Discovering the Influence of the Metaverse in experiential learning – a literature review

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***Abstract*—This research-to-practice full paper describes the implications of considering the metaverse as part of experiential learning based on computer-based instructions. The term "Metaverse" refers to a virtual world or universe gradually becoming a reality with the advancement of immersive technologies like virtual and augmented reality. One area where the Metaverse can be applied is in education and general learning, particularly experiential learning. By providing immersive and realistic virtual environments, the Metaverse has the potential to greatly enhance experiential learning, enabling us to explore and access resources and experiences that may not be possible in the physical world. However, limited information on this emerging technology and its potential educational applications is available. This article explores the benefits and challenges of the Metaverse in education by conducting a literature review of major digital repositories. The study includes researching and analyzing existing academic literature, articles, and reflections on how the Metaverse can enhance or be used for experiential learning. As a result, the paper discusses the potential advantages and issues that need to be addressed for the Metaverse to be effectively utilized in education, such as improving access to resources and experts and increasing motivation and engagement among learners.**

***Index Terms*—Metaverse, experiential learning, technology, education, innovation.**

I. Introduction

The idea of the Metaverse is not new; it has been around for decades in science fiction literature, films, and video games. However, with the recent advancements in technology such as virtual reality, augmented reality, and blockchain, the concept of the Metaverse is becoming increasingly realistic and tangible. The Metaverse is expected to be a vast, interconnected virtual world where users can interact with each other, digital objects, and AI-powered avatars in real-time. It will be a place where users can engage in various activities such as gaming, socializing, shopping, learning, and even working. The Metaverse is also expected to have a significant economic impact [1], [2], as it will create new opportunities for businesses and entrepreneurs to reach customers and build new revenue streams [5]. The Metaverse will also enable new forms of collaboration and communication, making it easier for people to connect and work together, regardless of their physical location [13]. The Metaverse is still in the early stages of development, but many companies and organizations are investing in its development, and it is expected to increase in the coming years. However, many challenges remain, such as data privacy, security, and regulation issues, which must be addressed to reach their full potential. One of the fields in which the Metaverse can assist with its technology is education and general learning, such as experiential learning. Within the research field, limited information exists on this emerging technology being applied in an educational environment. Approaches should be based on practical education at different academic levels. This article explores the Metaverse as a tool for educational development, analyzing its advantages and disadvantages through research papers published and indexed in major digital repositories. The article is organized as follows: Section II provides background information, Section III describes the methods used in this review, Section IV discusses the results related to the benefits and challenges of the Metaverse in experiential learning, Section V presents the discussion, and Section VI concludes the article.

II. Background

A. Metaverse

Metaverse can be defined in different ways, each one according to the nature of the application or even related to the interaction level. Research [15] presented a definition focused on the educational field in which possibilities and limitations are presented, considering a wide range of applicability. As presented in Figure 1, this definition shows four types of Metaverse: Augmented Reality (AR), Life-logging, Mirror Worlds, and Virtual Worlds. These types of Metaverse are segmented into four axes: intimate vs. external and simulation vs. augmentation [27].

Considering those as mentioned earlier, for a metaverse to be defined as such, it must have the following essential characteristics [5]:

- Interactivity - where the user can generate interaction within the Metaverse and with other users within it.
- Corporeality - the accessed Metaverse must be subject to different physical laws so that a sensation like a real physical environment can create a relationship with users and objects within the Metaverse.

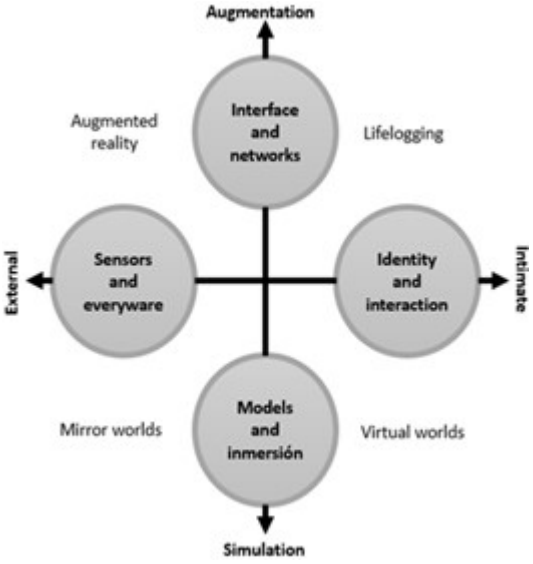

Fig. 1. Example of a figure caption.

