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WHAT IS THE CURRENT TRAJECTORY OF METAVERSE TOURISM RESEARCH: A BIBLIOMETRIC OVERVIEW

METAVERSE TURİZMİ ARAŞTIRMALARININ YÖRÜNGESİ NEDİR: BİBLİYOMETRİK BİR GENEL BAKIŞ

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Abstract

Metaverse tourism research has seen remarkable progress in recent years, driven by increasing interest and technological advancements. This study addresses a critical gap in metaverse tourism by analyzing its trajectory through bibliometric analysis techniques. Using a dual approach—performance and science mapping analyses—the research evaluates 152 publications to identify key patterns, authors, and sources, providing a temporal overview of metaverse tourism's development. The findings reveal a notable surge in metaverse tourism research since 2022, signifying a shift from generalized topics to more specialized focuses. Articles dominate as the primary publication type, with China leading in publication volume. "Journal of Information Technology and Tourism" emerged as the most influential source, while works by Gursoy, Malodia & Dhir (2022), Buhalis, Lin & Leung (2022), Buhalis, Leung & Lin (2023a) and Koohang et al. (2023) are the most cited. Early studies emphasized virtual reality, smart tourism, and blockchain, with 2023 marking the conceptual establishment of metaverse tourism. Recent research highlights user experience, marketing, adaptation, and destination management. Specific topics like Generation Z, sustainable education, and sustainable tourism have gained prominence, utilizing diverse analytical methods. By mapping collaborations and identifying future research opportunities, this study provides a comprehensive guide for advancing metaverse tourism research and its practical implications.

Keywords: Metaverse Tourism, Bibliometric Analysis, Virtual Reality, Smart Tourism

Özet

Metaverse turizmi araştırmaları, artan ilgi ve teknolojik gelişmelerin etkisiyle son yıllarda önemli bir ilerleme kaydetmiştir. Bu çalışma, bibliyometrik analiz teknikleri kullanarak metaverse turizminin gelişim seyrini analiz ederek önemli bir boşluğu doldurmaktadır. Performans analizini ve bilim haritalama analizini içeren çift yönlü bir yaklaşımla, bu çalışma 152 yayını değerlendirerek metaverse turizminin gelişimine ilişkin zaman çizelgesini, temel araştırma desenlerini, yazarları ve kaynakları sunmaktadır. Bulgular, 2022'den itibaren metaverse turizmi araştırmalarında belirgin bir artış olduğunu, genel konulardan daha özel odaklara doğru bir kayma yaşandığını göstermektedir. Makale, en yaygın yayın türü olurken, yayın hacminde Çin lider konumdadır. Journal of IT&T dergisi en etkili kaynak olarak öne çıkarken, Gursoy, Malodia & Dhir (2022), Buhalis, Lin & Leung (2022), Buhalis, Leung & Lin (2023) ve Koohang vd.'nin (2023) çalışmaları en çok atıf alan çalışmalardır. Yapılan ilk çalışmalar sanal gerçeklik, akıllı turizm ve blockchain konularına odaklanırken, 2023 yılı metaverse turizminin kavramsal temelinin atıldığı yıl olmuştur. Son dönemdeki metaverse turizm araştırmaları kullanıcı deneyimi, pazarlama, adaptasyon ve destinasyon yönetimi gibi konulara vurgu yapmakla birlikte Z kuşağı, sürdürülebilir eğitim ve sürdürülebilir turizm gibi özelleştirilmiş konular önem kazanmış ve çeşitli analitik yöntemler kullanılmıştır. Bu kapsamda çalışma, iş birliği haritalaması aracılığı ile mevcut araştırma yörüngesini sunarak metaverse turizmi araştırmalarını geliştirmek için gelecek araştırmalara ışık tutmaktadır.

Anahtar Kelimeler: Metaverse Turizm, Bibliyometrik Analiz, Sanal Gerçeklik, Akıllı Turizm

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1. Introduction

The concept of the metaverse, coined from "meta" signifying "beyond" and "universe," denotes a fusion of the physical and digital domains into a unified synthetic environment (Yaqob & Hafez, 2023). Initially portrayed in Neal Stephenson's 1992 novel "Snow Crash," the metaverse gained prominence when Facebook rebranded itself as Meta in 2021 (Kim, 2021). This surge in interest coincided with advancements in augmented reality (AR), virtual reality (VR), extended reality (XR), and mixed reality (MR), alongside the advent of 5G technology. These technologies collectively laid the groundwork for seamlessly merging physical and virtual realms through VR headsets, blockchain technology, and avatars (Simon, 2023).

Many fields have researched the metaverse's effects since its October 2021 launch. Metaverse tourism research is a new trend focused on the relationship between the metaverse and tourism. Studies on metaverse tourism, initiated in 2022, have been ongoing since then. Recent studies consider metaverse tourism as an innovative technology (Buhalis, Leung & Lin, 2023a; Gursoy, Malodia & Dhir, 2022; Zaman et al., 2022; Dwivedi et al., 2023; Koo, Kwon, Chung & Kim, 2023; Yang & Wang, 2023). Previous studies have highlighted the importance of systematically examining the roles and effects of metaverse repositories due to uncertainties about its functions and effects, given the changing nature of this technology (Gursoy et al., 2022; Buhalis et al., 2023a; Yang & Wang, 2023; Go & Kang, 2023). Advancing metaverse tourism research to address these uncertainties can provide further theoretical contributions. Despite the complexity of understanding metaverse tourism, researchers are working diligently to develop its theoretical underpinnings (Yang & Wang, 2023). There is a need to understand the focus of existing studies to address the gaps in literature. Identifying research trends can guide future studies and improve previous research efforts. Accordingly, the current study aims to identify the trajectory of metaverse tourism research using bibliometric analysis techniques.

2. Preview of Metaverse Tourism Research

Research on metaverse tourism began in 2022 with Buhalis et al. (2022), Gursoy et al. (2022), Suanpang et al. (2022), Tsai (2022), Wei (2022), and Zaman et al. (2022). The emergence of the metaverse prompted an analysis of its diverse effects on tourism from various viewpoints, resulting in the development of metaverse tourism as a concept. Metaverse tourism has been defined by several researchers, such as Tsai (2022), Go and Kang (2023), and Yang and Wang (2023). Yang and Wang (202, p.3), for example, defined the metaverse tourism experience as an individual's subjective assessment and experience of tourism-related events in a mixed reality environment. Several studies have examined the dynamics of the metaverse tourism ecosystem, such as Buhalis et al. (2023), Go & Kang (2023), and Yang & Wang (2023).

Metaverse tourism has focused on several areas, such as tourism marketing (Ampountolas et al., 2024; Buhalis et al., 2023a; Ioannidis & Kontis, 2023; Kılıçarslan et al., 2024; Martí-Testón et al., 2023; Rather, 2023; Sánchez-Amboage et al., 2023; Tsai, 2022), tourism management (Buhalis et al., 2023a; Chen, 2024; Dutta et al., 2023; Koo et al., 2022; Monaco & Sacchi, 2023; Özdemir Uçgun & Şahin, 2023; Prados-Castillo et al., 2024; Saleh, 2024; Wei, 2022; Wei, 2024; Wong et al., 2023; Yang & Wang, 2023; Zaman et al., 2024), tourist behavior (Ariza-Montes et al., 2023; Buhalis et al., 2022; Çolakoğlu et al., 2023; Hassan & Saleh, 2023; Ioannidis & Kontis, 2023; Jafar & Ahmad, 2024; Kılıçarslan et al., 2024; Koo et al., 2023; Liu & Park, 2024; Rather, 2023; Shin & Kang, 2024; Yoon & Nam, 2024; Zhong et al., 2023), and destination marketing and management (Allam et al., 2022; Florido-Benítez, 2024; Kouroupi & Metaxas, 2023; Suanpang et al., 2022; Zhang & Quoquab, 2023; Ghali et al., 2024; Ioannidis & Kontis, 2023). Metaverse tourism research is currently undergoing continuous development and attracting increasing interest from tourism scholars.

3. Research Questions

Bibliometrics is a quantitative method for analyzing academic publications to identify patterns and trends in research activity across various topics, fields, institutions, or countries (De Bellis, 2009; Ramos-Rodríguez & Ruíz-Navarro, 2004). Bibliometric methods can be used to evaluate the research productivity of authors, journals, countries, and institutions, as well as to quantify international cooperation (Abramo et al., 2011; Chiu & Ho, 2007). Regarding the metaverse specifically, such analyses can provide insights into areas of growing scientific interest, notable authors and institutions, emerging themes, and research areas (Gomes et al., 2015). Bibliometric analyses can monitor the development of research trends and reveal how the research focuses on the metaverse has changed and grown. Having a longitudinal perspective is crucial for understanding the trajectory of metaverse research and forecasting future advancements in the field.

