International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 11 - Issue 06 || June 2025 || PP. 48-58

The Metaverse in Education: A Literature Review

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Abstract: The evolution of the web from a static form, like that of the first version Web 1.0, to an interactive system like Web 2.0, and its further transformation into a fully decentralized social web Web 3.0, mark a significant advance in technological development. This development has brought about the emergence of the Metaverse, a set of online, 3D virtual worlds where we participate, communicate, collaborate with our digital selves, known as "Avatar", in digital multi users environments. The Metaverse has gained significant attention since 2021, when Facebook rebranded as Meta, highlighting its role in the Metaverse world. In this context, this paper focuses on the analysis of the integration of the metaverse in the educational space. The research explores the potential and benefits of the metaverse, as well as the related issues and risks that may arise. To support the research process, a literature review was used in international research databases as well as authoritative websites of academic and business organizations. Findings indicate that Metaverse enhances the educational process by creating realistic and interactive learning environments and promoting social interaction and experiential learning. However, potential risks such as digital inequality, misuse of educational data, cyberbullying, overuse of the metaverse by students, isolation from the physical environment, and obsession with virtual worlds and our digital persona need to be seriously considered.
Keywords: Web 3.0, Metaverse, Avatar, Virtual Worlds, Educational Metaverse

I. Introduction

The history of the internet is marked by rapid developments, with each new generation bringing innovative capabilities and shaping the way we interact with the digital world. Starting from Web 1.0, where information was static and users were passive receivers, the internet evolved rapidly [12]. Web 2.0 revolutionized it by bringing active user participation to the fore. Blogs, social media, and forums created an interactive landscape where users shared, created, and interacted. Despite the benefits of Web 2.0, however, there have been challenges. The exploitation of personal data, the spread of misinformation, and the existence of the "dark web" have created ethical and security issues [27]. In this context, Web 3.0 comes to offer solutions. Based on blockchain technology, Web 3.0 focuses on decentralization, security, and privacy [19]. We're still in the early stages, but the possibilities for a fairer and more democratic internet are exciting.

Metaverse, as part of Web 3.0, is revolutionizing the internet. As a 3D virtual environment, it offers interaction, communication, and activities through avatars. It combines the digital and real world, leveraging Virtual Reality (VR), Augmented Reality (AR), blockchain, and Artificial Intelligence (AI). Influencing entertainment, lifestyle, education, work, and social relationships, it opens new horizons and poses research challenges [47]. It is being adopted by more and more organizations, creating issues that require a multidisciplinary approach.

While the domain of Web 2.0 has been extensively researched, there is a large gap in research activities related to Web 3.0. Web 2.0 has played an important role in the evolution of education and technological interaction, Web 3.0 seems to offer new possibilities that have not yet been extensively explored. However, despite the interest in these possibilities, the amount of research remains small in the Metaverse space and even less in its application to education [46]. Among other technologies, detailed research is needed on whether and how the metaverse will be used specifically in school education. To be successful, any new technology introduced must be accepted by the community of people who will potentially use it. Teachers, students, and all other participants in the education system will play an important role in whether or not the metaverse will be accepted in the education sector in the coming years. However, there is little research on the educational value and potential of the emerging Web 3.0 and little research on the use of the metaverse in school education. Understanding the opportunities and risks of the metaverse for educational processes, assessment, and distributed collaboration is an important challenge that requires further research and development.

This research highlights the significant contribution of the emerging and recent technology of the metaverse in the educational field. This paper focuses on the potential of the metaverse in education. It will discuss its usefulness, the issues that arise, the risks to students and teachers, and the open questions of safety and negative impact of the metaverse on students. Currently, there is a limited amount of empirical research specifically focused on the use of the metaverse in education. While there are some studies and examples of how

virtual reality and other immersive technologies can enhance learning experiences, the metaverse as a concept is still relatively new and emerging. The research was conducted at the level of a literature review on the metaverse in education, in studies published after 2021 in authoritative scientific journals. The purpose of the bibliographic research is to highlight the current trends and implications of the metaverse in the field of education.

The literature review highlights the existing knowledge about the Metaverse and its applications in the educational field. Finally, the conclusions of this research extend to the real world, offering educational organizations valuable information on how and why they should leverage the Metaverse in the educational process. Overall, our research highlights the significant contribution of Metaverse to the educational field and offers important approaches for its future application in the field of education.

The objectives of this research are:

[1] Trend Mapping: Documenting current trends and developments in the metaverse in education.
[2] Investigating Impact: Investigating the potential impact of the metaverse on various aspects of education, such as teaching, learning, assessment, and collaboration.

The structure of this paper is organized as follows:

Section I presents the introduction to the study. Section II outlines the theoretical framework underpinning the research. In Section III, the methodological approach is described. Section IV reports the main findings, while Section V provides a discussion and interpretation of the results. Finally, Section VI concludes the paper, summarizing key insights and suggesting directions for future research.

II. Theoretical Background

Although the term "Metaverse" seems modern, its birth took place in 1992, in the novel "Snow Crash" by Neal Stephenson, where he envisions a digital, three-dimensional universe, a "metaverse", that aspires to mimic the real world [56]. In this virtual environment, the lines between digital and real life blur, offering an unprecedented, immersive experience [22]. The Metaverse is not just an evolution of the internet, but a radical extension of it. In addition to the current capabilities of the internet, the metaverse offers users a sense of physical presence in the virtual world. Through avatars, users interact with each other, work, entertain, and socialize, experiencing an unprecedented digital reality [3].

