also be done in a real environment, but when a student sees a cadaver for the first time, it can be frightening, and some students even drop out of the program when confronted with a cadaver in class. Instead, if they were introduced to it in a virtual environment, the experience could be very different. Surgeries can be performed in a virtual environment using an experimental simulator, and this can be done collaboratively. We can involve many people in the same surgery simultaneously."*

P2: "*Today, we can place children inside a three-dimensional representation of a museum and guide them through it using augmented and virtual reality. However, in these scenarios, children can only interact using a mouse. In the Metaverse, children can move, explore, and touch things within the museum. They can experience this environment enriched with virtual and augmented reality that we embed into the Metaverse. As you can see, the Metaverse has the potential to provide positive contributions to education. For another example, when children engage in planting seedlings or other plants, they can do this in the Metaverse. They can witness what happens when the wrong plant is sown in the wrong soil or when proper fertilization and watering are not done. In the virtual environment, children can cultivate the field and learn about it. The Metaverse offers us the incredible opportunity to facilitate such experiences."*

P1: "In environmental education, we tell children not to litter, but they often don't understand why it's important. In the Metaverse, we could create a simulator where children can actually throw trash on the ground. After they do that, they can see the consequences of their actions. They will understand that throwing trash makes the environment uninhabitable. This way, we facilitate a deeper learning experience."

P4: "*I don't believe that the Metaverse or any other platform directly influences learning. In my opinion, the most important factor in education is pedagogy. Even if we use a hologram of Einstein to teach physics, there will still be people who don't understand. Regardless of how much technology is employed, we can never fully disconnect from traditional education. This is particularly crucial for younger students, where face-to-face education plays a vital role. We need to present information with the right method and appropriate pedagogy."*

P1: "*The Metaverse has many dimensions; these can include sociological, technological, and economic aspects, but these dimensions manifest quite differently in the Metaverse. Education is one of the prominent applications of Metaverse technologies. Especially during the Covid-19 period, the experiences gained from distance learning and people's adaptation to this technology will remove a significant barrier to teaching with avatars in the Metaverse. I believe that people's acceptance will be quite straightforward. Whether this is successful or not will depend on the quality of education, which is a separate topic. However, I think users will have a high level of acceptance. There are no technological obstacles; it's very feasible. This can be achieved in different Metaverse environments or a dedicated Metaverse can be created for such purposes. Creating avatars is very straightforward today, and environments similar to classrooms can also be easily set up in the Metaverse. Sharing resources like YouTube videos or educational materials on a board will be very simple, and this is already being done. Therefore, I don't see any significant obstacles in that regard."*

P3: *"For instance, let's say to take this training, a student needs to use a coin, and if Bitcoin is expensive, they might receive it as a form of payment for taking the course. After completing the course, they take an exam, and in return, they get an NFT, which they can use in a game. This way, the student has to show interest in successfully completing the course to obtain that NFT and use it in the game afterward."*

P2: "*The definition of a teacher as the one who imparts knowledge has become outdated. This definition has been replaced by the idea of a teacher as someone who guides students in accessing information, learning paths, and methods of learning.*

P4: "*When certain elements are gamified, they attract people's attention and can reach a wider audience. This gamification can be adapted to education. There are numerous graduate theses written on Second Life. Globally, there are campuses and classrooms within the Metaverse where you can directly participate and attend classes."*

P3: "*For these systems to be effective, all teachers, including Information Technology teachers, must undergo a certain orientation training. Ultimately, education will take place in a different environment. We experienced this with the FATİH project. Merely transferring technology into education does not improve educational quality. It is essential first to understand, analyze, and use that technology correctly. Otherwise, the likelihood of failure is high. Research consistently shows this. When students encounter unfamiliar new technology, their success tends to decline. However, once students become accustomed to the environment, and if the environment has beneficial effects, their success will subsequently increase."*

