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A bibliometric analysis of digital immersion technology research in tourism based on WoS database

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Abstract:
This study utilized CiteSpace software to analyze 216 English documents from the Web of Science database. The analysis included the number of publications and keywords. The findings showed a steady increase in the number of related literatures since 2010, with a significant acceleration after 2019 and a peak in 2023. The keyword analysis revealed a focus on Computer Science, Software Engineering, Electrical & Electronic Engineering, Public, Environmental & Occupational Health, Computer Science, Information Systems, and Hospital, Leisure, Sport & Tourism. Research hotspots included Virtual Reality, Augmented Reality, Virtual Tourism, Satisfaction, Destination Image, Behavioral Intentions, and Place Attachment. The study's scope has been expanding since 2015, reaching a peak between 2018 and 2023. This study is crucial for understanding the impact of digital immersion technology on the tourism experience and provides valuable insights for guiding future research directions, despite some limitations.

Keywords:
Web of Science (WoS) database, digital immersion technology, CiteSpace, bibliometric visualization analysis

1. Introduction

Digital immersion technology refers to the use of virtual or augmented reality to provide users with an interactive and immersive experience by simulating or enhancing the real environment (Santos et al., 2022). This technology is generally categorized into two types: augmented reality (AR) and virtual reality (VR) (Liberatore et al., 2021). Research in digital immersion technology has shifted from basic visual displays to more complex and interactive experiences. Initially, early virtual reality technologies focused heavily on head-mounted displays (HMDs) to create immersive experiences (Bowman et al., 2007). However, as technology has advanced, immersive experiences now extend beyond visual effects to include multi-sensory stimuli, such as sound and touch, and more natural human-computer interactions, providing users with a more authentic auditory experience (Sun, X. 2021). Digital immersion technology enhances the overall quality of the digital tourism experience by providing multi-sensory cues such as visual and auditory cues (Wu et al., 2020). These cues facilitate affective states and presence, which in turn influence the tourist experience. (Guo et al., 2023). Currently, digital immersion technologies are applied across various sectors, including education, entertainment, tourism, medicine, architecture, and science, demonstrating a significant market potential (Lin et

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al., 2020).

With the development of the Internet and artificial intelligence, digital immersion technology has been applied in several tourism-related fields (Ercan, 2020). Its application scenarios range from hotels to cultural heritage sites, museums, theme parks, and more (Park et al., 2018). In the tourism experience, high-quality visual and auditory content can significantly enhance tourist immersion and satisfaction (Alyahya et al., 2022). Digital immersion technologies enhance the cognitive, affective, and behavioral dimensions of tourism engagement through interactivity, immersion, and imagery, resulting in an unforgettable experience for tourists (Verma et al., 2022). As digital immersion technology evolves, the improvement of communication infrastructures such as 5G and the increase in information technology at tourist destinations are deeply integrating into all aspects of the tourist experience. Before traveling, digital immersion technology provides tourists with a realistic preview of their tour (M. Rosario et al., 2020); during traveling, it can provide tourists with a multi-dimensional sensory experience, enhancing the entertainment, education, and overall satisfaction of the travel experience, as well as improving the destination's reputation (Tussyadiah et al., 2018).

Therefore, this study conducted a bibliometric analysis of 216 articles published on the Web of Science (WoS). Bibliometric analysis is a method of quantitative analysis that examines the scientific knowledge graph to understand the dynamics of the research field's development, its patterns, and hotspots, and to predict future research trends in the field (Chen, C., & Song, M., 2019). This method enables us to better comprehend the data.