- Persistence - regardless of the users' connection status, the Metaverse must continue functioning.

B. Experiential Learning

Experiential learning is a type of learning that occurs through direct experience or participation in activities. It is based on the idea that people learn best by doing and that knowledge and skills are most effectively acquired through direct experience. It is an active and hands-on approach to learning that allows individuals to apply their knowledge and skills in real-world situations. It will enable users to reflect on their experiences to gain new insights and perspectives [30]. Experiential learning can take many forms, including internships, apprenticeships, fieldwork, service learning, and simulations. It is often used in education and training programs, particularly in business, engineering, healthcare, and the arts.

Experiential learning is also commonly used in outdoor and adventure education. Participants engage in hiking, camping, rock climbing, and white-water rafting to learn about themselves and nature. Experiential learning is considered a practical approach to learning as it allows individuals to learn by doing, which can lead to deeper understanding and retention of knowledge. It also provides opportunities to apply skills in real-world settings, which can be beneficial in preparing individuals for future careers. Additionally, experiential learning encourages critical thinking, problem-solving, and collaboration, essential skills for success in today's rapidly changing world. Experiential learning is an approach to learning that focuses on direct experience and active participation. It is considered an effective way to develop new abilities and skills and is widely used in education and training programs across various fields. By providing a virtual reality environment where users can interact with each other and digital objects, the Metaverse can offer unique and immersive learning experiences that are impossible in the physical world. For example, students could virtually visit historical sites, conduct virtual lab experiments, or collaborate on projects with classmates from other countries.

One key benefit of using the Metaverse for experiential learning is that it allows for creating realistic and highly engaging simulated environments. This can enable students to explore and learn in a safe and controlled environment while still gaining real-world experience. The Metaverse allows the creation of equipment simulations and field tests, which in the physical world can be expensive, emphasizing that field tests can also be carried out in remote or hostile areas.

Another advantage of the Metaverse in experiential learning is that it allows for greater flexibility in terms of time and location. Students can access virtual environments and participate in activities anytime, regardless of physical location. This can help to remove barriers such as distance and mobility costs, making learning more accessible to a broader range of students. The Metaverse has the potential to revolutionize education by fostering teamwork, communication, and personalization between students and teachers. It transcends conventional limitations such as time and distance, enabling fluid interaction and knowledge sharing for more effective learning. Through the Metaverse, students and teachers can involve personalized learning experiences tailored to their interests and objectives, including simulations and virtual environments. Immersive and realistic virtual environments allow students to explore resources and experiences beyond the physical world's limits, eliminating traditional barriers and ensuring more accessible and effective learning.

A literature review of the Metaverse and experiential learning involves researching and analyzing academic literature, articles, and studies on how the Metaverse can enhance experiential learning. One key area of research focuses on the applicability of virtual and augmented reality in education and how the Metaverse can create immersive learning environments. Studies have shown that virtual and augmented reality can improve student engagement, motivation, and retention of material [6].

Another area of research examines the Metaverse as a tool for collaboration and communication in experiential learning. This includes the ability for students to work together and share information in real-time, regardless of their physical location, thereby improving the effectiveness of experiential learning. Research also addresses the design and implementation of effective metaverse-based experiential learning activities, including best practices and guidelines for creating engaging virtual environments and evaluating their effectiveness [24].

