

A Study on Artificial Intelligence and the Metaverse

ALPEREN KAYAN, MUHAMET FATİH ZENGİN, KEMAL GÖKHAN NALBANT

Department of Software Engineering, Faculty of Engineering and Architecture,
Istanbul Beykent University,
Sariyer, Istanbul,
TURKEY

Abstract: - Metaverse and artificial intelligence stand out as two leading areas in emerging technology. In this study, studies and research carried out at the intersection of artificial intelligence and metaverse concepts are examined. In addition to these, the relationship and effects of these technologies with sectors such as education, gaming, and business are discussed. The findings from this study highlight the mutual contribution of the fields of artificial intelligence and metaverse, and the social and economic dimensions of the combination of these two fields.

Key-Words: - Artificial Intelligence, Metaverse, Virtual Reality, Augmented Reality, AI-Based Interaction, Survey

Received: June 11, 2025. Revised: March 15, 2026. Accepted: May 5, 2026. Published: July 13, 2026.

1 Introduction

1.1 Artificial Intelligence and the Metaverse: Intersection of Past and the Future

1.1.1 Artificial Intelligence

Artificial intelligence is a journey that started in the 1950s with Alan Turing's question, "Can a machine think?" In 1956, the term artificial intelligence was defined for the first time at the Dartmouth Conference, and the foundations of this field were laid. In the 1960s, systems were developed that perform simple tasks such as problem solving and logical reasoning. By the 1980s, expert systems gained more popularity as tools for processing information and making decisions in specific areas. Since the 2000s, artificial intelligence has advanced rapidly with the development of machine learning and deep learning algorithms. Nowadays, artificial intelligence takes an important role in natural language processing, image recognition, and real-time interactions.

1.1.2 Metaverse

The term metaverse first appeared in Neal Stephenson's science fiction novel Snow Crash [1], where it is described as a vast digital universe accessible to users through virtual reality headsets. In the early 2000s, platforms like Second Life offered the first examples of metaverse-like experiences that allowed users to interact with each other in virtual worlds. The term metaverse has

gained prominence since the 2020s. The advent of technologies such as augmented reality, virtual reality, and blockchain has increased interest in the metaverse. As a direct result of this, Facebook changed its name to "Meta," demonstrating the increased interest in the metaverse.

1.1.3 Integrating Artificial Intelligence and the Metaverse

Recently, artificial intelligence has surfaced as a key ingredient for the metaverse. Artificial Intelligence technologies feature the creation of avatars, natural language processing in virtual worlds, and building virtual environments that make the metaverse accessible and more interactive.

1.2 The Evolution of Artificial Intelligence Technologies

Artificial Intelligence is a branch of science that appeared with the purpose of developing systems capable of imitating human intelligence. The development of artificial intelligence technologies has been shaped by milestones from the past to the present. This evolution has accelerated in innovative ways that have appeared in different periods and has paved the way for advanced artificial intelligence applications today.

1.2.1 First Steps: Theoretical Foundations (1950-1970)

The research work on artificial intelligence began with the publication of the article titled "Computing

Machinery and Intelligence" in 1950, [2]. Turing introduced the Turing Test to determine if a machine could think. The term artificial intelligence was formally coined at the Dartmouth Conference of 1956, [3]. The systems designed at that stage were limited to performing simple tasks such as playing chess or solving mathematical calculations. The limited processing power of computers did not allow them to solve complex tasks.

1.2.2 The Rise of Expert Systems (1970-1980)

Initially, the 1970s saw a shift in AI research toward the creation of systems that were knowledgeable in a particular domain. Known as 'expert systems,' these computer programs utilized carefully constructed knowledge bases to guide them through even the most complex decision-making tasks. This was the first period during which the use of AI was brought into prominence with applications in medicine and business.

1.2.3 The Birth of Machine Learning (1980-2000)

The 1980s were a very significant time, marking the point when the machine learning began to take hold as a reality. The algorithms designed during this time were based on the capacity to learn and develop independently. The basic principles of artificial neural networks emerged during these years. The proliferation of the internet and digital data in the 1990s accelerated the development of machine learning algorithms.

