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The impact of extended reality technologies (XR) on the enhancement of cultural heritage experience: a bibliometrics analysis

Alice Fontana*

Abstract

In recent decades, Extended Reality (XR) technologies, including Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR), have been increasingly adopted by cultural institutions to enhance heritage preservation and offer new modes of engagement. This shift has generated growing interest in international research, with a significant rise in publications over the past decade focusing on how visitors perceive and evaluate these technologies. This study presents a bibliometric analysis of academic literature from 1985 to 2024, using a PRISMA-based protocol to rigorously identify relevant studies. The aim was to map the development of research on the topic, identify key trends, and assess the methodologies used to evaluate the impact of immersive technologies on cultural experiences. The findings highlight four main areas of investigation: the role of XR in cultural tourism, its effect on visitor behavior, its contribution to learning processes, and the factors influencing its acceptance and adoption. In conclusion, the study identifies emerging research directions and underscores the need for further exploration of the long-term implications of XR in cultural heritage engagement.

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Negli ultimi decenni, le tecnologie Extended Reality (XR), tra cui la Realtà Aumentata (AR), la Realtà Virtuale (VR) e la Realtà Mista (MR), sono state progressivamente adottate dalle istituzioni culturali per favorire la conservazione del patrimonio e offrire nuove modalità di fruizione. Questo cambiamento ha suscitato un crescente interesse nella ricerca accademica, con un notevole aumento delle pubblicazioni incentrate sulla percezione e valutazione di tali tecnologie da parte dei visitatori. Il presente studio propone un'analisi bibliometrica della letteratura accademica dal 1985 al 2024, utilizzando un protocollo di selezione basato sulle linee guida PRISMA al fine di garantire un'identificazione rigorosa degli studi rilevanti. L'obiettivo è quello di mappare l'evoluzione della ricerca accademica, individuare le principali tendenze e analizzare le metodologie impiegate per valutare l'impatto delle tecnologie immersive sulle esperienze culturali. I risultati evidenziano quattro principali ambiti di indagine: il ruolo della XR nel turismo culturale, il suo effetto sul comportamento dei visitatori, il contributo ai processi di apprendimento e i fattori che ne influenzano l'accettazione e l'adozione. In conclusione, lo studio individua nuove direzioni emergenti nella ricerca e sottolinea la necessità di approfondire le implicazioni a lungo termine dell'impiego della XR nella valorizzazione del patrimonio culturale.

1. *Introduction*

Over the past decades, cultural heritage institutions have undergone digital transformation and have started using new information technologies to enhance cultural heritage and improve audience development[1]. The application of these technological developments is reshaping the concept of cultural heritage where the physical and digital layers are becoming increasingly interconnected, enhancing the meaning and value of the original object. This strong interconnection can be defined as Phygital Cultural Heritage, which is characterized by the space (the graphic field), the heritage object (the attractive elements) and the users[2]. Among the various technologies used to experience Phygital Cultural Heritage, particular attention is given to Extended Reality (XR) technologies due to their high capacity for engagement. According to Fast-Berglund *et al.*, Milgram *et al.* and Silva and Teixeira[3], the term XR defines a spectrum (Fig. 1) of new media technologies such as Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) that differ in the degree of involvement and technologies used.

[1] Bakhshi, Throsby 2010; Carrozzino, Bergamasco 2010; Potts 2014.
[2] Lo Turco, Giovannini 2020.
[3] Fast-Berglund *et al.* 2018; Milgram *et al.* 1995; Silva, Teixeira 2022.

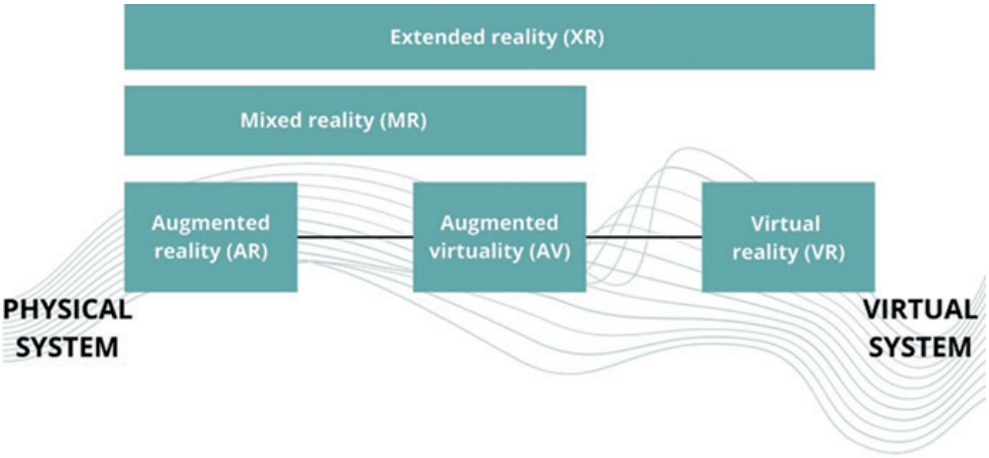

Fig. 1. Relation between XR technologies and environment (Source: adaptation from Milgram *et al.* 1995)

Virtual Reality, when fully exploited, completely immerses the users in an environment entirely computer-generated (e.g., virtual computer simulated world or reproduction); Augmented Reality enhances reality by adding spatially aligned computer-generated information (e.g., 3D models, textual annotations) onto the user's surroundings through specialized display technologies; and Mixed Reality is characterized by the total blend of virtual elements (e.g., holograms or projections) with the real world so that users can interact simultaneously with both digital and real contents[4].

According to Gans and Nagaraj[5], the success of these technologies is due to the fact they reduce both the cost of obtaining and processing information and the cost of accessing complex, uncertain, and risky environments, all while maintaining a high degree of immersiveness. This dual benefit makes them a useful tool for the mediation and enhancement of cultural heritage.

In recent years, an increasing number of cultural heritage institutions have applied or are applying immersive technologies to enhance the preserved heritage and make it more accessible[6]. The comparative analysis of current usage and future planning of immersive technologies in exhibitions, based on data from the Museum Innovation Barometer[7], highlights a significant growth in the adoption of Extended Reality. Although Augmented Reality (18%), Virtual Reality (21%), and immersive audio (23%) represented a relatively limited

[4] Beck *et al.* 2019; Leopardi *et al.* 2021.
[5] Gans, Nagaraj 2023.
[6] Bekele *et al.* 2018; ICOM France 2023.
[7] Museum Booster 2021.

share of the technologies employed, the planning implementation indicates an expansion of these tools, with Augmented Reality reaching 34%, Virtual Reality 30%, and immersive audio 28%. This trend is followed not only by major museums such as the British Museum[8], which launched Virtual Reality (VR) to offer its visitors an immersive and spectacular experience, but also smaller like the Museum of Traditional Valdostan Crafts (MAV), which has incorporated Virtual Reality (VR) to enhance the emotional response to heritage and culture and increase user engagement[9]. The introduction of these technologies, on the one hand, seems to meet the need for cultural consumption that is increasingly interactive and dynamic, intensifying its experiential character[10] and, on the other hand, helps cultural institutions to enhance the heritage they preserve allowing many consumers to perceive, understand, and appreciate its value[11].

According to the report published by EMISSIVE[12], the growing public interest in these immersive projects underlines the importance of digital technology as a mediating ecosystem and lever for growth, disrupting cultural consumption habits. This is evidenced by the success of spaces such as the *Atelier des Lumières* (Culturespaces) and its immersive exhibition. Since its opening in 2018, the Atelier des Lumières has experienced remarkable growth by welcoming 1,2 million visitors[13].

With the increasing production of immersive technology projects implemented by cultural institutions to enhance their heritage and make it more immersive, studies on their application in cultural institutions have also increased[14]. However, a gap remains in understanding how visitors perceive these technologies, as well as their actual attitudes and motivations toward this innovation[15]. In this context, there is an emerging need to understand the landscape of literature surrounding the consumption of immersive technologies applied to the cultural heritage sector and the perceived value of the consumption experience. This knowledge will be useful for identifying emerging trends in Extended Reality, understanding their future evolution, and assessing their impact.

[8] Schofield *et al.* 2018.
[9] Pioletti 2024.
[10] Valeri 2018.
[11] Cerquetti *et al.* 2024; Golinelli 2015; Montella 2009.
[12] EMISSIVE 2024.
[13] <https://www.atelier-lumieres.com/fr/decouvrir/un-peu-dhistoire>, 30.01.2025.
[14] Bekele *et al.* 2018; Poulopoulos, Wallace 2022; Zhou *et al.* 2022.
[15] J. Li *et al.* 2023.

2. *Objective and methodology*

Despite existing reviews on the use of immersive technologies in cultural heritage[16], gaps remain in understanding their impact on cultural consumption and its valuation. In fact, while Bekele *et al.* and Poulopoulos and Wallace[17] focused their attention on the application of Extended Reality technologies in cultural heritage, Zhou *et al.*[18] have focused on their effect on museum learning, and Li *et al.* have focused on user experience, but limited only to the museum context. This study bridges these gaps by providing a comprehensive, up-to-date analysis of recent advancements (1985 – early 2024) in Augmented Reality, Virtual Reality, Mixed Reality, and Extended Reality applied to Cultural Heritage.

