Learning in the Metaverse

Omar Fourati[1,2], Hanna Jobst[1,3], and Magnus Schneider[1,4]

[1] *Friedrich Alexander University Erlangen-Nürnberg, Findelgasse 7/9, 90402 Nürnberg, Germany*

Abstract

The metaverse, characterized by immersive and interconnected digital experiences, has garnered significant attention for its potential to revolutionize learning environments. This paper explores the intersection of learning and the metaverse, aiming to unravel the transformative implications of implementing metaverse solutions in higher education. Drawing on an extensive review of existing literature, we examine the evolving nature of education in digital realms, the impact of immersive technologies on pedagogical approaches, and the potential benefits and challenges of incorporating the metaverse into higher education settings. Central to our investigation is the research question: What are the implications for the implementation of metaverse solutions in higher education? By addressing this query, we seek to provide insights that can guide educators, policymakers, and technologists in navigating the uncharted territories of educational innovation within the metaverse.

Keywords

Metaverse, Immersive learning, Educational technology, Higher education, Pedagogical implications, Gamification in education

1. Introduction

The advent of the metaverse marks a pivotal moment in the digital era, transforming the way individuals interact with virtual environments. Defined as a collective virtual space that amalgamates physical reality with augmented and virtual realities, the metaverse has transcended its origins in gaming and entertainment, making significant inroads into diverse sectors, including education. As higher education institutions grapple with the imperative to adapt to an increasingly digitalized world, the metaverse presents a unique set of opportunities and challenges in reshaping traditional learning paradigms. This paper endeavors to delve into the dynamic intersection of learning and the metaverse, shedding light on the multifaceted dimensions that this amalgamation entails. By examining the evolving landscape of educational technology, the potential pedagogical shifts brought about by immersive technologies, and the broader implications for higher education, we aim to address a critical question: What are the implications for the implementation of metaverse solutions in higher education?

2. Theoretical Foundation – What is the Metaverse?

The metaverse is an embodied version of the internet. [1] It is a computer-generated, immersive environment where people can interact in real-time with other users. Users can engage in a variety of different activities such as socializing, working, playing games, attending event, and more. [2] The main aspect is the unity of reality with the possibilities of the internet.

The metaverse is a convergence of physical and virtual reality. However, there are different technologies in use that offer an immersive and interactive 3D environment, for example virtual reality (VR), augmented reality (AR), mixed reality (MR) or extended reality (XR), and other advanced computing technologies. Developers all over the world are actively working to create metaverse experiences. It has become a focus topic for some

[2] Omar Fourati is the author of the abstract and the sections 1. Introduction, 3.2. Data Collection – Use Cases and 4.2. Use Cases.

[3] Hanna Jobst is the author of 2. Theoretical Foundation -What is the Metaverse?, 3.1 Literature Review and 4.1 Findings in Literature (subsections included).

[4] Magnus Schneider is the author of 3.3 Expert Interviews and 4.3 Expert Interviews (subsections included).

industries and companies are investing a lot of money to build a seamless interconnected digital space that fosters presence and community.

Within the metaverse there a variety of solutions for different real-world activities, e. g. the use of the metaverse in education. In education holds big potential to improve the knowledge transfer as well as decrease costs and increase accessibility. [3]

3. Methods

3.1. Literature Review

A structured literature review was adopted as a research method to structure existing knowledge on the topic. The review was divided in the three parts: planning, conducting, and reporting, adopted from Kitchenham and Charters by Hericko and Sumak. [4] & [5]

Planning the review consisted of formulating the question for the review, as follows: "What are implications for the implementation of metaverse solutions in higher education?" The search strategy subsists of setting the search terms, libraries, and search query. First, search terms consisted of "metaverse", "learning", "education", "higher", "VR", "AR", "3D", "stud*", and "immersive" including alternative spelling and synonyms were agreed on. Secondly, digital academic libraries were selected to be searched; Science Direct, Scopus, and IEEE Xplore. However, the review was not limited to only scientific sources since the Metaverse itself is a trending topic in pop culture as well as relevant for innovative companies. We although considered practical source from companies and other projects. Furthermore, we screened the papers for other relevant sources within its references. Thirdly the search query was adapted to cover metadata, such as title, abstract, keywords, and citations. Studies were selected by highest relevance for the review research question. Relevance was ensured by using the following inclusion & exclusion criteria's:

Inclusion criteria:

IC1: The paper is published in a journal, conference proceeding, workshop proceeding, or is a practical source which applies the researched topic.