2. Methodology

CiteSpace software is equipped with advanced data processing systems and powerful visualization functions, covering both structural and temporal indicators to ensure highly accurate data presentation. Researchers frequently use these metrics to assess and analyze research hotspots and frontiers in specific fields, thus grasping the research dynamics, latest progress, and development trends in those fields (Lv et al., 2022). Web of Science, as the most trusted and publisher-independent global citation database, includes over 1.7 billion citations and 159 million records, with access to more than 9,000 first-class citation databases and over 1,000 research institutions. As the most trusted and publisher-independent global citation database, Web of Science is comprehensive, containing over 1.7 billion citations and 159 million records. It is relied upon by more than 9,000 leading academic, corporate, and government organizations, as well as millions of researchers. In this paper, the Web of Science database is used as the source of literature, and the keywords are "virtual reality tourism", "tourism experience", "digital immersion technology", within the research field of "Tourism". A total of 216 English literature articles from 2010 to 2024 were manually screened and selected for analysis in this paper.

3. Bibliometric analysis

3.1 Statistical analysis of the number of publications

Literature is not only an essential tool for humans to accumulate and share experiences, create new knowl-

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edge, and promote the progress of civilization, but it also provides a window into the growth lineage and evolutionary characteristics of a research field. The number of papers published serves not only as an indicator of the attention and research depth that experts and scholars have dedicated to a certain field but is also considered a key metric for assessing the vitality and development trends of that field over a specific period (Bornmann et al., 2021). In this study, we statistically analyzed the number of English-language documents in the field that explores the impact of digital immersion technologies on the tourism experience. Using data from papers published in the Web of Science (WoS) database between 2010 and 2024, we created a line graph to illustrate the annual trend in the number of published papers (see Figure 1). The graph clearly depicts the trend in the number of papers from 2010 to 2024.

Since 2010, the number of published papers in the field of the impact of digital immersion technology on the tourism experience has gradually increased and reached a peak in 2023, with a total of 61 papers published. The lowest number of papers published during this period was 2 in 2010, while the highest was 61 in 2023. There is an overall increasing trend in the number of papers published over time. Specifically, between 2010 and 2018, the number of papers exhibited a steady upward trend with a moderate growth rate. The change in the number of papers during this period was relatively smooth, without significant fluctuations. However, from 2019 onward, the number of papers entered a phase of rapid growth, displaying a significantly higher growth rate. Notably, there was a brief decline in the number of papers in 2021, but in 2023, the number of papers rose again to reach a new peak.

In summary, the number of papers in the field of the impact of digital immersion technologies on the tourism experience has shown a general trend of growth from 2010 to 2024, reaching a peak in 2023. During this period, the lowest number of papers published was 2 in 2010, while the highest was 61 in 2023. Overall, there has been an increasing trend in the number of papers published over time.



Figure 1. Distribution of English-language literature postings on the impact of digital immersion technologies on the tourism experience, 2010-2024

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3.2 Keyword Research Analysis

3.2.1 Analysis of high-frequency keywords

Keywords are an important component of the research literature, and their frequency and centrality can reveal the hot issues and research trends within a field. Generally, keywords with high centrality represent the research focus and cutting-edge directions of a field (Xin Huang,2024). By analyzing keywords, one can gain a deeper understanding of the themes and focal points within the research domain. In this study, we analyzed the co-occurrence of keywords using CiteSpace software and identified the top 20 most frequent keywords (see Table 1). These keywords encompass not only terms related to digital immersion technology such as virtual reality, augmented reality, reality, co-creation, user acceptance, and virtual tourism but also include experience, tourism, technology, impact, satisfaction, model, tourist destination, social media, destination image, experience, intention, behavioral intention, and place attachment. This indicates that research on the impact of digital immersion technology in social media, destination image, tourism experiences, and tourism-related technology, influence, satisfaction, tourist destinations, behavioral intention, and place attachment has garnered significant attention. This reflects the research hotspots and developmental trends concerning digital immersion technology and tourism experiences in the tourism sector.