P5: *"I believe that the use of the Metaverse in education could be beneficial at this time, but it would be incorrect to assert that it will replace the teacher or take on the role of teaching. However, I do think it will certainly add value to education."*
P4: "*For instance, if I want to take a course from MIT, I can participate online, but with the Metaverse, it would be as if I am physically present in the classroom. While the Metaverse may not enhance equal opportunities among students, it does improve access quality and increases interaction between people.*
P2: "*If we can create educational ontologies in learning areas, we can at least use these ontologies to structure content recommendation systems. One of the best examples of this is EBA (the Educational Information Network). With very limited content adaptation, you can filter the contents on EBA according to age groups and types. Now, imagine if this could be further developed. If an educational ontology can be established, it could significantly minimize the time teachers take to find the instructional information they are looking for. For instance, similar to what Google Earth does—'You visited this place, would you like to go here this year?'—having educational ontologies that offer such suggestions would greatly facilitate learning and ease the workload for teachers. Back in the 1980s, when Computer-Assisted Instruction was introduced, there was a strong reaction in Türkiye against the idea that teachers would become obsolete, suggesting that 'How could one learn from a machine?' Now, machines can learn too, and we can foresee that people will continue their learning processes more in informal environments than in formal learning settings."*
P1: "*We should not think of the Metaverse solely as virtual reality. If we are tied to virtual reality in the selected Metaverse environment, we cannot keep the existing VR headsets on for long periods. This poses a problem. For instance, a school conducting half-day instruction with VR goggles cannot sustain it for long, as it can lead to headaches, nausea, or other discomforts. One student may not experience issues, while another might. Therefore, while virtual reality can be utilized, it shouldn't be the sole method; sometimes augmented reality (AR) or mixed reality (MR) could be applied, and it doesn't always have to be three-dimensional. Many things can be tried, and these can be mixed. We need to do what is necessary to ensure that the student is comfortable for a longer duration, allowing them to understand better. Ultimately, our problem is how to formulate the academic success of students in a more secure and comfortable environment. The Metaverse could be one of the environments that provide these opportunities. The question then becomes how to follow a methodology in the Metaverse to achieve this. My impression from what we have discussed so far is that we need to consider how the Metaverse can be used to enhance student comfort and success. This raises further issues; for instance, if augmented reality is to be used, then it necessitates a setting where students can be together to integrate with reality. The Metaverse can exist in a classroom setting, but if it's virtual reality, then it can also exist outside of that classroom environment. However, as mentioned, there are also concerns like dizziness and nausea associated with it."*
P3: *"For example, in language education, we often feel shy about speaking due to fears of making mistakes, being embarrassed, or feeling humiliated. The Metaverse can eliminate these fears. In this virtual space, there is a digital persona—an avatar. You are speaking, but you are not physically visible as yourself. The person you are interacting with doesn't know who you are. You are in a real environment where you can use gestures, body language, and facial expressions. These movements and gestures facilitate conversation, enabling you to express yourself better and ultimately boost your confidence.*
P4: *"When social media first entered our lives, it seemed like a savior. It was seen as something that would revolutionize our lives and bring new horizons to education. However, now we see people going to doctors to disconnect from social media. Technologies are always changing, and none of us may be able to keep up with that change. What's important is teaching pedagogy. Why is pedagogy important? Why do learning theories exist in our lives? When learning a subject, which strategy or method is the right one to use? These aspects are much more significant."*
P1: *"The actions taken by the student can be easily visible to everyone if desired. This could involve using Public Blockchain, Private Blockchain, or Hybrid Blockchain. At this point, algorithmic designs can be implemented. If we're thinking about a crowded classroom, the teacher may not be able to keep track of every student. In fact, there's no need for the teacher to monitor the students directly. Based on the algorithmic work done, it can be determined what assignments need to be completed next, which tests can be opened according to the student's performance, and so on. The integrity of these processes can be maintained in some way."*
P2: "*In the Metaverse, technology companies and capital will provide the same consumption opportunities to both the public sector and private sector. Control can also be implemented. Just as inspectors come to physical schools, there could be avatars of inspectors in the Ministry of Education who can check how teachers conduct their lessons in different locations. Centralized exams would still exist, and the achievements of students could be revealed through these exams. Firms that build Metaverse Schools will also emerge. For instance, a private school could partner with such a firm, and education would take place in the Metaverse environment."*
P5: *"We need to think of education as a whole. The educational elements in the Metaverse environment must be integrated. For example, we need to be able to write and communicate effectively. My avatar should be able to*

deliver lessons in the Metaverse. If I simply transfer my performance from Zoom to the Metaverse by changing the platform or replacing my visible real self with an avatar, nothing significant will change."
P4: "*One of the elements that makes the Metaverse what it is, is its connection to blockchain and the crypto world. How will this be established? On the other hand, students will find it much easier to imagine and realize many projects in the Metaverse because a variety of technologies are already available in a more advanced form in that environment. For instance, using three-dimensional models, elementary school students can create many things there. This can also enhance their achievements.*
P2: "*Hologram usage is something entirely different. All of these will have their advantages, but it's crucial to consider which advantage the student will use at what stage and for what purpose. There may also be disadvantages associated with all of these. We need to evaluate all these advantages and disadvantages. Students from different cities and countries can be in the same Metaverse classroom. This allows for applications that stretch geographical boundaries, enabling resources to be used more efficiently."*
P3: "*The Metaverse is designed to replicate the reality of everything. People can visit virtual worlds created to mirror real-life environments precisely. For instance, while you may not have the opportunity to physically visit the Egyptian pyramids, you can explore them as if you were there in the Metaverse. This enables a wealth of learning opportunities. Children today no longer spend time playing outside as they used to; games have now integrated into technological devices, computers, and phones."*

Participants' Opinions on the Theme of "Requirements for Education through the Metaverse"

