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SDG-Related Development in Digital Heritage Tourism: A bibliometric analysis

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Abstract

Digital has been shown to enhance heritage tourism by offering new experiences to visitors. This research aims to examine the evolution of digital heritage tourism through the lens of the Sustainable Development Goals (SDGs). A thorough literature review was conducted examining key publications from Scopus and WoS using relevant keywords. The review showed that the pillars of IR4.0 have a significant impact on the progress of digital heritage tourism towards achieving the relevant SDGs, i.e., by improving digital performance. This study subsequently offers insights and recommendations for the industry and policymakers to better support the achievement of the SDG targets.

Keywords: Development; Digitalization; Heritage Tourism; Sustainable Development Goals (SDGs).

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1.0 Introduction

Tourism is a complex and expanding industry, becoming one of the most significant sources of revenue across the world. As the tourist sector opens numerous job possibilities, it is a major contributor to the GDP of a country (Manzoor et al., 2019). The Department of Statistics Malaysia (DOSM) reported that tourism earned RM197.9 billion "gross value-added of tourism industries" (GVATI) in 2021 (Bernama, 2022). Meanwhile, heritage tourism contributes to the current maintenance and preservation of buildings, artefacts, and heritage sites (Cuomo et al., 2021). Historical or heritage tourism refers to travel focusing on learning about a place's history and heritage which includes exploring renowned historical structures, sampling authentic historical dishes at traditional venues, and exploring local museums that preserve the past through relics, artwork, and cultural elements (Boboc et al., 2022). The process of heritage tourism can range from straightforward to intricate. Additionally, history lovers occasionally mix their passion with shopping, amusement parks, and luxurious resort stays (Manrai et al., 2020). Thus, tourist destinations with rich traditions and excellent infrastructure must accommodate all types of visitors.

Today, digital technology is becoming increasingly prevalent in the tourism sector, and research into digital heritage tourism has expanded from various angles. The sophistication of digital tools is advancing, particularly in marketing within the tourism industry,

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offering travellers new and exclusive experiences (Pencarelli, 2020). These technologies facilitate the rapid dissemination of information and help travellers manage their trips more effectively. Digital innovations have also made significant inroads in heritage tourism. Now, technologies such as Artificial Intelligence, 3D modelling, Virtual Reality (VR), and Augmented Reality (AR) can create virtual presentations of monuments and ancient artefacts (Anastasiadou & Vettese, 2019; Boboc et al., 2022; Graziano & Privitera, 2020; Paliokas et al., 2020; Poux et al., 2020). These advancements allow travellers to explore natural landscapes, destinations, ruins, attractions, and architectural sites without needing to visit them physically (Hajirasouli et al., 2021).

As each technology offers its unique capabilities and attributes, it is vital for the heritage tourism industry to ensure that its digitalisation efforts promote sustainable development effectively (Ali, 2024). Therefore, this study aims to examine the evolution of digital heritage tourism through the lens of the Sustainable Development Goals (SDGs). Through a comprehensive bibliometric analysis of relevant publications indexed in Scopus and Web of Science, the study seeks to identify key research trends, emerging technologies, and their impact on advancing sustainability within heritage tourism. By analyzing citation patterns, co-citation networks, and keyword distributions, this paper aims to offer insights into the evolution of digital heritage tourism and its contributions to achieving SDG targets, particularly in relation to cultural preservation, environmental sustainability, and socio-economic development.

2.0 Literature Review

Bibliometric analysis has been increasingly utilised to assess and visualise research trends in various academic fields. In the context of digital heritage tourism and its intersection with the Sustainable Development Goals (SDGs), bibliometric methods offer valuable insights into how research is shaping the development and implementation of sustainable practices in heritage tourism (Zhang et al., 2023; Lian & Xie, 2024; Geçikli et al., 2024). This review examined the usage of bibliometric analysis and explored the alignment between cultural heritage tourism and SDG-related development.

Consequently, this paper applied bibliometric analysis to evaluate the trend, co-citation analysis, bibliographic coupling, and co-authorship analysis of research on the integration of digital technologies in heritage tourism and their alignment with the SDGs. The analysis of publication trends and citation patterns can reveal the evolution of digital heritage tourism in meeting the SDG objectives. Tools like VOSviewer and Publish or Perish were employed to visualise these trends and identify emerging research areas (Ariyanto, 2023). Bibliometric methods assessed the contributions of different institutions and regions to digital heritage tourism research and their impact on SDG-related development.