Hence, the bibliometric study here aims to extensively review research on metaverse tourism by mapping the research landscape, identifying significant author collaborations, and monitoring emerging trends. The study is guided by the following two research questions:

1. What does the performance analysis of metaverse tourism research reveal?
2. Based on science mapping analysis, what is the trend of metaverse tourism research?

4. Methodology

The study adopted a four-stage bibliometric analysis procedure in Table 1. Bibliometric analysis is typically carried out using two specific methods: performance analysis and science

mapping (Aria & Cuccurullo, 2017; Donthu et al., 2021). Performance analysis evaluates the research components, while science mapping examines the connections between research components. In the present study, bibliometric analysis is used to comprehensively understand developments in metaverse tourism research and map the field's knowledge structure (Bota-Avram, 2023).

Table 1: The Bibliometric Analysis Procedure

Step	Procedure
Step 1. Research purpose	• To reveal a bibliometric overview of metaverse tourism publications
Step 2. Choosing bibliometric analysis techniques	• Performance analysis • Science mapping
Step 3. Selections of studies	• Suitability for research purposes • Prepare the data by cleaning it before moving forward (152 publications from Scopus) • Remove errors like duplicates.
Step 4. Analysis and reporting	• *Phase 1.* Performance analysis
	• *Phase 2.* Science mapping

Source: The author's elaboration

4.1. Selection of Studies

Scopus and Web of Science (WoS) databases provide extensive publication archives for bibliometric research. Using Scopus and WoS keywords "metaverse AND tourism" and "metaverse tourism," respectively, a literature search was conducted on March 30, 2024. From 2022 to the present, 152 metaverse tourism publications were identified on Scopus and 96 on WoS. An initial review of these publications showed that all WoS publications were also present in the Scopus database. Hence, only Scopus database publications were included in the analysis to prevent duplication. The WoS publications had already been identified by Prados-Castillo et al. (2024) using the keywords "metaverse tourism" and "virtual reality tourism." Thus, the present study can broaden Prados-Castillo et al.'s (2024) study by incorporating the Scopus database.

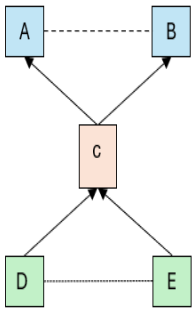
The data were extracted up to the specified date following the PRISMA Statement methodology (Page et al., 2021) and guidelines from leading authors in bibliometric analysis and literature review (Kraus et al., 2022). Without imposing any limitations, all publications were included in the analysis to provide a comprehensive profile. To reveal emerging trends, there should be sufficient data to perform the bibliometric analysis (Ozdemir & Goktas, 2021; Prados-Castillo et al., 2024). In the present study, the core data comprised 152 publications that reflect the growing trend in exploring trajectories of metaverse tourism.

4.2. Data analysis

Practical data analysis is facilitated using bibliometric software like Gephi, Leximancer, and VOSviewer (Kumar et al., 2021). In the present study, VOSviewer was used for analysis. During the preparation phase, publications were obtained in CSV format using the search criteria in TITLE-ABS-KEY-AUTH. The analysis was carried out in two stages. For the first phase, performance analysis was used, which relies on activity indicators to reveal research productivity and impact (Caputo et al., 2021; Wang et al., 2021). In the present study, eleven indicators were used: year of publication, type of publication, number of contributing authors, most published authors, organization with the most publications, country with the most publications, most published sources, total citations, number of cited publications, most cited publications, and most cited organization. VOSviewer was used to analyze four indicators, namely total citation, number of cited publications, most cited publications, and most cited organization. The remaining indicators were analyzed using Scopus's analyze results function. The performance analysis of the publications entailed the use of descriptive statistics to provide an overview of metaverse tourism research.

For the second stage, science mapping analysis was used to investigate the connections between research components in metaverse tourism publications (Baker et al., 2021). VOSviewer software is an effective mapping tool for clarifying relationships and collaborations among items (van Eck & Waltman, 2022; Xu et al., 2021). The software provides three types of science maps, which were all used in the present study: network visualization, overlay visualization, and density visualization. As shown in Table 2, five analysis indicators were used to examine the documents, cited authors, sources, keywords, authors, and countries in publications on metaverse tourism: citation analysis, co-citation analysis, bibliographic coupling, co-occurrence, and co-authorship analysis (Bota-Avram, 2023). These indicators play a crucial role in analyzing and following scientific research trends, thereby helping researchers identify important contributions, prominent journals, and leading researchers in metaverse tourism research (Hallinger & Kovačević, 2021).

Table 2: Bibliographic Data

Links	Items	Definition	Citation patterns
1. Citation analysis	• Documents	• A connection between two items where one references the other (e.g. A-C)	
2. Co-citation analysis	• Cited authors	• A connection between two items that are cited by the same document (e.g. (A-B)	
3. Bibliographic coupling	• Sources	• A connection between two items that reference the same document (e.g. D-E)	
4. Co-occurrence	• Keywords	• Represents the number of documents in which a keyword appears	
5. Co-authorship analysis	• Authors • Countries	• A connection between an author and other authors.	

Source: van Eck & Waltman,2022: 24; Fujita et al., 2014:133.

The research questions were addressed by analyzing the 152 documents listed. The documents are discussed, and the results are presented in the following section.

5. Results

5.1. Performance Analysis

Performance analysis resembles the profile of publications (Bota-Avram, 2023). The components of performance analysis (e.g., publications and citations) are selected, analyzed, and reported. Figure 1 indicates the longitudinal trend in metaverse tourism publications and the publication types. The figure shows that metaverse tourism studies (e.g., Buhalis et al., 2022; Gursoy et al., 2022; Fan et al., 2022; Filimonau et al., 2022; Tsai, 2022; Zaman et al., 2022; Wei, 2022) first appeared in databases in 2022 (n=17) and increased significantly in 2023 (n=99). The fact that there was about one-third as many publications in the first two months of 2024 as in all of 2023 (n=36) indicates that the rising trend in metaverse tourism research will continue in the near future. Regarding the type of publication, metaverse tourism publications are predominantly articles (n=83), followed by conference papers (n=33), and book chapters (n=15).