Participants have emphasized the need for important infrastructure to ensure education in the Metaverse. High-speed internet, technical knowledge regarding usage, and various pre-usage training programs are among these requirements. Some of the comments made by participants on this theme are as follows:
P3: "*Therefore, it is necessary to analyze the needs first. There is a need for teachers who will guide the students in this context. Experts in the field are needed. Technology specialists are required in this scope. If the connection settings of the hardware and software to be used need to be configured, technical personnel are needed for that. In this process, it is essential to have educational programmers, educational technologists, teachers, and technical personnel to provide support and solve problems."*
P4: "*For example, there is language education. No matter how well you know a language, there is still the fear of embarrassment. Students might think, 'What if I make a mistake or embarrass myself?' This fear doesn't exist in the Metaverse. The Metaverse is a great platform for overcoming all these human qualities and taking action. No one recognizes your face; it doesn't matter if they recognize your avatar or not. In a virtual environment, students can engage in movements and gestures as part of their experience. It can become an incredible attraction for learning a language. However, this does not mean that Metaverse is an alternative for every educational system. There is no system in the world that effectively applies the same method to all people. If we compare this system to distance education, I believe that the Metaverse is superior to distance education systems."*
P2: *"What impact does the Semantic Web have on education? We can say that we expect content-focused content recommendation systems to develop further. There is an expectation that the number of applications where content-based teaching practices can be more queried and executed by machines will increase significantly. We can already see this in the learning management systems we use today. Many of us are likely using the Moodle learning system in our universities. This is one of the learning management systems that emerged within the relationship between the Semantic Web and e-learning. These systems are designed to interpret and understand only a limited amount of information, such as student exam results, student log records, and student interactions. What can we do because of this? We can analyze questions like how many students have logged into the system, how many questions they answered correctly, and what they answered incorrectly. However, what is still the problem there? When we look at educational systems created with content clouds, there is still an issue of understanding."*
P1: "*What we are currently discussing are actually technology-based learning environments. You can place the Semantic Web on top of this, and in the future, you can also place the Metaverse on top of it. To understand these technology-based learning environments, you need to have at least some knowledge, meaning you must have technical knowledge as well."*
P5: *"In courses related to artificial intelligence, we should first teach basic artificial intelligence knowledge, introduction to artificial intelligence. Not everyone has to be interested in the Semantic Web. Not everyone has to know basic artificial intelligence information at a very good level. Courses that will provide basic data structures and basic programming logic should be taught by experts in the field who are experts in that subject. In other words, these courses should not be passed superficially because the depth that will be provided in these courses will make it easier for them to understand and interpret constantly developing new technologies."*
P3: *"In order to use Metaverse properly, a very high-speed internet connection is needed. For this, it is necessary to go much higher than the fiber connection speeds that exist in our country. Considering that even the speeds in Europe may be insufficient, the speeds of those connected with normal ADSL connections in our country will not*

be sufficient. For this reason, very serious infrastructure investments need to be made. Metaverse requires sending and receiving very high amounts of data."
P2: "Since ADSL connections are asymmetric, our data receiving speed is high, but our data sending speed is low."
P5: "With Web 3.0, especially the upload speeds need to be increased. Generally, download speeds are high, and bandwidths are greater, but in Web 3.0, upload speeds must also be very high. This requires serious infrastructure."

Word Cloud, Word Map, and Text-Related Images Obtained Using Artificial Intelligence

A word cloud has been created using artificial intelligence to determine the most frequently used words from the data obtained in the interview, with the aim of revealing commonly mentioned concepts. In word clouds, the size of the text indicates the frequency of usage of the word found in the interview data. It is known that as the text size increases, the frequency of the word's usage also increases. Thus, the prominent concepts and emphasized expressions can be visualized.

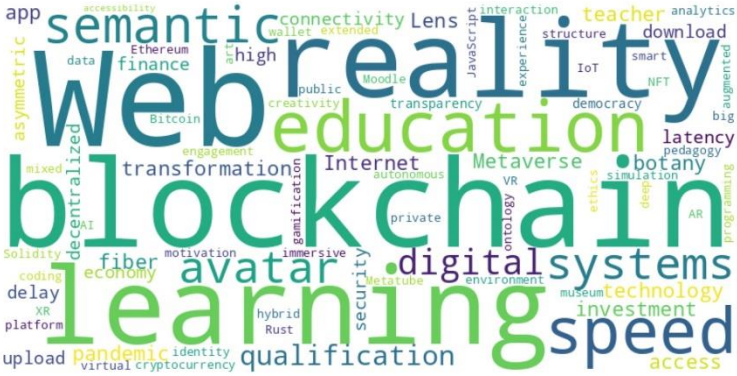


Figure 2. Word tree for interview data

According to the findings obtained in this research, it was determined that words such as web, blockchain, learning, reality, semantic, education, avatar, were used more frequently. This finding indicated that the participants frequently mentioned concepts, technologies and education related to Web 3.0 and Metaverse in the interview and that the participants used expressions related to these phenomena.
In the study, a word network was also created to access information such as where the participants' expressions were used in written texts and their combination with other concepts and to examine their relationships. It was determined that the Web 3.0 concept, which had the highest frequency, was the most used expression and the other most used concepts and the sub-concepts they were used with were also included in the word network. VOSviewer software was used to create this concept map.