This study conducts a bibliometric analysis of the existing literature on immersive technologies applied to cultural heritage and their consumption experiences to answer the following research questions:

RQ1. How has academic research on the consumption and valuation of immersive technologies experience in cultural heritage evolved over time?

RQ2. What are the key findings and contributions of recent studies on immersive technology experiences in the context of cultural heritage?

The decision to adopt a bibliometric analysis was guided by the nature of the research questions and the characteristics of the research field examined. Bibliometric analysis summarizes large quantities of bibliometric data to present the state of the intellectual structure and emerging trends of a research topic, analyzing the social and structural relationships between different research components, such as authors and keywords. This approach provides a comprehensive overview of the topic, allowing researchers to identify key trends, knowledge gaps, and emerging topics[19]. Considering the aims of the research, the bibliometric approach was considered the most suitable, allowing for a quantitative assessment of scientific production and thematic development, while at the same time enabling a qualitative interpretation of emerging patterns and research directions. To ensure transparency and methodological rigor in the article selection process, a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was adopted (Fig. 2) for guiding the inclusion and exclusion process, following emerging best practices in bibliometric research[20]. This ensured a replicable and structured approach

[16] Bekele *et al.* 2018; J. Li *et al.* 2023; Poulopoulos, Wallace 2022; Zhou *et al.* 2022.
[17] Bekele *et al.* 2018; Poulopoulos, Wallace 2022.
[18] Zhou *et al.* 2022.
[19] Donthu *et al.* 2021; Öztürk *et al.* 2024.
[20] Donthu *et al.* 2021.

to data collection, without compromising the fundamentally quantitative and exploratory nature of the analysis[21].

The database used in this search is Web of Science where the following query was conducted: TS=((“museum*” or “cultural.heritage” or “creative.industr*” or “cultural.industr*”) AND (“XR” OR “VR” OR “AR” OR “MR” OR “virtual reality” OR “extended reality” OR “augmented reality” OR “mixed reality”)) and with the following inclusion criteria: English (Languages) and Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH) or Social Sciences Citation Index (SSCI) or Arts & Humanities Citation Index (A&HCI) or Book Citation Index – Social Sciences & Humanities (BKCI-SSH) (Web of Science Index). The query was formed on the field “Title, abstract, author keyword” with a time range 1985-2024.

By using PRISMA methodology, this study analyzes 644 records, ultimately focusing on 50 papers that fully address the topic.

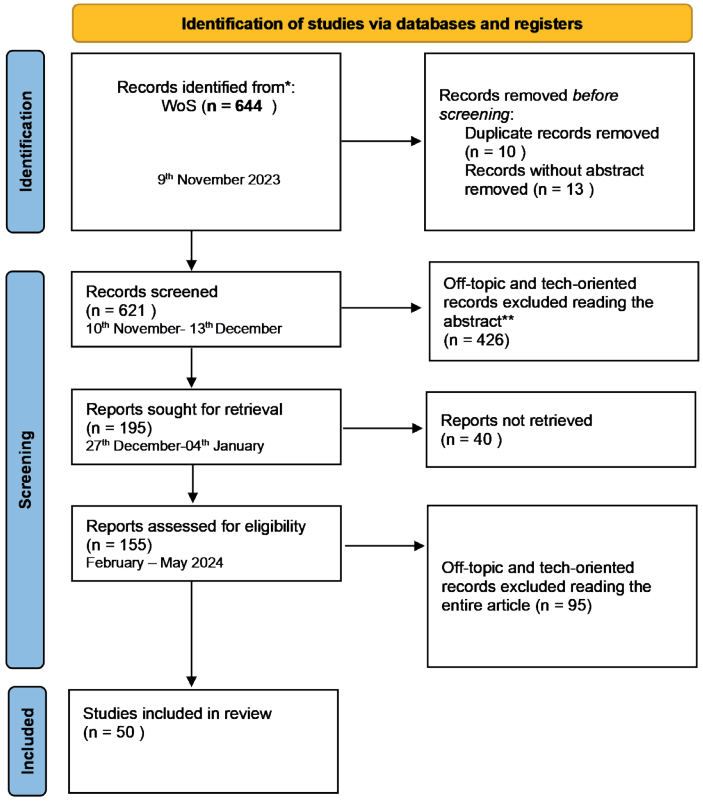

Fig. 2. PRISMA 2020 flow diagram for new systematic reviews (Source: own elaboration)

[21] Moher *et al*. 2009.

Data collection began in November 2023, and the final eligible dataset was obtained in May 2024. As illustrated in Figure 2, the selection process followed several sequential screening phases, based on different exclusion criteria. In the first phase, records without abstracts and duplicate entries were identified and removed, resulting in the exclusion of 23 documents. In the second phase, the abstracts of all remaining records were carefully reviewed to assess their relevance to the research aim. Articles were excluded if they were off-topic or if they approached the subject from an overly technical or engineering-oriented perspective, for example, studies focused exclusively on the development, design, or implementation of XR technologies, without any connection to the visitor cultural heritage experience. This step led to the exclusion of 426 records. This step was a fundamental one to align the corpus with the aim of this bibliometric study, which seeks to explore XR in cultural heritage consumption contexts, not in engineering or computer science domains.

The remaining 195 articles underwent a third screening phase, during which 40 records were excluded due to the unavailability of full-text access through any academic or institutional database. Finally, in the full-text reading phase, 95 additional studies were removed because they did not meet the scope of the review (e.g., limited relevance to cultural heritage experiences). As a result, 50 studies were retained and analyzed.

Following Öztürk *et al.*[22], two main analysis procedures are applied in this bibliometric research: *performance analysis* for giving an overview of the field in terms of scientific outputs (using bibliometric data for evaluating the field, i.e. citations performance or number of journal publications) and *science mapping* for analyzing the relationship networks between authors-papers-concepts-citations (co-authorship analysis and keyword co-occurrence). The analysis was conducted through a semi-automatic procedure, combining manual data processing with dedicated bibliometric software.

For the performance analysis, the bibliographic metadata were exported from Web of Science in tab-delimited format and processed manually using Microsoft Excel. This allowed the calculation of descriptive statistics related to publication output, citation frequency, and productivity by authors or journals. For the science mapping, the cleaned dataset was imported into VOSviewer, a tool specifically designed for constructing and visualizing bibliometric networks. Two main types of analysis were performed. The first one is the co-authorship analysis, aimed at identifying collaboration patterns among authors, and the second one is the keyword co-occurrence analysis, used to explore thematic structures and research trends within the selected corpus. VOSviewer automatically generated visual representations of the networks, with clustering based on co-occurrence strength.

[22] Öztürk *et al.* 2024.

3. *Results*

3.1. *The evolution of publications over time*

To illustrate the evolution of scholarly interest over time in immersive technologies applied to cultural heritage – particularly regarding their effects on consumers – Figure 3 presents the publication trend observed in our selected data sample. Notably, despite the longer research time span (1985-2024), the articles in the final sample seem to be concentrated in the last 10 years, reflecting a growing body of literature on the effects of immersive technologies on cultural consumption. Interest in this subject has been growing, with peaks in 2018, 2020 and 2022.

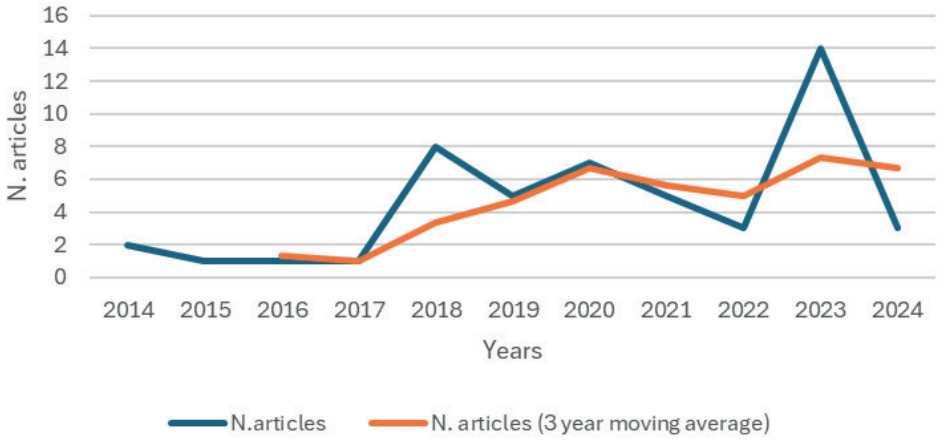

Fig. 3. The number of annually published articles in the research field (Source: own elaboration)

Instead, if we consider literature from the point of view of the typology of Extended Reality technologies, we observe that, between 2014 and 2018, Augmented Reality was the only immersive technology examined, dominating the entire literature. As of 2018, Virtual Reality technologies began to make their way in, and from 2019, the terms Mixed Reality and Extended Reality also appeared. In total, half of the articles focus more on the effects of Augmented Reality technologies (n=25), followed by VR (n=14), four articles focus on both technologies, while the remainder deal with MR and XR.