With the rise of Virtual Internet Based Multi-User Worlds (VIBMUWs), it opens the door to new experiences and possibilities. Unlike simple online games, virtual worlds are evolving environments that continue to exist and develop even when there is no user interaction. According to Richard Bartle, co-creator of the MUD (Multi-User Dungeon), «…a virtual world…continues to exist and evolve internally even when there are no humans interacting with it» [7]. Fixed virtual online multi-user worlds, developed collaboratively by users and simulating a parallel universe in digital space (e.g. Second Life), are called metaverses [52].

Entry into the Metaverse takes place through special devices, such as VR headsets and AR glasses, which offer a realistic and interactive experience. Virtual Reality (VR) is a cornerstone of the Metaverse, offering an unparalleled experience of realism. Through special VR devices, users are fully immersed in a simulated environment, interacting with digital objects and other users. VR in the Metaverse is not just a screen, but a gateway to a digital universe full of interactions and possibilities [25]. Augmented Reality (AR) is also an exciting aspect of the Metaverse, incorporatingdigital elements into the real world, creating a hybrid experience. Unlike VR, which transports you into a virtual environment, AR enriches the existing environment with digital information.

Avatars, as digital alter egos, are three-dimensional and fully adjustable representations of ourselves in the virtual world. They allow us to shape our appearance and style. In the Metaverse, avatars become our virtual presence, through which we interact with other avatars, chat, make new acquaintances, and create friendships. We can attend virtual meetings, collaborate with colleagues in digital offices, enjoy virtual concerts online, play games, explore digital museums, and go shopping. We can try on clothes, accessories, and other goods using our digital avatars [51]. We can also take virtual trips, explore digital worlds, historical sights, and exotic destinations without any limitations of space and time. The digital world of the Metaverse encompasses every aspect of human activity, from education and work to entertainment and social relationships.

The Metaverse brings with it a groundbreaking economy based on digital currencies: cryptocurrencies. At the center of this economy is blockchain technology, which ensures transparency and security in transactions [21]. Thanks to blockchain, every transaction is recorded in an immutable public network, offering traceability and preventing any fraud [45]. With cryptocurrencies, you can buy digital goods and services, such as clothes for your avatar, plots of land in virtual worlds, or tickets to virtual events. Convert cryptocurrencies to real

money and vice versa, offering flexibility and liquidity. Create digital assets, such as NFTs (non-fungible tokens), and sell them on the Metaverse market.

Many tech giants are investing in the development of their own Metaverses, envisioning their future. Mark Zuckerberg's vision for the metaverse, Meta, is a virtual universe with avatars that communicate via VR [40]. Meta has acquired Oculus, a VR company, and is investing billions in developing its platform. Microsoft's metaverse Mesh platform is a mixed reality platform that combines virtual and real elements. Microsoft focuses on developing holograms, 3D spaces, and virtual work and business environments [42]. Epic Games is the company behind Fortnite, a game that is already considered the progenitor of the Metaverse. Epic Games is investing in the development of realistic digital avatars and 3D environments, bringing the Metaverse one step closer.

Competition is fierce and the future of the Metaverse remains uncertain, but progress is rapid and its adoption by the general public is steadily increasing. The Metaverse is revolutionizing the way we interact, work, entertain, and consume. Its adoption by the general public may radically change our daily lives, paving the way for an exciting and hitherto unknown future. However, this future development of the internet brings with it, in addition to benefits, great challenges and issues, raising new questions about ethics, security, and equality in the digital world [2].

III. Our Methodological Approach

This study was based on a literature review aimed at conceptually clarifying the metaverse as an educational tool. The research strategy included the search, selection and analysis of highly valid scientific sources. The review was carried out in international databases, mainly Scopus and Google Scholar, using keywords such as: "metaverse and education", "metaverse and learning", "immersive learning environments", "VR/AR in education". The search terms were combined with logical operators (AND, OR) to ensure the breadth and focus of the results. All the documents collected were in English, published between 2021 and later, and were evaluated based on scientific validity (peer-reviewed articles), thematic relevance to the present study and timeliness. The review allowed for the recording of current theoretical trends and research findings regarding the integration of the metaverse in education, with an emphasis on pedagogical approaches such as experiential learning, differentiated teaching and the utilization of multiple types of intelligence. At the same time, the technological, cognitive and ethical issues that accompany the educational use of immersive virtual environments were highlighted.

IV. Results of the Review

Virtual worlds in the form of the metaverse present significant potential for the educational process, offering a flexible and configurable environment for both educators and students, to meet a variety of teaching needs. Through virtual tours, students can participate in experiential learning experiences, with a strong element of interaction and exploration. The metaverse transcends the limitations of physical space, allowing any student, regardless of location, to participate in immersive digital environments for educational purposes. Metaverse applications have the potential to redefine e-learning, offering a virtual space for navigation, collaboration and interaction among participants.

Advances in virtual reality technology have been instrumental in paving the way for the metaverse [34] in education, with the continuous innovation and improvement of virtual reality equipment and applications greatly increasing the ability to create immersive and interactive virtual environments. These advancements include high-resolution audio, realistic graphics, motion tracking, and haptic feedback, all of which contribute to a more authentic and engaging learning experience in the metaverse. According to the study [24] by Jiang and Xu (2022), the educational metaverse can be conceptualized as the incorporation of intelligent education within the cloud, where teachers and students, through their digital avatars, have a social presence and interact with each other and with the educational content.

The use of 3D virtual environments is indicated in cases where the subject matter is of an empirical or technical nature. Pantelidis (2010) states that the use of virtual reality in education is particularly appropriate in the case of simulation, as the experience of creating a simulated environment or model is considered very important for the knowledge of the object that is performed in this environment [49].