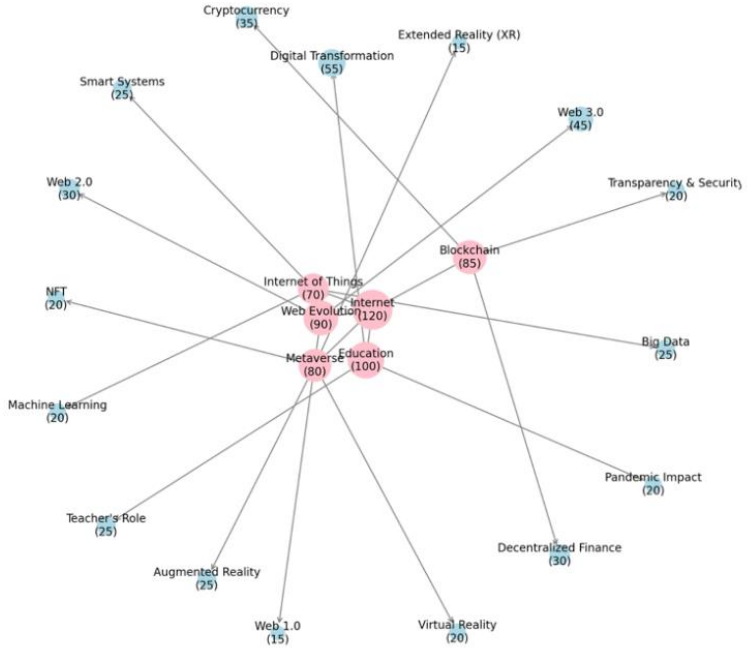
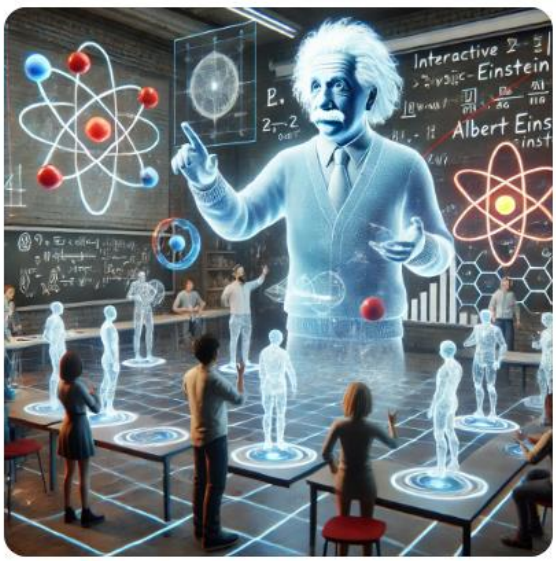


Figure 3. A concept map related to the interview data.

According to the concept map derived from the interview data, the most frequently used main concepts are Internet (120), education (100), web evolution (90), Blockchain (85), Metaverse (80), Internet of Things (70). The sub-concepts associated with these main concepts are presented in Figure 3. The main concepts, along with the three sub-concepts most commonly used with them and their respective frequencies, are as follows:

- For the concept of internet: big data (25).
- For the concept of education: digital transformation (55), teacher's role (25), pandemic impact (20).
- For the concept of web evolution: web 3.0 (45), web 2.0 (30).
- For the concept of blockchain: cryptocurrency (35), decentralized finance (30), transparency (20).
- For the concept of metaverse: NFT (25), virtual reality (25).
- For the concept of internet of things: big data (25), smart systems (25), machine learning (20).

In qualitative studies, the visualization of data is crucial. ChatGPT artificial intelligence tool was used to generate the visuals. The interview data were uploaded to this tool and the prompt "Produce a visual depicting the classroom environment described in the text" was typed. As a result, the following visuals were obtained:



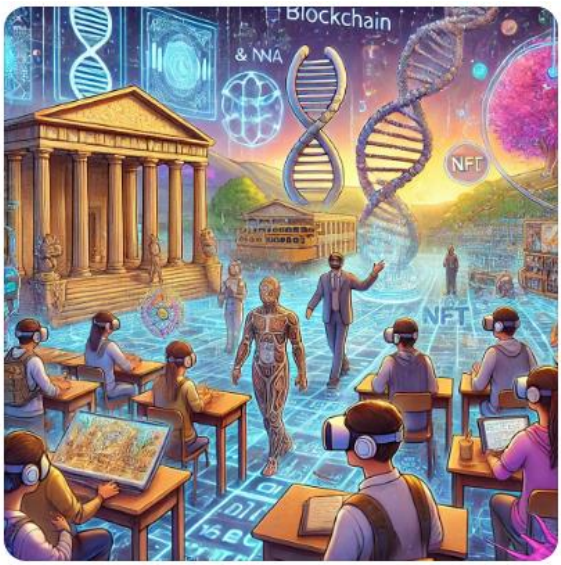


Figure 4. AI visuals that define the metaverse

The visuals presented include hologram technologies and the Metaverse environment created in a real classroom environment, the use of virtual reality technologies in a real classroom environment based on the examples given in the interview, the transfer of historical environments to the classroom environment with the Metaverse, and the Metaverse environment created by combining the history course teaching in the interview data with the real classroom environment.