III. Methods

In this work, researchers performed an in-depth analysis of the reported studies involving Metaverse and experiential learning. This study aims to understand how the Metaverse impacts experiential learning. It is an important step in the research process as it allows researchers to understand the

current state of knowledge on the topic, identify gaps in the literature, and report the development of a research question or hypothesis [18]. The current study is developed in several stages. Reported results are obtained after following the next steps presented on Figure 2:

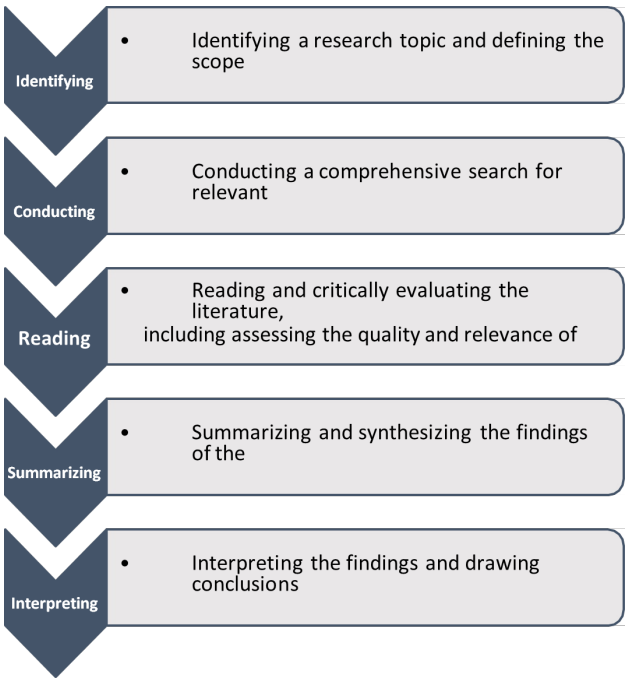

Fig. 2. Protocol literature review

A. Identifying research question

The current study aims to examine the aspects of experiential learning that can be addressed by the current use of the metaverse. Thus, the following research question is presented: *"How does the Metaverse impact experiential learning?"*.

The idea behind the following research question is to explore the effects of the Metaverse, a virtual reality space where users can interact with a computer-generated environment and other users, on experiential learning, which is the process of learning through direct experience. Therefore, this question encourages an exploration of both the theoretical and practical implications of using the Metaverse as a tool for enhancing experiential learning.

B. Conducting a search strategy

This study used digital databases such as IEEExplore, ACM Digital Library, Web of Science, and Scopus to extract documents [3]. These repositories encompass many specific conference proceedings and journals pertinent to software engineering and computer science. The initial phase of the search strategy involved defining the search string for the query. During this phase, the keywords, abstracts, and titles of the papers were searched using the following terms in combination with the boolean operators "AND" and "OR": *("metaverse" AND "experiential learning") OR ("metaverse reality" AND "experiential learning").*

The search covered the period from 2014 to 2023 and included articles in English. 69 papers were selected for preliminary review.

C. Selection criteria and paper reading

In this step, researchers ensure that only pertinent studies on metaverse within the experiential learning context are included for further analysis. This is accomplished by applying specific inclusion and exclusion criteria to the mapping study to determine the eligibility of each paper for subsequent steps. Studies were included if they met the following criteria: supporting educational practices through the use of metaverse, being full papers, and originating from academic journals and conference proceedings. Studies were excluded if they met any of these criteria:

- Not focused on education and experiential learning, only addressing the development and implementation of a metaverse
- Not written in English, studies published before 2014
- Duplicated reports of the same study in different sources, introductory papers for special issues, books, workshops, and technical reports (grey literature)

Researchers read the paper title, abstract, and keywords to apply the inclusion criteria and consider that at least papers should mention the keywords presented in the search strategy. Then, the exclusion criterion was used during the full paper reading, generating what we call the primary studies. As a result, 12 papers were selected to conduct a full reading, summarizing, and synthesizing the literature findings

D. Summarizing primary studies

Researchers thoroughly read and analyzed the selected primary studies for further classification. Data extraction was performed by subdividing the research question into more specific criteria. The purpose of this approach is to ensure that each paper is classified using the same extraction criteria, thereby simplifying document categorization and data extraction.

E. Interpreting findings

This process entails analyzing how virtual environments enhance or hinder the learning experiences of students. Researchers assess the effectiveness of the Metaverse in providing immersive, interactive, and practical learning opportunities compared to traditional methods. By examining patterns, trends, and gaps in the literature, researchers can determine the extent to which the Metaverse facilitates experiential learning, identify best practices, and propose future research directions. This comprehensive analysis helps in understanding the potential of the Metaverse to transform educational practices and improve student engagement and outcomes through experiential learning.

