

STATUS OF THE APPLICATION OF IMMERSIVE TECHNOLOGIES IN TOURISM RESEARCH

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Abstract:

This study presents a systematic bibliometric analysis of immersive technologies in tourism, focusing on VR, AR and MR. It analyzes 420 publications in Scopus and Web of Science across three periods: VR (1995–2023), AR (2014–2023), and MR (2018–2023). Key metrics examined include publication trends, thematic evolution, journal impact, collaboration networks, and national contributions.

VR emerges as the most mature and extensively studied field, with major contributions from China, the UK, and the US. Key themes include destination marketing and tourist satisfaction. AR has seen rapid growth since 2020, particularly in cultural heritage tourism, led by scholars in the UK, China, and Portugal. Increasing attention is directed toward user experience, technology acceptance, and immersive storytelling. In contrast, MR remains underexplored due to technical and cost barriers but show potential for multisensory engagement. Authorship in both VR and AR is fragmented, with a few high-impact teams contributing the majority of output. Research is also geographically imbalanced, with limited contributions from Latin America, Africa, and Southeast Asia.

Future research should focus on personalizing immersive experiences and deepening understanding of users’ emotional and behavioral responses to VR, AR, and MR. Advancing AR, addressing MR’s technical barriers, evaluating long-term impacts, and expanding regional representation are key to enhancing the inclusivity and generalizability of immersive tourism research.

Keywords: Augmented reality; virtual reality; mixed reality; tourism; bibliometric analysis.

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ESTADO DE LA APLICACIÓN DE TECNOLOGÍAS INMERSIVAS EN LA INVESTIGACIÓN TURÍSTICA

Resumen:

Este estudio presenta un análisis bibliométrico sistemático de las tecnologías inmersivas en el turismo, centrándose en la realidad virtual (VR), la realidad aumentada (AR) y la realidad mixta (MR). Se analizan 420 publicaciones en Scopus y Web of Science a lo largo de tres periodos: VR (1995–2023), AR (2014–2023) y MR (2018–2023). Las métricas clave examinadas incluyen las tendencias de publicación, la evolución temática, el impacto de las revistas, las redes de colaboración y las contribuciones nacionales.

La VR surge como el campo más maduro y ampliamente estudiado, con importantes contribuciones de China, el Reino Unido y los Estados Unidos. Los temas principales incluyen el marketing de destinos y la satisfacción del turista. La AR ha experimentado un rápido crecimiento desde 2020, especialmente en el turismo de patrimonio cultural, liderado por académicos del Reino Unido, China y Portugal. Se presta una atención creciente a la experiencia del usuario, la aceptación tecnológica y la narración inmersiva. En contraste, la MR sigue poco explorada debido a las barreras técnicas y de costo, aunque muestra potencial para la participación multisensorial. La autoría en VR y AR está fragmentada, con unos pocos equipos de alto impacto que contribuyen con la mayoría de las publicaciones. La investigación también está geográficamente desequilibrada, con contribuciones limitadas de América Latina, África y el Sudeste Asiático.

Las futuras investigaciones deberían centrarse en personalizar las experiencias inmersivas y profundizar en la comprensión de las respuestas emocionales y conductuales de los usuarios a la VR, AR y MR. Avanzar en la AR, abordar las barreras técnicas de la MR, evaluar los impactos a largo plazo y ampliar la representación regional son claves para mejorar la inclusividad y la generalización de la investigación en turismo inmersivo.

Palabras clave: Realidad aumentada; realidad virtual; realidad mixta; turismo; análisis bibliométrico.

1. INTRODUCTION

As digital technologies continue to evolve, immersive technologies have increasingly captured scholarly interest within tourism research. Despite their expanding use in both academic and practical applications, several research gaps remain. First, existing literature often focuses on individual immersive technologies, particularly VR or AR, providing isolated, technology-specific insights. Compared to more established research areas, comprehensive quantitative analyses encompassing VR, AR, and MR within tourism industry are still relatively limited. Second, interdisciplinary collaboration remains fragmented, with research dispersed across disciplines such as tourism, communication, education, and psychology, and lacking integrated theoretical frameworks (Bhowmik, 2024).

To address these gaps, this study employs bibliometric analysis, a widely recognized method for systematically mapping and synthesizing scientific knowledge (Donthu et al., 2021). By systematically examining VR, AR, and MR literature in tourism, the study identifies empirical patterns, theoretical foundations, and emerging trends, offering a clear roadmap for future research.

2. BACKGROUND

2.1 VR, AR and MR

AR is transforming how individuals interact with physical environments, especially within tourism and cultural heritage areas. By overlaying digital elements such as 3D models, images, audio, and video onto real-world settings in real time, AR enriches sensory experiences and spatial awareness, creating a seamless integration of virtual and physical realities. (Bec et al., 2018; Cranmer et al., 2020; He et al., 2018; Dieck et al., 2016; Jung and Dieck, 2017; Trunfio et al., 2022; Jiang et al., 2022).

In contrast, VR offers fully immersive digital environments. Utilizing head-mounted displays, users are transported into virtual worlds, enabling deep engagement through real-time interaction and a strong sense of presence (Hincapié et al., 2021; Sousa et al., 2022).

MR advances this further by integrating AR and VR. In MR environments, digital and physical elements not only coexist but interact dynamically, creating experiences that blur the boundaries between virtual and real worlds, thus providing richer, more interactive engagements (Bec et al., 2018; Trunfio et al., 2022).

2.2 The importance of immersive technologies

In the preservation and dissemination of cultural heritage, immersive technologies such as AR and VR provide unique value (Han et al., 2017). Recent tourism research increasingly emphasizes these technologies' potential to enhance visitor experiences. For instance, virtual museums and alternative immersive experiences are being explored as effective strategies to mitigate the negative impacts of overtourism (Trunfio et al., 2022). Furthermore, immersive technologies significantly enhance the quality of tourist experiences and stimulate visitors' motivation to explore destinations in person (Loureiro et al., 2018).

As major technology companies, such as Meta and Apple, continue investing in dedicated AR and VR platforms and devices, these technologies are expected to transform further how tourists experience, understand, and interact with destinations, substantially reshaping their travel experiences and satisfaction levels.

3. METHODOLOGY

The methodology used in this research work is depicted in Fig. 1. It consists of four steps.

3.1 Step 1: Field of study identification

The study focuses on immersive technologies applied within tourism research, specifically VR, AR and MR. The goal is to systematically review and analyze scholarly contributions addressing these technologies in the tourism industry.

3.2 Step 2: Database selection

Bibliographic data are collected from two widely recognized academic databases: Scopus and the Web of Science Core Collection (WoS). Scopus provides extensive coverage across multiple disciplines and includes a broad range of international peer-reviewed literature. Web of Science Core Collection, known for its rigorous selection criteria, ensures access to high-quality, impactful scholarly sources. The combination of these databases provides comprehensive coverage and ensures the reliability and scholarly rigor of the data.

