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Bibliometric Analysis of Studies on The Concept of "Metaverse"

Gökhan Sontay*
Science Teacher, Ministry of Education, Amasya, Türkiye
ORCID: 0000-0003-4199-8674

Orhan Karamustafaoğlu
Faculty of Education, Amasya University, Amasya, Türkiye
ORCID: 0000-0002-2542-0998

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Due to the importance of using metaverse technology in various fields, it is essential to examine published works on this subject. This study aims to reveal the current status and trends of the field by reviewing works that include the concept of "metaverse" through the Web of Science (WoS) database with bibliometric analysis techniques. Data were gathered from the WoS database using the bibliometric analysis method within the framework of a quantitative research design. The VOSviewer program was used to process the data. There were 5334 results for the keyword search "metaverse" in Web of Science. The obtained data were examined through author, citation, keyword, country, and institution analyses. When the publication years of works related to the concept of "metaverse" were examined, the examination determined that the highest concentration was in 2023 and 2024, and the names that created the most works were Dusit Niyato (63), Zehui Xiong (36), and Jiawen Kang (35). In terms of the distribution of the most frequently cited works on the metaverse by country, it was determined that the People's Republic of China was the leader (13006 citations), followed by the United States (10516 citations) and South Korea (6140 citations). The most frequently cited institution was the Chinese Academy of Sciences (1756 citations). It was concluded that the most frequently cited countries and institutions on the metaverse were Asian. The results can be compared by analyses similar to those of other programs performing bibliometric analysis.

Introduction

The metaverse is a combination of the word "universe" and the prefix "meta," which defines a virtual environment connected to the physical world. The prefix "meta" means "after" and "beyond" in ancient Greek. The term "metaverse" is derived from "universe" and means "beyond the universe" (Çelik, 2022). Although it does not have the same meaning as, the word 'virtual universe' is often used instead of metaverse. Metaverse is the third revolution (Web 3.0) of the Internet world (Sutikno & Aisyahrani, 2023).

The metaverse was first proposed in 1992 by Neal Stephenson in his science fiction novel Snow Crash, in which people try to escape real-world problems by exploring a digital world

* Correspondency: gokhansontay@gmail.com

through several digital avatars (Stephenson, 1992). The foundations of the metaverse were laid with the use of digital avatars.

There are many definitions in the literature of the metaverse. The metaverse is a new Internet application that integrates various technologies, providing an immersive experience based on augmented reality technology and tightly integrating the virtual and real worlds to allow each user to produce content and organize the world (Ng, 2022; Wang et al., 2023). The metaverse is a virtual universe that includes augmented reality and virtual reality (Wolitzky et al., 2005). According to Odama (2022), the metaverse is the execution of daily physical life in virtual reality environments with created digital avatars. Anderson and Rainie (2022) define the metaverse as a life where the virtual and real world coexists. According to Díaz et al. (2020), the metaverse is the idea of digital users creating virtual societies with real features, beyond sectors such as entertainment and commerce. According to the literature, the generally accepted definition of the metaverse is a virtual universe parallel to and independent of the real world (Lee, 2021; Truong, Le & Niyato, 2023).

The world's first metaverse was CitySpace, which was operational between 1993 and 1996 (Benedikt, 2008). Later, many metaverses such as Active Worlds emerged (Schroeder, Huxor & Smith, 2001). Developed by Linden Lab in 2003, Second Life (SL) was the most popular (Rudolphi-Solero et al., 2024). Thus, the doors of the internet-based virtual world were opened. SL promised its users a second world where they could create their avatars and determine all their features, limited only by their imagination (Gökçe Narin, 2021). Later, metaverse examples, such as Roblox, Sandbox, and Fortnite, proliferated in the game world. In this world, the metaverse allows users to shape the lives and virtual personas they want.

Marc Zuckerberg's change of his company name to Meta affected the transition of the concept of "metaverse" from the game world to the real world. After Marc Zuckerberg changed the company name from Facebook to Meta, people began to discover what the metaverse was. This situation caused many technology companies to launch new business models using metaverse technology (Lee, 2021). According to Google Trends reports of October 2021, there has been a significant increase in searches related to the metaverse.

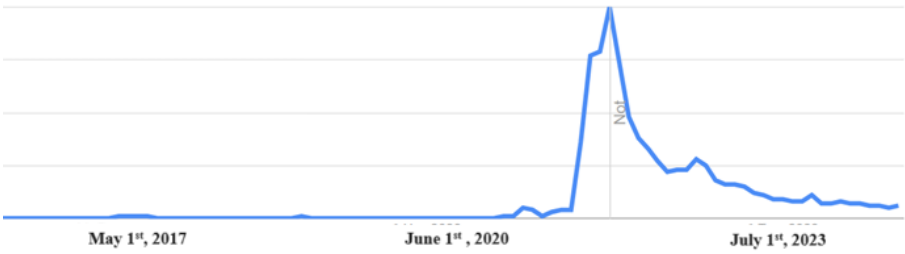

Figure 1. Google trends report on the concept of "metaverse"

While the metaverse affects many fields, it enables innovations in these fields. It has been observed that the number of studies on how the metaverse affects many different fields such as commerce, education, medicine, law, fashion, art, health, architecture, and tourism has increased recently (Ağaoğlu, Ekinci & Tosun, 2022; Babur, 2022; Gauttier, Simouri & Milliat, 2024; Karyağdı, 2022; Lee & Kim, 2022; Rahman et al., 2023; Turan & Kavut, 2022; Yang et al., 2022; Yılmaz & Ceranoğlu, 2022). Recently, the number of studies on the metaverse has increased with the adoption of metaverse technology in various fields.