1.2.4 The Age of Deep Learning and Big Data

In the early 2000s, deep learning algorithms began to be used thanks to big data and advanced processing power. These algorithms have revolutionized the extraction of meaningful information from large and complex data sets. Major innovations:

- Convolutional Neural Networks (CNN): Transformed the image recognition and computer vision landscape.
- Recurrent Neural Networks (RNN): An area in which RNNs contributed considerably is sequential data processing. This could include projects such as natural language processing and speech recognition.

Large tech giants such as Google, Amazon, and Facebook have also increased their spending on artificial intelligence during the same period and developed applications from it.

1.2.5 Present and the Future: Artificial Intelligence in All Areas (2010-Present)

In the last decade, artificial intelligence applications have begun to touch every aspect of human life:

- Natural Language Processing (NLP): Virtual assistance in the form of Siri, Alexa, or ChatGPT.
- Computer Vision: Autonomous vehicles and security systems.
- Generative AI: The application of AI-based solutions in creative domains such as the arts, music, or writing.
- Reinforcement Learning: It has many use cases, from game playing (e.g., AlphaGo) to robots.

On the flip side, apart from the benefits of the integration of artificial intelligence with the metaverse, there are innovative developments such as smart avatars, customized experiences, and dynamic content generation in virtual worlds.

1.3 The Rise of the Metaverse

The metaverse is a completely immersive and interactive virtual world that exists at the crossroads between the physical and digital worlds. The metaverse has gained prominence in a short while through technological advancement and increased investment interests. The Metaverse's history has started off as an investment concept but has actually proven to be a reality that has led to a revolution in most fields.

1.3.1 Technological Advances and the Proliferation of Virtual Worlds

In the early 2000s, the idea of the metaverse gained recognition with the development of the technological infrastructure and the rise of virtual online communities. The development that took place in this phase helped lay the foundation of the metaverse and laid the groundwork in a concrete form.

- Development of Augmented and Virtual Reality Technologies: During this period, the first commercial versions of Augmented Reality and Virtual Reality devices began to become widespread. Devices like these have made it possible to access virtual worlds and make the metaverse experience more realistic.
- The Age of Game Ecosystems: Games created worlds in which the digital communities of the age socialized with one another and created their own narratives in virtual realities. Such games could be seen as the initial exemplars of the social dynamics at work in the Metaverse.

- **The Power of Social Networks:** The likes of Facebook, Twitter, and Instagram have been responsible for the spread of digital socialization. The aforementioned social media platforms have played an indirect role in the creation of the Metaverse in that they have raised the user's need for the creation of digital or virtual space.

During this period, technological development and growing user engagement with digital services have created a foundation for the metaverse to spread. Although this is a very early stage for the full development of metaverse technology itself, this developmental process has garnered attention as a step in which action has been undertaken to materialize the metaverse.

1.3.2 The Future of the Metaverse and Its International Implications

The pandemic has triggered a rising interest in the metaverse and a demand for virtual realms such as virtual offices and virtual meetings.

- **Education:** Online classrooms, interactive training materials, and simulations.
- **Health:** VR-based therapy, surgical simulations, and patient education.
- **E-commerce:** A new shopping experience where brands will create virtual stores and will display products through 3D models.
- **Arts & Entertainment:** Virtual concerts and art shows in digital spaces and using NFTs.

The metaverse has emerged as a game-changer in terms of how people and businesses engage with each other in conducting business. The metaverse has dawned as one of the cornerstones of digital ecologies in a world where technological development has been happening at an unimaginable pace. The metaverse is driving away all boundaries connected to a digital world.