3.2 Step 3: Bibliometric data extraction

The search criteria are detailed in Table 1.

Table 1. Search criteria.

Database	Scopus	Web of Science
Topic	TITLE-ABS-KEY augmented reality AND tourism virtual reality AND tourism mixed reality AND tourism	TITLE-ABS-KEY augmented reality AND tourism virtual reality AND tourism mixed reality AND tourism
Document type	Article	Article
Language	English	English
Categories/ Subject area	Business, Management and Accounting; Social Sciences; Economics, Econometrics and Finance	Behavioural Science; Business; Communication; Hospitality, Leisure, Sport & Tourism; Management; Social sciences, interdisciplinary

3.4 Step 4: Mining bibliometric data

Data collection begins on April 1, 2024, ensuring that all records reflect the most up-to-date scholarly publications available by that date. The research team performs the bibliometric analysis using Biblioshiny (version 4.1), the graphical interface of the Bibliometrix R package.

For VR, the study includes relevant publications from January 1, 1995, to December 31, 2023, retrieved from Scopus and the Web of Science Core Collection. The initial search yields 706 records. After removing duplicates based on DOI and SR identifiers, 483 unique records remain. A manual screening of keywords, titles, and abstracts excludes irrelevant articles, resulting in a final dataset of 350 articles.

The same procedure applies to AR, focusing on literature published from January 1, 2014, to December 31, 2023. The initial search identifies 353 records. After removing duplicates and conducting further relevance screening, the study retains 68 articles from 35 unique sources.

Additionally, the study reviews literature on MR and Immersive Virtual Experiences published between January 1, 2018, and December 31, 2023. The MR search initially yields 36 records, of which 2 articles meet the inclusion criteria following manual screening.

The search results are detailed in Table 2.

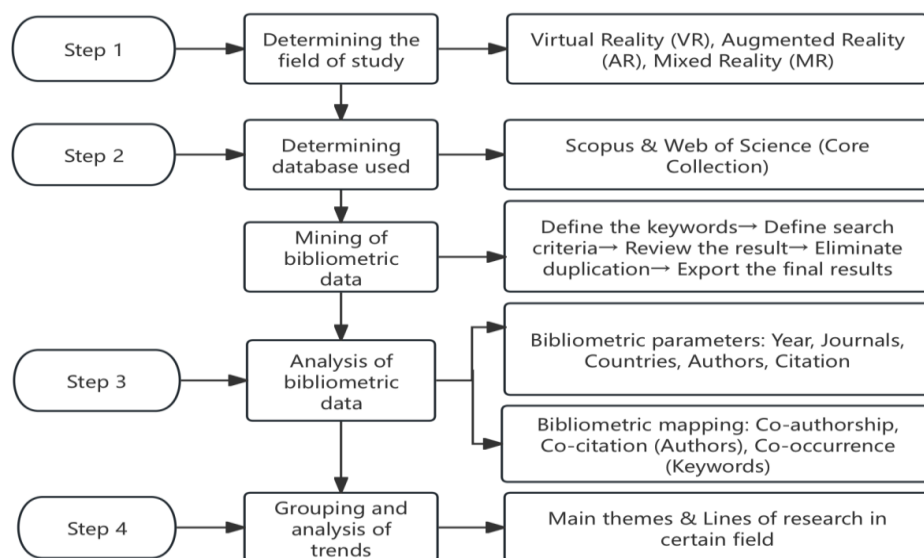
Table 2. Search results in academic databases.

	Number of records obtained without filtering	Number of records obtained after deleting duplicates DOI and SR	Manual screening of keywords, titles, and abstracts
Virtual reality	706	483	350
Augmented reality	353	94	68
Mixed reality	36	4	2

3.5 Step 5: Bibliometric analysis

Next, bibliometric analysis is conducted to analyse the records.

Figure 1. The general framework of methodology.



Source: own elaboration based on Biblioshiny

As shown in Figure 1, the framework outlines the methodology for bibliometric analysis.

4. RESULTS AND DISCUSSION

4.1 Result of VR bibliometric analysis

4.1.1 Publication frequency related to VR per year

The first article on virtual reality (VR) in tourism, “The Design of Virtual Reality” by Heim (1995), marks the beginning of this research field. From 1995 to 2016, research in this area remains limited and primarily theoretical, with fewer than ten publications annually. Interest begins to grow in 2017 as VR technology matures and application scenarios broaden. A steady rise in output from 2017 to 2019 culminates in a sharp increase in 2020, peaking at 111 publications by 2023 (see Table 3), reflecting growing academic attention and industry relevance.

Table 3. Frequency of publication of articles related to VR per year.

Year	Frequency	Accumulated percentage (%)
1995	1	0.29
1996	0	0.29
1997	0	0.29
1998	0	0.29
1999	1	0.57
2000	0	0.57
2001	0	0.57
2002	0	0.57
2003	0	0.57
2004	0	0.57
2005	1	0.86
2006	0	0.86
2007	0	0.86
2008	0	0.86
2009	1	1.14
2010	2	1.71
2011	1	2.00
2012	4	3.14
2013	1	3.43
2014	7	5.43
2015	2	6.00
2016	5	7.43
2017	7	9.43
2018	15	13.71
2019	22	20.00
2020	39	31.14
2021	46	44.29
2022	84	68.29
2023	111	100.00

Source: own elaboration based on Biblioshiny

4.1.2 Top journals in VR tourism research.

Articles on VR in tourism are disseminated across a wide range of sources. Among the 350 documents analyzed, 311 are published in academic journals, while 35 are classified as early access articles, 3 appear in book chapters, and only 1 is found in a conference proceeding (see Figure 2).

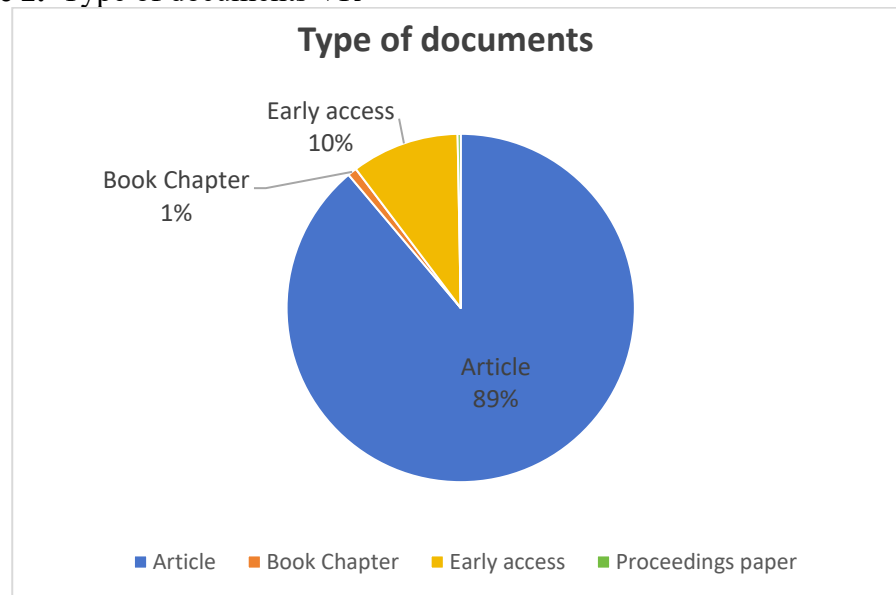
Table 4 presents the most productive and influential journals in VR tourism research. Sustainability (Switzerland) and Current Issues in Tourism lead in publication volume, with 27 and 21 articles respectively, indicating high research output. However, publication quantity does not necessarily reflect academic influence. Tourism Management, with 18 articles, emerges as the most influential journal, leading in both local citations (1,273) and H-index (15), thereby underscoring its central role in shaping the field. Other journals, such as the Journal of Travel Research, Journal of Business Research, and Annals of Tourism Research, also demonstrate strong citation performance, highlighting their academic impact despite publishing fewer articles.