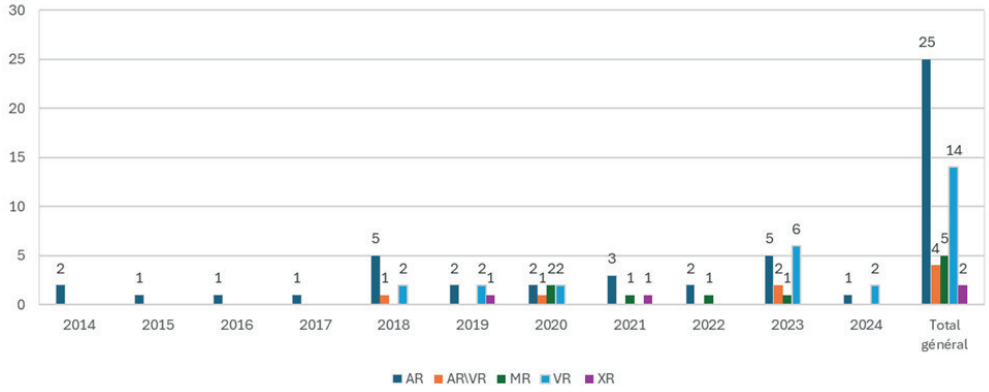

Fig. 4. Typology of immersive technologies by number of articles over different years (Source: own elaboration)

3.2. *Articles' distribution in Journals*

The 50 articles in the final sample were published in 28 Journals, pointing out a significant fragmentation (Tab. 1). This seems to testify to the wide range of disciplines involved in the immersive technologies applied to cultural heritage, as education (*Computer & Education*, *Australian Journal of Educational Technologies*), tourism (*Current Issues in Tourism*, *Journal of Destination Marketing And Management*, *Journal of Vacation Marketing*, *International Journal of Contemporary Hospitality Management*, *Journal of Management Tourism*), computing and its effect on consumer behavior (*International Journal of Human-Computer Interaction*, *Computer in Human Behavior*, *Information Technologies and People*, *Behavior & Information Technologies*, *Soft Computing*).

The top three journals are *Sustainability* (n=6), *Journal on Computing and Cultural Heritage* (n=5) and *International Journal of Human-Computer Interactions* (n=4). The first one, *Sustainability* is an international, peer-reviewed, open-access journal on environmental, cultural, economic, and social sustainability of human beings, published by MDPI; the second one, *ACM Journal on Computing and Cultural Heritage (JOCCH)* works on areas relating to the use of information and communication technologies (ICT) in support of Cultural Heritage, demonstrating innovative use of technology for the discovery, analysis, interpretation and presentation of cultural material; the third one, *The International Journal of Human-Computer Interaction*, is interested on the cognitive, creative, social, health, and ergonomic aspects of interactive computing.

	Publisher	Journal Title	N. Articles (%)
Articles	MDPI	*SUSTAINABILITY*	12%
	ASSOC COMPUTING MACHINERY	*ACM JOURNAL ON COMPUTING AND CULTURAL HERITAGE*	10%
	TAYLOR & FRANCIS INC	*INTERNATIONAL JOURNAL OF HUMAN-COMPUTER INTERACTION*	8%
	PERGAMON-ELSEVIER SCIENCE LTD	*COMPUTERS & EDUCATION*	4%
	PERGAMON-ELSEVIER SCIENCE LTD	*COMPUTERS IN HUMAN BEHAVIOR*	4%
	ROUTLEDGE JOURNALS, TAYLOR & FRANCIS LTD	*CURRENT ISSUES IN TOURISM*	4%
	ELSEVIER FRANCE-EDITIONS SCIENTIFIQUES MEDICALES ELSEVIER	*JOURNAL OF CULTURAL HERITAGE*	4%
	ELSEVIER	*JOURNAL OF DESTINATION MARKETING & MANAGEMENT*	4%
	SAGE PUBLICATIONS INC	*JOURNAL OF TRAVEL RESEARCH*	4%
	AUSTRALASIAN SOC COMPUTERS LEARNING TERTIARY EDUCATION-ASCILITE	*AUSTRALASIAN JOURNAL OF EDUCATIONAL TECHNOLOGY*	2%
	TAYLOR & FRANCIS LTD	*BEHAVIOUR & INFORMATION TECHNOLOGY*	2%
	FRONTIERS MEDIA SA	*FRONTIERS IN PSYCHOLOGY*	2%
	ELSEVIER	*INFORMATION & MANAGEMENT*	2%
	EMERALD GROUP PUBLISHING LTD	*INFORMATION TECHNOLOGY & PEOPLE*	2%
	EMERALD GROUP PUBLISHING LTD	*INTERNATIONAL JOURNAL OF CONTEMPORARY HOSPITALITY MANAGEMENT*	2%
	ACADEMIC PRESS LTD-ELSEVIER SCIENCE LTD	*INTERNATIONAL JOURNAL OF HUMAN-COMPUTER STUDIES*	2%
	WILEY	*INTERNATIONAL JOURNAL OF TOURISM RESEARCH*	2%
	EMERALD GROUP PUBLISHING LTD	*INTERNET RESEARCH*	2%
	MDPI	*ISPRS INTERNATIONAL JOURNAL OF GEO-INFORMATION*	2%
	ELSEVIER SCIENCE INC	*JOURNAL OF BUSINESS RESEARCH*	2%

Articles	SAGE PUBLICATIONS LTD	*JOURNAL OF VACATION MARKETING*	2%
	EMERALD GROUP PUBLISHING LTD	*LIBRARY HI TECH*	2%
	ROUTLEDGE JOURNALS, TAYLOR & FRANCIS LTD	*MUSEUM MANAGEMENT AND CURATORSHIP*	2%
	SAGE PUBLICATIONS LTD	*SCIENCE PROGRESS*	2%
	ELSEVIER SCIENCE INC	*SOCIO-ECONOMIC PLANNING SCIENCES*	2%
	SPRINGER	*SOFT COMPUTING*	2%
	MDPI	*SYSTEMS*	2%
	ELSEVIER SCI LTD	*TOURISM MANAGEMENT*	2%
ProceedingsPapers	SPRINGER INTERNATIONAL PUBLISHING AG	*INFORMATION AND COMMUNICATION TECHNOLOGIES IN TOURISM 2023, ENTER 2023*	2%
	IEEE	*2018 3RD DIGITAL HERITAGE INTERNATIONAL CONGRESS (DIGITALHERITAGE) HELD JOINTLY WITH 2018 24TH INTERNATIONAL CONFERENCE ON VIRTUAL SYSTEMS & MULTIMEDIA (VSMM 2018)*	2%
	SPRINGER INTERNATIONAL PUBLISHING AG	*DIGITAL HERITAGE: PROGRESS IN CULTURAL HERITAGE: DOCUMENTATION, PRESERVATION, AND PROTECTION, EUROMED 2018, PT II*	2%
	VARAZDIN DEVELOPMENT & ENTREPRENEURSHIP AGENCY	*ECONOMIC AND SOCIAL DEVELOPMENT (ESD 2018): 28TH INTERNATIONAL SCIENTIFIC CONFERENCE ON ECONOMIC AND SOCIAL DEVELOPMENT*	2%

Tab. 1. Distribution of articles in the journals (Source: own elaboration)

3.3. *Core articles*

Considering highly cited articles as more influential in the research field, Table 2 provides the list of 11 top articles for the number of citations, with at least 50 citations. These articles can be defined as "disseminators"[23], as they have contributed more than others to spreading research on this topic. These articles alone achieve 74% of the citation number of the entire sample (n=1586). The total 2127 citations are shared between the 50 articles, with an average of 43 citations for articles.

[23] Lazzeretti *et al.* 2018.

Authors	Article Title	Source Title	Publ. Year	N. Citations
Chang, Kuo-En; Chang, Chia-Tzu; Hou, Huei-Tse; Sung, Yao-Ting; Chao, Huei-Lin; Lee, Cheng-Ming	Development and behavioral pattern analysis of a mobile guide system with augmented reality for painting appreciation instruction in an art museum	*COMPUTERS & EDUCATION*	2014	243
Sommerauer, Peter; Mueller, Oliver	Augmented reality in informal learning environments: A field experiment in a mathematics exhibition	*COMPUTERS & EDUCATION*	2014	209
Chung, Namho; Lee, Hyunae; Kim, Jin-Young; Koo, Chulmo	The role of augmented reality for experience-influenced environments: The case of cultural heritage tourism in Korea	*JOURNAL OF TRAVEL RESEARCH*	2018	204
He, Zeya; Wu, Laurie; Li, Xiang (Robert)	When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions	*TOURISM MANAGEMENT*	2018	201
Dieck, M. Claudia tom; Jung, Timothy Hyungsoo	Value of augmented reality at cultural heritage sites: A stakeholder approach	*JOURNAL OF DESTINATION MARKETING & MANAGEMENT*	2017	170
Marasco, Alessandra; Buonincontri, Piera; van Niekerk, Mathilda; Orlowski, Marissa; Okumus, Fevzi	Exploring the role of next-generation virtual technologies in destination marketing	*JOURNAL OF DESTINATION MARKETING & MANAGEMENT*	2018	146
Jung, Timothy Hyungsoo; Lee, Hyunae; Chung, Namho; Dieck, M. Claudia tom	Cross-cultural differences in adopting mobile augmented reality at cultural heritage tourism sites	*INTERNATIONAL JOURNAL OF CONTEMPORARY HOSPITALITY MANAGEMENT*	2018	128
Dieck, M. Claudia tom; Jung, Timothy Hyungsoo; Dieck, Dario tom	Enhancing art gallery visitors' learning experience using wearable augmented reality: generic learning outcomes perspective	*CURRENT ISSUES IN TOURISM*	2018	90
Errichiello, Luisa; Micera, Roberto; Atzeni, Marcello; Del Chiappa, Giacomo	Exploring the implications of wearable virtual reality technology for museum visitors' experience: A cluster analysis	*INTERNATIONAL JOURNAL OF TOURISM RESEARCH*	2019	82
Deng, Xiaoyan; Unnava, H. Rao; Lee, Hyojin	Too true to be good? when virtual reality decreases interest in actual reality	*JOURNAL OF BUSINESS RESEARCH*	2019	63
Moorhouse, Natasha; Dieck, M. Claudia tom; Jung, Timothy	An experiential view to children learning in museums with Augmented Reality	*MUSEUM MANAGEMENT AND CURATORSHIP*	2019	50

Tab. 2. The 11 top articles by number of citations (Source: own elaboration)

All these studies highlight how immersive technologies have the potential to enhance the experience with cultural heritage and how these affect the relationship with the visitors-users, particularly on engagement, learning and satisfaction. Studies focused on Augmented Reality[24] and those centered on Virtual Reality[25] highlight fundamental differences between the two technologies, emphasizing the difficulty of making generalizations about all Extended Reality technologies. Indeed, divergences in technological orientation should reflect the different goals and contexts of cultural institutions themselves, and the application of these technologies must be context-sensitive and carefully designed.