Results and Discussion

The transition from Web 1.0 to Web 2.0 brought about significant changes. There will be even greater transformations in the transition from Web 2.0 to Web 3.0. Web 3.0 is characterized as a more secure environment compared to existing web technologies, often referred to as decentralized web or semantic web. Web 3.0, with the integration of artificial intelligence and machine learning, will provide users with increasingly personalized content, predominantly existing within virtual worlds. (Li et al., 2024) also supported this view in his research.

In recent years, we have started to hear the term Metaverse frequently. The popularity of the Metaverse has increased since Mark Zuckerberg rebranded the company as Meta in 2021 (Suryodiningrat et al., 2024). In our research, it was concluded that Metaverse has started to be used today. Tinmaz & Dhillon (2024) also stated that Metaverse environments, which were once limited to science fiction, have now become reality. Senadheera et al. (2024) emphasised that the Metaverse offers incredible advantages and transformation, but also brings privacy and security risks, and that more precautions are needed in the use of these environments.

Currently, virtual learning environments are offering experiences similar to the Metaverse. However, the Metaverse, which will become widespread with Web 3.0, will provide a significantly different environment. While traditional education allows for the representation, contemplation, and construction of knowledge for students, the Metaverse is offer students the opportunity to experience knowledge firsthand, immersing them directly in the learning environment. Aydın et al. (2023) and Yıldız and Bozkurt (2023) have also reached similar conclusions in their respective studies.

On the other hand, Wong et al. (2024) and Ruiu et al. (2024) found that the use of metaverse in education is attracting more and more attention every day. Similarly, Arantes (2024) stated that there is a tendency in education to replace or empower teachers with machines instead of humans. In contrast to these positive views, Mahmoud (2024) and Ruiu et al. (2024) stated that the Metaverse is beginning to shape our understanding of education, but that it will ultimately pose serious technological challenges and digital divide, privacy and security concerns.

In their research, Tinmaz & Dhillon (2024) and Wong et al. (2024) emphasised the difficulties encountered in the metaverse environment related to learning difficulties. They stated that training is needed for the use of these environments. This result coincides with the findings of our study. Tınmaz & Fanea-Ivanovici (2024) also saw the use of the metaverse in education as a great potential in the age of innovation, but stated that it has various challenges.

Metaverse can be used very widely in daily life. It has an immersive feature in entertainment, education and working life (Guo et al., 2024). Political regulations and important technical infrastructures are needed for the efficient use of the Metaverse in education (Shwedeh, 2024).

In designing learning environments within the Metaverse, the focus is not solely on creating virtual spaces. It is believed that the Metaverse can address the shortcomings of various existing methods and enhance student interaction in a way that resembles traditional classroom settings. To accomplish this, collaborative learning and flipped learning approaches, as well as hybrid models, can be implemented. This aligns with findings from several studies that support these conclusions (Diaz, 2020; Diaz et al., 2020; Jeon & Jung, 2021).

Like many other technologies, the Metaverse does not provide direct learning and should not be seen as a savior in education. However, similar to other technologies, the Metaverse can serve as an effective tool to facilitate learning. It is particularly believed that when gamification techniques are employed, especially those that incorporate technologies suitable for the Web 3.0 and Metaverse environments (like tokens), the learning experience can be enhanced. Metaverse will increase students' intrinsic motivation by appealing to more senses and creating the impression that students are having an extraordinary learning experience in a world apart. Some studies support these findings (Atmaca Demir & Kandemir 2020; Duan et al., 2021; Park et al., 2021; Tokgöz & Karabatak, 2022; Vaca et al., 2016; Yaratan, 2022). Although the boundaries of the Metaverse are still not fully defined and it continues to evolve, it is expected to make significant contributions to education. Akpınar and Akyıldız (2022) identified some of these contributions as reducing tension between school and social media, opening new horizons for thinking, personalizing instruction, and increasing access to education.

Additionally, The use of Web 3.0 and the Metaverse will require technical knowledge and infrastructure, user training, and very high-speed internet connections. Yıldırım and Keçeci (2024) also noted that necessary planning should be carried out in this context, and updates should be made continuously according to users' needs. (Guo et al., 2024) is also worried about utilizing Web 3.0 applications in case Web 3.0 becomes widespread, unless very high speed internet connections are provided with advanced technologies.

Based on the results obtained from this study, the following recommendations have been developed:

• Necessary preparations for the technical infrastructure for the Metaverse, identified as the technology of the future, should be made, and ethical boundaries regarding the Metaverse should also be established.

• When developing Metaverse environments for educational purposes, these environments should be developed in line with the opinions and suggestions of educators.

• Metaverse platforms should be adaptable to different educational environments.

• Training should be provided to Metaverse users before they begin using the platform.

• New and specialized professions should be created and encouraged to train qualified individuals who can develop metaverse technologies.

Authors Contribution Rate

The authors equally contributed to this research.

Ethical Approval

Ethical permission (5/12/2024 – 12/09) was obtained from Hatay Mustafa Kemal University Ethics Committee for this research.