Table 4. Top 10 journals in VR tourism research.

Sources	Articles	local citations	H-index	G-index
Sustainability (Switzerland)	27	-	4	23
Current Issues in Tourism	21	380	2	21
Tourism Management	18	1273	5	18
Asia Pacific Journal of Tourism Research	9	31	5	9
Journal of Travel Research	9	442	6	9
Information Technology & Tourism	8	70	4	8
Journal of Hospitality and Tourism Management	8	125	7	8
Journal of Hospitality and Tourism Technology	8	139	6	8
Tourism Recreation Research	8	47	5	8
Journal of Business Research	7	421	6	7

Source: own elaboration based on Biblioshiny

Figure 2. Type of documents VR



Source: own elaboration based on Biblioshiny

4.1.3 Top cited articles in VR tourism research.

The most highly cited articles in VR tourism research constitute foundational studies that significantly shape the evolution of the field. As illustrated in Table 5, Guttentag's (2009) seminal work, "Virtual Reality: Applications and Implications for Tourism" (*Tourism Management*), ranks first with 105 citations. This study provides a conceptual framework outlining both the potential and limitations of VR in tourism. Closely following is Tussyadiah et al. (2017a), also published in *Tourism Management*, with 103 citations; their research examines how VR influences tourist attitudes and the sense of presence, thereby deepening the understanding of immersive experiences.

Several other influential studies contribute to the theoretical and empirical development of VR tourism. Kim et al. (2018) apply the Stimulus-Organism-Response (S-O-R) model (Pavlov, 2010) to examine behavioral responses in virtual tourism environments, while Huang et al. (2015) propose a framework linking VR technologies with tourism marketing strategies. These studies receive 67 and 72 citations respectively, indicating strong scholarly impact.

Additional widely cited works include Wei et al. (2018) and Bogicevic et al. (2019), who explore the emotional and cognitive effects of VR on users, focusing on constructs such as presence and mental imagery. Hyun and O'Keefe (2011) introduce the concept of telepresence, helping to explain how VR shapes tourist perceptions and attitudes toward destinations. More recent research by Lee et al. (2020), Yung et al. (2020), and Errichiello et al. (2019) reflects increasing scholarly interest in the role of VR in shaping visitor experience, behavioral intentions, and applications within museum.

Table 5. Top cited articles in VR tourism research.

Citation	Authors	Title	Source title
105	Guttentag (2009)	Virtual reality: Applications and implications for tourism	Tourism Management
103	Tussyadiah et al. (2017a)	Virtual reality, presence, and attitude change: Empirical evidence from tourism	Tourism Management
72	Huang et al. (2015)	Exploring the implications of virtual reality technology in tourism marketing: an integrated research framework	Journal of Travel Research
67	Kim et al. (2018)	Exploring consumer behavior in virtual reality tourism using an extended Stimulus-Organism-Response model	Journal of Travel Research
49	Wei et al. (2018)	Effects of virtual reality on theme park visitors' experience and behaviors: A presence perspective.	Tourism Management
48	Bogicevic et al. (2019)	Virtual reality presence as a preamble of tourism experience: The role of mental imagery.	Tourism Management
35	Hyun and O'Keefe (2011)	Virtual destination image: Testing a telepresence model.	Journal of Business Research
22	Lee et al. (2020)	Quality of virtual reality and its impacts on behavioral intention	Journal of Business Research
20	Yung et al. (2020)	Virtual reality and tourism marketing: conceptualizing a framework on presence, emotion, and intention	Journal of Business Research
19	Errichiello et al. (2019)	Exploring the implications of wearable virtual reality technology for museum visitors' experience: A cluster analysis	International Journal of Tourism Research

Source: own elaboration based on Biblioshiny

4.1.4 Top authors in VR tourism research

The most productive and influential authors in VR tourism research constitute a small but significant group that drives the development of the field. As shown in Table 6, Flavián C. and Jung, T. H. are identified as the leading authors, each with six published articles. Flavián holds the highest h-index (6), while Jung has the greatest number of citations (104), reflecting their strong academic impact. Other prominent contributors include Fong L.H.N., Ibáñez-Sánchez S., Orús C., and Zhu C., each with five publications. Among them, Fong has accumulated 72 citations, while both Ibáñez-Sánchez and Orús have achieved h-indexes of 5. Huang Y.C. is also noteworthy, with four articles and 82 citations. However, as indicated in Table 8, the majority of authors (76.52%) have contributed only a single publication, suggesting that the field remains emergent and attracts scholars from diverse academic backgrounds.

The co-authorship network map (see Figure 3) highlights several collaborative clusters. The strongest collaboration is led by Flavián C. from Spain, who maintains close research ties with Ibáñez-Sánchez S. and Orús C. They form a tightly connected team focused on VR applications in marketing and customer experience. This red cluster demonstrates both high productivity and internal cohesion. Another major group, the green cluster, is led by Fong L.H.N. and Zhu C. from Macao, whose work centers on the use of AR/VR in heritage tourism, particularly in enhancing visitor engagement and interpretation. The purple cluster comprises Backman K.F., Backman S.J., and Huang Y.C., who collaborate on cross-cultural perspectives in VR tourism. Meanwhile, the orange cluster, consisting of Yung R. and Khoo-Lattimore C., investigates emotional engagement and user behavior in virtual environments. Although the field remains somewhat fragmented, these clusters indicate growing collaboration among researchers with shared interests, helping to define distinct thematic directions within VR tourism research.

The co-citation map (see Figure 4) illustrates the theoretical foundations underpinning the field. Seminal studies by Guttentag (2009), Tussyadiah (2017a), and Huang et al. (2015) are among the most frequently co-cited works, particularly in research addressing user experience and technology adoption. Subsequent studies have increasingly drawn upon well-established theoretical frameworks, including the Technology Acceptance Model (Davis, 1989) and the Theory of Planned Behavior (Ajzen, 1991). This pattern reflects the interdisciplinary nature of VR tourism research, which integrates perspectives from tourism studies, marketing, psychology, and information systems. Note: The publication years shown in the co-citation map are derived from bibliometric database records and may differ slightly from the officially published years.