What emerges is that Augmented Reality tends to emphasize real-time interaction with the physical environment, and it is often favored for its ability to augment the real world with digital information, focusing on effects that make it ideal for on-site cultural heritage experiences. Augmented Reality technologies seem to improve engagement with the cultural heritage and learning from heritage collections. The strengths of these technologies for enhancing learning have been identified in their ability to improve effectiveness, flow experience and time spent on an artwork[26]; in the increased interactivity that can make the visit more dynamic and participative[27] and in creating an informal learning environment[28]. Augmented Reality technologies have, in addition to the utilitarian component, a hedonic one (measured by perceived benefit, aesthetic experience and perceived enjoyment), which enhances visit satisfaction and improves enjoyment, which in turn influences attitudes and behavioral intentions towards the destination[29] and increases their willingness to pay more for museum services[30]. It also needs to highlight how this hedonic component depends on cross-cultural differences and thus may influence behavioral intentions differently. The study conducted by T.H. Jung *et al.*[31] with tourists in South Korea and Ireland finds out that the impact of perceived usefulness of the Augmented Reality technology was not strong in both cultures, but the relationship between perceived enjoyment and behavioral intention to use Augmented Reality was stronger in South Korea's higher power distance culture, showing that users' perceived enjoyment and social influence in South Korea is extremely important, a finding that can be linked to their perception

[24] Chang *et al.* 2014; Chung *et al.* 2018; Moorhouse *et al.* 2019; Sommerauer, Müller 2014; tom Dieck *et al.* 2018; tom Dieck, Jung 2017.
[25] Deng e*t al.* 2019; Errichiello *et al.* 2019; Marasco *et al.* 2018.
[26] Chang *et al.* 2014.
[27] Moorhouse *et al.* 2019; tom Dieck *et al.* 2018.
[28] Sommerauer, Müller 2014.
[29] Chung *et al.* 2018.
[30] He *et al.* 2018.
[31] T.H. Jung *et al.* 2018.

of power and relation to superiors. This study shows that in the development of Augmented Reality applications, developers need to be aware that different content and functionalities will appeal to different target markets.

Instead, studies on Virtual Reality focus on fully immersive and simulated experiences, and it is more suitable for creating completely new digital environments or pre-visit experiences, which can be used for marketing or remote engagement, allowing new business models for cultural institutions to be hypothesized. The study by Marasco *et al.*[32] examines the impact of Virtual Reality experiences on the intention to visit tourist sites, finding that the perceived visual attractiveness (PVA) and emotional engagement (EI) of VR experiences are two key factors influencing users' intention to visit cultural heritage sites. Errichiello *et al.*[33] show visitors recognize the added value of Virtual Reality applications in terms of usefulness and learning opportunities. The reason is that it allows them better access to information about the cultural site and its history, enabling them to experience the visit from a new perspective when compared with the traditional experience. The authors have shown that the perception of users is not homogeneous for all but depends on six factors – sense of involvement, technology added value, escapism, personal innovativeness with technology, technology usage intention, and experience sharing intention – and identifying three distinct groups of visitors, each with significantly different attitudes and perceptions towards the VR experience and with different emotional responses: "enthusiast", "moderates", and "sceptics". While most studies state that Virtual Reality technologies can be a tool for enhancing the visit and be a useful tourism marketing tool, Deng *et al.*[34] investigate the counterintuitive effects of Virtual Reality on consumer behavior, particularly in the context of museum visits and leisure travel, exploring whether high quality Virtual Reality simulations may reduce consumers' interest in continuing real experiences. The authors suggest that when Virtual Reality experiences are perceived as very similar to real experiences, they may decrease the desire to engage in the physical experience, due to a sense of repetition or satiety. The study concludes that Virtual Reality can be an effective marketing tool, but it can also unintentionally reduce consumer interest in the real experience, depending on the perceived similarity and involvement of the consumer in the experience. This highlights the need for a nuanced understanding of how Virtual Reality can affect onsite cultural heritage consumption, seeing it as a complement or substitute for physical visits.

[32] Marasco *et al.* 2018.
[33] Errichiello *et al.* 2019.
[34] Deng *et al.* 2019.

3.4. *Active authors*

Based on the sample of our study, a total of 147 authors contributed to the production of literature about the topic of immersive technologies applied to cultural heritage. Among them, 17 (12%) have at least two publications, as reported in Table 3, while the remaining 88% published only one article, highlighting a network of authors that is not cohesive. To discover the main groups of co-authors, a co-authorship analysis – using VOSviewer – was conducted. This analysis examines the interactions among scholars in a research field, in fact co-authorship is a formal way of intellectual collaboration among the authors[35].

Authors	n. Papers
Jung, Timothy	10
Dieck, M. Claudia tom	7
Chung, Namho	4
Lee, Hyunae	4
Cai, Shengdan	3
Ch'ng, Eugene	3
Kwon, Ohbyung	3
Moorhouse, Natasha	3
Bae, Sujin	2
Chen, Chun-Ching	2
Kang, Jian	2
Kang, Xin	2
Leow, Fui-Theng	2
Li, Xin-Zhu	2
Li, Yue	2
Nechita, Florin	2
Rezeanu, Catalina-Ionela	2

Tab. 3. Authors with more than two papers on the topic (Source: own elaboration)

The result is 37 clusters of different sizes by the number of authors as nodes, but most of them disconnected, as can be observed in Figure 5. The largest group comprising two clusters meeting with authors as Timothy Jung and Claudia tom Dieck, authors very influential for the topic.

[35] Donthu *et al.* 2021.

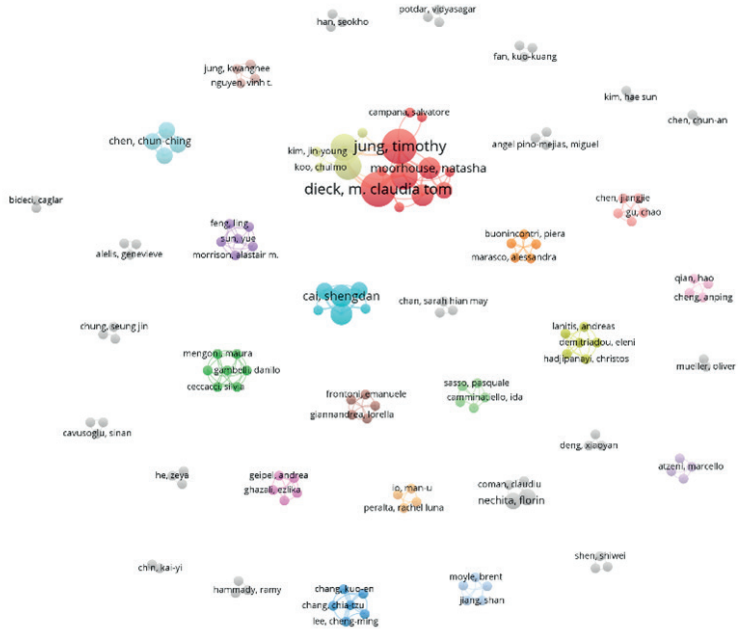

Fig. 5. Co-authorship analysis via VOSviewer (Source: own elaboration)

3.5. *Methodologies used*

The 50 articles in the final sample address the topic using different methodologies, but, as we can see in Table 4, the quantitative approach seems to dominate with more than 50% (n=34) articles using it, while 9 use a mixed qualitative-quantitative method and 7 a qualitative method. For data collection, the methods used include experiments[36] and surveys[37], and for qualitative methods, focus groups[38], observations[39] and interviews[40].

Research Methods	Research Design	N. Articles (%)
Quantitative	Experiment	68%
Quali-quantitative	Experiment, interviews, focus group	18%
Qualitative	Interview, Focus Group, Behavioral observation, Textual analysis	14%

Tab. 4. Methodologies used in the literature (%) (Source: own elaboration)

[36] Chang *et al.* 2014; He *et al.* 2018; Sommerauer, Müller 2014.
[37] Chung *et al.* 2018; Errichiello *et al.* 2019; T.H. Jung *et al.* 2018.
[38] Jiang *et al.* 2023; Moorhouse *et al.* 2019.
[39] Ch'ng *et al.* 2019; X.-Z. Li *et al.* 2022.
[40] tom Dieck *et al.* 2018; tom Dieck, Jung 2017.