Table 1. Top 20 high-frequency keywords

Freq	Degree	Centrality	Label	Year
68	44	0.1	virtual reality	2010
47	42	0.1	experience	2018
46	41	0.11	travel	2018
44	40	0.09	technology	2018
42	41	0.13	impact	2018
42	29	0.04	satisfaction	2018
40	35	0.08	model	2018
38	41	0.07	augmented reality	2016
32	25	0.05	tourism	2018
29	45	0.1	destination	2018
21	20	0.06	social media	2018
19	36	0.09	destination image	2018
19	14	0.02	experiences	2019
19	13	0.03	reality	2022
18	36	0.09	co-creation	2018
18	33	0.08	user acceptance	2018
18	28	0.06	intention	2020
18	8	0	virtual tourism	2022
15	26	0.05	behavioral intentions	2018
15	26	0.03	place attachment	2020

3.2.2 Keyword Clustering Analysis

The Timezone function in the CiteSpace software can be used to analyze keyword frequency over time,

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which helps to identify technical applications and research hotspots in the field (Liu et al., 2022). Additionally, the Timeline view focuses on outlining the relationships between clusters and the historical span of literature within each cluster. By generating a time-zone mapping atlas, the main keywords and their interrelationships can be visualized, thus aiding in the analysis and summary of the evolution and future trends of the research field (Chen Yue et al., 2015). To clearly grasp the development and evolution path of the research field on digital immersion technology and tourism experience, CiteSpace software was employed to generate keyword clustering Timeline views and keyword co-occurrence Timezone views for analysis. As illustrated in Figure 2, the first 9 clusters were selected to demonstrate the sequential occurrence of keywords within the same category over time. The clustering labels on the timeline represent the research areas at each point in time and are displayed on the right. In the sequential stack from the initial occurrence to the subsequent reappearance, a larger diamond shape indicates a higher frequency of the keyword in the English literature concerning scholars' research on digital immersion technology and tourism experience between 2010 and 2024. The connecting lines between the diamonds indicate that the keywords corresponding to these lines appear together in the same literature.

The nine clusters in the current research on digital immersion technology and tourism experience can be clearly identified in Figure 2. The main research areas of digital immersion technology and tourism experience are as follows: Cluster 0: Computer Science, Software Engineering; Cluster 1: Engineering, Electrical & Electronic; Cluster 2: Public, Environmental & Occupational Health; Cluster 3: Computer Science, Information Systems; Cluster 4: Hospital, Leisure, Sport & Tourism; Cluster 5: Computer Science, Theory & Methods; Cluster 6: Social Issues; Cluster 7: Information Science & Library Science; Cluster 8: Regional & Urban Planning.

Cluster 0: Computer Science, Software Engineering. The study of the impact of digital immersion technologies on the tourism experience is a core topic in the fields of computer science and software engineering. Keywords central to this research include information technology, co-creation, tourism, and smart tourism, signifying the focus of study from 2015 to 2020. Further analysis indicates that scholars are dedicated to investigating how information technology can be applied within the tourism sector, as well as how co-creation and digital immersion technologies can enhance the tourism towards greater intelligence and personalization. This research direction not only mirrors the scholarly trends in computer science and software engineering but also addresses the needs and obstacles of the tourism industry as it undergoes digital transformation.

Cluster 1: Engineering, Electrical & Electronic. The research into the impact of digital immersion technology on the tourism experience can be divided into two main periods. The first period is around 2010, a time when research was relatively limited and still in its initial stages. During this period, the focus was narrow, centering solely on the keyword of virtual reality. However, as technology advanced and research deepened, the second period, after 2015, saw a significant broadening of research horizons. Beyond virtual reality, the studies began to encompass emerging technology fields such as mixed reality and augmented reality. Additionally, the content of the research shifted to concentrate on user behavioral intentions and interactive experiences. This indicates that during this time, scholars not only pursued the development of digital immersion technologies but also gave greater consideration to the actual effects of these technologies on the tourism experience, as well as the behavioral responses and psychological perceptions of users within these virtual

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tourism environments.