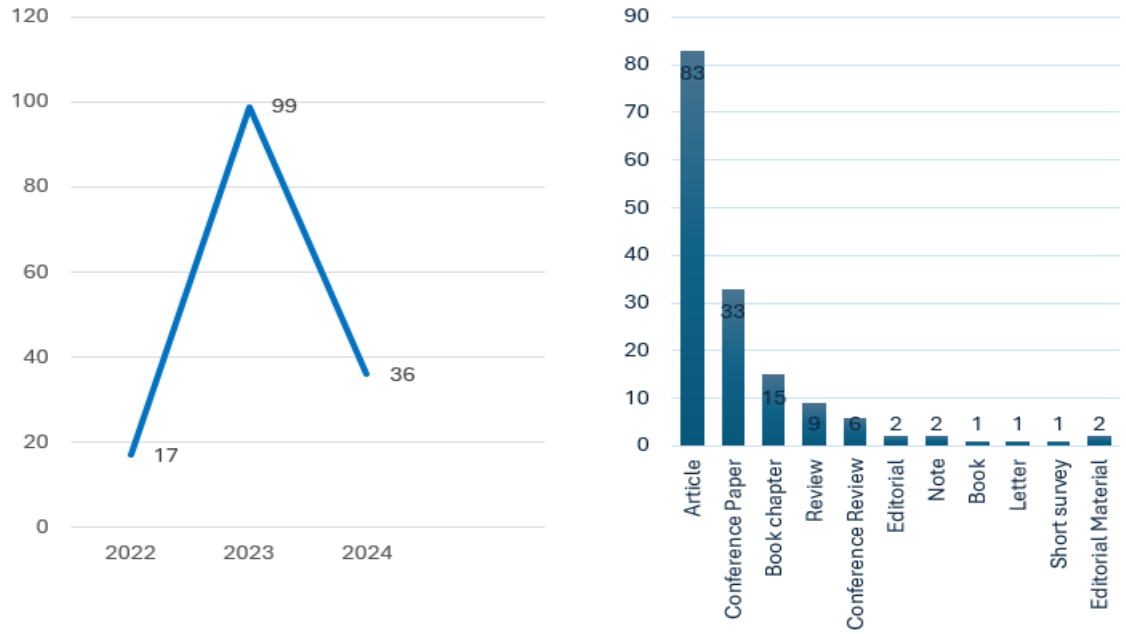
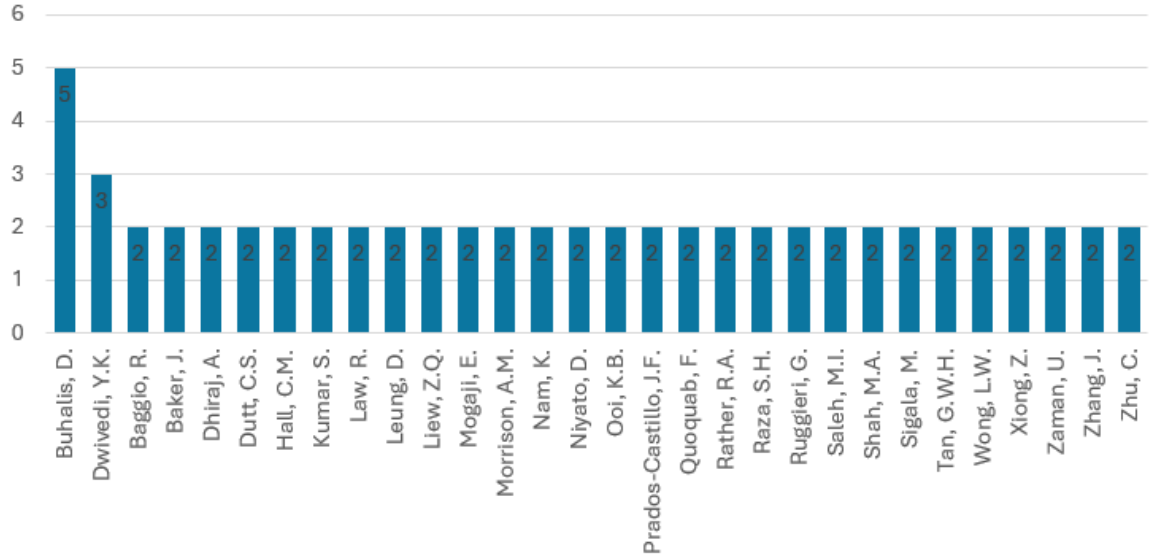


Figure 1. Number of Publications Over Time and Types of Publications

Source: Created by the author based on Scopus analyze results.

Regarding authorship trends, 463 authors contributed to metaverse tourism research in the period studied. Figure 2 shows that the most productive authors in metaverse tourism publications are Buhalis, D. (n=5) and Dwivedi, Y.K. (n=3). Another 28 authors have conducted multiple studies on metaverse tourism. The important role of these studies and the significant contributions of these authors to metaverse tourism should not be ignored.



*Authors with multiple publications

Figure 2. Most Published Authors

Publication performance is a widely used metric to assess organizational activity (Bota-Avram, 2023). Thus, it is desirable to be published in top sources within a certain field. The analyze

shows that 375 organizations conducted studies on metaverse tourism within the study period, of which there were 156 organizations. As shown in Figure 3, the four organizations with the most publications were Hong Kong Polytechnic University (n=8) and the University of Macau (n=8), followed by Nanyang Technological University (n=6) and Swansea University (n=6). Thus, these organizations appear to be at the forefront of this emerging research trend.

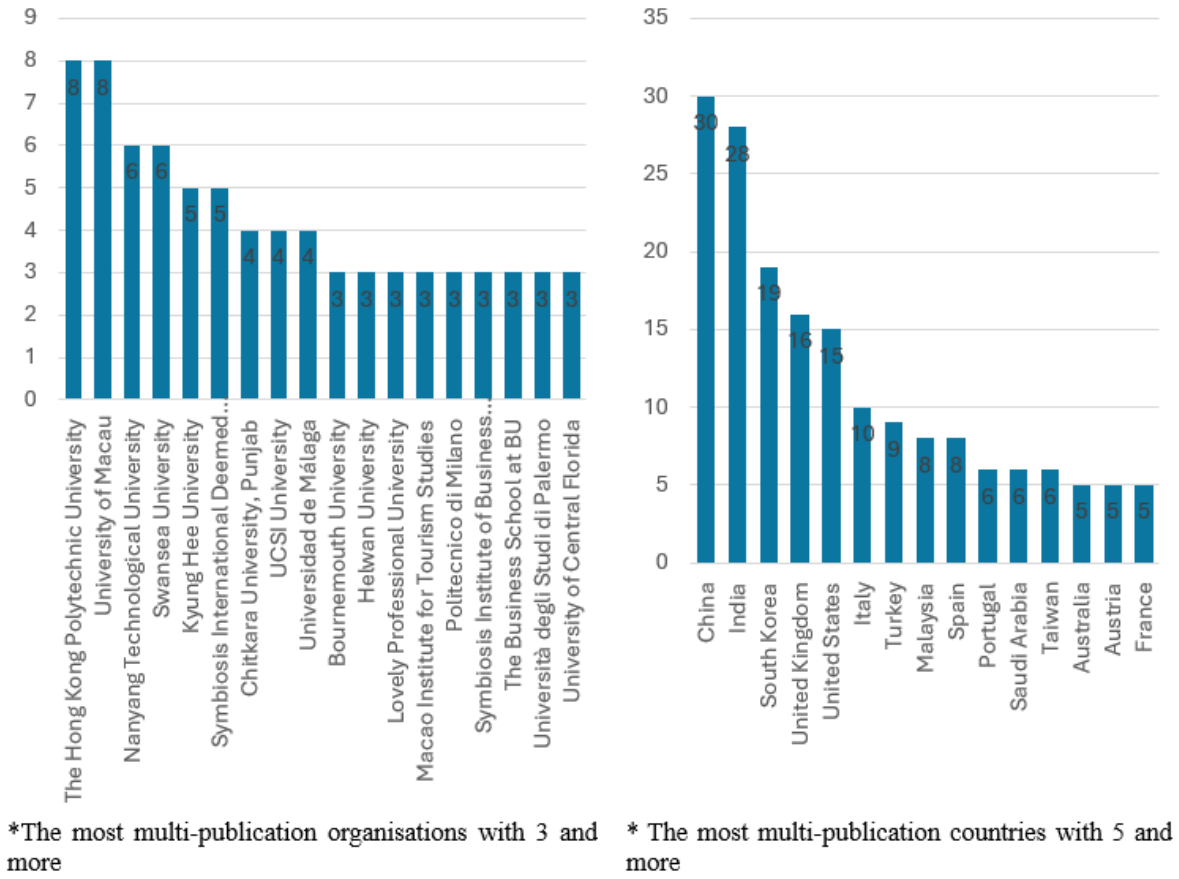


Figure 3. Most published organizations and countries

Source: Created by the author based on Scopus analyze results

Regarding countries of origin, metaverse tourism studies were conducted in 55 countries. The country was unidentifiable for seven studies, so these were categorized as "undefined." As Figure 3 shows, six countries had ten or more publications: China (n=30), India (n=28), South Korea (n=19), United Kingdom (n=16), United States (n=15), and Italy (n=10). Türkiye had 9, followed by Malaysia and Spain with 8. Thus, these countries are the ones where metaverse tourism studies have grown most significantly, with authors from these countries demonstrating a greater interest in metaverse tourism research. Figure 3 also indicates the countries that are lacking in metaverse tourism studies.

The studies were published in 95 sources, mostly as articles in peer-reviewed journals. The journal with the most metaverse tourism publications (n=16) was Information Technology and

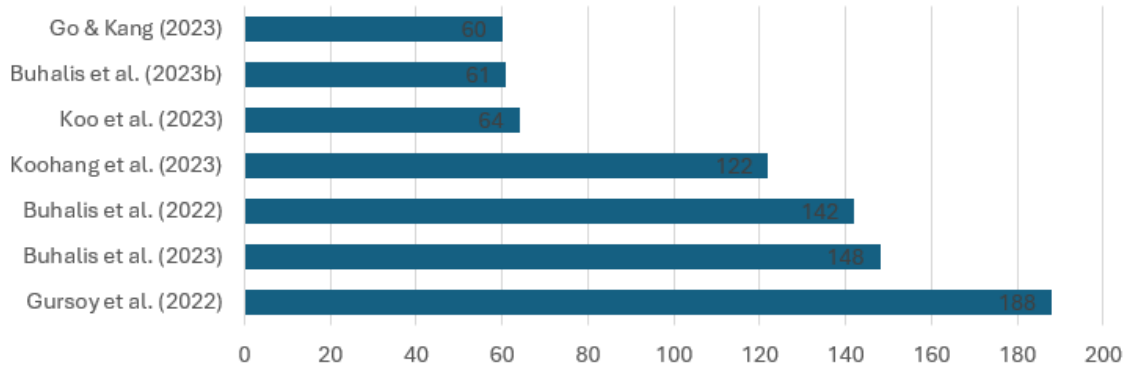
Tourism. This is because it published two special issues on the theme of the metaverse in 2023 (Issues 3 and 4). Other frequently used journals were Tourism Review (n=8), Sustainability (n=6), and International Contemporary Hospitality Management (n=6). Figure 4 lists all publications with four or more articles on metaverse tourism. Given that they gave the most priority to the field, these sources can be considered the primary contributors to metaverse tourism research. Future researchers would be advised to consult these sources for insights into emerging research trends.