1.4 Interaction between Artificial Intelligence and the Metaverse

Metaverse and artificial intelligence are complementary in that artificial intelligence enhances natural and adaptive behavior within virtual environments, while metaverse platforms provide context that can improve artificial intelligence models. Artificial intelligence can be used to achieve believable avatars and conversational agents, and for procedural environment generation; on the other hand, the metaverse provides controlled and large-scale environments where Artificial intelligence approaches can be developed and tested.

1.5 The Role of the Metaverse in AI Development

1.5.1 Big Data & Training Kits

Metaverse is a big source of information that can contribute to the development of AI. Information gathered from user behavior can be used to train AI algorithms. Moreover, some experiments are not easily conducted in the real world when there is limited information, but they can happen in metaverse.

1.5.2 Social and Interactional AI Development

The metaverse provides a testing ground for developing AI's human-like interaction capabilities. AI-based social bots interact with users, enhancing their capabilities such as natural language processing and sentiment analysis. Simulation of the social experiences helps AI learn more complex social behaviors.

1.6 Literature Review

This section examines and describes research on virtual worlds and the metaverse. Information about these studies, including the methods used, is provided in Table 1 (Appendix).

2 Problem Formulation: Understanding the AI - Metaverse Interaction

2.1 The Relationship Between Artificial Intelligence and Metaverse

The way to build a true-to-life metaverse is to precisely capture real-world features and information and transform them into the virtual world. Here, Artificial intelligence has made a great contribution to the development of a wide range of fields, from the imaging system for visual perception to multi-sensor perception [4].

An important technology in improving the visual experience and performance in the metaverse has been introduced by NVIDIA in recent years. This technology introduced was DLSS, the purpose of this technology is to use deep learning and AI technologies to increase the frame rate (FPS) value by minimally affecting the graphics quality in games.

2.2 Research Design

This study was conducted with a qualitative model based on a literature review and secondary data analysis. Within the scope of the research, existing

academic studies, sector reports, and published secondary survey data from international research organizations such as PwC and YouGov were examined, and a thematic analysis method was used to understand the interaction areas of artificial intelligence and the metaverse. In the research, different perspectives such as technology, sociology, and economics were discussed using a multidisciplinary approach.

2.3 Data Collection and Analysis

2.3.1 Data Sources

The data sources used in the research are given below:

- **Academic Articles:** Articles related to artificial intelligence and the metaverse scanned in directories such as SCI, SCI-E, and SCOPUS.
- **Industry Reports:** Market analysis reports published by technology companies and working groups.
- **White Papers:** Technical documentation on AR and VR technologies, blockchain infrastructure, and AI algorithms.

2.3.2 Analysis Methods

The data were analyzed using thematic analysis and case study methods. The steps followed in this process are given below:

- **Coding:** Data from the literature has been coded to create themes on the intersections between the metaverse and AI.
- **Thematic Grouping:** The coded data were grouped under the main themes, and a structural analysis model was developed.
- **Evaluation of the Results:** The themes obtained were analyzed in depth to make inferences related to the aims of the study.

Table 2. Interaction Areas of Artificial Intelligence and the Metaverse

Interaction Area	Sample Applications
Game-Based & Immersive	Dynamic Game Scenarios, VR Simulations
Commerce	Online Store Experience
Learning & Education	Virtual Classrooms, Interactive Educational Materials

Source: created by the authors

Table 2 shows the main interaction areas where artificial intelligence and metaverse converge and sample applications in these areas. In addition to the areas illustrated in Table 2, online users can use the

Metaverse to create/modify user-generated content, interact with other avatars, increase their work productivity, play games, transact with businesses, and even use their apps for educational purposes, [5]. These visuals were used to support the analysis process and to make the findings more concrete

2.4 Limitations

The limitations of the research are:

- **Data Coverage:** Only academic articles, published industry reports, and secondary survey datasets produced by third-party organizations were used in the research. Fieldwork was not carried out, and individual opinions were not directly collected by the authors.
- **Focus Area:** The area of concern is the relationship between the metaverse and artificial intelligence, and does not include specifics in other technological fields.
- **Generalization Limitations:** The results are constrained because they are derived from the data collected within a certain time.