Cluster 2: Public, Environmental & Occupational Health. It can be observed that research into the impact of digital immersion technologies on the tourism experience has primarily focused on the period after 2015 in the fields of public, environmental, and occupational health. These studies examine various aspects such as cultural tourism, authenticity, design, perception, and reality, highlighting the significant role digital immersion technologies play in the tourism experience. A further analysis reveals that this research predominantly concentrates on the technological aspect, seeking to understand how tourists' experiences can be enhanced through advanced technological means. Over time, there has been a shift in focus towards the potential applications of digital immersion technology within the tourism sector, with researchers endeavoring to explore its impact from diverse perspectives. Cultural tourism, in particular, has emerged as a key research direction due to its ability to facilitate a deeper understanding and appreciation of the cultural nuances within different regions. Additionally, the studies focus on the role of digital immersion technology in bolstering tourism authenticity, fostering design innovation, and enhancing the perception of reality. Digital immersion technology is thus considered a critical tool for refining the tourism experience. By probing deeper into the technological intricacies, researchers aim to devise methods that allow tourists to become more fully immersed in digitally fabricated environments, thereby enriching their travel experiences. This not only enriches the tourism industry but also offers novel insights for the innovative and developmental strategies of the tourism business.

Cluster 3: Computer Science, Information Systems. It can be observed that since 2016, researchers in the fields of computer science and information systems have been concentrating on the impact of digital immersion technologies on the tourism experience, reaching a peak in their research in 2018. This line of inquiry explores various aspects such as cultural heritage, impact, psychological intention, experience, and technology, aiming to gain a deeper understanding of how digital immersion technology alters people's travel experiences and the implications of this for cultural heritage preservation, the development of the tourism industry, and other areas. Within this research domain, scholars have investigated how digital immersion technology introduces innovation and change to the tourism experience through empirical studies and theoretical analyses. Specifically, the digital presentation of cultural heritage, the utilization of virtual reality technology, and the integration of augmented reality technology have emerged as focal points of study. In addition, there has been a focus on examining the influence of digital immersion technology on tourists' psychological intentions and experiences, as well as the practical application's effect within the tourism industry. As technology continues to advance, digital immersion technologies are increasingly being employed in the tourism sector, providing tourists with richer and more distinctive experiences. In this process, researchers in computer science and information systems will continue to monitor the development trends of digital immersion technology and its potential effects on the tourism experience. This not only aids in fostering innovation and advancement within the tourism industry but also offers novel insights and methodologies for the protection and enhancement of cultural heritage and the tourism experience.

Cluster 4: Hospital, Leisure, Sport & Tourism. This cluster presents a series of in-depth studies from 2018 to 2022 on how digital immersion technologies can influence the tourism experience. The research concentrates on analyzing various dimensions such as behavioral intention, destination image, satisfaction, place attachment, perceived value, psychological intention, and immersion experience. These dimensions are cen-

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tered around understanding the inner feelings of tourists. Through these studies, the objective is to refine and enhance the image of destinations, increase tourists' desire and likelihood to travel, and thereby promote the sustainable and healthy development of the tourism industry.

Cluster 5: Computer Science, Theory & Methods. The analysis reveals that the majority of studies on the impact of digital immersion technologies on the tourism experience are centered around the years 2018 to 2019. Key research topics of interest during this period encompass user acceptance, destination marketing, consumer behavior, and models. These topics signify researchers' comprehensive exploration into the integration of digital immersion technology within the tourism sector, examining its influence on user acceptance, strategies for marketing destinations, patterns of consumer behavior, and the development of predictive models.

Cluster 6: Social Issues. This cluster focuses on social issues arising from the impact of digital immersion technologies on travel experiences, with research spanning from 2018 to 2022. Common keywords in this domain include "intention," "consumer," "social media," "information," and "virtual reality tourism." These phrases highlight the primary subjects of study and emphasize the widespread and profound influence of digital immersion technologies on the tourism sector. By examining these keywords, researchers have identified central concerns and trends within this field. As digital immersion technology continues to advance, the tourism industry is poised to confront additional opportunities and challenges.

Cluster 7: Information Science & Library Science. The research in the field of information science and library science appears to be more limited, with only one keyword identified in 2019: "online."