Magetos et al. (2023) propose the creation of virtual worlds for teaching art history, utilizing the ADDIE methodology. In their research, they integrate open educational resources into the virtual worlds, which they reuse through digital repositories [35]. Virtual spaces offer unique opportunities to attract students' attention through impressive visualization, interactive scenarios, and experiences based on curiosity, surprise, and stimulus switching [36].

Mitropoulos & Magetos (2024) then propose three types of models for the development of metaverse infrastructures in universities: Public/Corporate Model: Developed by large technology companies (such as

Meta, Microsoft, Google). Private Model: Implemented by the educational institutions themselves or state agencies (e.g. Ministry of Education) with full management of the technological infrastructure and virtual spaces. Hybrid Model: Combines characteristics of both and is implemented through cooperation between public organizations and private companies [38].

In their more recent study (Magetos et al., 2024), it is pointed out that the metaverse can be utilized in both in-person and hybrid or distance education, offering seamless interactivity, communication and collaboration in three-dimensional, immersive environments [37].

When using the Metaverse, educational resources that enable cognitive understanding are made more effective by using 3D graphics. By making books VR-enabled, students can immerse themselves in them, listen to texts, and see diagrams in 3D [4]. The metaverse can transform learning resources, bring them closer to reality, and promote a stronger field of e-learning.

Virtual environments provide students with experiential experiences that require representation that would not be accessible in different circumstances. In this context, object representations and simulations can be created in locations of historical significance or that are difficult or impossible to visit in reality, such as Ancient Athens or another planet. In history courses, virtual reality can be used to navigate students and live by participating in roles and embodying historical figures, such as Aristotle, Socrates, and Alexander the Great, in another historical moment, the period of the Pharaohs in Ancient Egypt, or Alexander the Great's campaign in Persia.

Experiments in physics, chemistry, or complex and dangerous situations can be simulated in a safe environment in the metaverse. The metaverse provides a fully immersive learning experience for students. For example, when learning about planets, the metaverse displays the entire galaxy and can be zoomed in and out to allow students to observe the textures and features of the universe. When learning about ancient architecture, students can travel back in time and directly observe the complex elements of architecture. Through the immersive learning experience, the technology and tools of the metaverse have had a significant impact on the educational field and have increased the pedagogical and technical support for teaching and learning, this has led to an increase in student motivation [59]. The combination of instruction and entertainment promotes the educational environment's effectiveness, it encourages students to participate more actively in the process. As such, the metaverse is now employed as a virtual environment for 3D educational activities [8].

According to [32], augmented reality immersive environments, compared to traditional learning environments, can provide a more interactive experience while reducing the resources, costs, and time required. Creating engaging and immersive experiences in secure and hybrid environments, with an emphasis on guided learning, brings a multitude of educational benefits and opens up new learning opportunities.

The application of the metaverse can make exams more attractive. For example, exam questions can be made interactive or virtual, and realistic case studies conducted [54].

The metaverse has the potential to promote interdisciplinary learning [58]. It can combine subjects that are usually taught separately, such as math and science, promoting STEAM education (Science, Technology, Engineering, Art, Mathematics). It can also enhance intercultural education and bring students of different cultures and locations closer together in shared online environments.

Geographical barriers are breaking down, providing global access to high-quality education for students from diverse cultural backgrounds.

The Metaverse allows students to actively engage in simulated activities, fostering a powerful «learning by doing» approach known as kinesthetic learning [23].

Virtual learning environments also include virtual worlds, which are three-dimensional environments built on a computer with the participation of a large number of users who are presented as "avatars" and can navi-gate freely, exploring the environment, manipulating objects, creating new content, and interacting with other users by communicating in various ways such as text and audio [10].

The most well-known virtual worlds of the third generation are Somnium Space, Mozilla Hubs, Spatial, EngageVR, RecRoom, Virbela, Sansar, High Fidelity, Sinespace, AltSpaceVR, Decentraland, VRChat, and Meta (Facebook) Horizon Worlds. Platforms mainly which focus on the field of education, are: Roblox, Eduverse by Avantis Education Universe by ViewSonic, Minecraft [30] Education Edition [31].

As studies by Antonacci & Modaress (2008) and Falloon (2010) point out, virtual worlds offer multiple advantages in the field of education. They enable users to carry out activities that would be difficult or impossible to implement in the physical world, either due to financial cost, time constraints, or geographical distances. Furthermore, the continuous and available nature of virtual environments supports the cultivation and maintenance of social bonds. Through these interactions, students can develop relationships, exchange ideas, and collaborate on common projects — thus strengthening important social and professional skills, useful for their future careers.

One of the major advantages of virtual worlds is their flexibility. They can be easily configured and adapted, taking into account the individual needs and learning styles of learners. The metaverse can contribute to continuous and seamless learning. Seamless learning is characterized as the learning process that provides individuals with the ability to access educational resources through mobile and wireless devices, without time and place limitations, in order to combine students' formal educational experiences at school with their everyday experiences outside of school. In the research study of [48], an analysis was performed to determine the compliance of metaverse environments with the ten principles of seamless learning, and they concluded that Second Life, Minecraft, Spatial.io, and Roblox environments largely meet the principles of seamless learning.