*Sources with four or more publications

Figure 4. Most Published Sources

Source: Created by the author based on Scopus analyze results

Research studies can have substantial and widespread impacts beyond the number of publications. Citation indexes are widely used to measure such impacts of publications and organizations (De Bellis, 2009). In the present study, this was done by analyzing total citations, number of cited publications, most cited documents, and most cited organization. Out of the 152 publications analyzed, 83 received a total of 1,329 citations, with more than half (54.6%) being cited, indicating that metaverse tourism publications are interconnected and influence each other. Figure 5 displays those publications with 50 or more citations, of which the most influential were Gursoy et al. (2022), Buhalis et al. (2023a), Buhalis et al. (2022), and Koohang et al. (2023). The oldest publications, such as those by Gursoy et al. (2022) and Buhalis et al. (2022), were typically the most cited. Nevertheless, more recent studies also had comparable impacts to the early studies, with publications from 2023 being frequently cited, showing the growing importance of metaverse tourism studies despite their recent origin.



*Publications with fifty or more citations

Figure 5. Most Cited Publications and Organizations
Source: Created by the author based on the VOSviewer analysis.

Table 3 displays the most cited publications categorized by their respective organizations. A total of 6,524 citations were made to publications from 227 organizations. "Bournemouth University" had the most citations (n=473), followed by "Hong Kong Polytechnic University" (n=351) and "Mica, University of Agder", "Washington State University", "North-West University", "University of Johannesburg", and "University of Stavanger" (n=188). These organizations can thus be considered to have the most significant influence on metaverse tourism research and are the primary contributors to this research trend.

Table 3: Most Cited Organizations

Organization	Citations	Organization	Citations
Bournemouth University	473	Ajman University	122
The Hong Kong Polytechnic University	351	Curtin University	122
Mica, India	188	Dijlah University College	122
University Of Agder	188	Em Normandie Business School	122
Washington State University	188	King Abdulaziz University	122
North-West University	188	Middle Georgia State University	122
University Of Johannesburg	188	Nanchang Institute of Technology	122
University Of Stavanger	188	National Institute of Industrial Engineering	122
UCSI University	136	Oklahoma State University	122
Yunnan Normal University	128	Sheffield Hallam University	122
Middlesex University	122	Symbiosis International Deemed University	122
Swansea University	122	Tashkent State University of Economics	122
Swinburne University	122	The British University in Dubai	122
University of Greenwich	122	University of Piraeus	122
		Xiamen University	122

*Organizations with 100 or more citations
Source: Created by the author based on the VOSviewer analysis.

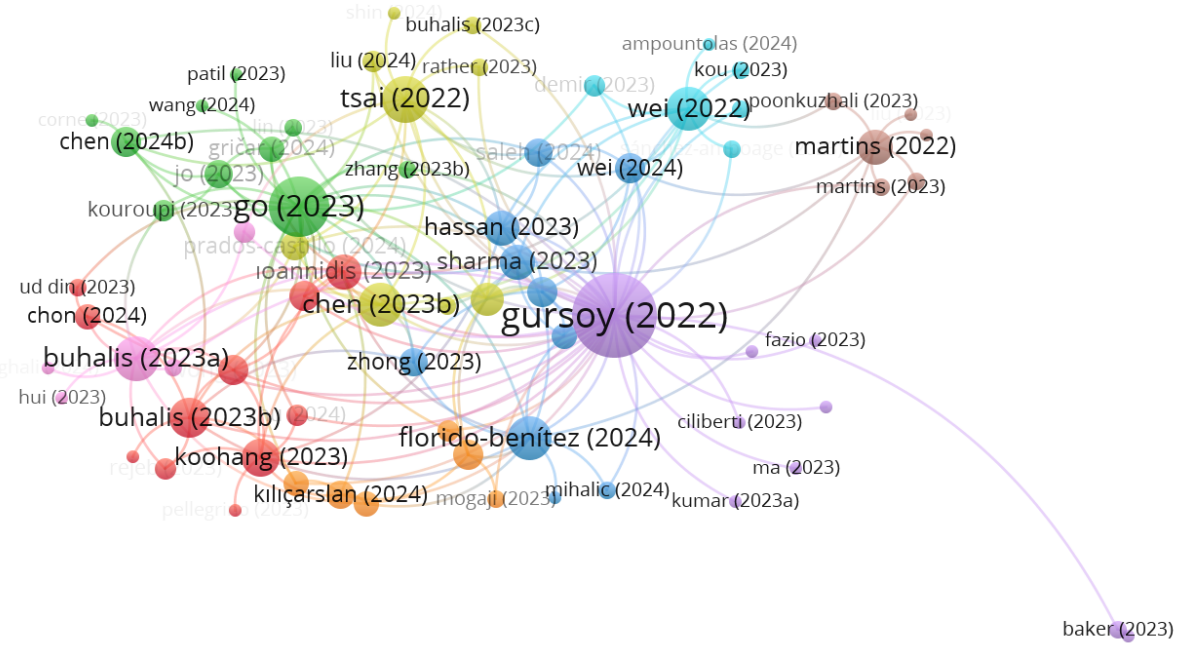
5.2. Science Mapping Analysis

The science mapping analysis aims to provide an overview of the bibliometric and intellectual framework of a field (Caputo et al., 2021). This is accomplished by using techniques such as citation analysis, co-citation analysis, co-occurrence analysis, bibliographic coupling, and co-authorship analysis, along with advanced bibliometric methods like network and clustering visualization (Donthu et al., 2021). This section displays science maps based on the five indicators mentioned earlier by extracting the tables from Supplementary Material 1.

To understand the outcomes of the analysis, it is essential to understand certain specialized terminology used in VOSviewer. Items are focal points like publications, researchers, or terms, while links are connections between these items without specifying their strengths. A network emerges through the combination of items and connections, resulting in interconnected elements. Each color on the map represents a distinct cluster that groups items, with each item belonging to a single cluster. The term total link strength quantifies the collective strength of links that an item has with other items. Link strength and total link strength are both indicators of attribute weights, which are visually represented by label sizes. That is, objects with greater weights are represented with larger labels in the visualization (van Eck & Waltman, 2022, p. 4,5).

5.3. Citation Analysis

Citation analysis indicates "the number of citations received by a document or the total number of citations from all documents published by a source, author, institution, or country. Citation links are links between two items that cite each other" (van Eck & Waltman, 2022, p. 25). Citation analysis in this context identifies the most influential publications in the research field and examines the relationships between publications. Citation analysis has several advantages, such as categorizing publications, visualizing information dissemination within a network, evaluating publication importance, and identifying research communities. In short, citation analysis measures scientific impact in the field (Allam et al., 2021, p.7). VOSviewer conducts citation analysis using the publication's author/s, source, organization, and country. Given that the citation link between two items is directed, there is no distinction in terms of direction regarding a citation from one variable to another. Examining citation connections can reveal which studies are most interconnected, thereby indicating that these studies have the most significant influence on the relevant field (van Eck and Waltman, 2022,p. 27).



Note: The link indicates the relationship between a certain publication and other publications.