References

Akpınar, B., & Akyıldız, T. Y. (2022). Metaversal teaching as a new educational ecosystem. *Journal of History School (JOHS), 15*(56), 873-895. http://dx.doi.org/10.29228/Joh.57283

Antoniou, G., & Van Harmelen, F. (2008). *A semantic web primer.* The MIT Press.

Arantes, J. (2024). Digital twins and the terminology of "personalization" or "personalized learning" in educational policy: A discussion paper. *Policy Futures in Education*, *22*(4), 524-543. https://doi.org/10.1177/14782103231176357

Aroyo, L., Dicheva, D. (2004). The new challenges for e-learning: The educational semantic web. *Educational Technology & Society*, *7*(4), 59- 69. https://pure.tue.nl/ws/portalfiles/portal/1824531/623993.pdf

Atmaca Demir, B., & Kandemir, C. (2020). On Virtual Reality Applications in Education: 'Ben De Varım in the Classroom' Project. *Turkish Online Journal of Design Art and Communication, 10*(4), 339-354. https://doi.org/10.7456/11004100/002

Aydın, S., Nalbant, K. G., & Ozat, K. (2023). The experiences that the Metaverse will bring to virtual markets in the digitalising world. *Journal of Social, Human and Administrative Sciences, 6*(1), 130-147. https://doi.org/10.26677/TR1010.2023.1175

Baker, C., Wuest, J., & Stern, P. N. (1992). Method slurring: The grounded theory/phenomenology example. *Journal of advanced nursing*, *17*(11), 1355-1360. https://doi.org/10.1111/j.1365-2648.1992.tb01859.x

Beck, R. (2018). Beyond bitcoin: The rise of blockchain world. *Computer*, *51*(2), 54 – 58. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8301120

Bektaş, G. A. (2012). *An application on the use of Web 3.0 technology in internet based education systems* [Master Thesis]. Gazi University, Informatics Institute.

Lassila, O., Hendler, J., & Berners-Lee, T. (2001). The semantic web. *Scientific American*, *284*(5), 34-43. https://www.lassila.org/publications/2016/lassila-dickinson-semweb-lecture-2016.pdf

Choe, H. (2006). Ontology Based E-Learning Authoring System. *Asian Journal of Information Technology*, *5*(12), 1319 – 1322. https://doi.org/ajit.2006.1319.1322

Choi, H.S., & Kim, S.H. (2017). A content service deployment plan for Metaverse museum exhibitions Centering on the combination of beacons and HMDs. *International Journal of Information Management*,37, 1519-1527. http://dx.doi.org/10.1016/j.ijinfomgt.2016.04.017

Corbin, J., & A. Strauss (2015). *Basics of qualitative research.* Sage. http://ejournals.library.ualberta.ca/index.php/cjuce-rcepu

Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Pearson.

Çapar, M. C., & Ceylan, M. (2022). Comparison of case study and phenomenology designs. *Anadolu University Journal of Social Sciences*, *22*(2), 295-312. https://doi.org/10.18037/ausbd.1227359

Damar, M. (2021). Metaverse and educational technology. Tarık Talan (Ed.), *In Digitalisation and New Approaches in Education* (ss. 169-192). Efe Academy Press.

Damar, M., Özdağoğlu, G., & Özdağoğlu, A. (2018). Software Quality and Standards on a Global Scale: Trends in the Literature from Scientific and Sectoral Perspective. *Alphanumeric Journal*, 6(2), 325-348. https://doi.org/10.17093/alphanumeric.404102

Decentraland (2022). Metaverse Festival: Frequently Asked Questions. Erişim Tarihi: 29.07.2022 https://themetaversefestival.io/MusicFestivalFAQs.pdf adresinden erişilmiştir.

Díaz, J. (2020). Virtual world as a complement to hybrid and mobile learning. *International Journal of Emerging Technologies in Learning (iJET), 15*(22), 267-274. https://doi.org/10.3991/ijet.v15i22.14393

Díaz, J., Saldaña, C., & Avila, C. (2020). Virtual World as a Resource for Hybrid Education. *International Journal of Emerging Technologies in Learning (iJET), 15*(15), 94-109. https://doi.org/10.3991/ijet.v15i15.13025

Duan, H., Li, J., Fan, S.,Lin, Z., Wu, X., & Cai, W. (2021, October). Metaverse for social good: A university campus prototype. In Proceedings of the *29th ACM International Conference on Multimedia* (MM '21), October 20–24, Virtual Event, China.

Erkılıç, H., & Dönmez, S. C. (2020). Tracing the narrative of virtual reality: Examples of Trinity VR and cyathouse VR. *Journal of Cine Philosophy, Special Issue,* 318-344. https://doi.org/10.31122/sinefilozofi.674107

Gaubert, J. (2021). Seoul to become the first city to enter the Metaverse. What will it look like? https://www.euronews.com/next/2021/11/10/seoul-to-become-the-first-city-to-enter-the-metaverse-what-will-itlook-like

Gennett, Z. A. (2010). *Shortfall Online: The Development of An Educational Computer Game for Teaching Sustainable Engineering to Millennial Generation Students*. Master thesis, The Department of Mechanical and Industrial Engineering Northeastern University Boston.