The metaverse facilitates the use of pedagogical methods such as the flipped classroom and hybrid learning, thus promoting the flexibility and dynamics of the classroom [11]. The metaverse, a virtual extension of the physical world, offers unique opportunities for experiential learning [1]. It enables the creation of immersive, adaptive learning experiences, combining experiences, emotions, and learning motivations. The metaverse, a virtual world where users can interact with avatars, has the potential to support constructivist learning. (Sapliyan et al., 2023) [53] further emphasizes the potential of the metaverse in promoting self-learning through hands-on experiences, particularly for young innovative learners. (Suh & Ahn, 2022) highlights the close relationship between the metaverse and the education of elementary school students, indicating its potential for student-centered education [57]. (Wang et al., 2022) proposes a theoretical framework for an edu-metaverse ecosystem, which includes hubs for instructional design, knowledge, research and technology, and talent and education [62]. These studies collectively suggest that the metaverse can support constructivist learning by providing immersive, hands-on experiences that closely align with students' everyday lives.

The sense of presence offered to students through avatars, the possibilities of grouping and support of group communication and placement of activity material within the environment, combined with the flexibility and freedom they provide to users, turn them into ideal environments to support the collaborative teaching approach. Regarding engagement and interest, most research reports that students remained engaged with the environment throughout their interaction with it, and that most students and teachers are positive about the use of virtual reality for educational purposes [43]. Related research has shown that these 3D environments increase students' interest and motivation, compared to corresponding 2D environments, due to interaction and immersion in them, capabilities enhanced by the multisensory user interface [21].

Cooperative learning is successful in the metaverse, this environment promotes teamwork and communication between cultures, as students from different locations participate in educational activities. Experiential learning is enhanced because the metaverse offers a safe platform for practical activities such as dangerous phenomena or scientific experiments [26]. AI-based avatars and virtual teachers enable personalized learning experiences, catering to individual learning styles tailored to each student [44]. The metaverse provides a significant opportunity to surmount many of the difficulties associated with the real world, including physical impediments, limited access, social exclusion, and the opportunity to provide experiences to people with disabilities in both the sensory and cognitive domains [63]. Through the creation of new environments, children with disabilities can handle objects and experience things that would normally be impossible or difficult in their real life [13]. Students with special needs, using avatars, will focus on their self-awareness and not on the disability, that fixates them on their physical self.

The research analysis [59] of Metaverse utilization in education presents a breakdown with the following findings: 53% of Metaverse searches focus on science, mathematics, and engineering, followed by general education at 15%, arts and engineering at 11%, and the humanities [50]. Metaverse's extensive use in the natural sciences stems from its ability to provide 3D modeling software, as well as the creation of autonomous teaching systems based on interaction data analysis. In the field of arts and humanities, Metaverse is mainly used for language learning, creating opportunities to communicate in virtual worlds and providing innovative foreign language learning processes. The findings of the same investigation demonstrate that Metaverse is employed in nine different educational scenarios. The most popular form of learning is virtual, it accounts for 31.3% of all learning. Next, it is followed by collaborative, blended, game-based, individual and problem-based learning (PBL).

Metaverse's technology opens up new possibilities in education and research, offering realistic and safe environments for practice and experimentation, limited only by human imagination [35]. In this context, simulating a nuclear reactor in a virtual world in the metaverse can offer many benefits to engineering students. The virtual tour of a realistic nuclear reactor model allows students to explore its various parts and systems, fully understanding its structure and operation. In a controlled virtual environment, students can perform experiments that would be dangerous or impossible in real life. Phenomena such as coolant flow or radioactivity can be visualized, making it easier to understand complex concepts. Simulating realistic emergency scenarios or standard operating procedures equips students with the necessary skills for future work at nuclear facilities.

Virtual simulations allow researchers to assess the efficiency and safety of new nuclear reactor designs before they are implemented. The creation of virtual environments can shed light on rare or difficult-to-observe phenomena that take place in nuclear reactors. Virtual platforms can be used to develop and test new methods of controlling and monitoring nuclear reactors, with Einstein's avatar acting as our guide.

The metaverse is also used in various educational activities such as commencement and graduation ceremonies, job fairs, and experiential learning [33]. It was used at the University of California, Berkeley, which hosted an online graduation ceremony on the Minecraft digital campus [64]. South Korea's Ministry of Education has already launched a creative science education program based on Metaverse [60].

V. Discussion on Results

The metaverse is the future of the Internet and incorporates a variety of technologies. The metaverse guides future educational trends and brings profound changes in education that need to be explored from a holistic perspective. The present study draws on knowledge and methodologies from various scientific disciplines. The interdisciplinary perspective ensures the holistic study of the metaverse in education, taking into account the cognitive, emotional and social aspects of learning. It also examines the ethical and social implications of the use of the metaverse in education, raising issues of data protection, digital exclusion and equal access. It emphasizes the development of responsible and ethical practices for the application of the metaverse in education, which are necessary to avoid negative consequences.

The adoption of virtual worlds in the metaverse must be done with critical thinking, taking into account the teaching needs, learning goals, and capabilities of each student. Balancing traditional methods and ensuring equal access are essential for a comprehensive and equitable education leveraging metaverse technologies.

Education in the metaverse can support constructivism theory, which advocates that learning is an active process where students construct knowledge through experience and interactive dialogue. In constructivism, the creation of knowledge is a process where students actively participate in its creation. In the metaverse, we cancreate educational worlds where students are empowered to construct, interact with content, and create knowledge through experience. The environment can provide tools and interactive resources that encourage students to discover and develop ideas as well as their personal knowledge. Through the interactive nature of the metaverse, students can collaborate and communicate with each other and with students of different cultures and languages. An advantage of the metaverse is seamless and continuous learning.