Table 6. Top authors in VR tourism research.

Authors	Institution	Contributions	local citations	H-index
Flavián, C.	University of Zaragoza	6	77	6
Jung, T. H.	Manchester Metropolitan University	6	104	4
Fong, L. H. N.	University of Macau	5	72	4
Ibáñez-Sánchez, S.	University of Zaragoza	5	-	5
Orús, C.	University of Zaragoza	5	-	5
Zhu, C.	Macau University of Tourism	5	-	-
Huang, Y. C	National Pingtung University of Science and Technology	4	82	4
Trunfio, M.	University of Naples Parthenope	4	13	4
Yung, R.	University of Greenwich	4	42	4
Backman, K. F.	Clemson University	3	82	3

Source: own elaboration based on Biblioshiny

Table 7. VR Productivity of authors.

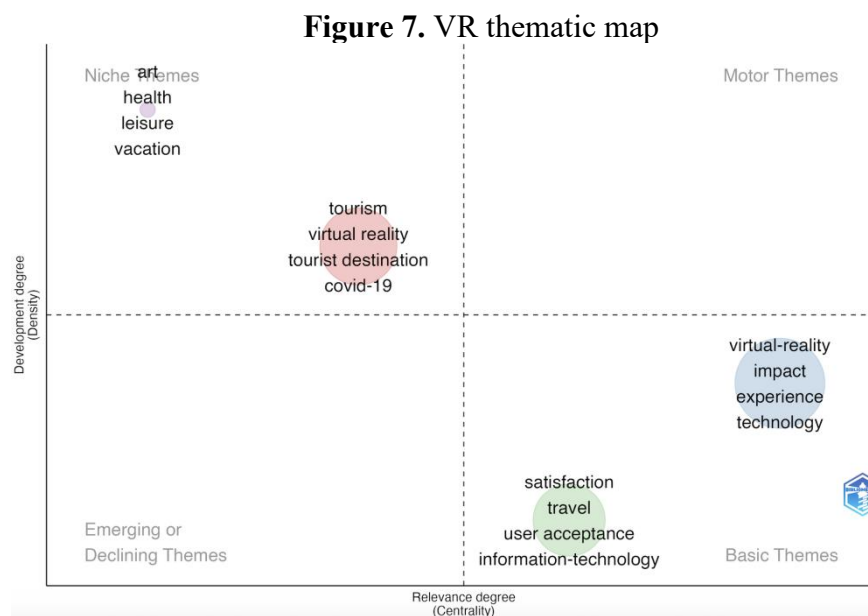
Number of Articles Published	Number of Authors	% of Total Authors
6	2	0.21%
5	4	0.42%
4	4	0.42%
3	21	2.19%
2	72	7.52%
1	854	89.24%

Source: own elaboration based on Biblioshiny

virtual reality, experience, impact, and technology are positioned within the basic theme quadrant, indicating both high centrality and conceptual maturity. These themes highlight the field’s sustained emphasis on how VR technologies shape tourist engagement, enhance experiential value, and influence destination perception.

Emerging clusters such as user acceptance, information technology, travel, and satisfaction demonstrate growing academic interest, though they remain theoretically underdeveloped and loosely integrated. This trend suggests a nascent but expanding effort to incorporate user-centered behavioral models and understand how tourists interact with and make decisions about VR-enhanced experiences.

In contrast, niche topics such as health, leisure, vacation, and art appear marginal and structurally peripheral. Although these areas represent focused research efforts, they remain largely disconnected from the central discourse. Nonetheless, they offer promising opportunities for future research, particularly in wellness tourism, cultural heritage interpretation, and immersive content development.



4.1.6 Top countries /regions in VR tourism research.

According to Table 8, China leads VR tourism research with 198 publications (26.57%), followed by the United Kingdom (95, 12.75%) and the United States (91, 12.21%). Together, these three countries account for over half of the total research output in this field. While China is the most prolific, the United States is the most influential, with 1,810 citations, indicating greater visibility and academic impact. The UK also ranks highly, placing second in citations (1,651) and third in publications. Spain (1,378 citations) and South Korea (1,258 citations) follow, demonstrating a strong balance between output and influence.

Notably, countries such as Indonesia, South Africa, and Egypt also appear in the rankings, reflecting the global scope of VR tourism research. The presence of South Africa and Egypt which are rich in historical resources, underscores the growing

multicultural interest and application of VR in diverse tourism beyond traditionally dominant Western countries.

Table 8. Top countries /regions in VR tourism research.

Country	Contribution	Percentage	Citations
China	198	26.57%	1182
UK	95	12.75%	1651
USA	91	12.21%	1810
Spain	60	8.05%	1378
South Korea	46	6.17%	1258
India	45	6.04%	303
Australia	42	5.64%	622
Italy	38	5.10%	564
Indonesia	23	3.09%	68
Canada	20	2.68%	804
South Africa	20	2.68%	22
Egypt	14	1.88%	166

Source: own elaboration based on Biblioshiny

4.2 Results of AR bibliometric analysis

4.2.1 Publication frequency related to AR per year

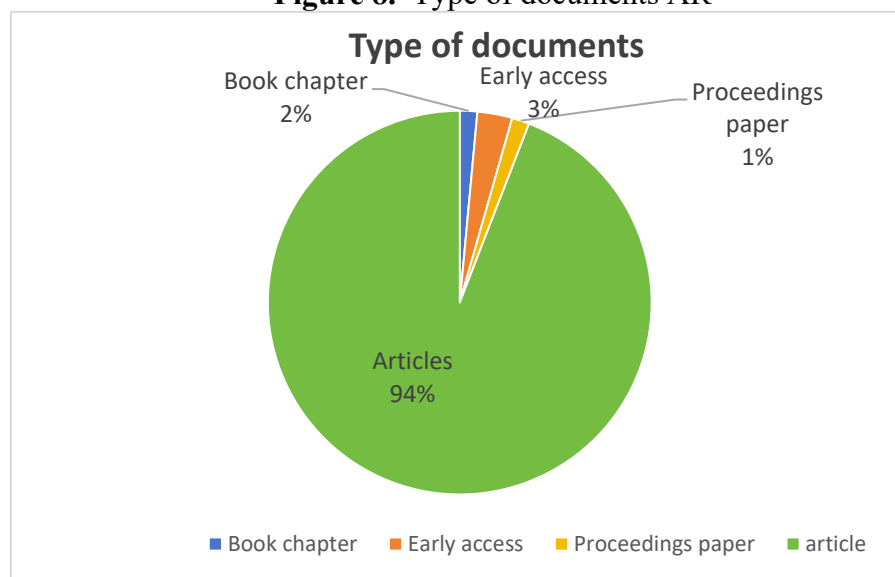
As shown in Table 9, the first article on AR technology in tourism appears in 2014. Research activity remains minimal during the initial years, with only two articles published in 2014 and 2016, and none in 2015. However, from 2017 onward, the number of publications begins to rise steadily. A notable surge occurs in 2020, with 13 articles published, coinciding with the COVID-19 pandemic and the annual output peaks at 21 publications in 2023. Nearly half of all articles are published between 2021 and 2023, reflecting the field's rapid expansion. The Price Index for the period 2019–2023 stands at 73.13%, indicating that the majority of research has emerged within the past five years and that the field remains highly active and focused on recent developments.