3.0 Methodology

This research employed a comprehensive literature review of existing studies to explore the intersection of technology, heritage tourism, and Sustainable Development Goals (SDGs). Scopus and Web of Science (WoS) were selected as data sources for this bibliometric analysis because they offer comprehensive and high-quality coverage of peer-reviewed literature, particularly in interdisciplinary fields like sustainable development and digital heritage tourism. Their rigorous indexing criteria ensure that the research analyzed is credible, relevant, and globally recognized—aligning with the academic standards expected for SDG-related studies. We conducted a thorough search and examination of relevant journals using carefully selected keywords on technology, heritage tourism, and SDGs. The literature review process is structured into several stages, which are outlined in Figure 1. Following Fig. 1, Table 1 explains the research strings employed in this study.

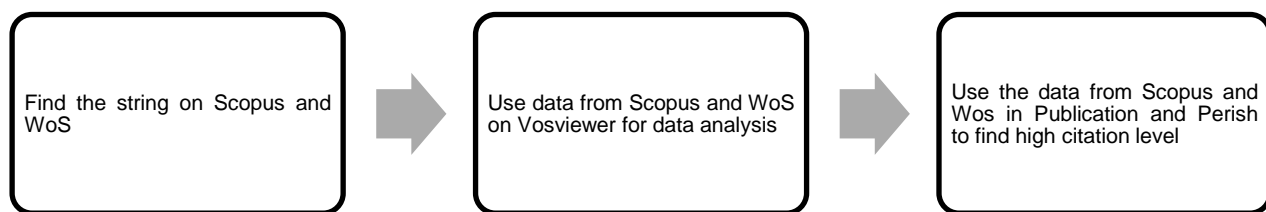


Fig. 1: Stages of Research Methodology
(Source: Researcher own)

Table 1. Research strings

Sources	Without SDG's	SDG's	Data Inclusion
Scopus	("Digital" OR "Technology" OR "Innovation") AND ("Heritage" OR "Cultural" OR "Spiritual") AND ("Tourism")	("Digital" OR "Technology" OR "Innovation") AND ("Heritage" OR "Cultural" OR "Spiritual") AND ("Tourism") AND ("SDG" OR "Sustainable Development Goals")	Research from 2014-2024
WoS	ALL= (("Digital" OR "Technology" OR "Innovation") AND ("Heritage" OR "Cultural" OR "Spiritual") AND ("Tourism"))	ALL= (("Digital" OR "Technology" OR "Innovation") AND ("Heritage" OR "Cultural" OR "Spiritual") AND ("Tourism") AND ("SDG" OR "Sustainable Development Goals"))	

(Source: Researcher own)

4.0 Findings

4.1 Previous Research in Digital Heritage Tourism

A thorough literature review highlights the development of heritage tourism that encompasses a diverse range of fields and topics. The studies summarised in Table 2 indicate that digitalisation is a prominent and frequently addressed aspect within this domain. Notably, areas such as the performance of heritage tourism through digital means, the application of big data, and the use of technologies like augmented reality, virtual reality, websites, applications, 3D modelling, chatbots, and the metaverse are prominent. These aspects were frequently cited and examined in the literature, reflecting their significant role in advancing the field of heritage tourism through digital innovations.