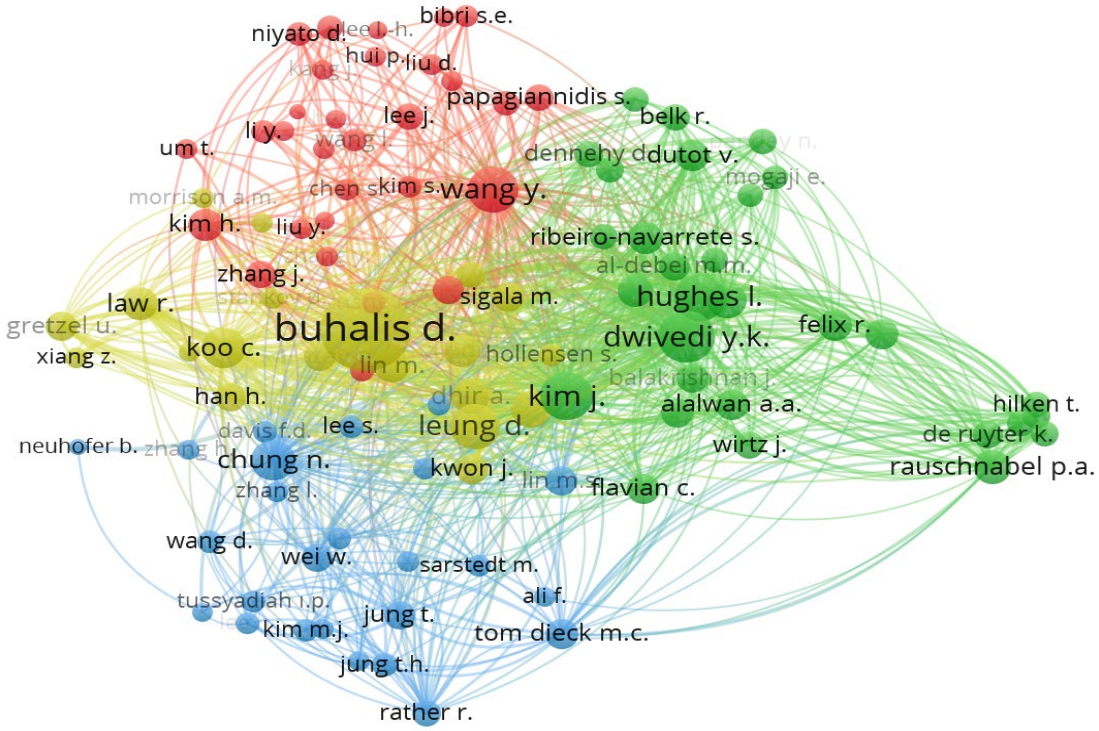
Figure 6. Citation Network Diagram of Documents

An initial attempt was made to identify the most impactful studies in the field by analyzing the publications cited most frequently. When dealing with dense data, setting a lower citation threshold is typical to achieve more precise outcomes. However, no limitations were imposed in the present study because the aim was to analyze the trajectory of metaverse tourism research. The analysis of all 152 documents using a document-based citation network map resulted in 15 clusters with 72 interconnected documents linked by 171 connections (Figure 6). The publications with the most citation network connections (10 or more) ranked as follows: Gursoy et al. (2022), Go & Kang (2023), Tsai (2022), Buhalis et al. (2023a), Florido-Benítez (2024), Wei (2022), Chen et al. (2023), and Buhalis et al. (2023b). Thus, citation network mapping shows how the most frequently cited authors within metaverse tourism research have made a significant contribution due to their pioneering dissemination of a developing idea within this specific field during a certain period.

5.4. Co-citation Analysis

A co-citation link runs "between two items that are both cited by the same document" (van Eck & Waltman, 2022, p. 27). In the present study, the co-citation analysis identified central sources, references, or authors in the field by selecting the author as the analysis unit (Zitt & Bassecoulard, 1994). Figure 7 presents the network diagram of co-citations among the analyzed authors within metaverse tourism to show which authors have constructed the theoretical framework of metaverse tourism studies. Based on a threshold of 20 citations per author, the

analysis produced 4 clusters comprising 105 researchers. These clusters comprised 5,255 links with a total link strength of 86,737. Figure 7 displays the four main clusters of cited references: A red cluster with 30 authors, a green cluster with 30 authors, a blue cluster with 25 authors, and a yellow cluster with 20 authors. The key authors with the highest contributions, based on total link strength, were Buhalis, D. (285.71), Dwivedi, Y.K. (104.72), Kim, J. (98.83), Leung, D. (93.25), and Wang, Y. (88.02). Other researchers frequently cited Buhalis, D. (n=5) and Dwivedi, Y.K. (n=3) as the authors with the most publications in metaverse tourism research.

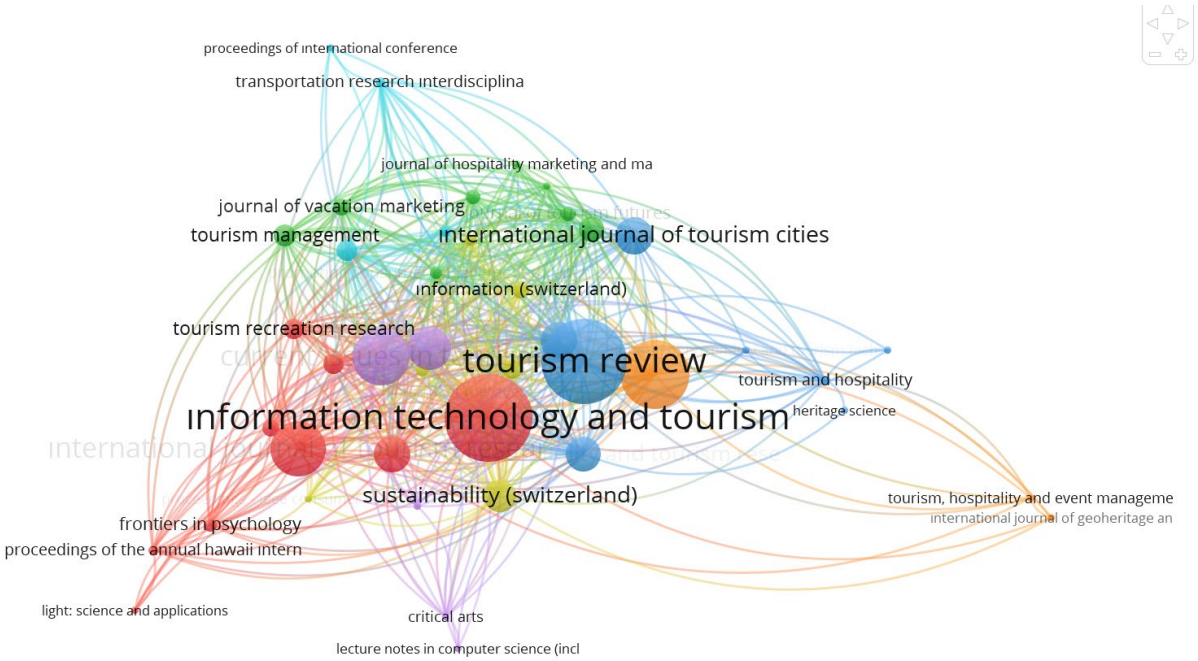


Note: The strength of a connection shows the number of authors referenced jointly, and the total link strength is the sum of the strengths of the various links in the network file.

Fig. 7. The Co-citation Network Diagram of the Authors

5.5. Bibliographic Coupling

Bibliographic coupling refers to "the link between two items that cite the same document" (van Eck & Waltman, 2022, p. 27). The analysis assumes that a significant connection exists between publications that share one or more references. According to Kessler (1963), the bibliography of a scientific study reveals the author's academic context. Hence, when two publications share similar bibliographies, it suggests a latent connection between them. a possible similarity in the subjects they cover, as explained by Caputo et al. (2021). Bibliographic coupling analysis is frequently conducted using a range of variables to evaluate scientific research in a specific field (Biggi & Giuliani, 2021), reveal its intellectual framework (Kumar et al., 2020), and measure its interconnectedness (Phan Tan, 2022).



Note: Overall link strength refers to the strength of the bibliographic coupling relationships between a specific journal and other journals.

Figure 8. The Bibliographic Coupling Network Diagram of the Sources

In the present study, the publications came from 95 different sources. Based on a threshold of one document and one citation per source, the resulting set contained 50 journal sources. Figure 8 presents the map of sources most closely associated with a specific focal source in publications related to metaverse tourism research. The map displays the total link strength among 44 sources, with 7 clusters, 508 links, and a total link strength of 3,925, representing the source network map of publications on metaverse tourism. It shows which sources have the strongest links with other metaverse tourism publications. The analysis indicated that two journals were the most influential, namely "Information Technology and Tourism", and "Tourism Review", with total link strengths of 1,005 and 966, respectively. Three other sources with high bibliographic coupling network strengths were "International Journal of Contemporary Hospitality Management (719)", "Current Issues in Tourism (559)", and "International Journal of Tourism Research (537)". These sources had the most citations in studies related to metaverse tourism.