3 Solution Approach: Implementation and the Findings

For the purposes of the proposed study, the qualitative paradigm is defined by a conceptual foundation that involves a review of literature studies, followed by the use of secondary data analysis. Under the above-scope, data collected through surveys by [6] in 2023 and data collected by [7] in 2023 were also used for the purposes of societal perceptions regarding the metaverse.

Secondary sources published by [6] and [7] provide complementary information on awareness, knowledge, and perceptions related to the metaverse and virtual environments. The published secondary sources also report selected demographic variables such as age, gender, occupation, and interest in digital technology, depending on the scope of each source.

The survey method that has been adopted by PwC and YouGov consists of an array of structured sections that focus on specific demographic attributes as well as the opinions held by survey participants related to digital innovations in emerging technologies such as the metaverse. In this case study, existing survey data have been examined in relation to the study objectives.

These results, which were formed on the basis of the conducted study on the secondary sources, were analyzed using the technique of qualitative interpretative analysis. This means that the results

would not be original primary evidence but a synthesis of the previously published data.

The questions asked in the PwC and YouGov survey included the following regarding the metaverse and the knowledge, experience, and expectations about the metaverse of the respondents: "These questions were considered at the aggregate-level and form part of the analysis of the results."

This study examines published survey findings reported separately by PwC and YouGov. Each source employs its own methodology, and the findings are interpreted comparatively rather than as a single unified survey. Focusing on understanding the respondents' knowledge, attitude, and expectations related to the concept of virtual worlds and the metaverse.

For example, in the metaverse research, rather than the questions in the study being crafted by the researchers, they are evaluated in connection with the original study in order for the metaverse data to be understood in the context of societal awareness. These questions evaluated in the metaverse study are focused on determining general trends surrounding societal awareness for the metaverse.

Consequently, from the above study, it has been identified that despite many individuals having awareness about the term metaverse, they know less about the information and abilities related to the functionality of the metaverse. Secondly, it has been identified that individuals eagerly wait to use the concept of metaverse for education, entertainment, and business.

The main aim of this scientific investigation is to determine the level of awareness of individuals pertaining to the existence of virtual universes, as well as the know-how of the metaverse, and to understand the associated social and economic repercussions related to this technology. The outcomes achieved are very useful to understand how society views this metaverse, as well as to develop future technology advancements.

3.1 Findings

In this section, key findings derived from two secondary sources, [6] and [7], are presented. The findings are evaluated based on reported demographic distributions and levels of metaverse awareness.

3.1.1 Metaverse Awareness by Demographic Groups

As shown in the results of the survey, approximately 78% of those respondents in the PwC and YouGov survey reported that they knew about the metaverse concept. This percentage was a little lower in other

age groups, such as 65% of the 18-24 years age group, 52% in the 35-44 years group, and 30% in the 45 years plus group. These results allow us to assume that the Metaverse is perhaps better known in the younger generations, [8].

3.1.2 Perceptions and Expectations by Gender

According to the PwC - YouGov survey results, 67% of female participants indicated that the metaverse is expected to play an important role in the future, particularly in the fields of education and health. In male participants, this rate was determined as 58%. While there is a positive perception among female participants that social interaction will increase with the metaverse, male participants evaluated the metaverse more in terms of business and trade, and the results of the survey on the business world and the metaverse are discussed in this article.

3.1.3 Attitudes towards Virtual Experiences

The results show that participants generally hold positive attitudes toward virtual experiences. Of the participants, 60% emphasized connecting with colleagues in virtual environments, and thus, the metaverse is considered an effective tool to help improve collaboration in virtual environments. Further, 55% of participants stressed offering customers virtual experiences, [6].

Participants also believe that training, recruitment, and onboarding processes conducted in virtual environments can become more engaging by simulating real-life situations and interactions. These immersive practices are expected to improve employee experience and increase organizational commitment. Overall, leaders view the metaverse as a channel that facilitates virtual connections among colleagues.