IV. Results

The identified articles include both theoretical and empirical studies. Table I summarizes the main empirical case studies relevant to experiential learning across different fields. After

the analysis and review of each article, the compilation of key aspects was conducted on how the Metaverse has the potential to generate an impact on experiential learning within the educational environment. These aspects are detailed as follows:

Immersive and interactive environments: The Metaverse allows the creation of immersive and interactive virtual environments that simulate real-world scenarios and situations. This can provide students with hands-on, experiential learning opportunities that are otherwise difficult or impossible to replicate in the physical world. In education, tests are being carried out, recreating scenarios such as historical places and educational centers to obtain a place where students feel comfortable and attached to reality. In [10], Kwangwoon University in Korea developed a "Metaverse Lecture Platform" for 43 courses, engaging 1,200 students in an immersive and interactive virtual learning environment (see Figure 3). The students participated in virtual campuses as avatars and attended lectures. This initiative aims to enhance digital content infrastructure and establish a virtual convergence lab for an XR campus.

Fig. 3. Metaverse of Kawangwoon University

Accessibility and inclusivity: By allowing students to access virtual environments from anywhere with an internet connection, the Metaverse can make education more accessible to those facing barriers to traditional in-person learning, such as individuals with disabilities or those living in remote or underserved areas.

The Hong Kong Polytechnic University has created one of the first immersive education centers based on developing a Metaverse to make an impact within the virtual world by creating action in various virtual worlds and continuous research. Based on this education center, spaces for primary, secondary, and higher education are being developed. Thanks to these research centers, accessibility is allowed to students from other countries or with mobile difficulty, breaking borders within education and generating benefits for students, teachers, and society [19].

In [20] is presented one of the Metaverse campuses created by the Hong Kong Polytechnic University (see Figure 4), where users can enter the educational system from any site with an internet connection aiming to ease accessibility from everywhere in the world.

Fig. 4. Virtual campus in Hong Kong Polytechnic University

Increased collaboration: The Metaverse allows activities to be carried out while maintaining real-time communication with the users connected within the mentioned universe. In this way, students can work together on various projects through simulations and shared activities within this virtual environment. In [9], students highlighted the convenience in facilitating small group activities. Students appreciated the ability to focus on group discussions in designated areas, which enhanced collaboration and communication among peers

Benefits and Challenges of the Metaverse within educational contexts Metaverse learning environments offer a range of benefits that can significantly enhance the learning experience for students. One of the most important advantages is providing practical and immersive learning experiences since these can be simulated as scenarios within the real world and daily life situations. This allows students to apply their knowledge effectively and develop practical skills for a future work environment and project resolution [14], [29].

Free access to virtual environments with any internet connection increases accessibility and inclusiveness within the educational field, allowing students worldwide to access resources developed by academic institutions through practical projects. This type of real-time feedback within a virtual environment increases interaction and collaboration compared to other online educational methods. However, several critical challenges must be addressed before the Metaverse fully integrates into the educational environment. For example, the high cost and technical expertise required to create and maintain this virtual environment can become a significant obstacle for academic centers, especially for their students. In addition, the lack of standards and regulations for this type of technology can hinder its development and implementation. Another critical challenge that the Metaverse presents is the issue of existing social and economic inequalities. This way, access to this platform type can be limited to specific groups. Ethics and privacy related to the entry of various types of personal data

TABLE I
CASE STUDIES

Reference	Type of Metaverse	Educational Area	Target Users	Challenges	Evaluation
[21]	Virtual world, VR	Sports education	College students	Cost and accessibility, lack of resources	Surveys on several constructs
[25]	Virtual world	Mathematics course	Learners with disabilities	Technical limitations, diverse learning needs	A/B evaluation and survey
[31]	Augmented reality	Foreign language course	High-school students	Technical issues and device accessibility, limited participant diversity	A/B evaluation, pre and post tests
[26]	Augmented reality	E-commerce course	University students	Lack of technological knowledge	Survey
[22]	Virtual reality	VR training	High school teachers	Lack of technological knowledge, high cost	Survey
[29]	Xtended reality	Architectural education	Undergraduate students	Difficulty to produce lessons for teachers, high cost	-
[14]	Virtual reality	Surgical training	Workers	Complexity of controls, limited experience with VR, increased cognitive load	Survey
[9]	Virtual reality and mirror worlds	Humanities courses	Undergraduate students	Lag and technical issues, limited generalizability	Survey
[16]	Virtual-augmented reality and life-like simulators	Emergency medical care training	University students	Determine timing of activities	Comparison with control groups
[12]	Augmented reality and virtual reality	Horticulture and landscape management education	Undergraduate students	Higher-order cognitive learning processes and resource limitations	Comparison with control groups