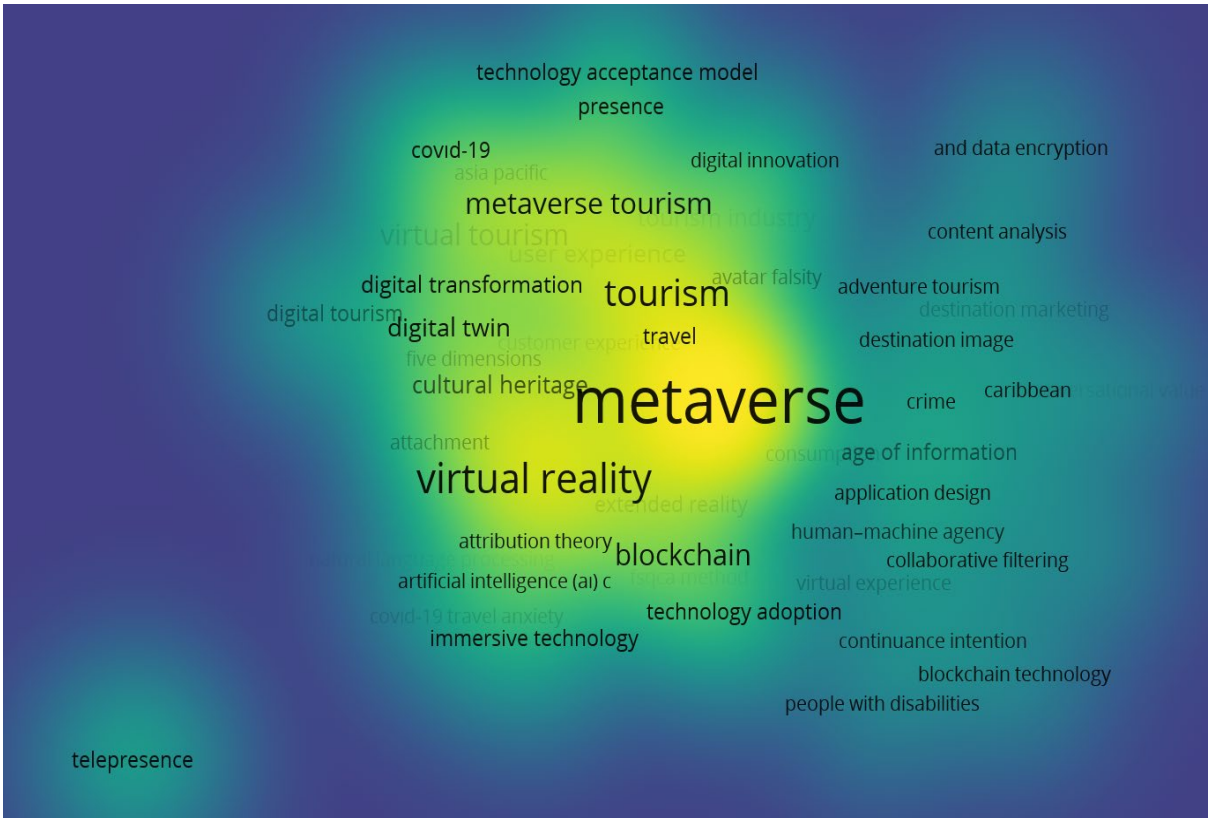
5.6. Co-occurrence Analysis of Keywords

Co-occurrence analysis, a key tool for measuring scientific production, provides a broad overview of a field's main research focuses based on relevant studies (Hu & Zhang, 2015). Through keywords in titles and abstracts, the tool provides a simple and meaningful way of evaluating research themes and emerging areas (Ding & Yang, 2020; Khandelwal et al., 2022; Rejeb, 2022). The analysis aims to provide researchers with an understanding of the content of

studies and establish the overall structure of the scientific field (Rejeb et al., 202, p.4). The co-occurrence frequency of keywords is believed to reflect the main themes of studies in a particular field (Fakhar Manesh et al., 2021).

In the present study, the most frequently co-occurring keywords indicate the main themes of metaverse tourism research. Figure 9 presents the item density visualization map for co-word occurrences across the years analyzed, while the overlay visualization map (Figure 10) presents co-word occurrences by year.

With a total of 452 keywords, the threshold was set at 1 keyword to ensure more meaningful results. This produced 423 keywords with 1,545 links and a total link strength of 1,705 in 51 clusters. The five most frequent co-occurrences are "metaverse" (92 co-occurrences), "virtual reality" (28 co-occurrences), "tourism" (19 co-occurrences), "augmented reality" (13 co-occurrences), and "metaverse tourism" (10 co-occurrences). This visualization improves comprehension by displaying the keyword density for each item individually.

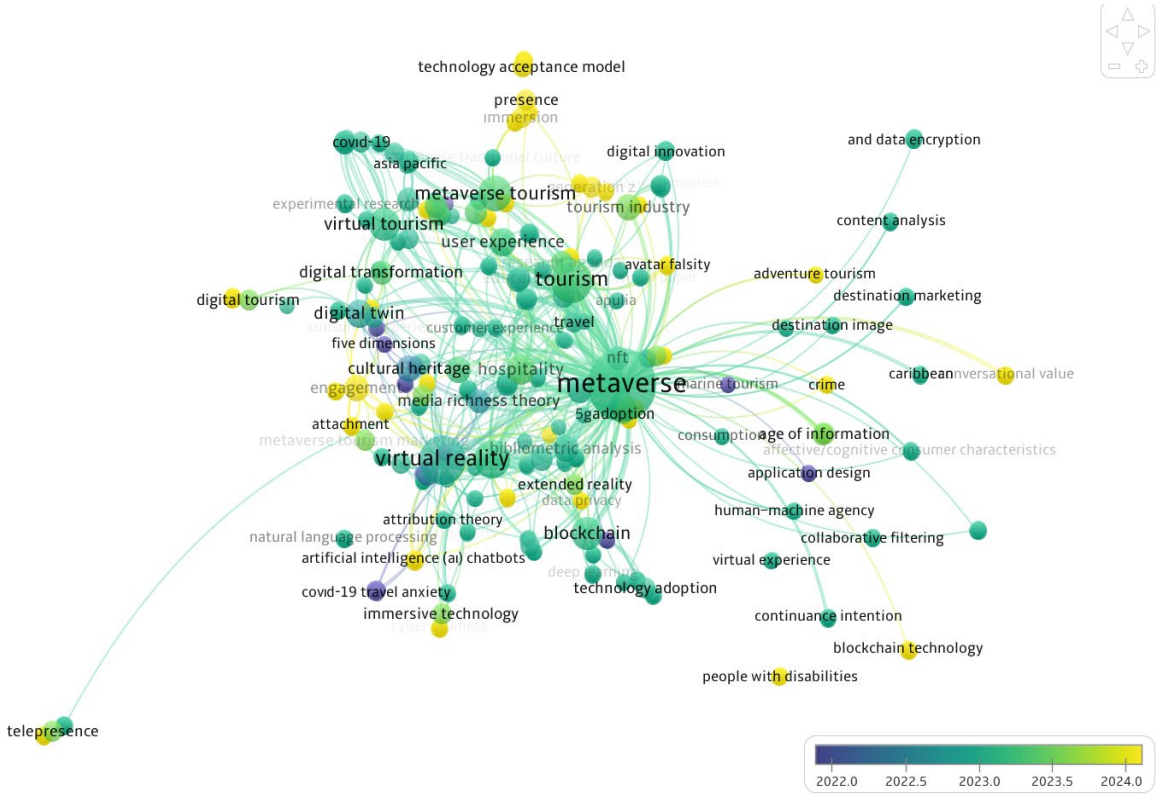


Note: Overall link strength indicates how many times an author term (item) appears in the same papers.

Figure 9. The Keyword Co-occurrence Density Diagram Based on Item Density.

The overlay visualization in Figure 10 highlights the temporal distribution of keywords. Keywords are color-coded based on a score derived from the average year of their occurrence, ranging from blue (earliest years) to green and yellow (most recent years). Figure 10 illustrates

the evolution of metaverse tourism research, which initially concentrated on topics such as smart tourism, mixed reality, virtual reality, blockchain, Covid-19 travel anxiety, digital documentation, consumer experience, and Internet 3.0. Over time, the focus shifted to more integrated and specialized concepts like technology adoption, consumer behavior, marketing, tourism development, education, tourism and hospitality, tourism marketing, artificial intelligence, metaverse tourism, and destination management organizations. Recently emerging themes, including metaverse tourism, digital tourism, sustainable tourism, service quality, tourism economics, and digital transformation, are expanding the field's perspectives. Overall, metaverse tourism research has followed the trajectory outlined in Figure 13. More recent publications are more specific (e.g., technological mindfulness, future threats, people with disabilities, age group).