IC2: The paper is written in either English or German.

IC3: The paper is electronically accessible.

IC4: The paper is considering learning aspects or kinds of knowledge transfer within the metaverse.

On the other hand, papers that did not meet the following were excluded:

EC1: The study is neither published in a journal, conference proceeding, workshop proceeding, or is a practical source which applies the researched topic.

EC2: The paper is not written in English or German.

EC3: The paper is not accessible electronically.

EC4: The paper does not consider learning aspects or kinds of knowledge transfer within the metaverse.

In addition, we looked for the latest publications to capture the recent recoveries.

The review wants to identify themes, debates, and gaps. No data extraction tool was used.

The conduction of the review and the result reporting is explained in the chapter 4.1.

3.2. Data Collection – Use Cases

Our initial exploration revealed a diverse array of literature and websites addressing metaverse learning examples. We prioritized articles and innovations published within the last five years to ensure the incorporation of recent advancements.

Key terms such as "metaverse education use cases" and "virtual reality in learning use cases" emerged as crucial components of the search. Index terms assigned by the databases, such as "virtual classrooms use cases" and "immersive simulations use cases," provided additional insights into the focus of the articles.

Based on this, we didn't focus on any specific design goal on existing use cases, but we wanted to understand what the trends are and what has been studied. We focused on 40 sources that we found explicit enough to understand and be able to analyze the presented use case well. All of the collected studies had explicit design goals where the learning strategies were sometimes not mentioned, not clear. Moreover, a small, programmed script helped us to directly look for specific words related to the learning strategies, which made it easy to categorize the specific papers found. This was only used for paper as for websites, the information about the solutions and use cases are directly described.

3.3. Expert Interviews

This study employed a comprehensive methodology to investigate the implementation of metaverse learning in higher education through structured interviews with three distinct participant groups: Higher Education Teachers (Professors, Tutors, and Ph.D. students), Metaverse Practitioners, and

Students. The methodology was adapted from Gioia et al. (2012). [6]

Participants were selected through purposeful sampling to ensure diverse representation within each group. For expert interviews, we systematically selected Higher Education Teachers crucial to the Bachelor Information System. We targeted faculties of Economics and Social Sciences and of the Technical Faculty, focusing on educators contributing at least one module to the curriculum and at best holding high importance through their extensive course offerings in the field. This approach ensures a diverse and comprehensive representation. The aim is to harness the expertise of teachers deeply integrated into the program, fostering a rich educational experience that spans both economic and technical perspectives. For students we focused on students currently studying the Bachelor Information System and those that already finished their bachelor's degree and can help identify potential change in the studies.

All participants provided informed consent, understanding the voluntary nature of their participation and their rights throughout the research process. Structured interviews, guided by a carefully designed interview guide, were conducted one-on-one with each participant group. For Higher Education Teachers, questions were tailored to their specific roles, while Metaverse Practitioners were asked about their practical experiences and Students' interviews explored their experiences with metaverse learning and potential integration wishes. Structured interviews were selected for conducting interviews with three distinct groups due to their capacity for minimizing bias and enhancing reliability in data collection. The standardized format ensures consistency, reducing the potential for interviewer influence. This approach facilitates unbiased assessments across diverse groups, promotes reliable data analysis, and streamlines the comparative evaluation of findings.

In total 22 participants were interviewed. Theoretical saturation was reached after eight interviews within the group Students, eight within Lecturers and six interviews in the group Practitioners.

Data collection involved obtaining participant consent for audio-recorded interviews, facilitating in-depth exploration of perspectives. Additionally, interviews were conducted in written form to expedite access and reduce time constraints, aiming to encourage more participants to engage in the study. Thematic analysis was employed during data analysis, identifying recurring themes and patterns across participant responses. Ethical considerations prioritized participant confidentiality and anonymity, and the study adhered to ethical guidelines for human research.

For analysing the expert interview we employed a dual strategy. Firstly, a structured analysis was conducted based on predefined groups established during question formulation. This involved systematic categorization and simple statistical measures to quantify responses within predetermined themes. Secondly, an exploratory analysis was carried out without predefined categories. Clustering techniques and pattern analysis were applied to identify emergent themes, allowing for a more open-ended understanding of the data. The integration of these approaches provided a comprehensive insight into both anticipated and unforeseen aspects of the interview responses. Triangulation was employed by comparing responses across the three participant groups, validating findings, and enhancing overall reliability. Reflexivity was maintained throughout the study, with researchers acknowledging and addressing potential biases during data collection and analysis.