3.1.4 Metaverse in the Business and Consumer World

This study draws on separate secondary sources: YouGov provides consumer survey findings, while PwC reports results from an executive survey conducted with 60 business leaders. These datasets are independent and are not part of a single combined survey, consumers were 18 years of age and older, reflecting the general worldwide population, and were evenly distributed across their income level, gender, age, and employment status, [7]. 64% of business respondents are in business roles, and 36% are in technology roles, which include industrial products and services 31%, retail 20%, financial services, 16%, technology, media,

and telecom, energy, 15%, utilities and mining, 9%, and healthcare, 8%, [6].

3.2 Comparative Analysis and Results

In this section, the comparative analysis of the survey results is presented, illustrating participants' awareness of and knowledge about the metaverse across different demographic and professional groups via figures. Figure 1 depicts the distribution of metaverse awareness by age group, with the highest awareness observed in the 25–34 cohort.

From Figure 2, it can be observed that metaverse knowledge is mainly distributed in high and medium categories. The distribution of metaverse knowledge level is shown in Figure 3. In this case, metaverse knowledge is mainly distributed in medium and low categories.

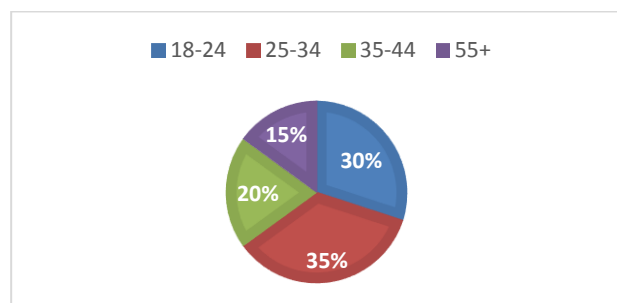


Fig. 1: Pie Chart of a wareness Levels by Age Groups
Source: [8]

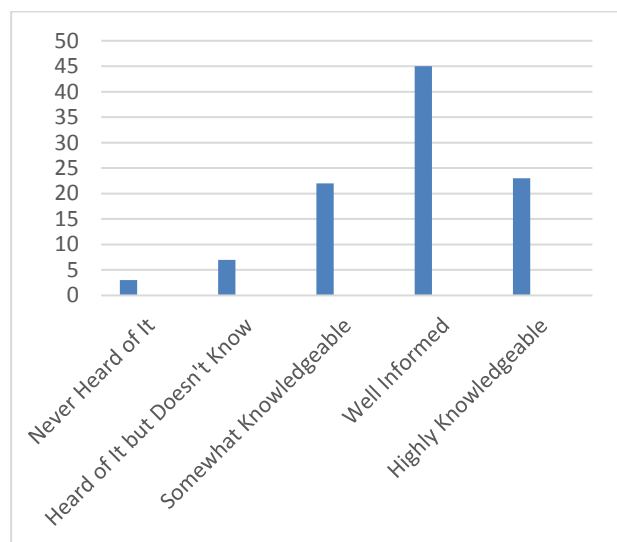


Fig. 2: The Knowledge Level of Business Leaders about the Metaverse
Source: [6]

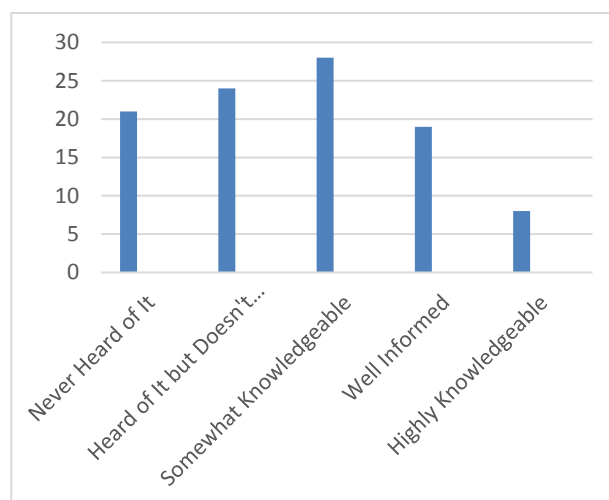


Fig. 3: The Knowledge Level of Consumers About the Metaverse
Source: [7]