Table 2. Publication of top-cited papers

Author	Year	Finding	Publication	Cited
Cuomo et al.	2021	The analysis concentrated on user-generated content about the Pompeii Archaeological Site (P.A.S.) to gather critical insights for the tourist experience enhancement.	Technological Forecasting and Social Change	89
Boboc et al.	2022	The findings identified eight key areas of augmented reality technology application to cultural heritage: 3D reconstruction of artefacts, digital heritage, virtual museums, user experience, education, tourism, intangible cultural heritage, and gamification.	Applied Sciences (Switzerland)	75
Poux et al.	2020	This paper explored new ways to interact with these high-quality 3D reconstructions in real-world contexts. It utilises a user-centred design approach to develop a virtual reality (VR) application with multi-modal capabilities.	Remote Sensing	64
Pierdicca et al.	2019	Explored how "La Valle del Pensare" contributed to defining the region's identity and viewed it not merely as a collection of municipalities but as a distinct system. This system aims to boost competitiveness by developing a regional logo that highlights the unique characteristics and specialisations of the Valley of the Potenza.	Journal of Hospitality and Tourism Technology	64
Paliokas et al.	2020	The key findings suggested that improved AR experiences in museum environments can effectively align with users' surroundings, physical and perceptual abilities, familiar metaphors, and their position and movement within 3D space.	Applied Sciences (Switzerland)	59
Van Der Zee et al.	2020	This paper illustrated how Destination Management Organizations (DMOs) can capitalise on the Web 2.0 revolution, which provides a crucial source of user-generated information and opens up new possibilities for data-driven destination management.	Current Issues in Tourism	59
Anastasiadou & Vettese	2019	The findings reveal a growing interest in using new technologies to design and personalised souvenirs. However, some intellectual and ethical challenges needed to be addressed. The study suggested that 3D-printed souvenirs represent a new category and proposed a future research agenda to explore the technological implications for tourist consumption.	Tourism Management	56
Casillo et al.	2020	This paper presented a recommender system designed to create adaptive tourist routes. The system proposes points of interest and associated services based on the tourist's profile and contextual factors.	Pattern Recognition Letters	51
Zhang et al.	2022	This paper presented a foundational framework for creating a cultural heritage metaverse. The study also detailed key elements necessary for designing a metaverse focused on cultural heritage. Efforts were directed towards using this metaverse concept for the conservation and protection of cultural heritage. This study could have a significant impact on the digitalisation of cultural heritage.	Electronics (Switzerland)	45
Graziano & Privitera	2020	The findings indicated that augmented reality (AR) in Syracuse remains in the early stages of development. It faced technical challenges that needed to be addressed before it could be fully adopted. Additionally, the results emphasised the importance of involving potential stakeholders early during the development and implementation of wearable AR applications in heritage settings.	Journal of Heritage Tourism	39

(Source: Researcher own)

4.2 Digital Heritage Tourism

A bibliometric analysis was conducted on articles indexed in the Scopus and Web of Science databases to identify common trends and variables in research related to the performance and development of heritage tourism. This study utilised the keyword strings detailed in Table 1 to systematically explore how often topics related to the impact of digitalisation on heritage tourism are discussed. The results of the bibliometric analysis using the Scopus. By examining these keywords, recurring themes and patterns in the literature regarding the integration of digital technologies and their role in advancing both heritage tourism and sustainability objectives could be uncovered.

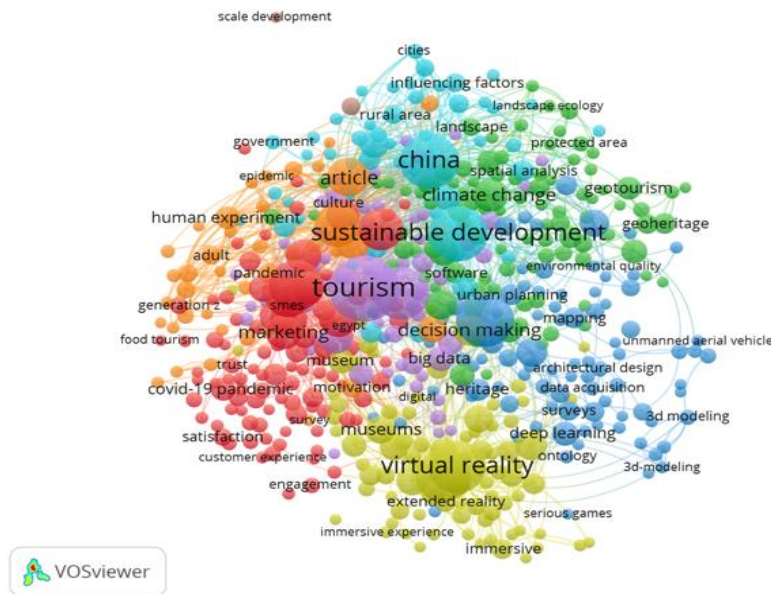


Fig. 2: Factors in Digital Heritage Tourism Research (Scopus)
(Source: Researcher own)

An analysis of keyword distribution and trends in the Scopus database identified several prominent keywords, including COVID-19, ecotourism, heritage tourism, internet, marketing, perception, social media, tourism development, tourism management, tourism market, tourist behaviour, tourist destination, climate change, ecology, environmental protection, forestry, land use, sustainable tourism, and world heritage site. Additionally, previous research often emphasised keywords such as cultural heritage, geographic information systems, historic preservation, smart city, urban area, urban development, urban growth, urban planning, sustainable development, and virtual reality. Meanwhile, from the analysis based on the Web of Science, the top keywords are Conservation, Cultural Heritage, Sustainability, Tourism, Augmented Reality, Education, Impact, Model Management, and Sustainable Tourism (Refer to Fig. 3).