Cluster 8: Regional & Urban Planning. It can be seen that research on the impact of digital immersion technology on tourism experience primarily focuses on the period from 2018 to 2023. The keywords in the field of regional and urban planning not only encompass the central topic of user acceptance but also extend to tourism as a whole and the model of technology acceptance. These keywords reflect the current hot topics in research and the directions for future exploration. By deeply analyzing the interaction between users and digital immersion technologies, scholars aim to uncover the psychological mechanisms behind technology acceptance and how these technologies are integrated into the tourism experience. This research seeks to offer theoretical support and strategic guidance for the digital transformation of the tourism industry.

From the analyses presented in Figure 2 and Figure 3, it is evident that the keyword 'virtual reality' made its first appearance in 2010 within the domain of research on digital immersion technologies and tourism experiences. Furthermore, it is the most frequently occurring term in English literature between 2010 and 2024, indicating a peak of interest in this topic during that period. It is noteworthy that, although research on this topic was somewhat limited in 2010, focusing predominantly on the field of virtual reality, there has been an exponential growth in relevant studies since 2015. This expansion has seen the research keywords evolve from initial focus on virtual reality to encompass a broader spectrum of topics, including co-creation, tourism, impact, experience, smart tourism, and virtual reality tourism.

Further analysis of Figure 3 reveals a significant increase in the number of keywords from 2018 to 2020, accompanied by richer and more diverse research themes. This development effectively illustrates that international scholars have gained a deeper understanding of the impact of digital immersion technology on tour-

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ism experiences. Their research now transcends single-level exploration, delving into various perspectives and dimensions. This evolution not only signifies the depth of the research but also indicates a continuous expansion of research boundaries.

In conclusion, Figure 2 and Figure 3 clearly illustrate the rapid development and broad application of research in the field of digital immersion technology and tourism experience. This indicates a promising future for more extensive and in-depth exploration in this area.

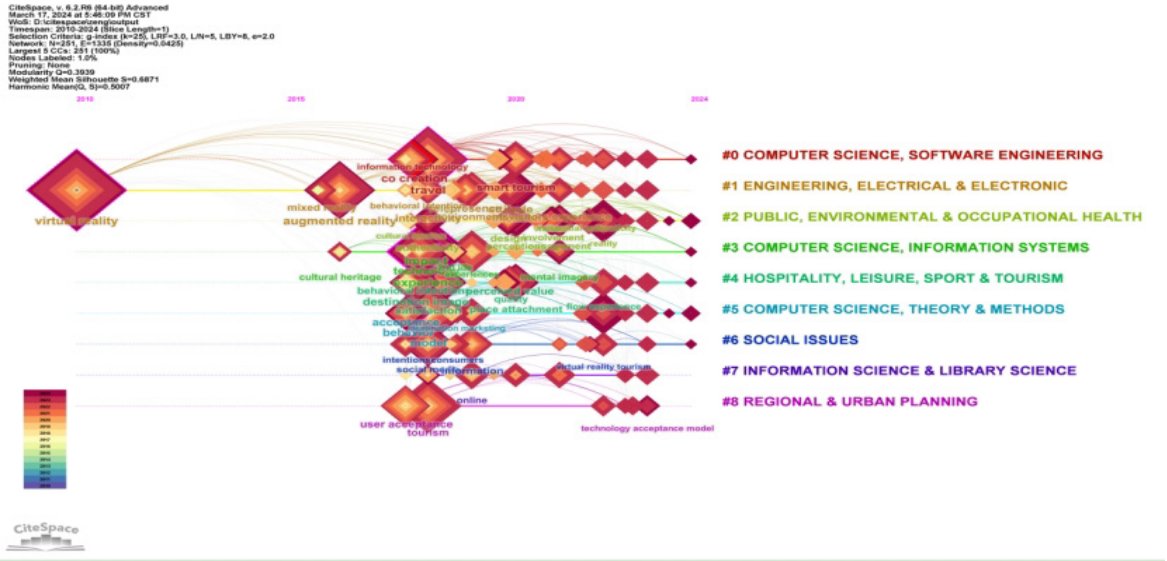


Figure 2. Timeline Analysis on Keyword of the impact of digital immersion technology and tourism experience