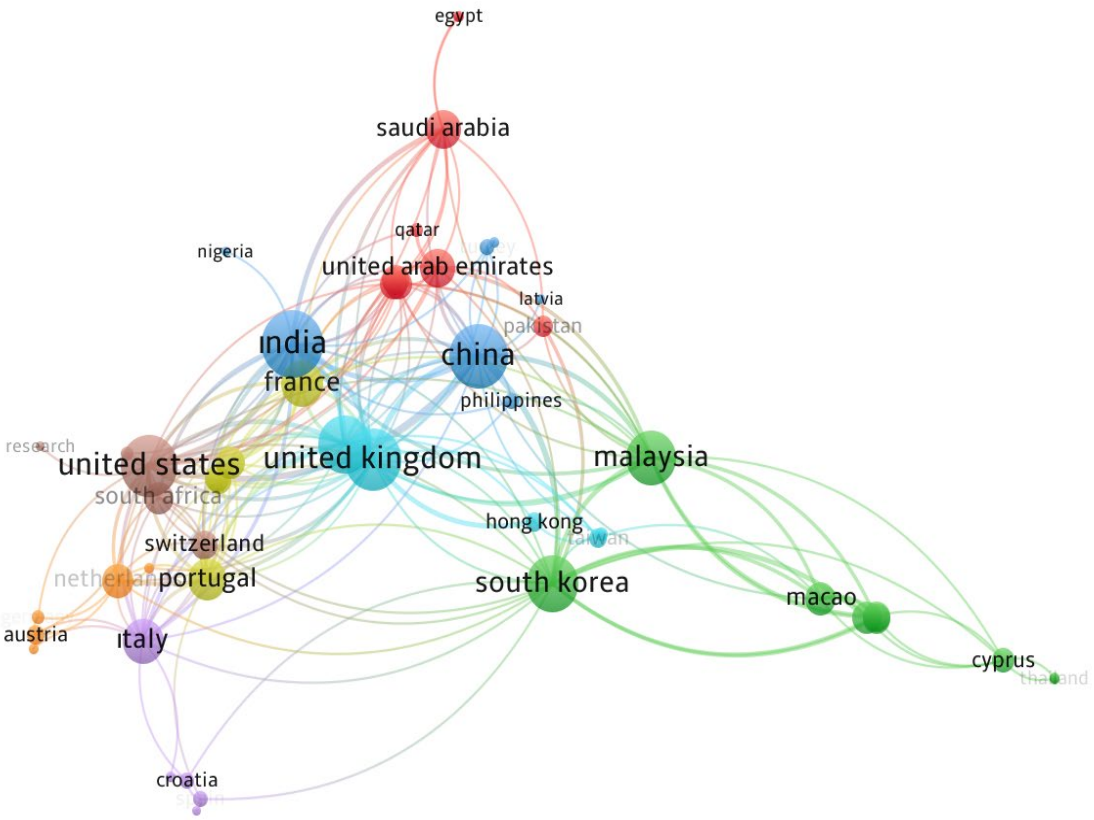
Note: Overall link strength reflects the presence of an author keyword (item) in the same publications by publishing year (from the oldest, blue, to the most current, yellow).

Figure 10. The Co-occurrence of Keywords Overlay Diagram

5.7. Co-authorship Analysis

Co-authorship is a clear and tangible form of scientific collaboration (Henriksen, 2016), which can be used to assess the standing of researchers in the relevant field (Liu et al., 2005). It measures intellectual partnerships among authors, countries, and organizations in terms of the number of co-authored publications. This enables the reliable tracking of almost all aspects of scientific collaboration networks (Glänzel & Schubert, 2005). Although it offers only a limited

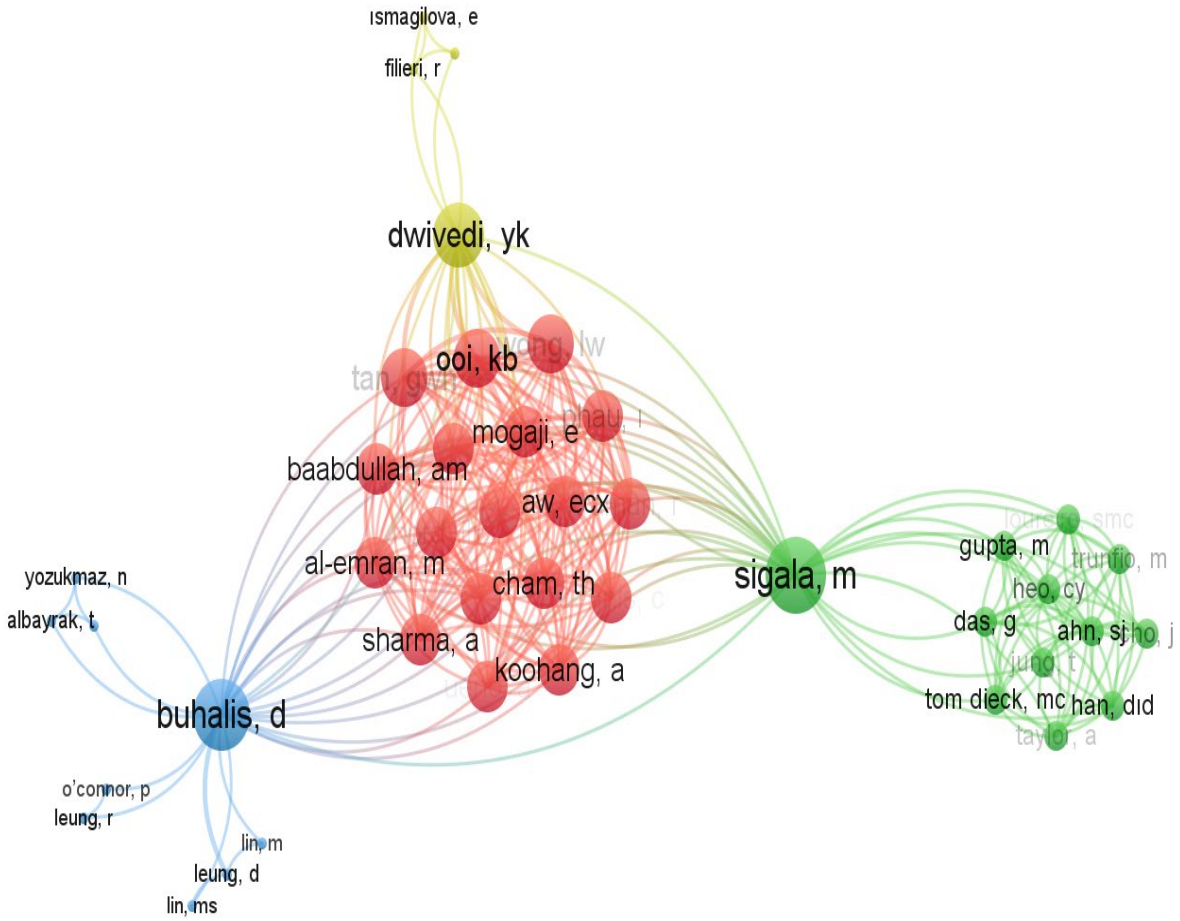
perspective on scientific research collaboration, it is considered one of the most effective techniques (Corley & Sabharwal, 2010, p. 627). Through co-authorship, researchers' cross-disciplinary and geographical collaborations have become increasingly important for cohesion and identity in the scientific community (Leifeld & Ingold, 2016). Accordingly, the present study also examined co-authorship links in terms of author and country units.



Note: Overall link strength refers to the total strength of co-authorship ties between a certain country and other countries.

Figure 11. Co-authorship Network Diagram of the Country

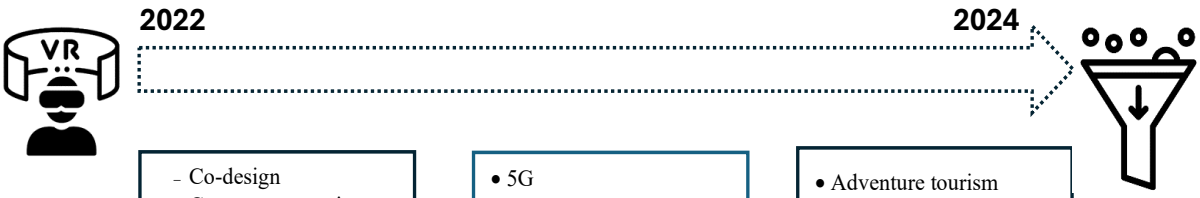
Figure 11 shows the results of the analysis. Of the 152 publications, 56 countries were identified. Based on a threshold of one publication per country, authors from 50 countries collaborated on co-authored publications related to metaverse tourism. Ten clusters were identified with 213 links and a total link strength of 288. India had the highest collaboration with a total link strength of 44, followed by China with 40, the UK and the USA with 38 each, Australia with 33, and South Korea with 32. Malaysia had a total link strength of 30.