3.3 Interpretation of Results

The findings from this survey have shown that there are some differences in metaverse awareness perception between different demographics. It has also been concluded that youth are more aware of the metaverse and that they are receptive to virtual reality. In addition, while female participants adopted a social benefit-oriented perspective, this emphasized the commercial potential of the metaverse more in male participants. When we look at the survey conducted in the commercial field, we see that business leaders have more information and more up-to-date information than consumers. In light of these results, the necessity of customizing strategic planning related to the metaverse to demographic characteristics comes to the fore. For example, campaigns targeting younger age groups may focus on entertainment and gaming, while for older age groups, benefits such as education and commerce may be emphasized.

4 Discussion

In this section, the research findings are related to the existing literature, the importance of the results in the field is discussed, and suggestions for future studies are presented.

4.1 Comparison with Literature

The findings obtained in this study show harmony and differences in certain respects when compared to previous studies in the literature. For example, findings on the integration of metaverse and AI are in line with [5]; In particular, the emphasis on the role of AI in delivering personalized experiences in the metaverse is similar. However, whilst the effect

of the metaverse in sectors like education and health is a more in-depth theme in this study, it is observed that this theme is not given sufficient attention in current literature. Moreover, studies on social and ethical impact assessments of the metaverse ecosystem literature are a key missing theme.

4.2 Significance of Findings

The findings and implications of this study are important in both theoretical and practical contexts. In a theoretical context, a study of the metaverse and AI integration in its technological infrastructure and application domains is one of the aspects that this study sheds more light on. In a practical context, this study opens opportunities for more effective and interactive application development on the basis of this study in educational institutions and gaming domains. The reviewed literature suggests that metaverse-based AI may contribute to educational experiences; however, this interpretation is limited to the scope of the analyzed secondary sources. The findings of this study also support that there is a need for collaborations in developments related to the metaverse.

4.3 Future Studies

In the context of understanding the limitations that this study has to offer, some avenues for conducting future studies have been suggested. The datasets analyzed in this study were derived from a limited number of published secondary data sources, which may constrain the generalizability of the findings. As a result, future studies that have larger datasets will provide greater generality for the obtained results. Similarly, while this study is centered on understanding how the metaverse and AI will converge in the future, this study does not place much emphasis on how other technologies like blockchain and virtual reality will have an impact on the metaverse. The implications that could arise from other technologies can be a versatile topic for future studies as well. Understanding and in-depth analysis of all the ethical aspects related to the metaverse and users can assist in the sustainable development of the metaverse.

5 Conclusion

This chapter will provide a summary of key findings in this study. In addition to this summary, suggestions for applying this finding in a real-world context and limitations in this study will also be provided.

5.1 Key Findings

The study conducted an in-depth analysis of the technical and applied aspects related to the metaverse and AI integration. The key finding related to this study is that AI technology has a great ability to personalize and improve the metaverse experience. Furthermore, it has been established that the metaverse offers an opportunity to develop innovative applications in sectors like education, health, and entertainment.

5.2 Contributions

The study will contribute to closing the existing literature gap regarding the integration of the metaverse and AI and will aid in building a theoretical framework related to this issue. From a practical point of view, this study can contribute to creating value in research and innovation in this industry since it will offer suggestions for AI integration in the metaverse. As a final point, this study offers a multidisciplinary strategy in relation to metaverse ethics.

5.3 Apps & Recommendations

The findings of research work can be applied in various domains. For instance, the concept of artificial intelligence-powered learning systems can be applied to personalize learning in the metaverse. In the healthcare sector, simulations enabled by virtual reality and artificial intelligence can enhance patient care and educational processes. In the coming days, research work on the interactions of the metaverse and AI can be proposed concerning security and ethics.