Due to the importance of using metaverse technology in various fields, it is essential to examine published works on this subject. Examining research conducted in the field of the metaverse will guide future research. Presenting the data of research conducted in the field of metaverse (along with authors and institutions) using bibliometric maps will enable readers to understand the concept. It will be easier to examine and evaluate the current status of existing works by conducting a bibliometric analysis for the metaverse. In this context, this research will shed light on the metaverse with a bibliometric analysis conducted for the metaverse. This study aims to reveal the current status and trends of the field by examining the works on the subject of metaverse through the Web of Science (WoS) database using bibliometric analysis techniques.

This research aimed to perform bibliometric analysis by accessing data on the subject of "Metaverse" through the WoS database. To this end, the following research questions were posed regarding the subject of metaverse:

(1) How are the publication years of the works listed?
(2) What are the publication languages of the works?
(3) What are the fields of the works?
(4) How is the collaboration between authors?
(5) How is keyword analysis?
(6) What/How is the link strength between author citations?
(7) How are the citation links between countries?
(8) How are the citation links of institutions?

Methodology

Model of the Study

The bibliometric analysis method was used in this study, based on quantitative research design. Bibliometric analysis, a quantitative research method, plays a crucial role in evaluating and understanding the evolution of specific disciplines (Zhu et al., 2020). This approach employs mathematical and statistical tools to analyze various aspects of published literature, including the relationships, distribution, and patterns of research output within a particular field (Liao et al., 2021). By examining these elements, bibliometric analysis offers a comprehensive perspective on the dynamics and development of research activities over time (Chen et al., 2017). The following three stages were followed for bibliometric analysis (Cobo et al., 2011).

Figure 2. Bibliometric Analysis Process

Data and Analysis

Bibliometric analysis is a common and accurate method for studying and analyzing significant amounts of scientific data. This method aims to grasp the connection between journal citations and to summarize the status of current or emerging research topics (Donthu et al., 2021). The scientific mapping technique was used in the analysis process to facilitate the analysis and understanding of the obtained data (Özsevgeç, 2019). Author, keyword, institution, and country information are analyzed in detail using the scientific network mapping method, and visuals are obtained as a result of these analyses (Bağış, 2021; Karamustafaoglu, Orbay & Kara, 2023). The VOSviewer program was preferred for the analyses in this study due to its strengths such as network mapping, multidimensional analysis, and visualization. The VOSviewer program creates a keyword map based on shared networks and maps containing many elements (Rahmawati & Subardjo, 2022).

The data used in the bibliometric analysis was taken from the WoS. To obtain the data file of the study prepared according to the criteria of the research using the WoS database, first the export option was clicked. Then, the full record and cited references option was selected, and a *tab delimited file* was prepared. The final file, prepared as a tab delimited file, was loaded into the data section of the VOSviewer program and analyzed. The sizes of the nodes in the shapes generated by the analysis in the Vosviewer program indicate their frequency of occurrence. The lines between the nodes represent the co-occurrence of words in the same sentence. The shorter the distance between two nodes, the greater the number of times the two keywords appear together (Eck & Waltman, 2022).

The WoS database is chosen because its analyses provide researchers with more accurate information and confidence. Using the Web of Science database, detailed search indicators are analysed in many categories. Thus, comprehensive information is presented to the reader. A search conducted on WoS with the keyword “metaverse” on June 10th, 2025, yielded 5334 results. When sorted by year, it was determined that the oldest studies were conducted in 1995, and the newest studies were conducted in 2025. The types of documents were 3363 articles, 1157 papers, 376 article reviews, 241 editorial content, 56 letters, 46 book chapters, 36 meeting abstracts, 25 book reviews, 15 corrections, 7 retracted publications, 4 news items, 3 books, 3 retractions, 1 art exhibit review, and 1 data paper. Data were analyzed by author, citation, keyword, country, and institution analysis.

Data from the WoS were downloaded in text format to be processed using VOSviewer to visualize and analyse bibliometric trends. The downloaded file was loaded into the VOSviewer program. Depending on the criteria selected in the program, the data were visualized with network maps and density maps.

Findings

This part of the research includes the findings obtained from the Web of Science interface and the graphs, tables, and network maps of the findings obtained from the VOSviewer program.

Findings Obtained from Web of Science Interface

This part of the research includes findings regarding the publication years, publication languages, and fields of study of works related to the concept of "metaverse".

The publication years of studies on the concept of "metaverse" are shown in Figure 3.

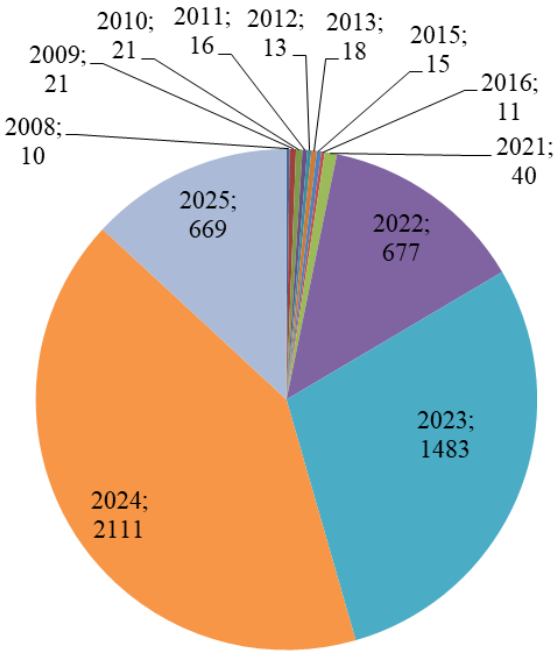

Figure 3. Publication Years of Works Related to the Metaverse

Works related to the concept of "metaverse" have been included in the Web of Science database since 1995. Years with fewer than 10 publications are not included in the figure. According to Figure 3, the number of works on the subject of the metaverse has increased after 2021. The highest number of studies was in 2024. Although the number of works projected for 2025 is 669, the amount of work needed in this subject is increasing gradually.