Students can access educational content anytime and from anywhere using the virtual environments of the metaverse, where learning is not limited by physical factors such as time and space. This seamless access to learning enables personalized learning and allows students to progress at the pace that works best for them. Through sophisticated technologies, the environment can be adapted to the individual needs, interests, and knowledge levels of each student. This creates a personalized learning experience, helping each student develop their skills and thus supporting differentiated instruction.

The ability to integrate virtual AI teachers into the metaverse has many benefits. First, virtual tutors can provide one-on-one tutoring tailored to each student's needs. Artificial intelligence can identify a student's strengths and weaknesses, offering personalized learning activities. The metaverse can support flipped instruction, where students can access information before class while the teacher directs the application of their knowledge to activities within the metaverse. The metaverse also supports playful teaching, offering a fun and interactive approach to education. Through games and simulations in the metaverse, students can acquire knowledge and skills in a way that is interesting and fun.

Virtual worlds [20] are inherently constructive (knowledge and meaning are produced by experience), experiential (effective learning occurs when people directly create meaning by interacting with the learning environment, its content, and its inhabitants), and engaging, motivating, and challenging (for example, games—both serious and recreational, role-playing, and immersive problem-solving or problem-solving activities).

The metaverse, through virtual worlds, offers great opportunities for students with special needs. Through advanced technologies, personalized learning experiences can be created that adapt to the specific needs of students.

The capabilities of virtual worlds to provide coexistence, co-creation, collaboration, graphical interface, interaction, persistence, and a sense of presence within shared spacesare advantages for education. Co-creation promotes the development or modification of content by multiple users. Coexistence allows multiple users to interact simultaneously in a shared environment. Collaboration allows users to select teams based on goals or needs. The graphical interface offers visual contact with the environment; persistence is the continuous and seamless metaverse, so that the virtual worlds remain constantly active, just like the real universe. While the feature of presence through avatars appears to be the ability to interact in real time with others located in the virtual world.

The metaverse inevitably offers many possibilities but at the same time faces [24] many challenges in technical, economic, pedagogical, and social issues, which must be mitigated in order to create a sustainable and acceptable metaverse. Some of these challenges, according to the literature, are:

- **Processing issues and resources:** The metaverse requires massive computing resources and high-performance graphics to create realistic and believable virtual environments. This can be a challenge in terms of processing power, data storage, and ease of access for users [6].
- **Efficiency and scaling:** A sustainable metaverse should be able to cope with increasing demand and provide enough resources to run virtual environments smoothly. Scaling and efficient infrastructure management are important challenges needed to ensure a smooth experience for users.
- **Environmental impact:** The wider environmental impact of the metaverse should also be considered. The evidence shows significant amounts of energy required to support digital technology infrastructure, with consequent carbon footprint accumulation [28].
- **Security and privacy challenges:** With increasing interaction and connectivity in the Metaverse, significant security and privacy issues arise. It is necessary to develop dataprotection and security mechanisms to deal with malicious use and breaches of privacy [21].
- **Cyber Security Threats:** The teaching and learning resources of a virtual education system are web-based and therefore may be vulnerable to cyber security threats such as hacking, malware and phishing attacks [10].
- **Financial accessibility:** Creating and accessing the metaverse may require significant financial resources. This can limit the access and participation of people who do not have the necessary resources. Solutions must be found to ensure affordability and use for all.
- **Moral and cultural issues:** The digital world and the metaverse raise new moral and cultural issues that must be addressed. Some of these include inequality of access because there is a risk of creating a new digital divide with some groups not having access to the metaverse due to economic, technical, and social constraints. It is important to ensure equality of access and the inclusion of all social groups in the metaverse [63].
- **Social isolation:** While the metaverse can connect people from different parts of the world, there is a risk that it leads to isolation from the real world [61]. It is important to find the balance between the digital and physical experience and to maintain human interactions and connections [41].
- **Negative health effects:** The extensive use of the metaverse may have had effects on people's eye strain and fatigue due to long-term exposure to virtual reality, as well as on social interaction and psychological health [29]. At this point we can mention the finding that «Gen Z» is the first to experience the world with constant internet access and smartphones. Increased cell phone use is linked to a rise in mental health problems among teenagers, such as depression and anxiety. Online communication lacks empathy, leading to the adoption of emojis and gifs to express emotions [39].
- **Overconsumption and addiction:** Can encourage overconsumption, addiction, and obsession with virtual images and objects. This can have a negative impact on people's psychological and emotional well-being. «The metaverse, as the new reality we are facing today, will completely change the order of priority in Maslow's Hierarchy of Needs, and the fact that people quickly jump on this bandwagon unaware of being manipulated by their desires is sure to have many serious consequences in the near future» [55].

Based on the foregoing, various benefits and possibilities arising from the integration of virtual worlds into educational practice are documented. This is an incentive for educators to adopt virtual reality technologies, especially virtual worlds in the metaverse, in their courses. However, the use of these virtual worlds must be conscientious, provided that they offer real pedagogical value to students. It is important to emphasize that virtual reality should not be used indiscriminately, but only when it offers additional educational value and complements real-life education. According to Pantelidis (2010), virtual reality should not completely replace traditional teaching, especially when physical interaction with the student community is required. Furthermore, it must be carefully evaluated so that its use does not lead to confusion between the simulation model and reality[49]. Finally, cost must be considered to ensure that it is commensurate with the expected educational outcomes.

In conclusion, the metaverse will not simply be a place where we travel to virtual worlds and then return to tangible reality to continue our lives; it will be a virtual reality where our lives unfold in parallel in a digital universe. Our parallel imaginary digital self will be able to move around in an imaginary digital world. The metaverse will not only be a space of escape from reality but also a space for new social organization. Themetaverse is a new field of inquiry in education, culture, and entertainment and opens up new horizons for

experimentation in every field of human activity. It is a fantasy world where the limitations of our physical selves will not be an obstacle [15].