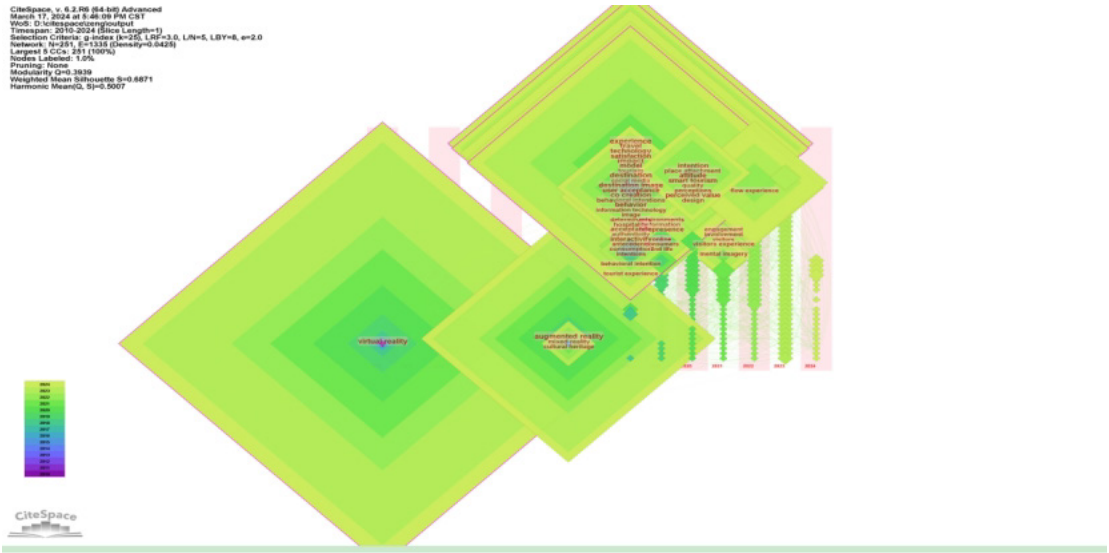


Figure 3. Time-zone Analysis on Keyword of the impact of digital immersion technology and tourism experience

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4. Conclusion and limitations

4.1 Conclusions

This study employed CiteSpace software to analyze 216 English documents from the Web of Science database, examining the number of publications and keywords. It was observed that the number of papers in this field has shown a yearly increasing trend, with a particularly significant growth rate acceleration after 2019, reaching a peak in 2023. The keyword analysis revealed that the research in this field primarily focuses on areas such as Computer Science, Software Engineering, Electrical & Electronic Engineering, Public, Environmental & Occupational Health, Computer Science, Information Systems, and Hospital, Leisure, Sport & Tourism. The main research hotspots include virtual reality, augmented reality, reality, virtual tourism, experience, tourism, satisfaction, destination, destination image, behavioral intention, and place attachment. The scope of research has been expanding since 2015 and reached its peak between 2018 and 2023.

In summary, it is evident from this study that research in the field of digital immersion technology and tourism experience is developing rapidly and has a wide range of applications. This suggests that, in the future, this field will have an even broader research prospect and application space.

4.2 Limitations

It is important to recognize that this study has some unavoidable limitations. Not only do these limitations provide a rich field for reflection in the current study, but they also suggest directions for future academic exploration.

Firstly, the data collection in this study was limited to English documents within the Web of Science (WoS) database. Language limitations suggest that the findings may not fully represent the current global scenario. Future research should endeavor to expand data collection to include more authoritative and representative databases, and non-English documents should be translated and examined.

Secondly, the small sample size of this study, encompassing only 216 papers, may impact the generalizability and replicability of the findings. This aspect should be considered when interpreting and applying the results. Future studies could increase the sample size to validate and further explore the findings of this research.

Finally, this study concentrates on keyword trends and the number of published articles to elucidate the progression of research into the impact of digital immersion technology on the tourism experience, as well as the trajectory of hot topic shifts. Despite the study’s efforts to capture and analyze these dynamic changes, there may still be nuanced trends that have not been thoroughly investigated. These untapped areas will be the subject of future inquiries.

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