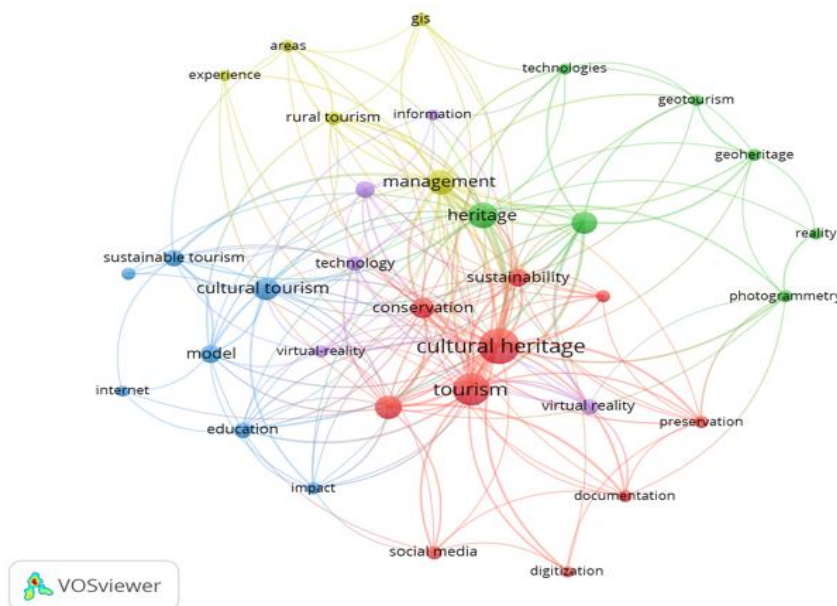


Fig. 3: Factors in Digital Heritage Tourism Research (Web of Science)
(Source: Researcher own)

4.3 SDGs in Digital Heritage Tourism

Then, the analysis focused on how digitalisation is linked to Sustainable Development Goals (SDGs) within the context of digital heritage tourism.

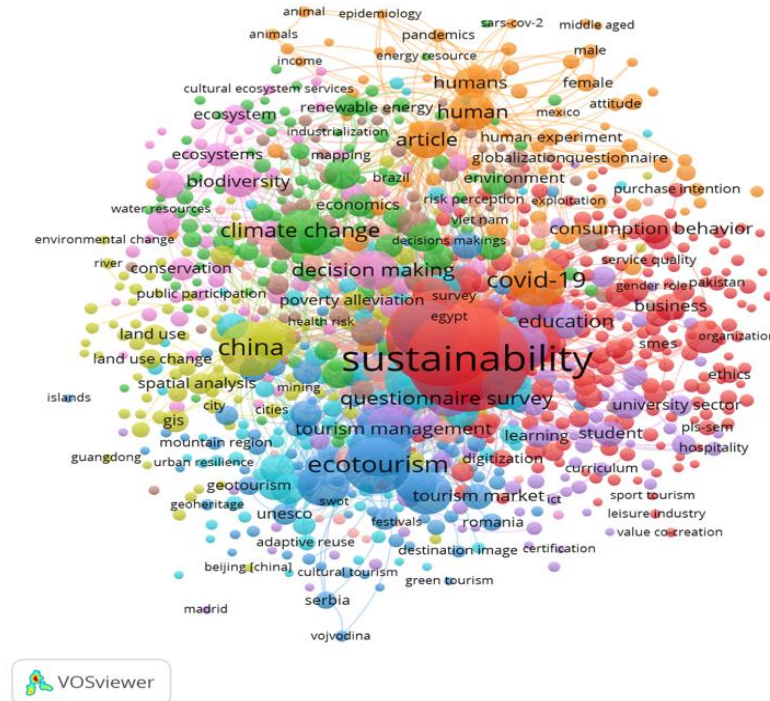


Fig. 4: SDG Factors in Digital Heritage Tourism Research (Scopus)
(Source: Researcher own)

The findings from the bibliometric analysis utilising the Scopus database reveal connections between SDGs and variables influencing the development of digital heritage tourism. Most previous studies emphasise that sustainability is essential for digital heritage tourism. These results are further supported by identifying other significant variables, including ecotourism, consumption behaviour, and tourism management. The more recent studies on the performance of digital heritage tourism focused a great deal on green tourism, ecosystem, urban resilience, and service quality as observed factors.