The publication languages of works related to the concept of "metaverse" are listed in Figure 4.

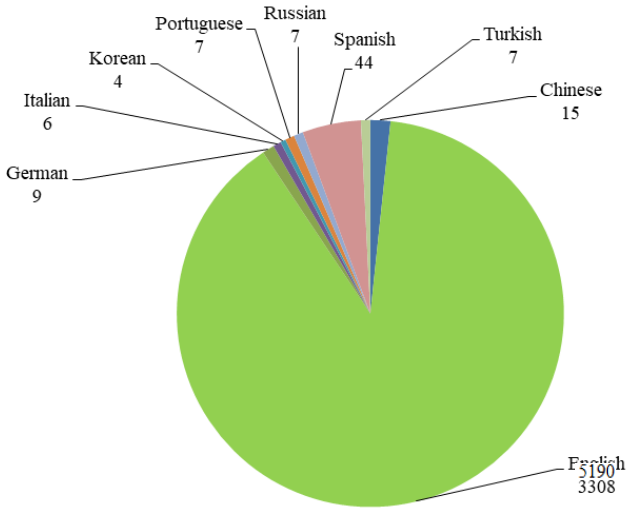

Figure 4. Publishing languages of works related to the concept of "metaverse"

Approximately 96% of the publication languages of the works related to the concept of "metaverse" are determined to be English (Figure 4). Countries with more than one publication are added to the graph.

There are 186 fields in the Web of Science database where the concept of "metaverse" is used. The twenty categories with the highest number of works from these fields are listed in Table 1.

Table 1. Fields, number of works and percentage values in the web of science database regarding the concept of "metaverse"

Web of Science Categories	Record Count	%
Computer Science Information Systems	1078	20.210
Engineering Electrical Electronic	960	17.998
Telecommunications	855	16.029
Computer Science Interdisciplinary Applications	657	12.317
Computer Science Artificial Intelligence	553	10.367
Computer Science Theory Methods	549	10.292
Business	441	8.268
Computer Science Software Engineering	426	7.987
Computer Science Cybernetics	379	7.105
Education Educational Research	291	5.456
Computer Science Hardware Architecture	269	5.043
Management	254	4.762
Physics Applied	116	3.112
Materials Science Multidisciplinary	161	3.018
Hospitality Leisure Sport Tourism	158	2.962
Information Science Library Science	150	2.812
Engineering Multidisciplinary	147	2.494
Communication	135	2.531
Social Sciences Interdisciplinary	130	2.437
Automation Control Systems	100	1.875

Table 1 shows the first twenty fields with the most metaverse keywords out of 186 categories. It is seen that the field with the most metaverse words is electrical and electronics engineering.

Findings Obtained from the VOSviewer Program

This part of the research includes modeling findings from co-author analysis, keyword analysis, citation analysis of authors, countries, institutions, and frequently used words in abstracts.

Co-authorship of Authors

Co-author analysis is a method that represents author groups and their connections. The size of the nodes in the visual represents the authors with the most publications. While obtaining data on author information before the analysis, at least one citation and at least one publication criterion were determined. Authors with the most connections were selected in the co-author analysis. A total of 79 interconnected clusters were formed. It was determined that there were 2421 connections between the authors in these clusters. The five authors who published the most on the concept of "metaverse" can be listed: Dusit Niyato (63), Zehui Xiong (36), Jiawen Kang (35), Fei-yue Wang (31), and Dong in Kim (24). Figure 5 shows the cluster groups formed by the authors.

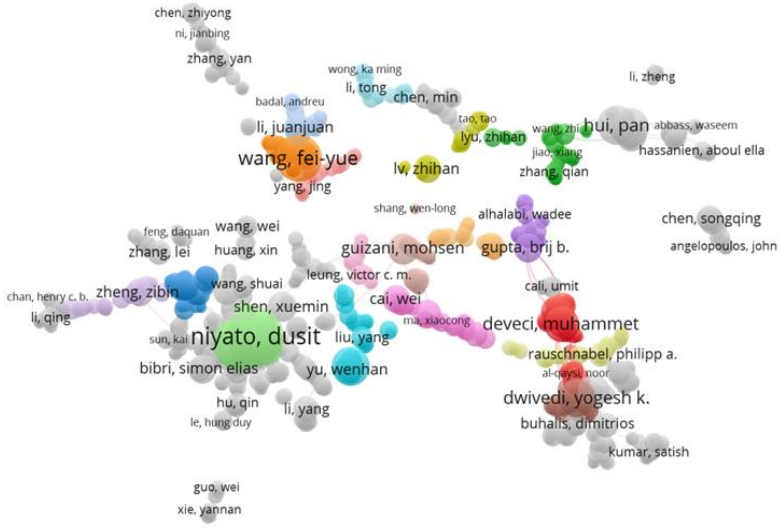

Figure 5. Co-Author analysis network map

The clusters formed by the authors are seen in Figure 5. Figure 6 presents the network map that connects the three authors with the most publications.

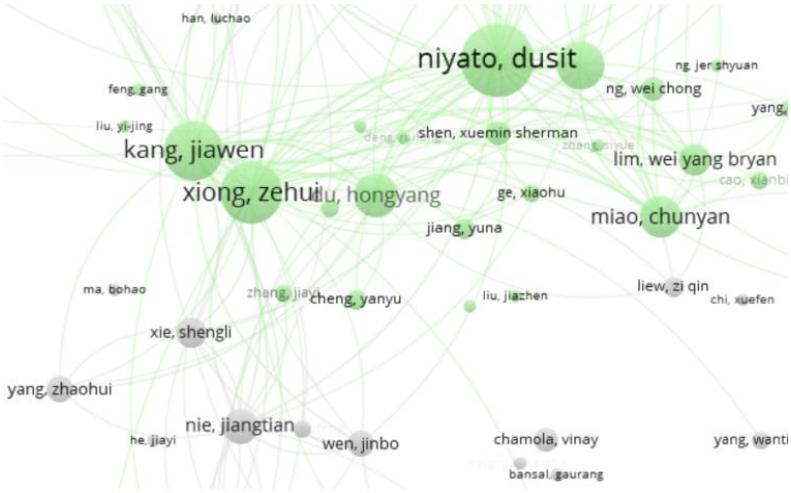

Figure 6. Network map of the three most published authors

According to Figure 6, Dusit Niyato, Zehui Xiong, and Jiawen Kang, who have published the most on the metaverse, have strong connections with each other.