According to Figure 8, of the 68 analyzed records, 64 are journal articles, while only 4 originate from other publication types. This distribution suggests that although scholarly interest is increasing, the field remains relatively fragmented in terms of publication diversity.

Table 9. Frequency of publication of articles related to AR per year.

Year	Frequency	Accumulated percentage
2014	2	2.99%
2015	0	2.99%
2016	2	5.97%
2017	6	14.93%
2018	8	26.87%
2019	2	29.85%
2020	7	40.3%
2021	13	59.70%
2022	6	68.66%
2023	21	100%

Figure 8. Type of documents AR



Source: own elaboration based on Biblioshiny

4.2.2 Top journals in AR tourism research

Table 10 lists the top 10 most productive and influential journals in AR-related tourism research. Tourism-specific journals dominate, with *Journal of Heritage Tourism*, *Current Issues in Tourism*, and *Journal of Hospitality and Tourism Technology* leading in both publication volume and citation impact.

Current Issues in Tourism receives the highest local citations ($n = 85$), ahead of *Journal of Travel Research* ($n = 65$) and *Journal of Destination Marketing &*

Management (n = 46). Meanwhile, Journal of Heritage Tourism ranked first in publication count (n = 7) and holds the highest g-index (7), indicating strong and sustained academic output. Both Journal of Heritage Tourism and Current Issues in Tourism also achieve the highest h-index (h = 6), reaffirming their central influence in the field.

Table 10. Top journals in AR tourism research.

Journal	Articles	local citations	h-index	g-index
Journal of Heritage Tourism	7	31	6	7
Current Issues in Tourism	6	85	6	6
Journal of Hospitality and Tourism Technology	5	36	5	5
European Journal of Innovation Management	4	5	-	-
Tourism Management Perspectives	4	34	3	4
European Journal of Tourism Hospitality and Recreation	3	4	-	-
Journal of Destination Marketing & Management	3	46	3	3
Journal of Travel Research	3	65	-	-
Journal of Vacation Marketing	3	14	3	3
Interdisciplinary Description of Complex Systems	2	-	2	2

Source: own elaboration based on Biblioshiny

4.2.3 Top cited articles in AR tourism research

According to Table 11, the leading article by Dieck and Jung (2015), cited 235 times and published in Current Issues in Tourism, proposes a theoretical framework for mobile AR acceptance in heritage tourism. Following closely, Chung et al. (2017), with 179 citations, examine AR's role in shaping experience-driven heritage tourism in Korea, highlighting its cross-cultural applicability. He et al. (2018), cited 175 times and published in Tourism Management, provide empirical evidence showing how AR enhances museum visitor engagement and purchase intentions, positioning AR as a marketing tool that connects technology with consumer behavior in cultural tourism.

Notably, Dieck and Jung co-author four of the top twenty most-cited articles, which underscores their leadership in the field. Their 2017 stakeholder-oriented analysis (157 citations) and two 2016 studies on wearable AR applications in gallery and museum contexts contribute to both methodological development and practical implementation

of AR in heritage tourism. In parallel, Tussyadiah et al. (2017b) explore the embodiment of wearable AR in tourism experiences (147 citations), while Han et al. (2017) propose a user experience model for AR applications (137 citations), reflecting the field’s growing emphasis on technological usability and experiential design in immersive tourism.

Additionally, more recent studies by Bird et al. (2022) and Jung et al. (2018) expand the scope of AR research to include museum-based and cross-cultural perspectives, further illustrating the thematic diversification and ongoing evolution of the field.

Table 11. Top cited articles in AR tourism research.

Citations	Authors	Title	Journal
235	Dieck and Jung (2015)	A theoretical model of mobile augmented reality acceptance in urban heritage tourism	Current Issues in Tourism
179	Chung et al. (2017)	The role of augmented reality for experience-influenced environments: the case of cultural heritage tourism in Korea	Journal of Travel Research
175	He et al. (2018)	When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions	Tourism Management
157	Dieck and Jung (2017)	Value of augmented reality at cultural heritage sites: A stakeholder approach	Journal of Destination Marketing
147	Tussyadiah et al. (2017b)	Embodiment of wearable augmented reality technology in tourism experiences	Journal of Travel Research
137	Han et al. (2017)	User experience model for augmented reality applications in urban heritage tourism	Journal of Heritage Tourism
126	Bird et al. (2022)	A magic leap in tourism: Intended and realized experience of head-mounted augmented reality in a museum context	Journal of Travel Research
115	Jung et al. (2018)	Cross-cultural differences in adopting mobile augmented reality at cultural heritage tourism sites	International Journal of Contemporary Hospitality Management
89	Dieck et al., (2016a)	Enhancing art gallery visitors’ learning experience using wearable augmented reality: generic learning outcomes perspective	Current Issues in Tourism

80	Dieck et al., (2016b)	Mapping requirements for the wearable smart glasses augmented reality museum application	Journal of Hospitality and Tourism Technology
71	Cranmer et al. (2020)	Exploring the value of augmented reality for tourism	Tourism Management Perspectives
59	Dueholm and Smed (2014)	Heritage authenticities—a case study of authenticity perceptions at a Danish heritage site	Journal of Heritage Tourism
57	Sia et al. (2023)	Smart mobile tourism app featuring augmented reality and big data analytics: an empirical analysis using UTAUT2 and PCT models	Journal of Science and Technology Policy Management
53	Mohanty et al. (2020)	Augmented reality for relaunching tourism post-covid-19: socially distant, virtually connected	Worldwide Hospitality and Tourism Themes
53	Huertas and Gonzalo (2020)	The role of augmented reality in destination branding	Journal of Hospitality and Tourism Management
44	Paulo et al. (2018)	Understanding mobile augmented reality adoption in a consumer context	Journal of Hospitality and Tourism Technology
44	Huang (2020)	Restorative experiences and online tourists’ willingness to pay a price premium in an augmented reality environment	Journal of Retailing and Consumer Services
40	Tsai et al. (2020)	Inspection or play? A study of how augmented reality technology can be utilized in advertising	Current Issues in Tourism
31	Jiang et al. (2022)	Augmented reality and the enhancement of memorable tourism experiences at heritage sites	Current Issues in Tourism
31	Olya et al. (2020)	Engaging visitors of science festivals using augmented reality: asymmetrical modelling	International Journal of Contemporary Hospitality Management

Source: own elaboration based on Biblioshiny

4.2.4 Top authors in AR tourism research

Table 12 highlights the authors who constitute the intellectual backbone of AR tourism research. Among them, Dieck, M. C. T. from Manchester Metropolitan University emerges as the leading scholar, with nine publications and 38 local citations. She also holds the highest h-index (9) within the dataset, underscoring her central role in advancing both theoretical frameworks and practical applications of AR in tourism. Jung, T. H., also affiliated with Manchester Metropolitan University, follows closely with eight publications and an h-index of 8. He has co-authored several foundational studies on wearable and mobile AR technologies with Dieck, reinforcing their shared contribution to the field’s development. Zhu, C. from the Macao University of Tourism appears as a promising emerging scholar, with four publications in 2023 and an h-index of 4.