5.4 Limitations

There are also some limitations in the above study. Firstly, the datasets analyzed were limited to a small number of published secondary data sources and thus there are limitations to the overall generality of the findings. Secondly, the study was performed on the integration concept between the Metaverse and AI, excluding other technological innovation aspects (for example, Blockchain and Augmented Reality).

References:

- [1] Stephenson, N, Snow Crash. New York: Bantam Books, 1992.
- [2] Turing, A. M. "Computing machinery and intelligence." *Creative Computing* 6.1 (1980): 44-53.
- [3] Moor, J. (2006 - USA). The Dartmouth College Artificial Intelligence Conference: The

- Next Fifty Years. *AI Magazine*, 27(4), 87. <https://doi.org/10.1609/aimag.v27i4.1911>.
- [4] Guo, Y., Yu, T., Wu, J., Wang, Y., Wan, S., Zheng, J., ... & Dai, Q. "Artificial Intelligence for Metaverse: A Framework." *CAAI Artificial Intelligence Research*, 2022, 1(1): 54-67. <https://doi.org/10.26599/AIR.2022.9150004>.
- [5] Hwang, Gwo-Jen, and Shu-Yun Chien. "Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective." *Computers and Education: Artificial Intelligence* 3 (2022): 100082. <https://doi.org/10.1016/j.caeai.2022.100082>.
- [6] PWC Belgium, Metaverse Survey, [Online]. <https://www.pwc.be/en/news-publications/archive/metaverse-survey-2023.html>, 2023 (Accessed Date: June 23, 2025).
- [7] Yougov, Over half of consumers in our poll have either never heard of the metaverse or don't know what it is, [Online]. <https://yougov.com/articles/47512-over-half-of-consumers-in-our-poll-have-either-never-heard-of-the-metaverse-or-dont-know-what-it-is>, 2023 (Accessed:5-Oct-2025)
- [8] Statista, Share of adults who know about the metaverse, [Online]. <https://www.statista.com/statistics/1302650/us-adults-heard-about-the-metaverse-generation/>, 2023 (Accessed Date: October 30, 2025).
- [9] Hatami M, Qu Q, Chen Y, Kholidy H, Blasch E, Ardiles-Cruz E. "A Survey of the Real-Time Metaverse: Challenges and Opportunities". *Future Internet*. 2024; 16(10):379. <https://doi.org/10.3390/fi16100379>.
- [10] Camilleri, M. A. (2024), "Metaverse applications in education: a systematic review and a cost-benefit analysis". *Interactive Technology and Smart Education*, Vol. 21 No. 2 pp. 245–269, <https://doi.org/10.1108/ITSE-01-2023-0017>.
- [11] Thakur, S.S., Bandyopadhyay, S., Datta, D. (2023). Artificial Intelligence and the Metaverse: Present and Future Aspects. In: Hassanien, A.E., Darwish, A., Torky, M. (eds) *The Future of Metaverse in the Virtual Era and Physical World*. Studies in Big Data, vol 123. Springer, Cham. https://doi.org/10.1007/978-3-031-29132-6_10.
- [12] Lv, Z. "Generative artificial intelligence in the metaverse era." *Cognitive Robotics* 3 (2023): 208-217. <https://doi.org/10.1016/j.cogr.2023.06.001>.
- [13] Huynh-The, T., Pham, Q. V., Pham, X. Q., Nguyen, T. T., Han, Z., & Kim, D. S. "Artificial intelligence for the metaverse: A survey." *Engineering Applications of Artificial Intelligence* 117 (2023): 105581. <https://doi.org/10.1016/j.engappai.2022.105581>.
- [14] Wang, H., Ning, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., ... & Daneshmand, M. "A Survey on the Metaverse: The State-of-the-Art, Technologies, Applications, and Challenges," in *IEEE Internet of Things Journal*, vol. 10, no. 16, pp. 14671-14688, 15 Aug.15, 2023, doi: 10.1109/JIOT.2023.3278329.
- [15] Wang, Y., Su, Z., Zhang, N., Xing, R., Liu, D., Luan, T. H., & Shen, X. "A survey on metaverse: Fundamentals, security, and privacy." *IEEE communications surveys & tutorials* 25.1 (2022): 319-352. <https://doi.org/10.1109/COMST.2022.3202047>
- [16] D. Wang, X. Yan and Y. Zhou, "Research on Metaverse: Concept, development and standard system," 2021 2nd International Conference on Electronics, Communications and Information Technology (CECIT), Sanya, China, 2021, pp. 983-991, doi: <https://doi.ieeecomputersociety.org/10.1109/CECIT53797.2021.00176>.
- [17] Trunfio, M., & Rossi, S. *Advances in Metaverse Investigation: Streams of Research and Future Agenda*. Virtual Worlds 2022, 1, 103-129. <https://doi.org/10.3390/virtualworlds1020007>.
- [18] Rejeb, A., Rejeb, K., & Treiblmaier, H. Mapping Metaverse Research: Identifying Future Research Areas Based on Bibliometric and Topic Modeling Techniques. *Information* 2023, 14, 356. <https://doi.org/10.3390/info14070356>.