Metaverse applications, however, to fulfil the potential of a massive universal virtual universe, must comply with certain requirements, such as ultra-low latency, huge resource requirements, interoperability between applications, and security and privacy issues. To build a parallel universe on an international level, it will take time, huge infrastructure, partnerships between huge technological giants, and tremendous social coordination. However, with the introduction of 5G with high speed and low latency in hardware and software [2] the power of graphics to display millions of polygons in 3D, and blockchain technology, this idea is no longer a fantasy [23]. This transition from today's Internet to a 3D Internet is, at its core, a transition from 2D to 3D interactions taking place in multiple virtual universes.

However, on the contrary of its development, according to the study of [55], the adaptation to the metaverse is expected to have serious effects on people's daily lives and lifestyles. It is, therefore, imperative that we develop an awareness of the potential dangers and critically examine the impact they may have on human society in order to be able to address the challenges arising from its rapid growth in the near future.

VI. Conclusions

The positive impact of the metaverse on education is great, but it is worth pointing out that further research is needed to comprehensively examine its actual pedagogical impact. This is important in order to ensure that the positive research results that have been reported are not solely due to the innovation of the metaverse. It is important to address these challenges in order to ensure that the metaverse will be a positive tool for human society, offering new possibilities in many areas.

Coordination between tech giants, infrastructure development, and social dialogue will play a key role in shaping the future of the metaverse. It is necessary to create a solid foundation of ethical and legal standards that will guide the development and use of the metaverse. In this way, it will be possible to avoid potential risks and ensure a digital environment that will promote the development and well-being of inclusive users.

The metaverse challenge has even captured the attention of policymakers. For instance, the European Commission [17] established the Virtual and Augmented Reality Industrial Coalition in 2020[16]. This platform fosters structured dialogue between the European VR/AR ecosystem and policymakers [14].

The adoption of a framework of ethical principles for the development and use of virtual worlds is considered imperative. Establishing rules that focus on freedom of choice, education, transparency, people-centeredness, sustainability, security, inclusiveness, and health ensures the responsible and beneficial use of this technology for the benefit of society. The adoption of virtual worlds should be based on the free will of the individual, without forcing participation, while avoiding the stigmatization of those who choose to abstain. Cultivating critical thinking and digital literacy is a cornerstone for properly exploiting the potential offered by virtual worlds. The education and awareness of teachers and the general public in matters related to this technology are deemed necessary. Establishing transparent regulations will ensure the protection of citizens, their personal data, and their psychological and physical health. The use of data by third parties must be governed by transparency and clarity.

The development and regulation of virtual worlds must take into account the needs, rights, and expectations of users, putting humans at the center, so as to create an anthropocentric metaverse.

The creation and operation of virtual worlds must adopt environmentally friendly practices, contributing to sustainability. Ensuring the safety and security of citizens, including data protection, tamper prevention, and safeguarding against digital threats, is a non-negotiable priority.

Equal access to the metaverse for all citizens, regardless of age, income, skills, available technologies, nationality, or any other criterion, must be ensured. The promotion of the physical and mental health of individuals exists as a fundamental pillar for the healthy development and use of virtual worlds.

As the Metaverse opens its gates, we must take a proactive stance, ensuring that it evolves into a digital place of prosperity, rather than a dystopian scenario. Drawing lessons from works such as Orwell's 1984, we look to Thomas More's Utopia, envisioning a digital world of equality, inclusion and human-centered development. Our priority must be to strengthen digital inclusion, bridging the skills and infrastructure gap. Transparency and ethical data management, combined with critical thinking and digital awareness, ensure a healthy digital environment. We should design digital experiences that promote mental and physical well-being, encourage empathy, collaboration and self-expression. We create a Metaverse that serves man, putting his values and needs at the center. Through proactive measures and vision, we can realize a Metaverse that transcends dystopian scenarios, reaching for utopia: a digital world of prosperity, social progress, and limitless possibilities for all.