Author productivity reveals a highly uneven distribution. As shown in Table 13, single-publication authors account for 85% of the total, while only 15% have published more than one article. This pattern suggests that the field remains relatively nascent and attracts contributions from a broad, but transient, scholarly base.

Institutional clustering is also evident. Many of the most productive authors are affiliated with the same institutions and engage in frequent collaboration, indicating that AR tourism research is driven by a small number of tightly connected academic teams. However, cross-institutional and international collaboration remains limited.

Table 12. Top authors in AR tourism research.

Author	Institution	Number of Contributions	Local Citations	H-index
Dieck, M. C. T.	Manchester Metropolitan University	9	38	9
Jung, T. H.	Manchester Metropolitan University	8	32	8
Zhu, C.	Macao University of Tourism	4	1	4
Han, D.I.	Manchester Metropolitan University	3	7	3
Anand, K.	National Institute of Technology Karnataka	2	-	2
Arya, V.	Rabat Business School	2	-	2
Chung, N.	Kyung Hee University	2	7	2
Coles, T.	University of Exeter Business School	2	7	2
Cranmer, E.E.	Manchester Metropolitan University	2	6	2
Fong, L. H. N.	University of Macau	2	-	2

Figure 9 presents the co-authorship network structure in AR tourism research, where node size corresponds to author productivity and connecting lines indicate collaborative relationships. The visualization reveals distinct author clusters, indicating that collaboration frequency and intensity shape research communities, with research directions largely driven by a core group of prolific contributors.

Table 13. AR Productivity of authors.

Documents written	Number of Authors	Proportion of Authors
9	1	0.62%
8	1	0.62%
4	1	0.62%
3	1	0.62%
2	20	12.4%
1	137	85%

Source: own elaboration based on Biblioshiny

Figure 9 presents the co-authorship network structure in AR tourism research, where node size corresponds to author productivity and connecting lines indicate collaborative relationships. The visualization reveals distinct author clusters, indicating that collaboration frequency and intensity shape research communities, with research directions largely driven by a core group of prolific contributors.

The central red cluster is led by Dieck M.C.T., in close collaboration with Jung T.H., Han D. I., and Cranmer E. E., all affiliated with Manchester Metropolitan University. This group forms the intellectual core of AR tourism research, having co-authored many of the field’s most cited studies. Their work centers on AR applications in cultural heritage, including user acceptance model, cross-cultural adoption, wearable AR in museums, and visitor learning experience. The dense co-authorship network and prominent node sizes indicate both high productivity and strong collaboration. Their research not only advances theoretical frameworks, but also supports practical implementations.

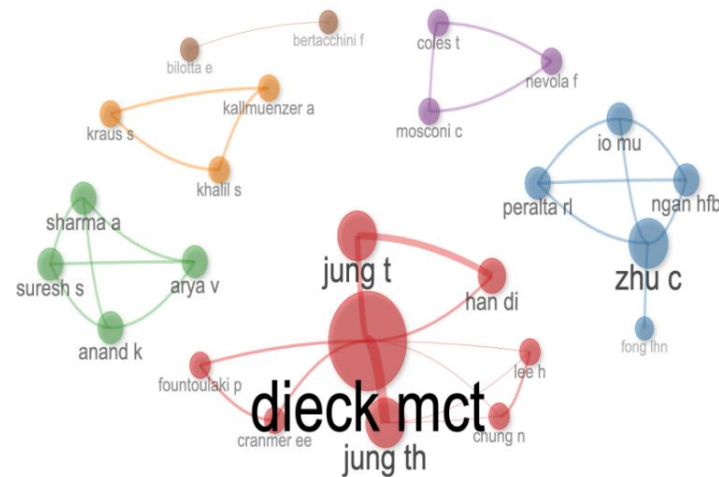
The blue cluster, led by Zhu C. from Macao University of Tourism, focuses on AR marketing in cultural heritage sites, with key themes including postmodern authenticity, immersive storytelling, and visitor intention. This cluster reflects an emerging stream of research that bridges technology, heritage interpretation, and consumer engagement.

The green cluster features Anand K., Arya V., Suresh S., and Sharma A, centers on AR applications in smart tourism, with a focus on app quality, user satisfaction, and continued usage.

Smaller clusters, involving Kallmuenzer A. and Coles T., are less central but contribute to the field’s thematic diversity. Their research typically focuses on the operational aspects of AR, as seen in studies like the operation of AR in world heritage city.

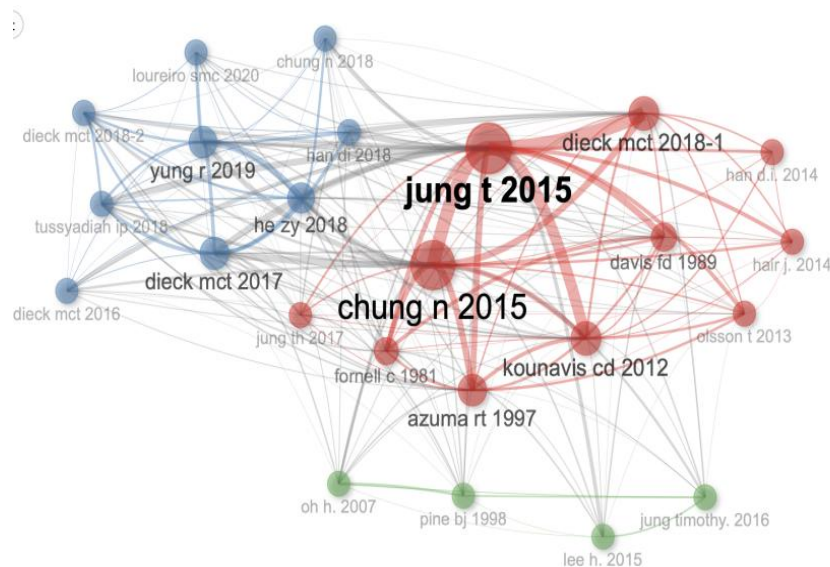
What's more, the co-citation map (see Figure 10) shows which studies are most often cited together. Key works by Jung et al. (2018), Chung et al. (2017), and Dieck and Jung (2017) are often used as the foundation for later research. Earlier theories, like the Technology Acceptance Model (TAM; Davis, 1989) is also widely used. Yung et al. (2020) and He et al. (2018), explore emotional experience and user interaction. Note: The publication years shown in the co-citation map are derived from bibliometric database records and may differ slightly from the officially published years.