APPENDIX

Table 1. Literature Review

Reference	Title	Purpose	Method	Originality	Limitations
[9]	A Survey of the Real-Time Metaverse: Challenges and Opportunities	Real Time Metaverse Technologies	Technology Analysis	Dynamic Data Integration	Infrastructure delays
[10]	Metaverse applications in education: a systematic review and a cost-benefit analysis	The use of the metaverse in education	PRISMA analysis	To address the opportunities and risks	Long Term effects
[11]	Artificial Intelligence and the Metaverse: Present and Future Aspects	Analysis of AI and the Metaverse in various sectors	Analysis and potential assessment	Joint examination of the impact of technologies	Interactions between technologies
[12]	Generative artificial intelligence in the metaverse era	The role of Generative AI in the Metaverse	Analysis	Metaverse content development	Long-term effects and ethics
[13]	Artificial Intelligence for the Metaverse: A Survey	The role of AI in Metaverse development	Analysis	Potential of AI methods for the Metaverse	Ethics and security risks
[14]	A Survey on Metaverse: the State-of-the-art, Technologies, Applications, and Challenges	Examining the technical framework of the Metaverse	Analysis	Analysis from five perspectives	Deficiencies in problem-solving
[15]	A Survey on Metaverse: Fundamentals, Security, and Privacy	Metaverse security	Research	New paradigm	Lack of practical applications
[16]	Research on Metaverse: Concept, development and standard system	Analyzing the concept and features of the Metaverse	Conceptual study	Proposing a new framework for the standard architecture of the Metaverse	Lack of practical examples
[17]	Advances in Metaverse Investigation: Streams of Research and Future Agenda	Analyzing the concept, features, and development of the Metaverse	Review and literature analysis	Proposing a new framework for the standard architecture of the Metaverse	Lack of practical examples
[18]	Mapping Metaverse Research: Identifying Future Research Areas Based on Bibliometric and Topic Modeling Techniques	Bibliometric analysis of studies	Literature review	Addressing gaps in the literature	Insufficiency of security and privacy

Source: created by the authors.

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

- Alperen Kayan conducted a comprehensive literature review on academic studies related to Artificial Intelligence and the Metaverse, and performed the corresponding analyses.
- Muhamet -Fatih Zengin reviewed and analysed sectoral reports and technical documents relevant to the topic.
- Assoc. Prof. Dr. Kemal Gökhan Nalbant supervised the entire process and was responsible for compiling and integrating the individual contributions into the final manuscript.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Creative Commons Attribution License 4.0 (Attribution 4.0 International, CC BY 4.0)

This article is published under the terms of the Creative Commons Attribution License 4.0
https://creativecommons.org/licenses/by/4.0/deed.en_US