3.6. *Co-occurrence of keywords*

In line with the objectives of this study, an analysis of the evolution of keyword connections over time proves to be particularly insightful for understanding the thematic progression within academic literature. The co-occurrence of keywords in academic publications helps to understand the trends, key research areas, and emerging themes in this domain. The connections (edges) between nodes indicate co-occurrence in the same publications, with thicker lines denoting stronger relationships, while the node size represents the frequency of the words.

Figure 6 represents a network visualization created using the software VOSviewer. As expected, the key nodes are "augmented reality", "virtual reality", "cultural heritage", "museum", and "mixed reality" which are the most prominent nodes. The Augmented Reality Cluster is prominently connected to terms like "learning experience", "education", "authentic learning activity", "heritage tourism", "tourism experience". This indicates that Augmented Reality is frequently discussed in the context of enhancing educational experiences and tourism activities. For example, Augmented Reality has been used to create more engaging learning environments or to enrich tourists' experiences by providing interactive visit experiences with cultural heritage sites. The Virtual Reality Cluster is related to "visualization techniques", "digital heritage", "experience economy" and "virtual museum", indicating its applications in heritage to create digital reconstructions of historical sites or to offer virtual tours of museums, making cultural heritage accessible in new ways and offering new types of experiences.

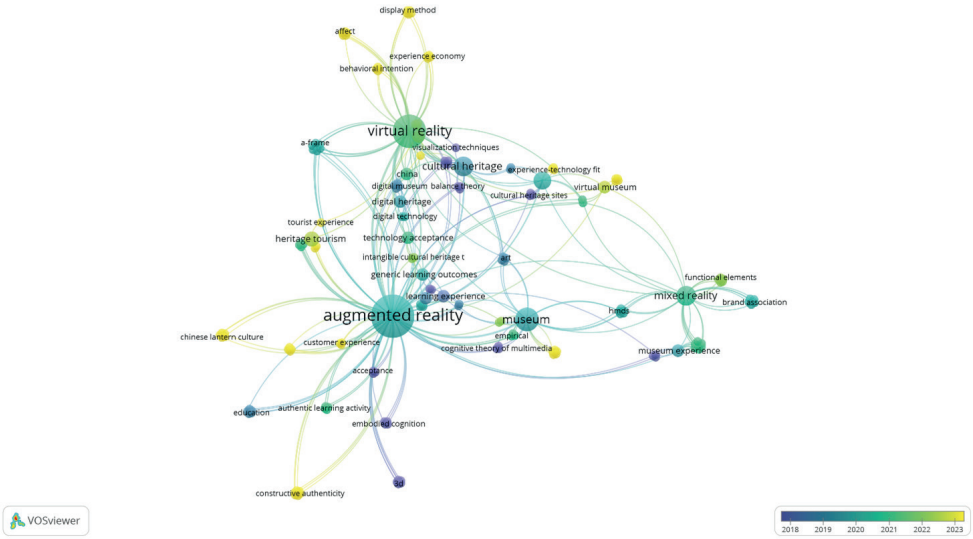

Fig. 6. Keywords co-occurance analysis via VOSviewer (Source: own elaboration)

The co-occurrence analysis of keywords identifies both the main nodes and connections and, through the use of a color gradient ranging from blue (earlier years) to yellow (recent years), allows for tracking the temporal evolution of academic literature. This color change makes it possible to identify shifts and developments in research themes, highlighting how scholarly focus has evolved over time. The Purple Cluster includes "learning experience", "embodied cognition" and "authentic learning activity", suggesting an emphasis on educational outcomes and cognitive aspects of experiences mediated by Extended Reality technologies. This concentration of terms indicates that in early years, research has focused on understanding how immersive reality technologies can be used to enhance learning, with particular attention to embodied cognition and educational experiences. The Blue Cluster features terms such as "digital heritage", "technology acceptance", "intangible cultural heritage" and "cultural technologies", pointing to research on the technological adoption and application in the heritage institutions sector, with increasing emphasis on user acceptance of these technologies. This cluster also highlights the importance of intangible cultural heritage, such as traditions and cultural practices, and how technologies can be used to safeguard and promote these less tangible aspects of cultural heritage. The Green Cluster contains terms like "museum experience", "functional elements", and "brand association" focusing on the practical implementation and user experience in museums and other heritage institutions. This cluster reflects a shift towards examining how technologies are practically implemented in museums. During this time frame, literature has explored how museums can use Virtual and Augmented Reality not only to enhance interactivity and engagement but also to strengthen the museum's identity as a cultural brand, improving public perception of its collection and visitor loyalty. The Yellow Cluster includes keywords like "experience economy", "affect", and "behavioral intention" indicating a focus on the experiential and psychological aspects of Virtual and Augmented Reality. This cluster is characterized by studies with the aim to explore how experiences mediated by these technologies influence users' emotions and their behavioral intentions.

3.7. *Emerging themes and trends*

This analysis highlights 4 macro themes in the literature focusing on the effects of the application of immersive technology in cultural heritage:

3.7.1. Effects on cultural heritage tourism and experience economy

Immersive technologies have emerged as essential tools for tourism engagement. The presence of keywords such as "tourism experience", "heritage tourism", "experience economy" indicates a strong presence of studies focused on

the application of immersive technologies for enhancing heritage tourism and its experience value perceived by the visitors.

The shift in consumer behavior from passive consumption to active engagement in the heritage consumption process[41] caused a bigger interest for the visitor's experience, and today's cultural institutions should focus on it, starting experiences that meet the visitor's desires[42]. Several studies[43] have shown that immersive technologies are able to enhance the experience of heritage visitors according to the four factors identified by Pine and Gilmore[44]: Entertainment, Education, Escapism and Aesthetics. The first one refers to the level of involvement and enjoyment that an experience provides to the participant; the second one concerns the informative and educational aspect of the experience; the third element focuses on the ability of an experience to allow people to temporarily escape from daily routines or worries; the fourth one refers to the visual and sensory aspect of the experience, characterized by beauty, harmony and positive sensory stimulation. All of these factors have been found in digital experiences mediated by immersive technologies, and it has been widely demonstrated how they may influence future behaviors. Furthermore, in recent years, there have been several attempts to extend the experience economy model in technology-related contexts to find additional context-specific factors influencing users' behavioral intentions. For example, Olya *et al.*[45] and tom Dieck *et al.*[46] extended the model by incorporating mediating variables of memory and satisfaction in the context of Augmented Reality (AR) festivals, while Hwang *et al.*[47] attempted to extend the model by considering spiritual experience in the context of a Virtual Reality experience.

Virtual Reality seems to be an effective technological tool for dealing with the cultural tourism experience, especially where visitors are able to visit without displacement, at any time, maintaining an authentic and immersive experience in cultural heritage and allowing them to experience the destination, also in its spiritual surroundings[48]. Indeed, far from being an inauthentic experience, immersive technologies applied to a world heritage site would overall maintain the authentic aspect of the experience in all three perspectives of authenticity (objective authenticity, constructive authenticity and existential authenticity). The objective authenticity refers to the inherent genuineness of original objects, the constructive authenticity that is attributed to objects based

[41] Olya *et al.* 2020.
[42] Leopardi *et al.* 2021.
[43] Hwang *et al.* 2023; T.H. Jung *et al.* 2018; Leopardi *et al.* 2021; Nechita, Rezeanu 2019.
[44] Pine, Gilmore 1998, 1999.
[45] Olya *et al.* 2020.
[46] tom Dieck *et al.* 2018.
[47] Hwang *et al.* 2023.
[48] *Ibidem*.

on tourists' perceptions, expectations, and social constructs rather than inherent originality and, finally, existential authenticity that focuses on a tourist's subjective, immersive experience and emotional connection. Augmented Reality enhances constructive and existential authenticity, positively influencing tourists' satisfaction and their intention to visit destinations, while objective authenticity alone has a limited impact on satisfaction, suggesting that tourists prioritize the overall experience over strict objectivity[49].

3.7.2. Behavioral intention

Keywords such as "behavioral intention" and "customer experience" highlighted works about how the experience with Extended Reality technologies has effects on future visitor behavior, allowing cultural heritage institutions to innovate from a business model perspective. A first effect is that if the user of immersive technology is satisfied with the experience, the visitor will have a positive attitude towards the destination and will have the intention to (re)visit[50], increasing the chances of fostering visitor loyalty[51]. A second effect is on visitors' willingness to pay more. Indeed, a virtual environment can function as a contextual cue that facilitates mental imagery and, consequently, vivid image processing enhances the aesthetic experience, thus increasing visitors' willingness to pay more[52]. Indeed, experiencing a high value of perceived usefulness for the technologies also increases the willingness to pay that could enable cultural institutions to increase their sources of income, as well as attractiveness. A third effect is that satisfaction with the experience of immersive technologies and a perception of authenticity may increase the willingness to support the preservation of tourism heritage, which may be an important factor for a visitor's post-visit activity[53]. Indeed, it can help heritage institutions dealing with the preservation and conservation's challenges.

Finally, the potential influence of Virtual Reality technologies on the quality of the visitor experience and perceived enjoyment influences the association with the brand awareness, brand association, and brand loyalty, and it can increase the purchase of souvenirs reminiscent of the experience, which may positively influence the bookshop income of the cultural heritage institutions[54].