Göçen, A. (2022). Metaverse in the context of education. *International Journal of Western Black Sea Social and Human Sciencesi*, *6* (1), 98-122. https://doi.org/10.46452/baksoder.1124844

Göker, G. (2017). Digital heterotopias: New media in a 'different' context. *Selcuk Communication*, *9*(4), 164-188. https://doi.org/10.18094/si.57679

Grayscale Research (2021). The Metaverse, Web 3.0 Virtual Cloud Economies. Grayscale. https://grayscale.com/wp-content/uploads/2021/11/Grayscale_Metaverse_Report_Nov2021.pdf

Guo, H., & Gao, W. (2022). Metaverse-Powered Experiential Situational English-Teaching Design: An Emotion-Based Analysis Method. *Frontiers in Psychology*, 13, 1-9. https://doi.org/10.3389/fpsyg.2022.859159

Guo, Y., Qin, Z., Tao, X., & Li, G. Y. (2024). Federated multi-view synthesizing for metaverse. *IEEE Journal on Selected Areas in Communications*, *42*(4), 867-879. https://doi.org/10.1109/JSAC.2023.3345427

Hazneci, U.Ö. (2019, October). A review on the use of current augmented reality applications in education. Ondokuz Mayıs University International 100th Year Education Symposium 26-28 October, (ss. 499-508). Samsun.

Koçak, Ö., Karakuş Yılmaz, T., & Göktaş, Y. (2018). Pedagogical challenges in the design of virtual worlds as a learning environment. *Educational Technology Theory and Practice*, 8(2), 90-106. https://dergipark.org.tr/en/download/article-file/506975

Kye, B., Han, N., Kim, E., Park, Y., & Jo, S. (2021). Educational applications of Metaverse: Possibilities and limitations. *Journal of Educational Evaluation for Health Professions, 18*, 1–13. https://doi.org/10.3352/jeehp.2021.18.32

Lee, J.Y. (2021). A study on Metaverse hype for sustainable growth. *International Journal of Advanced Smart Convergence*, 10 (3), 72-80. http://dx.doi.org/10.7236/IJASC.2021.10.3.72

Lee, L. H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., ... & Hui, P. (2021). All one needs to know about Metaverse: A complete survey on technological singularity, virtual ecosystem, and research agenda. *Journal of Latex Class Fıles, 14*(8), 1-66. https://doi.org/10.48550/arXiv.2110.05352

Lee, H., & Hwang, Y. (2022). Technology-enhanced education through vr-making and Metaverse linking to foster teacher readiness and sustainable learning. *Sustainability*, *14*(8), 4786. https://doi.org/10.3390/su14084786

Li, S., Bunlikhitsiri, B., & Punthupakorn, P. (2024). The evolution of cultural relics: environmental sculpture of huai'an in metaverse. *Journal of Ecohumanism*, *3*(4), 107-117. https://doi.org/10.62754/joe.v3i4.3551

Mahmoud, A. B. (2024). Exploring the public's beliefs, emotions and sentiments towards the adoption of the metaverse in education: A qualitative inquiry using big data. *British Educational Research Journal*, *42*(4), 867-879. https://doi.org/10.1002/berj.4026

Morse, J. M., & P.-A. Field (2013). *Nursing research: The application of qualitative approaches*. Springer.

Narin, N. G. (2021). A content analysis of the Metaverse articles. *Journal of Metaverse*, *1*(1), 17-24. https://dergipark.org.tr/tr/download/article-file/2167699

Özdemir, M. (2010). Qualitative data analysis: A study on the problematic of methodology in social sciences. *Eskişehir Osmangazi University Journal of Social Sciences*, *11*(1), 323-343. https://dergipark.org.tr/en/download/article-file/113287

Papapanagiotou, I., & Devetsikiotis, M. (2010). Aggregation network design methodologies for Triple Play Services. *2010 7th IEEE Consumer Communications and Networking Conference*, 1-5. https://doi.org/10.1109/CCNC.2010.5421849

Park, S., Min, K., & Kim, S. (2021). Differences in learning motivation among bartle's player types and measures for the delivery of sustainable gameful experiences. Sustainability, 13(16), 9121. https://doi.org/10.3390/su13169121

Priya L., Ravikumar G., Anandkumar M., Gunasekaran S., Kanimozhi E., & Jennifer D. (2012). Improving e-learning system using ontology web language. *International Journal of Modern Engineering Research, 2*(1) 366-370. http://www.ijmer.com/papers/vol2_issue1/BH021366369.pdf

Ruiu, P., Nitti, M., Pilloni, V., Cadoni, M., Grosso, E., & Fadda, M. (2024). Metaverse & Human Digital Twin: Digital Identity, Biometrics, and Privacy in the Future Virtual Worlds. *Multimodal Technologies and Interaction*, *8*(48), 1-22. https://doi.org/10.3390/mti8060048