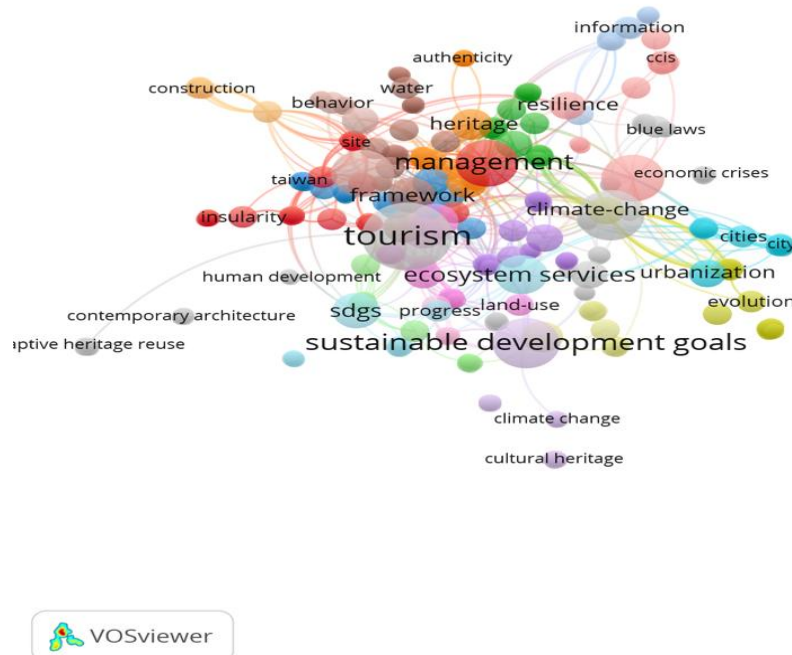


Fig. 5: SDG Factors in Digital Heritage Tourism Research (Web of Science)
(Source: Researcher own)

In terms of the Web of Science, regarding the connections between Sustainable Development Goals (SDGs) and the digital heritage tourism industry, a range of factors have been commonly addressed. These factors include climate change, evolutionary trends, blue

laws, human development, management practices, resilience, information systems, economic crises, ecosystem services, urbanisation, and authenticity. However, recent studies have increasingly delved into more detailed aspects, such as digital behaviour and advancements in the field. This shift in focus reflects a growing interest in understanding how digital interactions and technological progress impact the development and sustainability of heritage tourism.

5.0 Discussion

5.1 Keyword Trends and Common Variables

The keyword analysis conducted using Scopus and Web of Science highlighted a broad spectrum of research topics within the realm of digital heritage tourism. Prominent keywords identified in the Scopus database include "COVID-19", "ecotourism", "social media", and "sustainable tourism". These terms reflect current research interests that span from the impacts of global events (e.g., the pandemic) on tourism to the integration of digital tools for managing and marketing heritage sites. Additionally, the emphasis on "cultural heritage", "smart city", and "virtual reality" in previous studies further indicated a growing interest in how technological advancements and urban development are shaping heritage tourism.

Similarly, keywords from the Web of Science database, such as "Conservation", "Cultural Heritage", and "Augmented Reality", underscored the focus on the preservation and enhancement of heritage sites through digital means. Terms like "Impact" and "Model Management" suggested a trend towards understanding the effectiveness of digital interventions and management strategies in heritage tourism.

5.2 Linkages to Sustainable Development Goals (SDGs)

The analysis revealed a strong connection between digital heritage tourism and the SDGs, particularly through the lens of sustainability. According to the Scopus data, recent research increasingly emphasises "green tourism", "ecosystem", and "urban resilience" as crucial factors. This focus aligns with the SDG targets related to sustainable cities and communities, climate action, and life on land. The emphasis on sustainability reflects a growing recognition of the need to balance tourism development with environmental protection and conservation efforts.

Meanwhile, the Web of Science data underscored factors such as "climate change", "human development", and "ecosystem services". This suggests that current research is not only addressing the direct impacts of digitalisation on heritage tourism but also exploring broader socio-economic and environmental contexts. The recent shift towards topics like "digital behaviour" and "advancements" indicated a deeper exploration of how digital technologies affect both the operational aspects of tourism and visitor experiences.