Co-occurrence of All Keywords

When keywords in publications prepared on the concept of "metaverse", were examined, there were 10033 instances of keyword usage. The most used keywords were: “metaverse” (2241), followed by “virtual reality” (635), “augmented reality” (273), “blockchain” (248), and “artificial intelligence” (216). As a result of the analysis, 69 clusters and 19468 connections were revealed. The most frequently used keywords related to the concept of "metaverse" and the colour distribution of these words by year are shown in Figure 7.

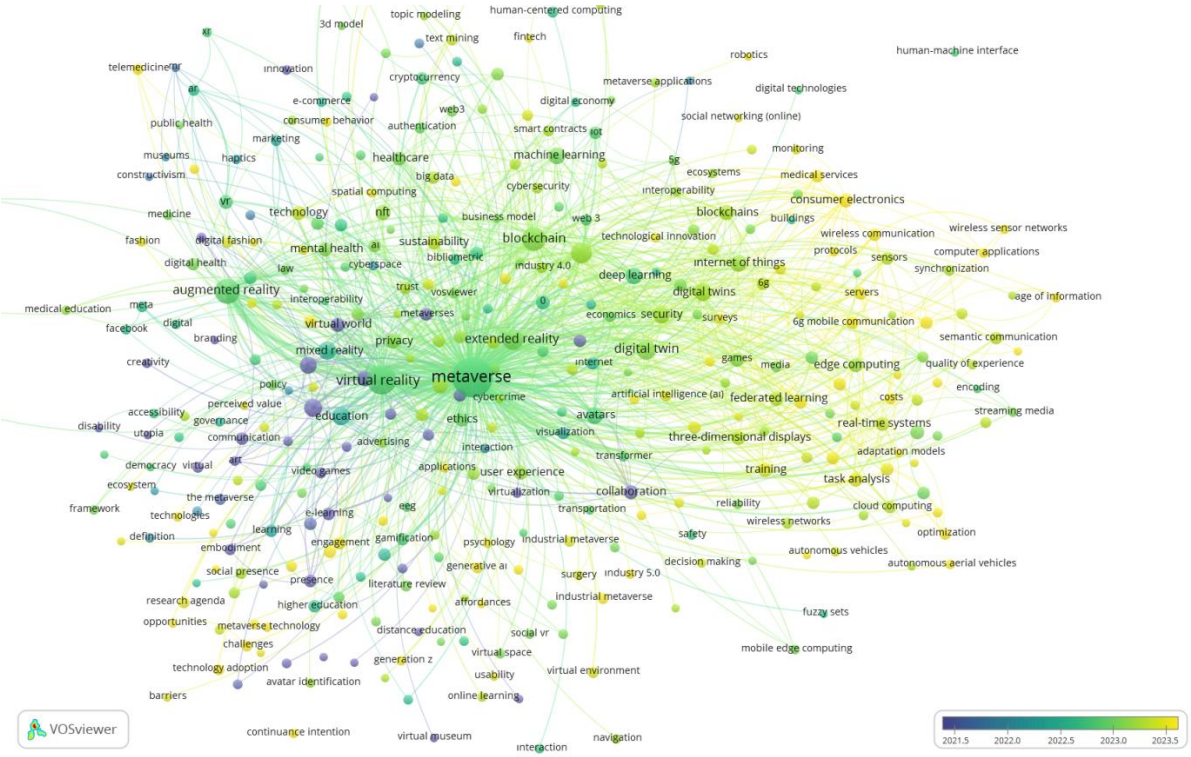

Figure 7. The most frequently used keywords in the works and their distribution by year

According to Figure 7, new concepts (yellow) related to "metaverse" were used in publications after 2023. It was determined that, by year, the distribution of the most frequently used keywords (augmented reality, virtual reality, and metaverse) in the works had a similar colour in the network map.

Citation of authors

An author citation network map was created to reveal the citation networks of the authors, based on the criterion of least one publication and at least one citation. As a result of the analysis, 68 clusters and 83966 connections were revealed. It was determined that the most cited authors were Dusit Niyato (1179 citations), Zehui Xiong (881 citations), and Fei-yue Wang (861 citations). The network analysis revealed that the citation connection between the authors Dusit Niyato and Zehui Xiong was strong; and Fei-yue Wang created a citation connection separately from these two authors. Figure 8 shows the authors' citation analysis network map.