3.7.3. Educational outcomes

Immersive technologies' studies agree that they satisfy new entertainment expectations, enhance the aesthetic experience, contribute to the escape from

[49] Zhu *et al.* 2023.
[50] Chung *et al.* 2018.
[51] Bae *et al.* 2020; T. Jung *et al.* 2020; Pratisto *et al.* 2023.
[52] He *et al.* 2018.
[53] Han *et al.* 2021.
[54] Bae *et al.* 2020; González-Rodríguez *et al.* 2020; T. Jung *et al.* 2020.

reality and facilitate the learning experience[55]. Keywords such as "embodied cognition", "authentic learning activity" and "generic learning outcomes" indicate a focus on the educational benefits of immersive technologies applied in museums and cultural heritage institutions, representing a major research theme.

In fact, several studies have shown that immersive technologies are capable of enhancing and making learning in museums effective, becoming an innovative mediation tool that should not be ignored by cultural institutions[56]. According to Sommerauer and Müller[57], the visitors learn better from Augmented Reality museum exhibits than from exhibits that are accompanied by traditional physical information displays only (e.g., boards, posters, leaflets, quizzes, books, screens), finding that education is one of the most promising application areas for these technologies. Their evidence comes from a field experiment with 101 participants at a mathematics exhibition, where they have measured the effect of Augmented Reality on acquiring and retaining mathematical knowledge. The explanation of the Augmented Reality success derives from the cognitive theory of multimedia learning (CTML) that argues that people learn better from words and pictures than from words alone[58]. Indeed, study of Moorhouse *et al.*[59] through experiments and focus groups found that the success of these technologies applied in a museum is due to students paying more attention to learning in education with Augmented Reality, thus improving their learning experience during the visit and enhancing knowledge acquisition.

But the effects of immersive technologies are not simply limited to the acquisition of knowledge; they can boost overall learning experience and achieve General Learning Outcomes (GLO) such as improving knowledge and understanding, skills, changing attitudes and values. Tom Dieck *et al.*[60] showed that the visitors experiencing the gallery through Virtual Reality have increased enjoyment, inspiration, and creativity, as well as improved activity, behavior, and progression of visitors at an art gallery compared to without access to this technology. Chang *et al.*[61], using an Augmented Reality museum guide, tested its effectiveness against an audio guide and no guide at all, finding that Augmented Reality groups showed significantly greater scores in the painting appreciation, extending the impact.

[55] Leopardi *et al.* 2021; tom Dieck *et al.* 2018.
[56] Chang *et al.* 2014.
[57] Sommerauer, Müller 2014.
[58] Mayer 2005.
[59] Moorhouse *et al.* 2019.
[60] tom Dieck *et al.* 2018.
[61] Chang *et al.* 2014.

3.7.4. Technological acceptance

Like any technological innovation, Extended Reality technologies need to be used and appreciated by future users. Keywords such as "experience-technology fit" and "technology acceptance" also highlight the importance of this concept in the literature analysis of how these technologies are accepted or not in the cultural heritage context, entering or not into our habits.

In the Extended Reality literature, the Technological Acceptance Model (TAM)[62] and Unified Theory of Acceptance and Use of Technology (UTAUT)[63] have emerged as a prominent theoretical framework for understanding and predicting individuals' acceptance or rejection of these new technologies[64]. These theoretical frameworks are used to empirically study which factors can influence the adoption of technologies, in our case, the immersive one (Tab. 5).

TAM	
Perceived Usefulness (PU)	The degree to which a person believes that using a particular technology will enhance their performance.
Perceived Ease of Use (PEOU)	The extent to which a person finds the technology easy to use.
UTAUT	
Performance Expectancy (PE)	The extent to which technology is expected to improve outcomes.
Effort Expectancy (EE)	The perceived effort required to use the technology.
Social Influence (SI)	The degree to which others influence an individual's decision to use the technology.
Facilitating Conditions (FC)	The availability of necessary resources and support to enable technology use.
Attitude Towards Use (ATU)	The individual's positive or negative feelings towards the technology.
Actual Use (AU)	The extent to which the technology is eventually utilized.
Self- efficacy (SE)	The belief in one's own ability to successfully use the technology.
UTAUT 2	
Hedonic Motivation (HM)	The enjoyment derived from using the technology.
Habit (HT)	The extent to which prior experiences shape technology adoption.
Price value (PV)	The user's perceived trade-off between the benefits of using the technology and the financial cost associated with it.

Tab. 5. Factors influencing technology acceptance according to TAM, UTAUT and UTAUT(2) (Source: own elaboration)

[62] Davis 1989.
[63] Venkatesh *et al.* 2003, 2012.
[64] Cheng *et al.* 2024; X.-Z. Li *et al.* 2022; Wen *et al.* 2023.

Cheng *et al.*[65] found out that different dimensions of experience mediated by Extended Reality, as aesthetic and escapist, contribute to increasing perceived usefulness and perceived ease of use, increasing the possibility to continue to consume these kinds of technologies in the future. In fact, the quality of the Extended Reality technologies experience offered and delivered to museum visitors is important and plays an essential role in the diffusion of these kinds of new technologies. This suggests that cultural institutions should focus on improving the quality of XR experiences when integrating an immersive experience into their strategies.

Wen *et al.*[66] found that the behavioral intention (BI) to use the Augmented Reality and Virtual Reality technologies in the cultural heritage context is significantly influenced by performance expectancy (PE), hedonic motivation (HM), habit (HT), personal innovativeness (PIN), and involvement (INV). This makes users more willing to adopt it when they perceive that the use of technologies will significantly improve their experience and understanding of cultural content, and make the learning experience more engaging and enjoyable. Nevertheless, individual habits or predisposition to experiment with new technologies are another significant element. Users who are already familiar with Augmented Reality and Virtual Reality in other contexts are more likely to use these technologies in cultural settings. Positive prior experience or attitude in trying a novelty reduces barriers to adoption and facilitates more natural and spontaneous use. For example, young people can be more attracted by these technologies because they will perceive Virtual Reality as easy to use, increasing the probability of using it in the future[67].

Finally, social influence is considered a critical factor in users' behavioral intentions and attitudes toward adopting immersive technologies[68], and this factor is stronger in a culture where collectivism is important[69].

4. *Conclusion*

The present bibliometric analysis has highlighted the evolving and multidisciplinary landscape of Extended Reality (XR) technologies – particularly Augmented Reality (AR) and Virtual Reality (VR) – in their application to cultural heritage. The growing intersection of different fields that study this topic, such as marketing, tourism, education, and human-computer interaction, has

[65] Cheng *et al.* 2024.
[66] Wen *et al.* 2023.
[67] Wang *et al.* 2023.
[68] T.H. Jung *et al.* 2018; X.-Z. Li *et al.* 2022; Pratisto *et al.* 2023; Wen *et al.* 2023.
[69] T.H. Jung *et al.* 2018.

posed challenges to maintaining a structured and systematic approach to the literature.

The analysis provided a comprehensive overview of the state of the literature in the last ten years, highlighting the growing interest in studying the experiential aspects of these technologies applied to cultural heritage. Four major research themes emerge from this study. The first one is about the impact on cultural heritage tourism where immersive technologies serve as tools for enhancing visitor engagement and satisfaction, and the perceived experience by visitors. The second one focuses on the effects of the consumption of these technologies on future behavioral intentions, including repeat visits, willingness to pay, and financial support for heritage preservation. The third one is the educational theme in which it emerges how immersive technologies are not only a hedonic but also a utilitarian tool for educational purposes and significantly contribute to learning processes in cultural heritage contexts, improving cognitive engagement, knowledge retention, and experiential learning. The fourth and final theme is related to the technological acceptance and user adoption of Extended Reality in cultural heritage, depending on factors such as perceived usefulness, ease of use, and social influence.

Several future research directions emerge. A key aspect that has yet to be explored is how Extended Reality technologies integrate into cultural consumption habits over time. As these technologies redefine the ways in which individuals engage with cultural heritage, it becomes critical to investigate whether these digital experiences complement or replace traditional forms of cultural participation. The extent to which Extended Reality technologies shape visitors' expectations and influence long-term engagement with cultural heritage sites requires further investigation. Indeed, the study by NESTA and i2 Media Research[70] – in which participants participated in two Virtual Reality experiences but with random order of administration – shows that the first Virtual Reality experience has higher values, while the ratings of that same experience when viewed second in the trial order were consistently (and in most cases significantly) lower. This could be because the first few times one consumes these technologies, one tends to characterize them positively due to a hype or novelty situation, but in the long run, they might have lesser effects. Understanding how these technologies can be effectively embedded in existing cultural consumption practices, rather than being perceived as temporary attractions or disruptive elements, will be essential for their sustainable adoption.

Another important consideration is that Extended Reality technologies have the potential to promote more sustainable tourism patterns, mitigating problems such as overtourism, resource depletion, and environmental impacts.

[70] NESTA, i2 Media Research 2018.