Note: Overall link strength refers to the strength of all co-authorship relationships between a certain author and other authors.

Figure 12. Co-authorship Network Diagram of the Author

Regarding the analysis of collaboration by author, 463 authors were identified from 152 publications. Based on a threshold of one publication per author, the resulting set contained 43 authors grouped in four clusters. Figure 12 presents the most collaborative authors in terms of the total link strength of their co-authorship. These authors were Sigala, M. (31 total link strength), Buhalis, D. (29), and Dwivedi, Y.K. (26). Given their substantial network strengths, these authors can be considered the most influential researchers in collaborations in metaverse tourism studies. Co-authorship networks comprise comparable sub-communities, which implies that researchers can enhance their visibility by bridging these disconnected sub-groups.



- Co-design
- Consumer experience
- Consumption
- Cultural heritage
- Cryptocurrency
- Digital documentation
- Digital tourism
- Digital twin
- Extensible metaverse
- Internet 3.0
- Smart tourism
- Space travel
- Tech savviness
- Tourism intention
- Tourism marketing
- Tourism service
- Virtual reality
- Virtual spaces
- Virtual tourism

- 5G
- Adoption
- Augmented reality
- Behavioral models
- Bibliometric analysis
- Blockchain
- Conceptual paper
- Content analysis
- Destination image
- Destination management
- Destination marketing
- Digital tourism
- Digital transformation
- Digital twins
- Experimental research
- Governance
- Heritage tourism
- Hospitality
- Human machine agency
- Immersive technology
- Literature review
- Meta-tourism
- Metaverse tourism
- Mixed reality
- NFTs
- Service quality
- Sustainability
- Sustainable tourism
- Technology
- Tourism
- Tourism economics
- User experience
- Virtual experience
- Virtual hotel
- Virtual world

- Adventure tourism
- Age group
- AR attachment
- Artificial intelligence
- Attachment
- Authenticity
- Avatar falsity
- Blockchain technology
- Challenges
- Ciber-sickness
- Consumer
- Conversational value
- Crime
- Data privacy
- Digital detox
- Disruptive businesses
- Engagement
- Escapism
- Future threats
- Generation Y
- Generation Z
- Hedonic
- Heritage sites
- Hotel sales and marketing
- Immersion
- Marketing strategies
- Metaversal sustainability
- Metaverse ecosystem
- Online travel agencies
- People with disabilities
- Place attachment
- PLS-SEM
- PRISMA
- Psychological ownership
- Responsible tourism
- Risk perception
- Sentiment analysis
- Sustainable development
- Sustainable tourism paradigm
- Technology acceptance model
- Technology mindfulness
- Text mining
- Tourist behavior
- Tourism demand
- Tourism in metaverse
- Tourism metaverse
- Tourism well-being
- Tourist motivation
- Traveler experience

Figure 13. The Trajectory of Metaverse Tourism Research

Table 4: The Outlines of Metaverse Tourism Research

Research questions	Results*
What are the findings of the performance analysis of Metaverse tourism publications?	
Year of publications	2022 (n:17), 2023 (n:99), 2024 (n: 36)
Types of publications	Article (n:83), Conference paper (n: 33), Book chapter (n:15)
Number of contributing authors	463
Most published authors	Buhalis, D., Dwivedi, Y.K.
Organization with the most publications	The Hong Kong Polytechnic University, University of Macau, Nanyang Technological University, Swansea University
Country with the most publications	China, India, South Korea, United Kingdom, United States, Italy
Most published sources	"Information Technology and Tourism", "Tourism Review", "Sustainability", "International Contemporary Hospitality Management"
Total citation	1329
Number of cited publications	83 of 152
Most cited publications	Gursoy et al. (2022), Buhalis et al. (2023a), Buhalis et al. (2022), Koohang et al. (2023)
Most cited organization	"Bournemouth University", "The Hong Kong Polytechnic University", "University of Agder", "Washington State University", "North-West University", "University Of Johannesburg", "University Of Stavanger"
What trends do metaverse tourism publications display according to science mapping analysis?	
Citation analysis	Gursoy (2022), Go (2023), Tsai (2022), Buhalis et al. (2023a), Florido-Benítez (2024), Wei (2022), Chen et al. (2023), Buhalis et al. (2023b)
Co-citation analysis	Buhalis, D., Dwivedi, Y.K., Kim, J., Hughes, L., Wang, Y., Leung, D., Chung, N., Koo, C., Gursoy, D.
Bibliographic coupling	"Information Technology and Tourism", "Tourism Review", "International Journal of Contemporary Hospitality Management", "Current Issues in Tourism", "International Journal of Tourism Research"
Co-occurrence analysis	Metaverse, metaverse tourism, virtual reality, tourism, augmented reality, virtual tourism, blockchain, hospitality, user experience, digital twin, sustainable tourism, tourism industry, engagement, bibliometric analysis, cultural heritage, virtual world
Co-authorship analysis (country)	China, UK, USA, Australia, South Korea, Malaysia
Co-authorship analysis (author)	Marianna, S., Buhalis, D., Dwivedi, Y.K.

*The highest weights

6. Conclusion

Metaverse interdisciplinary research shows considerable promise (Dwivedi et al., 2022). More specifically, tourism is a crucial testbed for the metaverse ecosystem while metaverse tourism research can enable global collaboration to explore complicated challenges (Yang & Wang, 2023). This can encourage more top universities to implement tourism initiatives with diverse scholars and expand metaverse tourism research. Bibliometric analysis is the quantitative assessment of academic publications to determine patterns and trends in research activity. In

the context of the metaverse, such an analysis sheds light on the growth of scholarly interest, prominent authors, and institutions, as well as emerging trends.

The present study provided a comprehensive overview of metaverse tourism research, helping to map its framework and identify key scholars and research trajectory. In other words, it provided a comprehensive overview of metaverse tourism research, shedding light on its development by revealing which researchers, countries, and organizations are involved and the key conceptual frameworks. Although metaverse tourism research is still in its early stage (Chen et al., 2023) as "an almost uncharted area" (Yang & Wang, 2023), it is swiftly advancing. Accordingly, Shin and Kang (2024) recommend examining various facets of metaverse tourism instead of continuously studying the same subjects. Through bibliometric analysis, the present study provides future researchers with a framework to understand the present status of metaverse tourism research and promotes investigation into its different aspects.

The present study also identified key publications (Table 4) and topics (Figure 13) to help researchers navigate the specific field. Metaverse tourism studies focusing on virtual reality, smart tourism, and blockchain initially emerged in 2022, with the conceptual inception of metaverse tourism taking place in 2023. In 2023, there was a growing trend focused on user experience, adaptation, marketing, and destination management. Metaverse tourism studies also advanced from broad to specific subjects, such as Generation Z, sustainable education, and sustainable tourism, employing various analysis methods. Future studies are expected to concentrate on more intricate aspects in comparison to earlier research.

Furthermore, the analysis identified key metaverse tourism publications by various authors for future research, particularly Gursoy et al. (2022), Go & Kang (2023), Tsai (2022), Buhalis et al. (2023a), Florido-Benítez (2024), Wei (2022), Chen et al. (2023), and Buhalis et al. (2023b). It also showed that certain journals have the highest bibliographic coupling, particularly Information Technology and Tourism, Tourism Review, International Journal of Contemporary Hospitality Management, Current Issues in Tourism, and International Journal of Tourism Research. These journals are extensively indexed in metaverse tourism research and feature publications by the authors mentioned above.

In its use of a bibliometric approach, the study has two limitations. First, its database was limited to publications included in Scopus, which was preferred for its advanced archiving capabilities and its reputation for containing high-quality publications and indexing top-tier journals (Caputo et al., 2021). Second, because bibliometric analysis does not use primary data, it provides a broad view of the research field rather than a detailed analysis of publication content and focuses more on quantitative statistical characteristics of the field.

That is, the study was structured around the bibliometric characteristics of publications.

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