Figure 9. AR Correlation in Co-authorship



Source: own elaboration based on Biblioshiny

Figure 10. AR Correlation in Co-citation



Source: own elaboration based on Biblioshiny

4.2.5 Main topic analysed and lines of AR research.

Based on the keyword co-occurrence analysis shown in Figure 11, five major thematic clusters are identified, representing key research foci in AR tourism studies. The map visualizes keyword relationships, where node size indicates frequency and color denotes cluster membership.

Cluster 1 (Green): AR-Enhanced tourism experience and satisfaction

This is the most prominent cluster, centered around key terms such as destination, technology, satisfaction, experience, and intention. It reflects the dominant research

focus on how AR enhances visitor experiences, satisfaction, and behavioral intentions at tourism destinations. Studies within this cluster frequently employ user-centered evaluations to assess how AR technologies improve tourist engagement and destination appeal.

Cluster 2 (Blue): AR applications in tourism and cultural heritage

Characterized by keywords such as tourism, authenticity, and impact, this cluster examines the application of AR particularly in cultural heritage and smart tourism contexts. Research in this area emphasizes immersive storytelling, the preservation and communication of authenticity, and the enrichment of cultural interpretation and visitor interaction through AR.

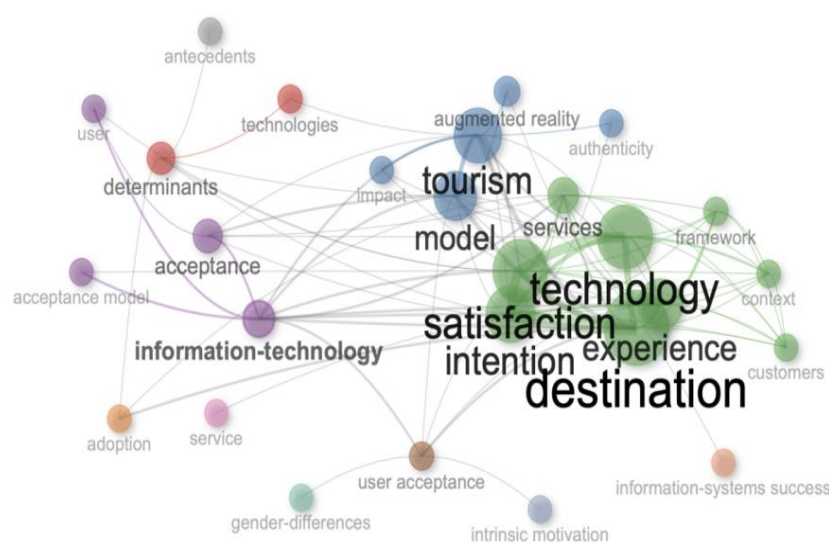
Cluster 3 (Purple): Technology acceptance in AR tourism

This cluster comprises terms such as information technology, acceptance, acceptance model, and user. It investigates the theoretical foundations of AR adoption in tourism, frequently drawing on frameworks such as the Technology Acceptance Model (TAM; Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2016).

Cluster 4 (Red/Brown): Technical foundations and User-Centric design

This integrated cluster includes keywords such as technologies, determinants, antecedents, user acceptance, gender differences, and information systems success. It addresses both technical infrastructure and human-centric factors critical to AR implementation. The cluster underscores the dual importance of robust technological development and adaptive, inclusive design in delivering effective and engaging AR tourism applications.

Figure 11. AR Correlation map between keywords



Source: own elaboration based on Biblioshiny

Figure 12. AR Wordcloud

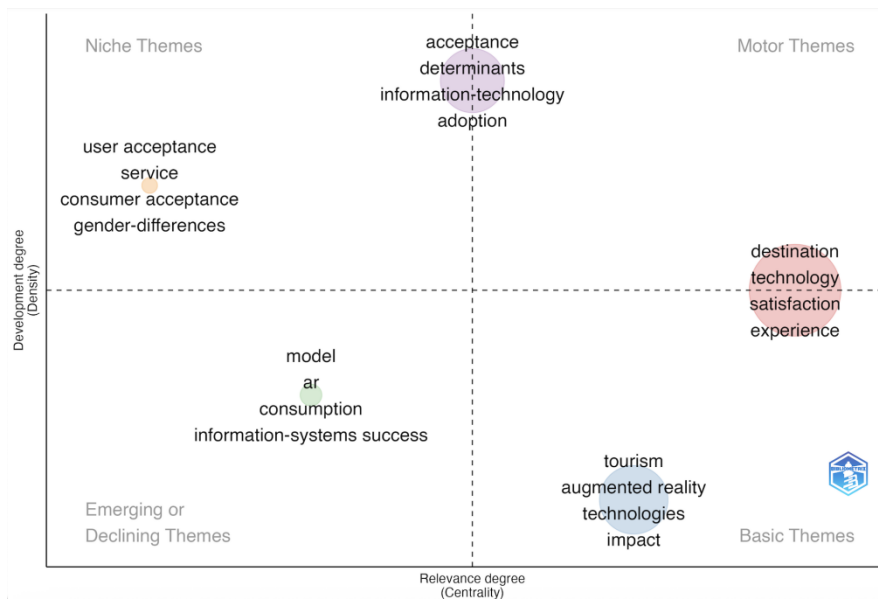


Source: own elaboration based on Biblioshiny

Figure 13 presents the thematic map of AR research in the tourism field, revealing a trend of thematic concentration alongside structural fragmentation. The most prominent and conceptually mature themes, such as destination, experience, technology, and satisfaction, are located in the motor quadrant, indicating their central position and developmental momentum within the field. These topics dominate the current literature, reflecting sustained academic interest in how AR enhances on-site engagement and improves visitor satisfaction. In contrast, themes such as impact models, consumption, and information systems success appear in the emerging or declining quadrant, suggesting limited theoretical development and empirical depth.

Additionally, user acceptance, service quality, gender differences, and consumer acceptance are situated in niche clusters, showing focused but disconnected attention. Meanwhile, adoption, acceptance, and determinants exhibit high frequency but low centrality, indicating a growing interest in the behavioral drivers of AR use, though they have not yet been integrated into the mainstream research framework. Future studies should further incorporate technology acceptance models such as TAM and UTAUT, exploring how individual differences, emotional engagement, and immersive characteristics jointly influence satisfaction and behavioral responses in AR experiences.