This comprehensive and systematic methodology ensures a thorough exploration of metaverse learning experiences from the perspectives of Higher Education Teachers, Metaverse Practitioners, and Students, contributing valuable knowledge to the ongoing discourse on the integration of metaverse learning in higher education especially the Bachelor Information Systems.

4. Results

4.1. Findings in Literature

The literature review was conducted on November 29th, 2023. From conducting the searches in digital libraries and practical sources, we initially retrieved a total of 68 articles, papers, and studies. After the application of the inclusion and exclusion criteria, two screening processes and duplicate removal 24 studies were found to be relevant for structuring existing knowledge on the topic.

The selected sources encompass a range of perspectives, including academic articles, industry reports, interviews, and podcasts. The analyzed sources, which were selected for data extraction and synthesis are documented in the table below.

Table 1
Identified Sources of Literature Review

ID	Author(s)	Ref.
S1	Muthmainnah, Yakin, & Seraj, 2023	[7]
S2	Zhang, Chen, Hu, & Wang, 2022	[3]
S3	Chen, Zou, Xie, & Wang, 2023	[8]
S4	Bhavana & Vijayalakshmi, 2022	[9]
S5	Newzoo, 2022	[10]
S6	Accenture, 2022	[11]
S7	Chen Z. , 2022	[12]
S8	Hines & Netland, 2022	[13]
S9	Yilmaz, O'Farell, & Clarke, 2023	[14]
S10	Makransky & Petersen, 2023	[15]
S11	Brookings, 2022	[16]
S12	Ribeiro, 2022	[17]
S13	World Economic Forum, 2023	[1]
S14	Havard Graduate School, 2022	[18]
S15	Bitkom e. V., 2023	[19]
S16	Yu, 2022	[20]
S17	Cengel & Yildiz, 2022	[21]
S18	Park & Kim, 2022	[2]
S19	Belova & Belova, 2023	[22]
S20	Son & Lee, 2022	[23]
S21	Rahman, Shitol, Islam, Iftekhar, & Saha, 2023	[24]
S22	Arés, 2023	[25]
S23	Hyunh-The, Pham, Nguyen, Han, & Kim, 2023	[26]
S24	Guo, et al., 2022	[27]

The knowledge of the named academic sources can be into those three categories: benefits & potential, downsides & obstacles, and future studies. Which represent the target of identifying themes (4.1.1), debates (4.1.2), and gaps (4.1.3).

4.1.1. Benefits & Potential

The use of Metaverse in higher education will result in the following benefits and potentials:

- Higher involvement and motivation of students (S1, S4),
- A better learning process overall (S2, S3, S8, S9, S13, S7, S15, S18, S19, S10),
- Location independent, low in cost and risk (S2, S3, S14, S13, S22, S7, S15, S19, S21),
- Technical skills for application exist (S5, S12, S6) and
- The huge potential is the use of AI for development and interaction features (S23, S24).

4.1.2. Downsides & Obstacles

On the other hand, some literature was claiming downsides and warning of obstacle to overcome in the process as following:

- Technical requirements are not met, and people are not ready to use the Metaverse (S2, S3, S7, S8, S16, S11, S17),
- Access restrictions are needed (S1),
- Privacy and data issue can/will arise (S2, S3, S7) and
- Ethics and morality need to be discussed (S2, S3, S7).

4.1.3. Future Studies

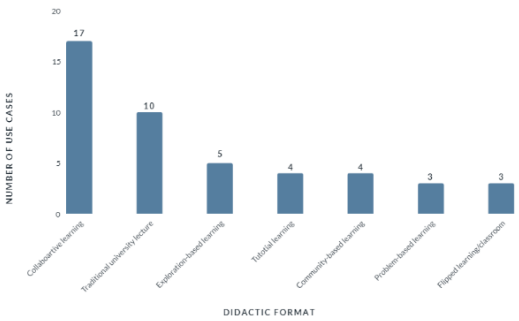
Gaps in literature that should be studied in the future are:

- Creator education (S2, S3),
- Frameworks and rules for application within the Metaverse (S2, S3, S9),
- The impact of immersion (S1, S10, S2, S3) and
- AI's potential and impact on the Metaverse (S23, S24).