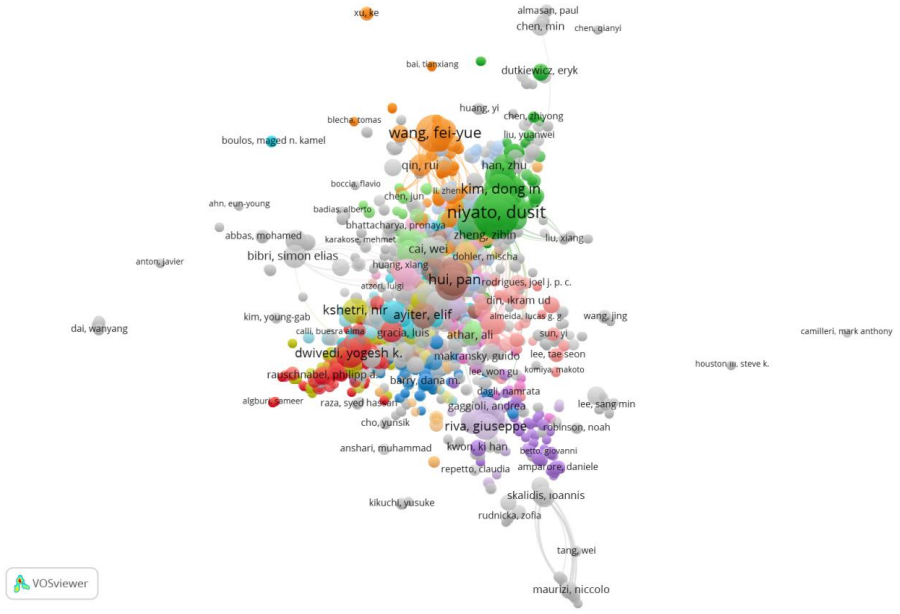

Figure 8. Authors' citation analysis network map

The cluster groups formed by the authors according to their citation numbers are shown in Figure 8. The fact that Dusit Niyato is in a central position on the map, and that there are many different authors around this position shows that it has been cited in many studies in the metaverse.

Citation of Countries

An author citation network map was created according to the criteria of at least one publication and at least one citation per author, thereby revealing the citation networks. As a result of the analysis, 10 clusters and 2130 connections were revealed. It was determined that the countries with the most citations were the People's Republic of China (13006 citations), the United States (10516 citations), and South Korea (6140 citations). According to the number of publications by country, it was determined that the countries with the highest number of publications were the People's Republic of China (1200 publications), the United States (534 publications), and South Korea (490 publications). The citation analysis density map of the countries is in Figure 9.

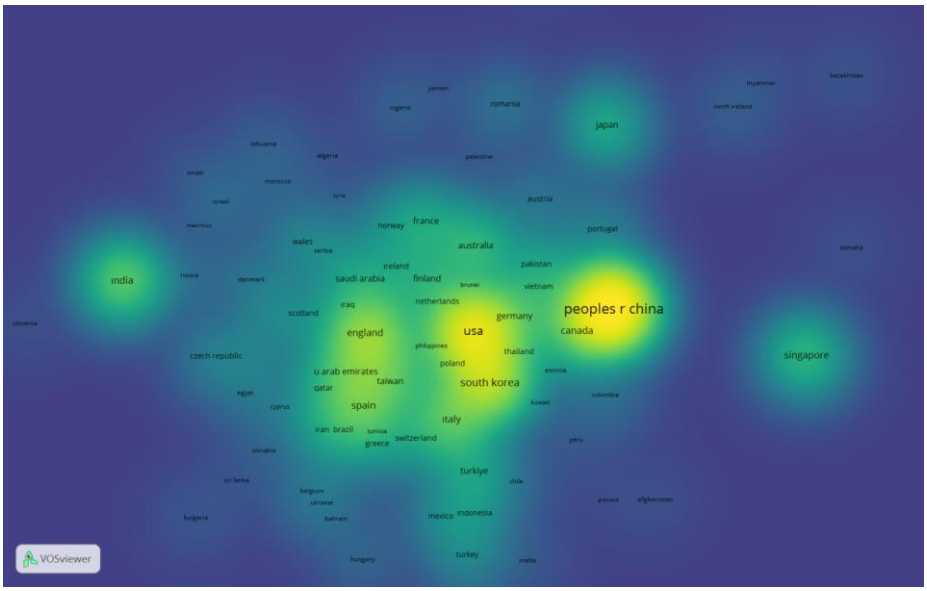

Figure 9. Authors' citation analysis network map

The co-citation density map of countries according to their works on the concept of "metaverse" is given in Figure 9. Accordingly, countries in bright yellow areas have more citations than those in green and blue.

The network map showing the years in which the works owned by the countries are concentrated is presented in Figure 10.