References

[1]. AbuKhousa, E., El-Tahawy, M. S., & Atif, Y. (2023). Envisioning architecture of metaverse intensive learning experience (MiLEx): Career readiness in the 21st century and collective intelligence development scenario. *Future Internet*, *15*(2), 53.
[2]. Agarwal, A., & Alathur, S. (2023). Metaverse revolution and the digital transformation: intersectional analysis of Industry 5.0. Transforming Government: People, Process and Policy, 17(4), 688-707.
[3]. EAl-Ghaili, A. M., Kasim, H., Al-Hada, N. M., Hassan, Z. B., Othman, M., Tharik, J. H., & Shayea, I. (2022). A review of metaverse's definitions, architecture, applications, challenges, issues, solutions, and future trends. IEEE Access, 10, 125835-125866.
[4]. Aloqaily, M., Bouachir, O., Karray, F., Al Ridhawi, I., & El Saddik, A. (2022). Integrating digital twin and advanced intelligent technologies to realize the metaverse. *IEEE Consumer Electronics Magazine*.
[5]. Antonacci, D. M., & Modaress, N. (2008). Envisioning the educational possibilities of user-created virtual worlds. *AACE Review (Formerly AACE Journal)*, *16*(2), 115-126.
[6]. Avsar, B. (2023). Historical Process and Theoretical Foundations of Metaverse Starting from Web 1.0. In *Metaverse: Technologies, Opportunities and Threats* (pp. 1-18). Singapore: Springer Nature Singapore.
[7]. Bartle, R. A. (2004). *Designing virtual worlds*. New Riders.
[8]. Bulu, S. T. (2012). Place presence, social presence, co-presence, and satisfaction in virtual worlds. *Computers & Education*, *58*(1), 154-161.
[9]. Chen, Z. (2022). Exploring the application scenarios and issues facing Metaverse technology in education. *Interactive Learning Environments*, 1-13.
[10]. Cui, L., Zhu, C., & Hare, R. MetaEdu: a new framework for future education. Discov Artif Intell. 2023.
[11]. 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.
[12]. Douligeris, C., & Mitropoulos, S. (2015). *Information systems on the internet.* Kallipos, Open Academic Editions. https://hdl.handle.net/11419/3969
[13]. Elfakki, A. O., Sghaier, S., & Alotaibi, A. A. (2023). An Efficient System Based on Experimental Laboratory in 3D Virtual Environment for Students with Learning Disabilities. *Electronics*, *12*(4), 989.
[14]. European Commission. (2020). The Virtual and Augmented Reality Industrial Coalition. Available online: https://digital-strategy.ec.europa.eu/en/policies/virtual-and-augmented-reality-coalition (accessed on 12 January 2024).
[15]. European Commission. Digital Education Action Plan (2021-2027). Available at: https://education.ec.europa.eu/el/focus-topics/digital-education/action-plan
[16]. European Commission. (2022). People, technologies & infrastructure – Europe's plan to thrive in the metaverse. https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_22_5525
[17]. European Parliament. (2022). Virtual worlds – opportunities, risks and policy implications for single market. Available at: https://www.europarl.europa.eu/doceo/document/IMCO-PR-751902_EL.pdf
[18]. Falloon, G. (2010). Using avatars and virtual environments in learning: What do they have to offer?. *British Journal of Educational Technology*, *41*(1), 108-122.
[19]. Gasser, L. (2023). *WEB3. Trends in Data Protection and Encryption Technologies*, 209-213.
[20]. Holden, J. T., & Westfall, P. J. L. (2007). An instructional media selection guide for distance learning. Online Submission.
[21]. Huang, Y., Li, Y. J., & Cai, Z. (2023). Security and privacy in metaverse: A comprehensive survey. *Big Data Mining and Analytics*, 6(2), 234-247.
[22]. Ioannidis, S., & Kontis, A. P. (2023). The 4 Epochs of the Metaverse. *Journal of Metaverse*, *3*(2), 152-165.
[23]. Iqbal, M. Z., & Campbell, A. G. (2023, October). Metaverse as tech for good: Current progress and emerging opportunities. In *Virtual Worlds* (Vol. 2, No. 4). MDPI.
[24]. Jiang, C., & Xu, J. (2022, December). The Application Research of Education Metaverse Under the Framework of SWOT Analysis. In *International Conference on Metaverse* (pp. 55-67). Cham: Springer Nature Switzerland.
[25]. Joy, A., Zhu, Y., Peña, C., & Brouard, M. (2022). Digital future of luxury brands: Metaverse, digital fashion, and non-fungible tokens. Strategic change, 31(3), 337-343.
[26]. Kaddoura, S., & Al Husseiny, F. (2023). The rising trend of Metaverse in education: challenges, opportunities, and ethical considerations. *PeerJ Computer Science*, *9*, e1252.
[27]. Kaur, S., & Randhawa, S. (2020). Dark web: A web of crimes. *Wireless Personal Communications*, 112, 2131-2158.