4.2. Use Cases

After extracting the use cases, we clustered these into different learning strategies to understand where the focus has been directed. Reisoğlu et al. [28] proceeded this way to cluster all the studies that are relevant to metaverse learning within all the existing learning strategies. Finally, after understanding the learning strategy associated to the study, we focus on creating didactical formats categories for the use cases to focus more on the use case within universities. The findings are described in the following graph:

Figure 2
Learning strategy occurrence in found paper.



As we can see in the graph, most of the studies and use cases found present mostly the didactic formats collaborative learning and traditional university lectures. Some examples to illustrate this could be the collaborative framework of Joshi and Pramod [29] or the use case of collaborative learning in the metaverse of Schiller et al. [30]. For the traditional university lectures, we can mention the study of Tate [31] about university lectures offered in the metaverse at the University of Edinburgh or at the Stanford University [32]. The other formats are certainly being studied and use cases exist but as presented in the work of Dwivedi et al. [33] in the formats of "Propositions", developing and implementing effective and successful tools for metaverse learning needs to follow important principles that may present challenges for specific didactic formats. This idea can be illustrated by the study of Belmonte et al. [34] showing that flipped learning classrooms and traditional lectures in the metaverse doesn't have any outcome differences. Thus, it is important to follow some main conditions for the optimal practical application of pedagogical models in virtual contexts.

4.3. Expert Interviews

Our study aimed to explore the perceptions of three distinct groups—Lecturers, Practitioners, and Students—regarding the potential of Metaverse solutions in higher education. The analysis of expert interviews revealed intriguing insights and diverse perspectives within each group.

4.3.1. Perception and Potential:

The Practitioners and Students groups exhibited a notably positive perception of Metaverse solutions in higher education. Participants expressed enthusiasm about the potential benefits and opportunities that the Metaverse could bring to the educational landscape. They highlighted the potential for individualization and tailored content delivery, foreseeing a transformative impact on the learning experience.
In contrast, Lecturers were generally more sceptical about the adoption of Metaverse solutions in education. While acknowledging the potential, they raised concerns and reservations about its practicality and effectiveness in traditional educational settings. Despite their scepticism, there was a recognition of the Metaverse's potential to bring about significant changes in education.

4.3.2. Individualization / Tailored Content:

Across all groups, there was a consensus on the potential of Metaverse solutions to provide personalized and tailored content. Participants highlighted the ability to cater to individual learning styles, thereby enhancing the overall educational experience.

4.3.3. Immersive Gamified Experience

Respondents from all three groups emphasized the importance of an immersive and gamified experience in the Metaverse. They believe that incorporating game elements into educational content could enhance engagement and make learning more enjoyable.

4.3.4. Engagement and Emotionalization

The anticipation of improved student engagement and emotional involvement emerged as a common theme. Participants envisioned the Metaverse as a platform to create emotionally engaging learning environments, fostering a more profound connection between students and educational content.

4.3.5. Collaboration and Communication

All groups highlighted the potential for the Metaverse to revolutionize collaboration and communication in educational settings. Virtual spaces were seen as platforms for innovative and interactive forms of collaboration, transcending traditional boundaries.

4.3.6. Importance of Motivation

Motivation was identified as a crucial factor for the successful implementation of Metaverse solutions. Participants emphasized the need for strategies to motivate both educators and learners to embrace and effectively utilize these innovative tools.

4.3.7. Training and Support:

Concerns regarding the need for adequate training and support were expressed across all groups. Participants underscored the importance of providing comprehensive training programs to educators to ensure the successful integration of Metaverse solutions in education.

4.3.8. Technical Barriers:

Technical barriers were acknowledged as a significant concern, especially by the Practitioners and Students groups. Issues related to accessibility, infrastructure, and technological literacy were identified as potential hurdles to widespread adoption.

4.3.9. Ethical Considerations:

Ethical considerations were a recurring theme in the responses. Participants across all groups emphasized the need for ethical guidelines and responsible use of Metaverse solutions to address potential challenges and concerns.

In conclusion, while there exists a diversity of opinions among Lecturers, Practitioners, and Students, there is an overarching assumption that the Metaverse holds substantial potential to revolutionize higher education.

5. Appendices

See files in Git Lab repository.

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