Virtual Reality-mediated heritage experiences, for example, can be an alternative to physical visits in cases where site preservation is an issue, allowing users to explore fragile or limited-access places without contributing to their degradation, but also allowing people to visit without actually moving, thus reducing pressure on overburdened heritage destinations. A crucial factor in this shift is visitor attitudes toward digital experiences as a substitute for or enhancement of physical visits. While some studies suggest that immersive technologies may reduce the perceived need for in-person experiences, e.g. Deng *et al.*[71], others emphasize their potential to generate interest and increase visitation rates[72]. Therefore, the subject remains to be investigated, especially the need to investigate the environmental impact of the production and use of these technologies also emerges[73].

A managerial key aspect is that although Extended Reality technologies offer significant potential to enrich cultural heritage experiences and develop new business models, their successful implementation requires a strategic and context-sensitive approach. Cultural heritage institutions must critically evaluate how these technologies align with their broader educational, preservation, and public engagement goals, ensuring that digital innovation serves as an enhancement rather than a superficial or disruptive element. In short, their success depends on thoughtful implementation that takes into account cultural contexts, user needs, and the specific goals of cultural sites.

In conclusion, while these technologies present transformative opportunities for cultural heritage accessibility, engagement, and valorization, their successful integration hinges on a strategic, user-centered approach that considers cultural contexts, visitor expectations, and institutional goals. Future research should continue to explore the long-term implications of immersive technologies in reshaping cultural experiences.

5. *Limitations*

While this study provides an overview of the literature on immersive technologies in the cultural heritage experience, several limitations should be acknowledged. First, the analysis relied exclusively on the Web of Science Core Collection database. Although this source has long been the most comprehensive citation data source worldwide[74], the exclusion of other databases such as Scopus or Google Scholar may have limited the breadth of the retrieved

[71] Deng *et al.* 2019.
[72] Bae *et al.* 2020; Chung *et al.* 2015.
[73] Novelab *et al.* 2024.
[74] Öztürk *et al.* 2024.

corpus. This choice, however, was driven by the need for compatibility with the bibliometric tool VOSviewer. Future research may benefit from a multi-database approach to ensure broader coverage.

Second, the final dataset includes 50 articles, a relatively small number for traditional large-scale bibliometric studies. Despite the limited number of documents, the bibliometric approach was chosen because it allows for structured, replicable, and quantitative insights into the intellectual and thematic structure of the field. In research topics where the literature is still emerging or highly specific – as in this case – bibliometric analysis can offer valuable perspectives, especially when combined with science mapping techniques that reveal patterns of collaboration and thematic clustering. The decision to proceed with a bibliometric approach, even with a focused corpus, was driven by the objective of mapping the conceptual and intellectual structure of a thematically coherent and emerging field.

References / Riferimenti bibliografici

Bae S., Jung T.H., Moorhouse N., Suh M., Kwon O. (2020), *The Influence of Mixed Reality on Satisfaction and Brand Loyalty in Cultural Heritage Attractions: A Brand Equity Perspective*, «Sustainability», 12, n. 7, 2956, <https://doi.org/10.3390/su12072956>.

Bakhshi H., Throsby C.D. (2010), *Culture of innovation: An economic analysis of innovation in arts and cultural organisations*, Research report, London: National Endowment for Science, Technology and the Arts (NESTA).

Beck J., Rainoldi M., Egger R. (2019), *Virtual Reality in tourism: A state-of-the-art review*, «Tourism Review», 74, n. 3, pp. 586-612, <https://doi.org/10.1108/TR-03-2017-0049>.

Bekele M.K., Pierdicca R., Frontoni E., Malinverni E.S., Gain J. (2018), *A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage*, «Journal on Computing and Cultural Heritage», 11, n. 2, pp. 1-36, <https://doi.org/10.1145/3145534>.

Carrozzino M., Bergamasco M. (2010), *Beyond virtual museums: Experiencing immersive Virtual Reality in real museums*, «Journal of Cultural Heritage», 11, n. 4, pp. 452-458, <https://doi.org/10.1016/j.culher.2010.04.001>.

Cerquetti M., Sardanelli D., Ferrara C. (2024), *Measuring museum sustainability within the framework of institutional theory: A dictionary-based content analysis of French and British National Museums' annual reports*, «Corporate Social Responsibility and Environmental Management», 31, n. 3, pp. 2260-2276, <https://doi.org/10.1002/csr.2689>.

Chang K.-E., Chang C.-T., Hou H.-T., Sung Y.-T., Chao H.-L., Lee C.-M. (2014), *Development and behavioral pattern analysis of a mobile guide sys-*

tem with Augmented Reality for painting appreciation instruction in an art museum, «Computers & Education», n. 71, pp. 185-197, <https://doi.org/10.1016/j.compedu.2013.09.022>.

Cheng A., Ma D., Pan Y., Qian H. (2024), *Enhancing Museum Visiting Experience: Investigating the Relationships Between Augmented Reality Quality, Immersion, and TAM Using PLS-SEM*, «International Journal of Human–Computer Interaction», 40, n. 17, pp. 4521-4532, <https://doi.org/10.1080/10447318.2023.2227832>.

Ch'ng E., Cai S., Leow F.-T., Zhang T.E. (2019), *Adoption and use of emerging cultural technologies in China's museums*, «Journal of Cultural Heritage», n. 37, pp. 170-180, <https://doi.org/10.1016/j.culher.2018.11.016>.

Chung N., Han H., Joun Y. (2015), *Tourists' intention to visit a destination: The role of Augmented Reality (AR) application for a heritage site*, «Computers in Human Behavior», n. 50, pp. 588-599, <https://doi.org/10.1016/j.chb.2015.02.068>.

Chung N., Lee H., Kim J.-Y., Koo C. (2018), *The Role of Augmented Reality for Experience-Influenced Environments: The Case of Cultural Heritage Tourism in Korea*, «Journal of Travel Research», 57, n. 5, pp. 627-643, <https://doi.org/10.1177/0047287517708255>.

Davis F.D. (1989), *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology*, «MIS Quarterly», 13, n. 3, pp. 319-340, <https://doi.org/10.2307/249008>.

Deng X., Unnava H.R., Lee H. (2019), *"Too true to be good?" when Virtual Reality decreases interest in actual reality*, «Journal of Business Research», n. 100, pp. 561-570, <https://doi.org/10.1016/j.jbusres.2018.11.008>.

Donthu N., Kumar S., Mukherjee D., Pandey N., Lim W.M. (2021), *How to conduct a bibliometric analysis: An overview and guidelines*, «Journal of Business Research», n. 133, pp. 285-296, <https://doi.org/10.1016/j.jbusres.2021.04.070>.

EMISSIVE (2024), *Virtual Reality and cultural venues: A winning combination*, Whitepaper, <https://www.emissive.fr/fr/downloads/>, 20.03.2024.

Errichiello L., Micera R., Atzeni M., Del Chiappa G. (2019), *Exploring the implications of wearable Virtual Reality technology for museum visitors' experience: A cluster analysis*, «International Journal of Tourism Research», 21, n. 5, pp. 590-605, <https://doi.org/10.1002/jtr.2283>.

Fast-Berglund Å., Gong L., Li D. (2018), *Testing and validating Extended Reality (xR) technologies in manufacturing*, «Procedia Manufacturing», n. 25, pp. 31-38, <https://doi.org/10.1016/j.promfg.2018.06.054>.

Gans J., Nagaraj A. (2023), *The Economics of Augmented and Virtual Reality*, arXiv:2305.16872, <https://doi.org/10.48550/arXiv.2305.16872>, 09.02.2024.

Golinelli G.M. (2015), *Cultural Heritage and Value Creation: Towards New Pathways*, Cham: Springer, <https://doi.org/10.1007/978-3-319-08527-2>.

González-Rodríguez M.R., Díaz-Fernández M.C., Pino-Mejías M.Á. (2020), *The impact of Virtual Reality technology on tourists' experience: A textual data analysis*, «Soft Computing», 24, n. 18, pp. 13879-13892, <https://doi.org/10.1007/s00500-020-04883-y>.

Han S., Yoon J.-H., Kwon J. (2021), *Impact of Experiential Value of Augmented Reality: The Context of Heritage Tourism*, «Sustainability», 13, n. 8, 4147, <https://doi.org/10.3390/su13084147>.

He Z., Wu L., Li X. (2018), *When art meets tech: The role of Augmented Reality in enhancing museum experiences and purchase intentions*, «Tourism Management», n. 68, pp. 127-139, <https://doi.org/10.1016/j.tourman.2018.03.003>.

Hwang K., tom Dieck M.C., Jung T., Kwon O. (2023), *The influence of Virtual Reality on the experience of religious cultural heritage content*, «Internet Research», <https://doi.org/10.1108/INTR-08-2022-0669>.

ICOM France (2023), *Les musées face à leurs responsabilités sociales et environnementales: Vers un modèle éthique et durable*, Publication on online debates, <https://bit.ly/4bdJ4xW>, 18.08.2024.

Jiang S., Moyle B., Yung R., Tao L., Scott N. (2023), *Augmented Reality and the enhancement of memorable tourism experiences at heritage sites*, «Current Issues in Tourism», 26, n. 2, pp. 242-257, <https://doi.org/10.1080/13683500.2022.2026303>.

Jung T.H., Lee H., Chung N., tom Dieck M.C. (2018), *Cross-cultural differences in adopting mobile Augmented Reality at cultural heritage tourism sites*, «International Journal of Contemporary Hospitality Management», 30, n. 3, pp. 1621-1645, <https://doi.org/10.1108/IJCHM-02-2017-0084>.