[28]. Kou, G., Yüksel, S., & Dinçer, H. (2023). A facial expression and expert recommendation fuzzy decision-making approach for sustainable business investments within the metaverse world. *Applied Soft Computing*, 148, 110849.
[29]. Kourtesis, P., Papadopoulou, A., & Roussos, P. (2024, February). Cybersickness in Virtual Reality: The Role of Individual Differences, Its Effects on Cognitive Functions and Motor Skills, and Intensity Differences during and after Immersion. *In Virtual Worlds* (Vol. 3, No. 1, pp. 62-93). MDPI.
[30]. Kuhn, J. (2018). Minecraft: education edition. *Calico journal*, 35(2), 214-223.
[31]. Kutay, E., & Oner, D. (2022). Coding with Minecraft: The development of middle school students' computational thinking. *ACM Transactions on Computing Education (TOCE)*, 22(2), 1-19.
[32]. Lampropoulos, G., Keramopoulos, E., Diamantaras, K., & Evangelidis, G. (2022). Augmented reality and gamification in education: A systematic literature review of research, applications, and empirical studies. *Applied Sciences*, 12(13), 6809.
[33]. Lee, J. (2022). A study on the intention and experience of using the metaverse. Jahr: Europski časopis za bioetiku, 13(1), 177-192
[34]. Li, H., Cui, C., & Jiang, S. (2022). Strategy for improving the football teaching quality by AI and metaverse-empowered in mobile internet environment. *Wireless Networks*, 1-10.
[35]. Magetos, D., Kotsifakos, D., & Douligeris, C. (2023). "Educational Virtual Worlds for Vocational Education and Training Laboratories," 2023 8th South-East Europe Design Automation, Computer Engineering, Computer Networks and Social Media Conference (SEEDA-CECNSM), Piraeus, Greece, 2023, pp. 1-6, doi: 10.1109/SEEDA-CECNSM61561.2023.10470662.
[36]. Magetos, D., Mitropoulos, S., & Douligeris, C. (2024, September). The Evolution of the Web and its impact on Education: From Web 1.0 to the Metaverse. In 2024 9th South-East Europe Design Automation, Computer Engineering, Computer Networks and Social Media Conference (SEEDACECNSM) (pp. 103-108). IEEE.
[37]. Magetos, D., & Mitropoulos, S. (2025). Effectiveness of Educational Virtual Worlds in the Metaverse: A Study Based on the ARCS Model. *International Journal of Latest Engineering Research and Applications*, pp 01 - 10, Vol 10 - No. 06, 2025
[38]. Mitropoulos, S., & Magetos, D. Incorporating Metaverse Technology into the Adult Distance Learning Process for Open Universities. I HE2024, 16.
[39]. McKinsey Health Institute. (2023). Gen Z mental health: The impact of tech and social media. Available in https://www.mckinsey.com/mhi/our-insights/gen-z-mental-health-the-impact-of-tech-and-social-media
[40]. Meta, I. (2021). A social technology company. Meta, 12(11), 2021.
[41]. Metavethics (2024). Advancing the metaverse through sustainable, ethical, and inclusive efforts. https://www.metavethics.com/Microsoft, 2021. Microsoft.Mesh for Microsoft Teams. https://www.microsoft.com/en–us/mesh?SilentAuth=1&wa=wsignin1.0 (2021), Accessed 9th Feb 2024.
[42]. Microsoft. Microsoft to acquire Activision Blizzard to bring the joy and community of gaming to everyone, across every device. https://news.microsoft.com/2022/01/18/microsoft-to-acquire-activision-blizzard-to-bring-the-joy-and-community-of-gaming-to-everyone-across-every-device/ (2022). Accessed 9th Feb 2024.
[43]. Mikropoulos, T. A., & Natsis, A. (2011). Educational virtual environments: A ten-year review of empirical research (1999–2009). Computers & education, 56(3), 769-780.
[44]. Mistretta, S. (2022). The metaverse—An alternative education space. AI, Computer Science and Robotics Technology.
[45]. Monrat, A. A., Schelén, O., & Andersson, K. (2019). A survey of blockchain from the perspectives of applications, challenges, and opportunities. IEEE Access, 7, 117134-117151.
[46]. Morton J. Metaverse Timeline. (2024). https://metaverse-timeline.com/
[47]. Mystakidis, S. (2022). Metaverse. Encyclopedia, 2(1), 486-497.
[48]. Ozdemir, O., & Kalinkara, Y. (2023). Rethinking Seamless Learning through Metaverse: Meta Seamless Learning. International Online Journal of Educational Sciences, 15(2).
[49]. Pantelidis, V. S. (2010). Reasons to use virtual reality in education and training courses and a model to determine when to use virtual reality. Themes in science and technology education, 2(1-2), 59-70.
[50]. Park, J., & Sohn, S. (2023). Exploring Students' Experiences of Virtual Learning Environment for Art History Classroom. Harmonia: Journal of Arts Research and Education, 23(1), 105-120.
[51]. Rene, G., & Mapes, D. (2019). The Spatial Web: How web 3.0 will connect humans, machines and AI to transform the world.

[52]. Santorinios, M., Zoi, S., Dimitriadis, N., Diamantopoulos, T., & Bardakos, G. (2016). From complex arts to hypermedia and new virtual-potential spaces. A handbook for the digital artist.
[53]. Sapliyan, S., Chatwattana, P., & Nilsook, P. (2023). Constructionism Imagineering Learning Model via Metaverse to Enhance Young Innovators. Journal of Education and Learning, 12(4), 81-91.
[54]. Seigneur, J. M., & Choukou, M. A. (2022, May). How should metaverse augment humans with disabilities?. In 13th Augmented human international conference (pp. 1-6).
[55]. SERPİL, H., & KARACA, D. (2023). The Metaverse or meta-awareness?. Journal of Metaverse, 3(1)
[56]. Stephenson, N. (2003). Snow crash: a novel.
[57]. Suh, W., & Ahn, S. (2022). Utilizing the metaverse for learner-centered constructivist education in the post-pandemic era: An analysis of elementary school students. Journal of Intelligence, 10(1), 17.
[58]. Sutikno, T., & Aisyahrani, A. I. B. (2023). Non-fungible tokens, decentralized autonomous organizations, Web 3.0, and the metaverse in education: From university to metaversity. Journal of Education and Learning (EduLearn), 17(1).
[59]. Tlili, A., Huang, R., Shehata, B., Liu, D., Zhao, J., Metwally, A. H. S., ... & Burgos, D. (2022). Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis. Smart Learning Environments, 9(1).
[60]. Tinmaz, H. (2023). Technology Giant South Korea's Metaverse Experiences. In Metaverse: Technologies, Opportunities and Threats (pp. 305-322). Singapore: Springer Nature Singapore.
[61]. Trunfio, M., & Rossi, S. (2022, October). Advances in metaverse investigation: streams of research and future agenda. In Virtual Worlds (Vol. 1, No. 2, pp. 103-129). MDPI.
[62]. Wang, M., Yu, H., Bell, Z., & Chu, X. (2022). Constructing an Edu-Metaverse ecosystem: A new and innovative framework. *IEEE Transactions on Learning Technologies*, 15(6), 685-696.
[63]. Zallio, M., & Clarkson, P. J. (2022). Designing the metaverse: A study on inclusion, diversity, equity, accessibility and safety for digital immersive environments. *Telematics and Informatics*, *75*, 101909.
[64]. Zhou, B. (2022). Building a smart education ecosystem from a metaverse perspective. *Mobile Information Systems*, *2022*, 1-10.