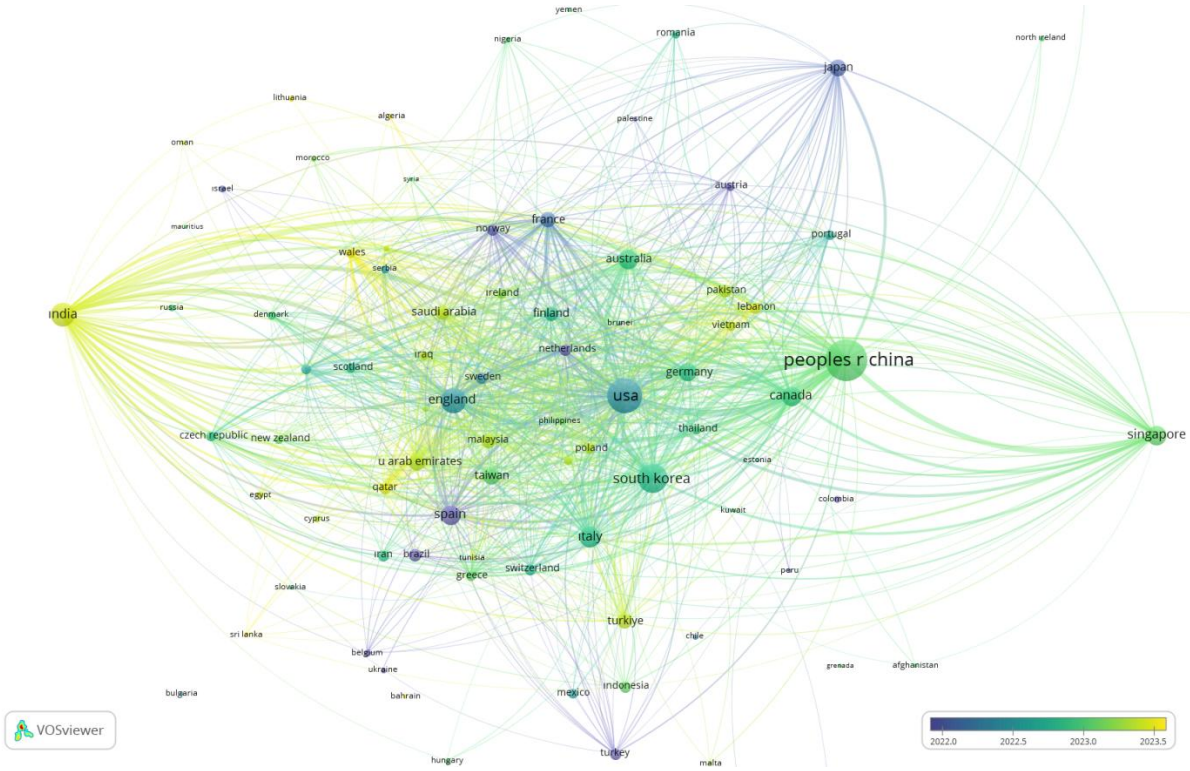

Figure 10. Citation analysis of countries and distribution by year

When looking at the network map regarding the number of citations received by countries

each year (Figure 10), it is observed that countries such as Spain and France were cited in earlier years, while countries such as India, the United Arab Emirates, Qatar, and Turkey were cited more in the last year.

Citation of Organizations

To reveal the citation networks of institutions, an institution citation network map was created with the criteria that at least one publication must be published by the institution and the relevant institution must receive at least one citation. As a result of the analysis, 44 clusters and 50814 connections emerged from 3165 institutions. It was determined that the institutions with the most citations were the Chinese Academy of Sciences (1756 citations), Nanyang Technological University (1600 citations), and the Singapore University of Technology and Design (1461 citations). When the publication numbers of the institutions were examined, it was determined that the institutions with the highest number of publications were Nanyang Technological University (125), Chinese Academy of Sciences (70), and Singapore University of Technology and Design (54). The citation analysis network map of the countries is in Figure 11.

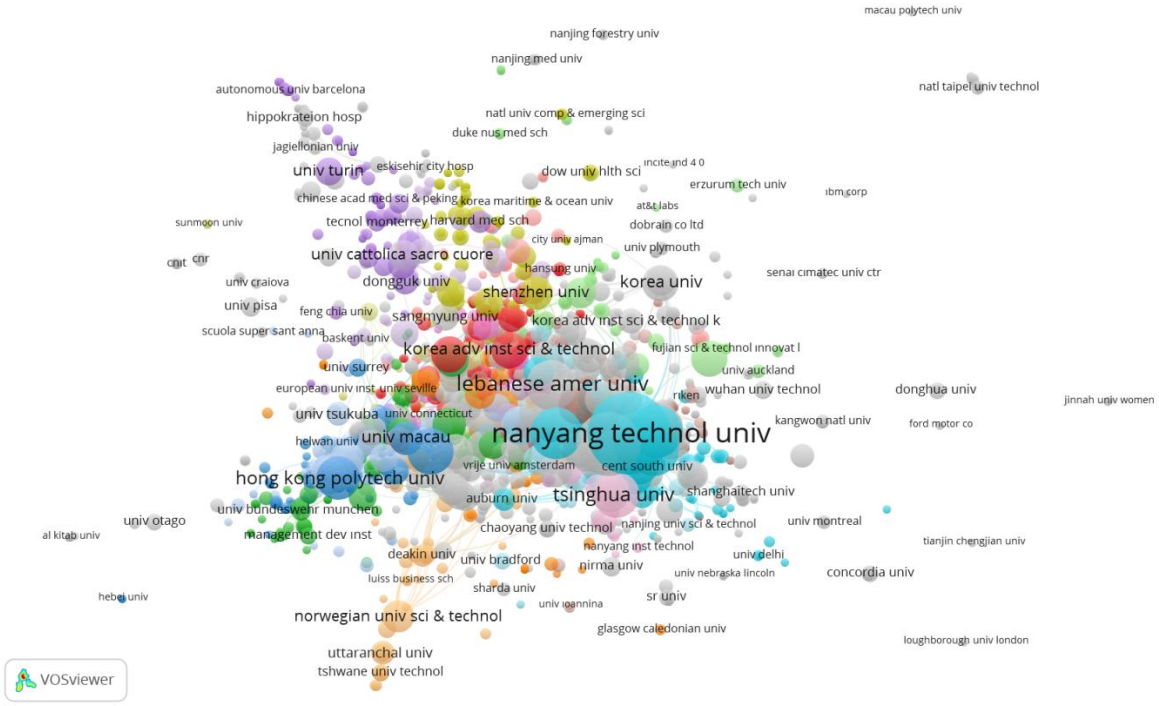

Figure 11. Citation analysis network map of institutions

Figure 11 shows clusters formed according to the citation numbers of institutions. The fact that Nanyang Technological University is located in a central position on the network map, and that there are many different institutions around it, shows that this institution has been cited in many studies in the metaverse field.

Bibliometric Analysis of Frequently Used Words in Abstracts

The network map was created by analysing the words repeated at least ten times in the abstracts of the studies obtained from the Web of Science. Out of 63350 words, 1647 words with the most intense relationships among them were included. Accordingly, the five words most frequently repeated in the abstracts were Metaverse (3658 repetitions), study (1754),

technology (1635), paper (1520), and application (1370). The density map for the most frequently used words in the abstracts is given in Figure 12.