Figure 13. AR thematic map



Source: own elaboration based on Biblioshiny

4.2.6 Top countries /regions in AR tourism research.

Table 14 presents the most contributing countries in AR tourism research, with the United Kingdom (28.57%, 180 contributions, 1123 citations) leading both in output and influence. China (11.59%, 73 contributions, 209 citations) and Portugal (10.32%, 65 contributions, 56 citations) follow as major contributors. Italy (9.37%) and South Korea (8.41%) also show notable involvement, with Korea demonstrating significant impact (325 citations) relative to its output.

Table 14. Top countries /regions in AR tourism research.

Country	Contribution	Percentage	Total Citation
United Kingdom	180	28.57%	1123
China	73	11.59%	209
Portugal	65	10.32%	56
Italy	59	9.37%	81
Korea	53	8.41%	325
Spain	53	8.41%	49
USA	32	5.08%	222
Denmark	30	4.76%	59
Croatia	22	3.49%	21
Poland	18	2.86%	18
Germany	15	2.38%	15

Source: own elaboration based on Biblioshiny

Nearly two-thirds of the studies originated from Western developed countries. China and South Korea stand out as the primary contributors from Asia. However, the distribution of citations reveals a concentration of academic influence in countries such

as the United Kingdom and the USA, which together account for more than 1,300 citations.

This Western-centric research pattern reveals a significant gap in representation from culturally rich but academically underrepresented regions including Africa, Latin America, and much of Asia. The current geographical concentration not only affects research diversity but also risks developing AR solutions that predominantly reflect Western cultural norms and tourist behaviors.

4.3 Result of MR bibliometric analysis

According to Table 15, which summarizes the application of MR in tourism, a total of 2 articles meet the inclusion criteria.

The first article, "Phygital Technologies and Environments for breakthrough innovation in customers and citizens' journey" by Del Vecchio et al. (2023), published in *Technological Forecasting and Social Change*, has received 30 citations. This study explores how MR and related digital technologies enhance customer and citizen experiences in hybrid physical-digital environments.

The second article, "Mixed reality experiences in museums: exploring the Impact of functional elements of the devices on visitors' immersive experiences and post-experience behaviours" by Trunfio et al. (2022), appears in *Information & Management* and has accrued 67 citations. It investigates MR applications in museums, focusing on how device functionality influences immersion and post-visit behaviors.

Table 15. MR applications in tourism.

Author	Title	Source	Citations
Del Vecchio et al. (2023)	Phygital technologies and environments for breakthrough innovation in customers' and citizens' journey.	Technological Forecasting and Social Change	30
Trunfio et al. (2022)	Mixed reality experiences in museums: Exploring the impact of functional elements of the devices on visitors' immersive experiences and post-experience behaviours	Information & Management	67

Source: own elaboration based on Biblioshiny

5. CONCLUSION

This study conducts a comprehensive bibliometric analysis of immersive technologies in tourism, based on 420 publications indexed in the Scopus and Web of Science databases. It focuses on three primary technologies: Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR).

The results indicate that VR represents the most conceptually developed area, with steady growth beginning in 2017 and reaching a peak in 2023. Research in this field is primarily led by scholars from China, the United Kingdom, and the United States. The research team led by Flavián C. in Spain contributes significantly to this domain. Core topics include destination marketing, immersive experience design, and tourist satisfaction, reflecting strong academic interest in how VR shapes perception, emotional response, and engagement. However, studies focusing on long-term experiential effects, psychological mechanisms, and behavioral continuity remain limited. Recent research begins to incorporate user-centered behavioral models to examine how tourists interact with VR-enhanced environments and make travel-related decisions, particularly in areas such as wellness tourism and cultural heritage interpretation.

AR research begins later but expands rapidly after 2020. Leading contributions come from the United Kingdom, China, and Portugal. The research shows strong application in cultural heritage and museum-based educational tourism. Scholars such as Dieck and Jung establish foundational frameworks, especially in mobile AR. Current literature emphasizes user experience, technology acceptance, and immersive storytelling. Future studies are encouraged to explore how emotional involvement, individual differences, and immersive design jointly influence user satisfaction and post-visit behavior.

Although VR and AR each demonstrate distinct theoretical and practical strengths, the overall research landscape remains fragmented. Most scholarly output depends on a small number of influential authors and research teams, with limited long-term participation and weak interdisciplinary collaboration. VR research is largely driven by the Spanish team led by Flavián C., while AR research is dominated by scholars such as Dieck and Zhang in the United Kingdom and Zhu C. in Macao. The field still relies heavily on early influential publications, such as Guttentag (2009) for VR and Dieck and Jung (2015) for AR, reflecting a need for theoretical innovation. Journals such as *Sustainability*, *Journal of Heritage Tourism*, and *Current Issues in Tourism* rank among the most influential in terms of both volume and citation impact.

MR receive less attention due to high technological costs and implementation challenges. Existing research focuses primarily on conceptual discussions and technical overviews, with limited empirical validation. As spatial computing, wearable devices, and intelligent interfaces continue to evolve, MR demonstrates strong potential in wellness tourism, remote site access, cultural visualization, and inclusive travel services.

Geographically, immersive tourism research remains concentrated in technologically advanced countries. Developing regions such as Latin America, Africa, South Asia, and Southeast Asia receive little academic attention. This imbalance limits the global relevance and cultural inclusiveness of the existing literature.

6. LIMITATIONS

This study presents several limitations that should be acknowledged. First, it only includes peer-reviewed journal articles included in the Scopus and Web of Science databases, thereby excluding conference proceedings, dissertations, industry reports, and non-English publications. As a result, relevant regional studies, especially from developing countries, may be underrepresented. Second, the bibliometric approach focuses on publication metadata, citation counts, and co-occurrence analysis, which provide a macro-level understanding but do not capture the theoretical depth, methodological rigor, or contextual relevance of individual studies. Third, while the analysis identifies emerging research trends and clusters, it does not assess the real-world effectiveness or user perceptions of immersive technologies, which require empirical and user-centered investigations. These limitations highlight the need for complementary qualitative and mixed-methods research to deepen the understanding of immersive technology applications in tourism.

7. FUTURE RESEARCH AGENDA

To advance immersive tourism research, several directions warrant deeper exploration. First, future studies should move beyond short-term user evaluations and strengthen theoretical models such as TAM and UTAUT by incorporating behavioral, emotional variables. Understanding how individual traits, affective responses, and situational factors jointly shape technology adoption is essential. Second, research should explore AI-driven personalization to deliver adaptive immersive content tailored to users' emotions, preferences, and profiles. Third, long-term outcomes such as satisfaction, behavioral intention, memory retention, and value co-creation should be empirically assessed.

Future work should also address underexplored areas such as accessibility, inclusivity, and sustainability, examining how immersive technologies can support disabled travelers, reduce carbon footprints, and preserve intangible heritage. Finally, greater geographic diversity is needed. Enhanced engagement from Latin America, Africa, South Asia, and Southeast Asia is crucial for developing culturally inclusive and globally relevant frameworks. Cross-cultural studies will ensure immersive technologies are both innovative and equitable

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