Jung T., tom Dieck M.C., Lee H., Chung N. (2020), *Moderating Role of Long-Term Orientation on Augmented Reality Adoption*, «International Journal of Human–Computer Interaction», 36, n. 3, pp. 239-250, <https://doi.org/10.1080/10447318.2019.1630933>.

Lazzeretti L., Capone F., Innocenti N. (2018), *The rise of cultural and creative industries in creative economy research: A bibliometric analysis*, in *Creative Industries and Entrepreneurship*, edited by L. Lazzeretti, M. Vecco, Cheltenham: Edward Elgar Publishing, <https://doi.org/10.4337/9781786435927.00007>.

Leopardi A., Ceccacci S., Mengoni M., Naspetti S., Gambelli D., Ozturk E., Zanoli R. (2021), *X-reality technologies for museums: A comparative evaluation based on presence and visitors experience through user studies*, «Journal of Cultural Heritage», n. 47, pp. 188-198, <https://doi.org/10.1016/j.culher.2020.10.005>.

Li J., Wider W., Ochiai Y., Fauzi M.A. (2023), *A bibliometric analysis of immersive technology in museum exhibitions: Exploring user experience*, «Frontiers in Virtual Reality», n. 4, 1240562, <https://doi.org/10.3389/frvir.2023.1240562>.

Li X.-Z., Chen C.-C., Kang X., Kang J. (2022), *Research on Relevant Dimensions of Tourism Experience of Intangible Cultural Heritage Lantern Festival: Integrating Generic Learning Outcomes with the Technology Acceptance Model*, «Frontiers in Psychology», n. 13, 943277, <https://doi.org/10.3389/fpsyg.2022.943277>.

Lo Turco M., Giovannini E.C. (2020), *Towards a phygital heritage approach for museum collection*, «Journal of Archaeological Science: Reports», n. 34, 102639, <https://doi.org/10.1016/j.jasrep.2020.102639>.

Marasco A., Buonincontri P., van Niekerk M., Orlowski M., Okumus F. (2018), *Exploring the role of next-generation virtual technologies in destination marketing*, «Journal of Destination Marketing & Management», n. 9, pp. 138-148, <https://doi.org/10.1016/j.jdmm.2017.12.002>.

Mayer R.E. (2005), *The Cambridge Handbook of Multimedia Learning*, Cambridge: Cambridge University Press.

Milgram P., Takemura H., Utsumi A., Kishino F. (1995), *Augmented Reality: A class of displays on the reality-virtuality continuum*, Proceedings Volume 2351, Telemanipulator and Telepresence Technologies, Boston, MA, <https://doi.org/10.1117/12.197321>.

Moher D., Liberati A., Tetzlaff J., Altman D.G., The PRISMA Group (2009), *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement*, «PLoS Medicine», 6, n. 7, e1000097, <https://doi.org/10.1371/journal.pmed.1000097>.

Montella M. (2009), *Valore e valorizzazione del patrimonio culturale storico*, Milano: Electa.

Moorhouse N., tom Dieck M.C., Jung T. (2019), *An experiential view to children learning in museums with Augmented Reality*, «Museum Management and Curatorship», 34, n. 4, pp. 402-418, <https://doi.org/10.1080/09647775.2019.1578991>.

Museum Booster (2021), *Museum Innovation Barometer*, Report, <https://www.museumbooster.com/mib>, 23.02.2025.

Nechita F., Rezeanu C.-I. (2019), *Augmenting Museum Communication Services to Create Young Audiences*, «Sustainability», 11, n. 20, 5830, <https://doi.org/10.3390/su11205830>.

NESTA, i2 Media Research (2018), *Evaluating Immersive User Experience and Audience Impact*, Research Report, <https://iuk.immersivetechnetwork.org/wp-content/uploads/2018/07/Evaluating_Immersive_User_Experience_and_Audience_Impact.pdf>, 12.11.2024.

Novelab, Tiny Planets, Coopérative Carbone (2024), *Cas d'Étude pour un Immersif Responsable*, <https://drive.google.com/file/d/1uKPE_kbqiCEzeOQmRtuLSELEfn7mXSOG/view>, 05.03.2024.

Olya H., Jung T.H., tom Dieck M.C., Ryu K. (2020), *Engaging visitors of science festivals using Augmented Reality: Asymmetrical modelling*, «International Journal of Contemporary Hospitality Management», 32, n. 2, pp. 769-796, <https://doi.org/10.1108/IJCHM-10-2018-0820>.

Öztürk O., Kocaman R., Kanbach D.K. (2024), *How to design bibliometric research: An overview and a framework proposal*, «Review of Managerial Science», 18, n. 11, pp. 3333-3361, <https://doi.org/10.1007/s11846-024-00738-0>.

Pine B.J., Gilmore J.H. (1998), *Welcome to the experience economy*, «Harvard Business Review», 76, n. 4, pp. 97-105.

Pine B.J., Gilmore J.H. (1999), *The experience economy: Work is theatre & every business a stage*, Brighton, Massachusetts: Harvard Business School Press.

Pioletti A.M. (2024), *Narrare il patrimonio locale valdostano: il progetto media*, «Il capitale culturale. *Studies on the Value of Cultural Heritage*», n. 29, <https://doi.org/10.13138/2039-2362/3291>.

Potts J. (2014), *New Technologies and Cultural Consumption*, in *Handbook of the Economics of Art and Culture* (vol. 2), edited by V.A. Ginsburgh, D. Throsby, Amsterdam: Elsevier, vol. 2, pp. 215-231, <https://doi.org/10.1016/B978-0-444-53776-8.00009-X>.

Poulopoulos V., Wallace M. (2022), *Digital Technologies and the Role of Data in Cultural Heritage: The Past, the Present, and the Future*, «Big Data and Cognitive Computing», 6, n. 3, 73, <https://doi.org/10.3390/bdcc6030073>.

Pratisto E.H., Thompson N., Potdar V. (2023), *Virtual Reality at a Prehistoric Museum: Exploring the Influence of System Quality and Personality on User Intentions*, «Journal on Computing and Cultural Heritage», 16, n. 2, pp. 1-19, <https://doi.org/10.1145/3585425>.

Schofield G., Beale G., Beale N., Fell M., Hadley D., Hook J., Murphy D., Richards J., Thresh L. (2018), *Viking VR: Designing a Virtual Reality Experience for a Museum*, in *Proceedings of the 2018 Designing Interactive Systems Conference*, pp. 805-815, <https://doi.org/10.1145/3196709.3196714>.

Silva M., Teixeira L. (2022), *Extended Reality (XR) Experiences in Museums for Cultural Heritage: A Systematic Review*, in *Intelligent Technologies for Interactive Entertainment*, edited by Z. Lv, H. Song, Cham: Springer, vol. 429, pp. 58-79, <https://doi.org/10.1007/978-3-030-99188-3_5>.

Sommerauer P., Müller O. (2014), *Augmented Reality in informal learning environments: A field experiment in a mathematics exhibition*, «Computers & Education», n. 79, pp. 59-68; <https://doi.org/10.1016/j.compedu.2014.07.013>.

tom Dieck M.C., Jung T.H. (2017), *Value of Augmented Reality at cultural heritage sites: A stakeholder approach*, «Journal of Destination Marketing & Management», 6, n. 2, pp. 110-117, <https://doi.org/10.1016/j.jdmm.2017.03.002>.

tom Dieck M.C., Jung T.H., tom Dieck D. (2018), *Enhancing art gallery visitors' learning experience using wearable Augmented Reality: Generic learning outcomes perspective*, «Current Issues in Tourism», 21, n. 17, pp. 2014-2034, <https://doi.org/10.1080/13683500.2016.1224818>.

Valeri A. (2018), *Millennials e cultura nell'era digitale: Consumi e progettualità culturale tra presente e futuro*, Venezia: Marsilio.

Venkatesh V., Morris M.G., Davis G.B., Davis F.D. (2003), *User Acceptance of Information Technology: Toward a Unified View*, «MIS Quarterly», 27, n. 3, pp. 425-478, <https://doi.org/10.2307/30036540>.

Venkatesh V., Thong J.Y.L., Xu X. (2012), *Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology*, «MIS Quarterly», 36, n. 1, pp. 157-178, <https://doi.org/10.2307/41410412>.

Wang J., Sun Y., Zhang L., Zhang S., Feng L., Morrison A.M. (2023), *Effect of Display Methods on Intentions to Use Virtual Reality in Museum Tourism*, «Journal of Travel Research», 63, n. 2, pp. 314-334, <https://doi.org/10.1177/00472875231164987>.

Wen X., Sotiriadis M., Shen S. (2023), *Determining the Key Drivers for the Acceptance and Usage of AR and VR in Cultural Heritage Monuments*, «Sustainability», 15, n. 5, Article 5, <https://doi.org/10.3390/su15054146>.

Zhou Y., Chen J., Wang M. (2022), *A meta-analytic review on incorporating virtual and Augmented Reality in museum learning*, «Educational Research Review», n. 36, 100454, <https://doi.org/10.1016/j.edurev.2022.100454>.

Zhu C., Io M.-U., Ngan H.F.B., Peralta R.L. (2023), *Understanding Augmented Reality marketing in world cultural heritage site, the lens of authenticity perspective*, «Journal of Vacation Marketing», 29, n. 2, pp. 242-255, <https://doi.org/10.1177/13567667221090990>.

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