5.3 Emerging Research Areas and Shifts

The findings highlighted a shift towards more nuanced research areas, particularly in understanding how digital technologies influence heritage tourism sustainability. The increasing focus on "digital behaviour" and "advancements" suggests the need to investigate how emerging technologies impact tourist interactions and site management. This shift reflects broader trends in digital innovation and its implications for heritage tourism, suggesting a transition towards more sophisticated analyses on the role and effectiveness of digital tools in promoting sustainable practices.

5.4 Challenges and Opportunities

Apart from significant advancements and interests, the analysis also pointed to challenges in integrating digital technologies with sustainable tourism practices. To align digital innovations with sustainability goals, ongoing research and collaboration among stakeholders are needed. Issues such as the long-term impacts of digital tools on heritage preservation and the balance between technological advancements and authenticity were seen as areas for further investigation.

6.0 Conclusion & Recommendations

In conclusion, the bibliometric analysis provides a detailed understanding of current research trends in digital heritage tourism and its connection to the SDGs. The findings underscore the importance of sustainability and the impact of digital technologies on heritage tourism development. These findings highlight that the integration of digital technology not only enhances the visitor experience but also has the potential to strengthen the sustainability of heritage tourism by supporting cultural preservation and innovation. Based on the distribution of keywords, it is evident that the digitalisation of the heritage tourism industry is closely linked to SDG 9, i.e., the aim to build resilient infrastructure, promote sustainable industrialisation, and foster innovation.

Keywords such as sustainability, social media, virtual reality, artificial intelligence, 3D modelling, software, digital technologies, the internet, and GIS frequently appear in discussions related to this sector. As research into digital technologies continues to evolve, the heritage tourism industry needs to ensure that its digitalisation efforts effectively support sustainable development. Different economic and institutional settings show various methods, priorities, strategies, and levels of success in fulfilling the SDGs. Thus, further study is needed to propel the development of heritage tourism, pinpoint effective strategies, improve visitor experiences, and safeguard cultural heritage.

The in-depth analysis of keyword trends and their relationship with the Sustainable Development Goals (SDGs) in this study provides

valuable insights for researchers, practitioners, and policymakers seeking to enhance the role of digital technology in advancing sustainable cultural heritage tourism. This study gives a complete outline of what is known about the connection between digitalisation and cultural heritage tourism. It also points out areas that need more research, like how to use advanced technologies to protect cultural heritage and how to use digital technologies in the marketing strategies of heritage tourism destinations. By identifying key trends and gaps in digital heritage tourism research, this study establishes a link between its findings and the achievement of the SDGs. It provides valuable guidelines for researchers and practitioners to understand the importance of digitalisation in promoting sustainable cultural heritage tourism. Future studies are expected to leverage a broader literature database to yield more comprehensive and applicable findings. Furthermore, identifying SDG-related factors within the cultural heritage tourism industry could be developed into an empirical research model that offers strategic guidance for the cultural heritage tourism sector and other stakeholders, particularly concerning the three ESG criteria—Environmental, Social, and Governance—to formulate targeted strategies for addressing specific sustainability challenges and opportunities in this sector. By employing bibliometric analysis to explore research trends in digital heritage tourism, this study also contributes to the development of more innovative research methodologies, which other researchers could adopt to examine similar topics or explore new dimensions in sustainability tourism studies.

6.1 Limitation

This study offers meaningful insights into how digital heritage tourism aligns with the Sustainable Development Goals (SDGs), yet several limitations merit attention. The analysis, while robust, is limited to Scopus and Web of Science, possibly omitting region-specific or non-English works that could enrich the discourse, especially from emerging economies. The chosen keywords, although broad, may not fully reflect interdisciplinary contributions from fields like urban planning, environmental science, or anthropology that indirectly inform heritage tourism. In addition, the study excludes grey literature—such as industry reports and white papers—which often reveal practical challenges and opportunities in digital heritage management. The reliance on bibliometric methods also limits depth; qualitative approaches like expert interviews or case studies could provide richer context. Despite these constraints, the study establishes a foundational understanding of research trends at the nexus of digital heritage and sustainable development, guiding future inquiries and offering practical value to scholars, practitioners, and policymakers.

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Paper Contribution to Related Field of Study

The bibliometric analysis was performed in this study to assist researchers in locating previous scholars. It can serve as a literature review for digital heritage tourism research. The co-occurrence analysis highlights the importance of the development of digital heritage tourism in the relevance of using technology in heritage tourism to enhance the tourist experience via technology advancements.

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