Salmon, G., & Edirisingha, P. (2010). Developing a five-stage model of learning in Second Life. *Educational Research 52*(2), 169-182. https://shorturl.at/ZsVq0

Senadheera, S., Yigitcanlar, T., Desouza, K. C., Li, R. Y. M., Corchado, J., Mehmood, R., Mossberger, K., & Cheong, P. H. (2024). Metaverse as local government communication platform: A systematic review through the lens of publicness theory. *Cities*, *155*, 1-21. https://doi.org/10.1016/j.cities.2024.105461

Shwedeh, F. (2024). Harnessing digital issue in adopting metaverse technology in higher education institutions: Evidence from the United Arab Emirates. *International Journal of Data and Network Science*, *8*(1), 489-504. https://doi.org/10.5267/j.ijdns.2023.9.007

Silverman, D. (2006). *Interpreting qualitative data : Methods for analyzing talk, text and interaction.* Sage Publications.

Sözcü, (2022). Here are the professions that will enter our lives with the Metaverse. https://shorturl.at/4cShu

Suryodiningrat, S. P., Prabowo, H., Ramadhan, A., & Santoso, H. B. (2024). The essential components of metaverse-based mixed reality for machinery vocational schools. *Journal of Applied Engineering and Technological Science (JAETS)*, *5*(2), 1069-1085. https://doi.org/10.37385/jaets.v5i2.4117

Tanrıverdi, M., Uysal, M., & Üstündağ, T. M. (2019). What is blockchain technology? What is not: A literature review, *Journal of Information Technology*, *12*(3), 203 - 217. https://doi.org/10.17671/gazibtd.547122

Tasa, U. B. (2009). *Art and architectural design in 3D virtual worlds whose content is created by users: A case study on Second Life®*, [Unpublished Master Thesis]. Yıldız Teknik University.

Tasa, U. B., & Görgülü, T. (2010). Meta-art: Art of the 3-D user-created virtual worlds. *Digital Creativity, 21*(2), 100-111. https://doi.org/10.1080/14626261003786251

Thompson, W. (2021). Wunderman Thompson Metaverse 2021 Raporu (2021) Into The Metaverse. Wunderman Thompson Intelligence.

Tinmaz, H., & Dhillon, P. K. S. (2024). User-centric avatar design: A Cognitive walkthrough approach for Metaverse in virtual education. *Data Science and Management*(7), 267–282. https://doi.org/10.1016/j.dsm.2024.05.001

Tınmaz, H., & Fanea-Ivanovici, M. (2024). The metaverse–the next big thing in education: A systematic literature review. *Milli Eğitim Dergisi*, *53*(242), 827-854. https://doi.org/10.37669/milliegitim.1235647

Tokel, S. T., & Topu, F. B. (2017). *The use of 3D virtual world s in education in 3D Virtual Worlds and Usage Areas (1-24)* (Ed. Yüksel Göktaş). Pegem Press.

Tokgöz, M. M., & Karabatak, S. (2022). Metaverse and educational technology. *Education & Science*, 9-24. https://shorturl.at/WjxIc

Ünlü, M. (2019). International studies on improving the quality of e-learning environments in the digital age. *Journal of Ufuk University Social Sciences Institute*, *8*(16), 165-182. https://dergipark.org.tr/en/download/article-file/1476301

Vaca, B., Cela, J., & Gallardo, E. (2016). Learning profiles and collaborative work in 3D-simulation environment. *Ried-Revista Iberoamericana de Educación a Distancia, 19*(2), 193-215. https://doi.org/10.5944/ried.19.2.15438

Wong, P. P. Y., Wong, G. W. C., Pangsapa, P., & Shen, D. J. (2024). Virtual to reality: Understanding the role of metaverse as a pedagogical strategy. *Electronic Journal of e-Learning*, *22*(3), 90-110. https://doi.org/10.34190/ejel.21.6.3219

Yalın, H.İ. (2001). Instructional Technologies and Material Development. Nobel Press.

Yaratan, A. S. (2022). *The effect of augmented reality applications on students' academic achievement and attitudes in architectural education* [Master Thesis]. Fırat University.

Yıldırım, P., & Keçeci, G. (2024). Metaverse and education: A new period is beginning!. *National Education, 53*(243), 1635-1654. https://doi.org/10.37669/milliegitim.1240070

Yılmaz, H., & Ceranoğlu, M. (2022). The digital future of fashion: 3d clothes, metaverse and Nft. *Art-e Art Magazine, 15*(29), 642-672. https://doi.org/10.21602/sduarte.1081397

Yıldız, S. K., & Bozkurt, G. (2023). The New Platform Of Virtual Reality: Metaverse. *TRT Academy, 8*(17), 268-293. https://doi.org/10.37679/trta.1203353

Yiğit, Y., Yıldırım, S., & Özden, M., (2000). Web based internet tutorial: A case study. *Hacettepe University Journal of Faculty of Education, 19,* 166-176. https://dergipark.org.tr/en/download/article-file/88048