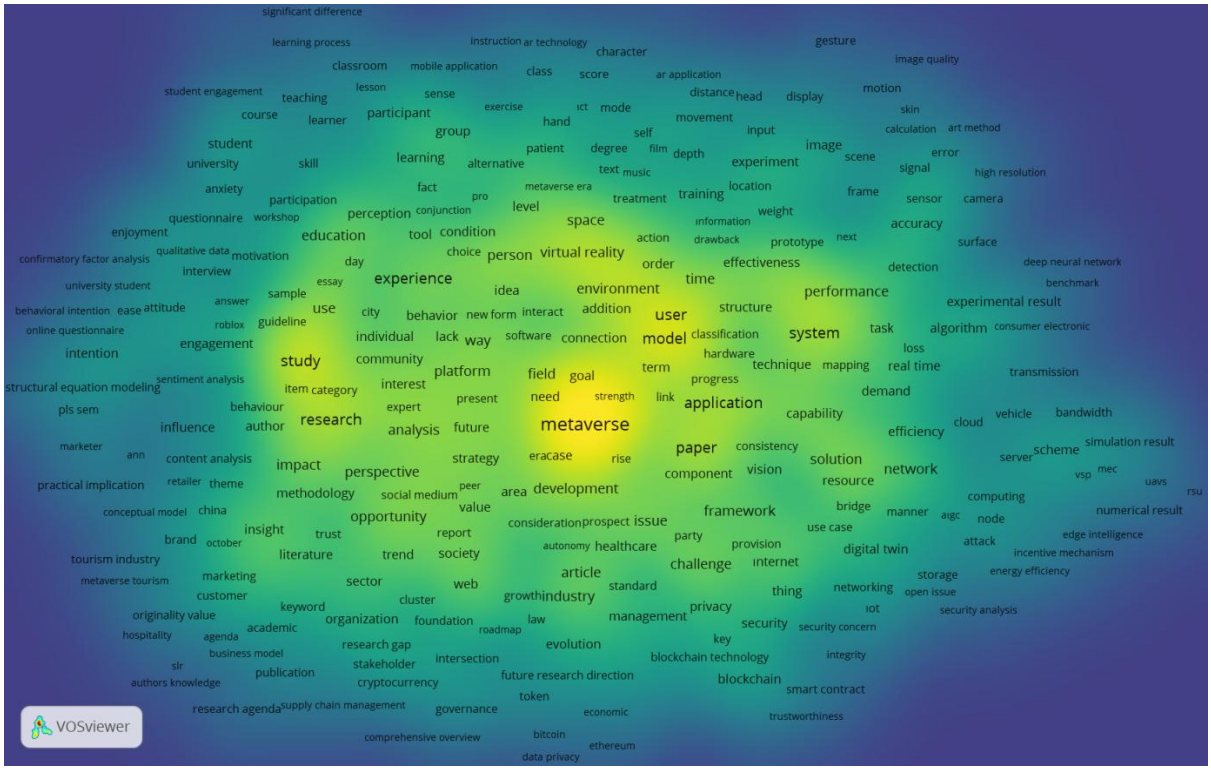

Figure 12. Density map of most frequently used words in abstracts

The citation density map of the most frequently used keywords in the abstracts for the concept of "metaverse" is given in Figure 12. Accordingly, the concepts in the bright yellow areas were used more than those in the green and blue areas.

Discussion and Conclusion

In this research, bibliometric analysis was conducted on the works on "metaverse" obtained from the WoS database.

The number of works in the literature on the subject of the metaverse has increased rapidly after 2021 (figure 1). The increase in the number of works since this date can be attributed to Marc Zuckerberg, the owner of Facebook, changing the name of his company to Meta (Mosco, 2023). In addition, another reason for the increasing number of works is the COVID-19 pandemic. Due to the COVID-19 pandemic, people have had to do many tasks at home via digital environments (Al-Habaibeh et al., 2021; Gökçe Narin, 2021; Na et al., 2024). Due to the pandemic, many teaching activities, meetings, and presentations have been held in the virtual environment. The pandemic accelerated the digital transformation process across societies, compelling individuals, organizations, and educational institutions to adopt virtual platforms for work, education, and social interaction (Lee et al., 2022). The need for remote communication, coupled with restrictions on physical gatherings, created fertile ground for the exploration of immersive virtual environments such as the metaverse. Teaching activities, business meetings, conferences, and even cultural events transitioned to virtual platforms during the pandemic, providing both users and organizations with practical exposure to virtual environments (Kye et al., 2021). As a result, interest in metaverse applications increased,

especially in areas such as virtual education, remote collaboration, digital tourism, and e-commerce.

It was determined that 96% of the works on the subject of the metaverse are in English, and there are publications in 186 different fields. When the publication areas are examined, it is determined that most studies are in the field of "Computer Science Information Systems". It is stated that in recent years, research on the concept of "metaverse" in the field of "Computer Science Information Systems" has intensified (Ho & Lee, 2023). It is thought that the increase in the number of studies on metaverse in the field of "Computer Science Information Systems" is because metaverse has started to be used with artificial intelligence (Hwang & Chien, 2022). The burgeoning interest in the metaverse is not confined to academic circles; it extends to industry and the broader public, signaling a profound shift in how we perceive and interact with technology (Bibri, 2022; Efe, 2025). This digital expansion is creating new opportunities for innovation and economic growth, while simultaneously posing significant challenges related to governance, security, and ethical considerations. The surge in metaverse research within "Computer Science Information Systems" is underpinned by the evolving capabilities of virtual and augmented reality technologies, which are essential for delivering immersive and interactive experiences.

When the findings regarding co-authors are examined (Figure 5), the authors who produced the most works include Dusit Niyato (63 works), Zehui Xiong (36 works), and Jiawen Kang (35 works). It has also been determined that these three authors, who have produced the most works, have the most connections with each other. According to the findings related to the citation networks of the authors, (Figure 8), it was determined that the most cited authors were Dusit Niyato (1179 citations), Zehui Xiong (881 citations), and Fei-yue Wang (861 citations). It was observed that the connection between Dusit Niyato and Zehui Xiong was strong. In other words, it was determined that these two authors had the highest number of citations in the same works. Based on the network maps, it was determined that Fei-yue Wang was cited in different works.