within the Metaverse must also be considered. Therefore, user information security must be guaranteed when entering virtual environments. The Metaverse has the potential to revolutionize education and the way we learn by providing hands-on and immersive learning experiences, increasing accessibility and inclusiveness within the educational environment. However, it is vital to analyze the different challenges that arise and work to create safe, inclusive, and high-quality virtual educational environments.

V. DISCUSSION

The Metaverse has the potential to provide immersive and interactive environments for experiential learning by allowing students to engage in simulations, virtual field trips, and other hands-on activities in a virtual environment that is similar to the real world. The mentioned can allow students to experience real-world scenarios and situations in a safe and controlled setting without expensive travel or equipment. One of the key features of the Metaverse is the ability to create and customize virtual environments. This allows educators to design and create simulations, virtual worlds, and other interactive experiences that align with the curriculum and learning objectives. For example, as stated by Ren [21], in a science class, students can visit a virtual lab and conduct experiments that would be too dangerous or expensive to perform in the real world. Moreover, researchers in [7] illustrate that in a history class, students can visit virtual recreations of historical sites, such as ancient cities or battlefields, and explore them as if they were there in person. The Metaverse also allows for real-time collaboration and communication among students, enabling them to collaborate on projects, simulations, and activities in a shared virtual environment. Collaboration can improve teamwork and problem-solving skills and allow peer-to-peer teaching and mentoring. Overall, the Metaverse can provide immersive and interactive environments that simulate real-world scenarios and situations, providing students with hands-on, experiential learning opportunities that are otherwise difficult or impossible to replicate in the physical world. The Metaverse has the potential to provide accessibility and inclusivity for experiential learning by allowing students to access virtual environments from anywhere with an internet connection. Virtual environments remove barriers to traditional in-person learning, such as geographical location or physical disabilities, and provide opportunities for students to participate in hands-on, experiential learning regardless of their location or ability level. Researchers from some research centers [8], [28] explain that students living in remote or underserved areas may not have access to specific resources or educational opportunities. Still, with the Metaverse, they can participate in virtual field trips, simulations, and other interactive experiences that would otherwise be unavailable. Additionally, students with physical disabilities or mobility issues may find it challenging to participate in certain hands-on activities in the physical world. Still, they can engage in interactive simulations and activities tailored to their abilities in the Metaverse. Furthermore, the Metaverse also allows for personalizing virtual environments, which can help accommodate different learning styles and abilities. For example, students with visual impairments can customize the virtual environment to meet their needs, such as adjusting the font size or adding audio descriptions [23]. Overall, the Metaverse has the potential to provide accessibility and inclusivity for experiential learning by removing barriers

to traditional in-person learning and providing opportunities for students to participate in hands-on, experiential learning regardless of their location or ability level. The Metaverse has the potential to provide increased collaboration for experiential learning by allowing students to work together on projects, simulations, and activities in a shared virtual environment. This can improve teamwork and problem-solving skills and enable peer-to-peer learning and tutoring. One of the critical features of the Metaverse is the ability to communicate and collaborate in real-time. Synchronous collaboration allows students to share ideas and feedback, work together on projects and simulations, and participate in group activities in a virtual environment. Çelik & Yangın [31] discuss that students in a virtual design class can work together on a virtual building project, sharing design ideas and receiving feedback from classmates. In a virtual lab class, students can collaborate on a virtual experiment and share data and observations in real-time. Additionally, the Metaverse allows the creation of virtual classrooms and meeting spaces where students and teachers can interact in real-time, regardless of their physical location. This can facilitate remote and hybrid learning, allowing students to participate in class discussions, collaborative projects, and other activities as if they were in the same physical location. In general, the Metaverse has the potential to provide increased collaboration for experiential learning by allowing students to work together on projects, simulations, and activities in a shared virtual environment, improving teamwork and problem-solving skills, as well as allowing for peer-to-peer activities to enhance different abilities.