When the findings related to the citation networks of countries regarding the metaverse are examined (Figure 9), it is noticed that the People's Republic of China has the highest number of citations (13006). The People's Republic of China is followed by the United States (10516 citations) and South Korea (6140 citations). When the number of citations received by countries by year is examined, it becomes evident that the United Arab Emirates, Qatar, Turkey, and India have received more citations in recent years. It can be said that developed countries such as the People's Republic of China, the United States and South Korea started using the concept of "metaverse" earlier. The fact that discussions on the use of metaverse in schools in the United States and South Korea started earlier than other countries supports this finding (Kanematsu et al., 2010). In particular, China's increased technology investments and digital transformation-focused policies in recent years can be said to have reflected its global leadership in metaverse research (De Masi et al., 2025). Additionally, the United States and South Korea's established technology infrastructure and research and development activities investments in this field are highlighted as a key factor contributing to the high level of scientific productivity in metaverse-related research (Thipphaphone, 2022). This situation shows that these countries attach more importance to metaverse technology.

When the citation networks of institutions are examined (Figure 11), the Chinese Academy of Sciences has become the institution with the highest number of citations (1756),. The Chinese Academy of Sciences is followed by Nanyang Technological University (1600 citations) and

the Singapore University of Technology and Design (1461 citations). When the citation networks of the institutions are examined, it is seen that the citations are concentrated in Asian countries. It is stated that Asian countries have focused on studies in the field of metaverse in recent years (Dudley et al., 2023). This situation shows that the countries concerned are prioritizing metaverse applications in areas such as the digital economy, smart cities, and educational technologies (Abdulzaher et al., 2023). In particular, investments in "digital twin" technologies, virtual reality (VR), and augmented reality (AR) by China and Southeast Asian countries have increased the scientific visibility of metaverse research (Patalay, 2022). Additionally, bibliometric data indicates that a global trend toward collaborative research in the metaverse is gaining momentum. In particular, joint projects between universities based in China and Singapore and institutions in Europe and the United States are accelerating knowledge sharing and promoting interdisciplinary research (Gaurav, 2023). This situation paves the way for metaverse technologies to expand beyond entertainment or virtual social spaces into multidimensional areas such as education, healthcare, Industry 4.0, and sustainable development.

In terms of the most frequently used words out of a total of 63350 words in the abstracts of the works (Figure 12), the most frequently used word is metaverse (3658). It was determined that metaverse was followed by study (1754) and then technology (1635). When the keywords used in the 5334 works obtained from the WoS database were examined, it was determined that the most frequently used keywords were metaverse (2241), virtual reality (635), and augmented reality (273). It was observed that these keywords in the works were most often connected to each other. It is stated that the metaverse is a general concept that includes virtual reality and augmented reality (Bizel, 2023; Dudley et al., 2023; Longo et al., 2024; Kan & Kumaş, 2024). Therefore, it can be thought that the use of the concept of "metaverse" by including other concepts is effective in the simultaneous use of these concepts in studies.

In conclusion, it has been revealed that the concept of "metaverse" has been used more in studies since 2021, due to Facebook changing its name to Meta and people using metaverse technology for their meetings, training, and presentations due to the COVID-19 pandemic. It has been concluded that researchers have increasingly focused on the subject of the metaverse in the last years. When all fields are examined, it is observed that metaverse technology has been used the most in the field of "electrical and electronics engineering" recently. When all authors who have researched the subject of the metaverse are examined, it can be concluded that Dusit Niyato has produced the most works. It has been concluded that the countries and institutions cited, the most, on the subject of metaverse are mostly Asian. It has been concluded that the metaverse is most often included in research together with the concepts of augmented reality, and virtual reality.

Despite the insightful results, this study has several limitations. First, relying solely on WoS as a data source may lead to selection bias, as it does not cover all published literature in the metaverse. Expanding data collections to include other databases could contribute to a more comprehensive view of the topic. The results of this study can be compared with other databases. The data in this study were analyzed using the VOSviewer program. Similar analyses can be performed with other bibliometric analysis programs to compare the data obtained from this study. Such bibliometric studies can be conducted at regular intervals to provide information to researchers and those interested in the subject. Secondly, the selection of 5334 documents may not be representative of all metaverse research, and a larger sample may provide more nuanced insights. Lastly, bibliometric analysis and topic modeling have advantages, but these methodological approaches may not sufficiently capture the depth of

this emerging field. In this vein, qualitative studies incorporating expert views can enhance our understanding of the evolving landscape of the metaverse.

Based on the results of the study, further recommendations can be made. The COVID-19 pandemic accelerated the adoption of virtual platforms, highlighting the potential of the metaverse in transforming education, professional training, and lifelong learning. Therefore, it is recommended that educational institutions systematically explore metaverse applications for immersive learning, virtual classrooms, and interactive simulations, while also addressing accessibility and digital literacy gaps. The concentration of metaverse research within fields such as computer science, information systems, and electrical and electronics engineering underscores the need for broader interdisciplinary engagement. Future studies should expand to include disciplines such as education, healthcare, social sciences, and ethics to explore the comprehensive societal implications of the metaverse. The bibliometric analysis revealed that the vast majority of metaverse publications are in English and geographically concentrated in Asia, particularly China, Singapore, and South Korea. To ensure equitable knowledge production and global inclusion, it is recommended that initiatives be developed to support metaverse research in underrepresented regions such as Africa, Latin America, and parts of Europe. Additionally, encouraging scientific outputs in languages other than English can broaden access and contribute to the diversity of perspectives. The growing trend of international collaborations, particularly between Asian institutions and those in Europe and the United States, has significantly enhanced knowledge exchange in the field. To sustain this momentum, funding agencies, universities, and research centers should foster global partnerships, multidisciplinary consortia, and joint projects that advance both theoretical and practical understanding of the metaverse.

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