A. Challenges of the Metaverse in Experiential Learning

While the Metaverse has the potential to revolutionize experiential learning, authors have exposed several challenges, that must be addressed to ensure that the benefits of the technology can be fully realized. Some of the main challenges include:

- **Technical and financial challenges:** Developing and maintaining virtual environments in the Metaverse requires significant technical expertise and resources. Wang et al. [29] emphasize the difficulty of quickly mastering and utilizing virtual environments due to insufficient systematic technical training and the expertise needed. Developing realistic and interactive virtual worlds, simulations, and educational content is a time-consuming and costly process. Schools and academic institutions may have difficulty affording the technology and infrastructure required to implement the Metaverse in their curriculum. Additionally, comprehensive training programs for teachers are needed to build their confidence and technical skills in using metaverse techniques such as VR or AR [22], [23].
- **Lack of standardization:** The Metaverse is a relatively new technology, and there is a lack of standardization regarding the platforms, tools, and content used [21]. This can make it difficult for educators to know which platforms and tools to use and create content compatible with different systems. Furthermore the lack of standardization it also extends to the tasks students perform in the metaverse. Initial training sessions aim to familiarize participants with the VR equipment in [14]. However, a transition from basic tasks to more complex manipulations requires significant cognitive effort, which could be overwhelming for some users. The current application of techniques like VR in education primarily emphasizes concrete experiences and active experimentation. However, it often neglects the internal stages of reflective observation and abstract conceptualization, which are crucial for comprehensive experiential learning [12]. This limitation suggests that the design of metaverse applications in education needs to be more holistic to support all aspects of an experiential learning cycle.
- **Privacy and security concerns:** The Metaverse collects and stores large amounts of personal data, and there are concerns about how this data is used and protected. For instance in VR experiences, due to the need for headset access, users frequently must identify themselves using biometric data, making them vulnerable to security assaults [17]. There is also a risk of cyberbullying, harassment, and other forms of abuse in virtual environments, making it necessary to ensure the safety and security of users in the Metaverse [4].
- **Inclusivity challenges:** The Metaverse may not be accessible to all students, particularly those who do not have access to the technology and internet needed to participate fully in the Metaverse [26]. This can further widen the digital divide and perpetuate social and economic inequalities. This diversity means that the experiences and perceptions of VR can differ significantly among different regions and communities [22].
- **Ethical challenges:** The Metaverse raises ethical concerns about using personal data and ensuring the safety of users in virtual environments in several of the articles reviewed [15], [27], integrity issues include printing and spreading false information and fraud [11], as well as issues related to the representation of individuals and groups in virtual environments [25].

VI. CONCLUSIONS

The concept of a metaverse, or a virtual world where users can interact and engage with each other and digital objects in a shared environment, can potentially revolutionize how we learn and experience the world. One of the most significant benefits of the Metaverse for experiential learning is the ability to create immersive and interactive environments that can simulate real-world scenarios and situations. This can provide students with hands-on, experiential learning opportunities that are otherwise difficult or impossible to replicate in the physical world. Additionally, the Metaverse can also improve accessibility and inclusivity in education. By allowing students to access virtual environments from anywhere with an internet connection, the Metaverse can make education more accessible to those facing barriers to traditional in-person learning, such

as individuals with disabilities or those living in remote or underserved areas. However, the development and implementation of a metaverse also presents several challenges. One of the major challenges is the cost and technical expertise required to create and maintain virtual environments. Additionally, there are concerns about the potential for the Metaverse to perpetuate existing social and economic inequalities, as access to the technology and resources needed to participate fully in the Metaverse may be limited to specific individuals or groups. Furthermore, there are ethical and privacy concerns related to using personal data in the Metaverse and ensuring the safety of users in virtual environments. These challenges must be addressed to ensure that the benefits of the Metaverse can be fully realized and that it is inclusive, accessible, and safe for all users. In conclusion, the Metaverse has the potential to transform the way we learn and experience the world, providing immersive and interactive environments that can simulate real-world scenarios and situations. However, developing and implementing a metaverse also presents several challenges that must be addressed to ensure that all users can fully realize the benefits.

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