



REVIEW ARTICLE



<https://doi.org/10.1057/s41599-023-02150-7>

OPEN

A ten-year review analysis of the impact of digitization on tourism development (2012–2022)

Chunyu Jiang ¹ & Seuk Wai Phoong ¹✉

Many tourism-related activities have been suspended due to the nationally enforced lockdown to combat the Coronavirus pandemic. The tourism industry suffered immensely from the lockdown, and as a result of this, digital tourism began gaining traction and attracted public attention. This study analyses the impact of digitalization on the social and economic sustainability of the tourism industry via systematic literature network analysis. The findings indicated that digitalization impacts economic sustainability, encompassing economic benefits in tourism product development, tourism consumption, and industrial development. Moreover, digitalization fosters social development, cultural awareness, and tourism participation in digital technology and cultural heritage. This study identified publication trends and research hotspots using bibliometric analysis, and it was confirmed that *Sustainability* was the top journal in published digital and tourism sustainability-related articles, followed by the *International Journal of Tourism Research*, *Tourism Management*, and *Current Issues in Tourism*. This study resulted in two implications: identifying the knowledge gap and evidence-based decision-making based on the (previous) literature. Recommendation for future research is also discussed in this study, which is helpful to policymakers, tourism planners, and researchers to develop strategies grounded in research.

Introduction

From 2019 through 2022, the Coronavirus disease 2019 (COVID-19) wreaked havoc on the world's tourism business (Navarro-Drazich and Lorenzo, 2021). Tourism contributes to many nations' gross domestic product (GDP) as it is intertwined with various industries (Gössling et al., 2017). Examples of tourism products include lodging options such as hotels and Airbnb. Food and drink, theme parks, museum visits, and fashion items such as clothes and bags are additional examples of tourism products that boost the economic health of the individual and the nation.

Tourism is regarded as a complex service-driven industry, one of the characteristics of which is that if external influences disrupt the tourism sector, other industries linked to it will also be directly affected. Tourism development refers to creating and maintaining the tourism industry in a particular location and is closely linked to economic and social progress (Telfer and Sharpley, 2015). Over the past four decades, global tourism development has reported intense growth performance and research on tourism development (Capocchi et al., 2019). Kreishan (2010) posited that the impact of tourism development on destination development is a

¹Department of Decision Science, Universiti Malaya, Kuala Lumpur, Malaysia. ✉email: phoongsw@um.edu.my

commonly discussed issue, particularly in terms of tourism development improving economic efficiency and local competitiveness. The growth of tourism currently is significant not only from an economic perspective but also from a social perspective, as evidenced by the optimization of the local social structure (Yang et al., 2021), increased community participation (W. Li, 2006), participation of women (Ferguson, 2011), and increased cultural awareness (Carbone, 2017). Also, the development of the tourism industry benefits the environment by increasing environmental protection awareness and providing greater funding for initiatives to conserve resources and the environment (Zhao and Li, 2018).

However, unmanaged over-tourism can cause serious harm, according to Berselli et al. (2022). From an economic standpoint, excessive tourism can result in higher prices and imbalanced industrial structure development, which lowers industries' overall resilience. Social issues arising from over-tourism include the commercialization of culture (Wang et al., 2019), the shift in locals' attitudes from friendliness to hostility towards tourists (Kim and Kang, 2020), and the emergence of on-stage authenticity (Taylor, 2001). In terms of the environment, issues such as excessive carbon emissions causing global warming (Liu et al., 2022), damage to water and soil resources, destruction to flora and fauna (Gössling and Hall, 2006), and even harm to cultural heritage (Zhang et al., 2015) are some of the effects of over-tourism. Since the development of the tourism industry combines economic, social, and cultural phenomena, as well as the past COVID-19 disruptions, the industry's suspension for several years presents a significant opportunity for all stakeholders to reposition tourism for sustainable development.

Some studies suggest the tourism industry will recover after COVID-19 (Zhong et al., 2021). However, given the above-mentioned problems caused by over-tourism, what needs to be considered is the sustainability of the tourism industry post-COVID-19. Researchers and tourism stakeholders are becoming more aware of the importance of the concept of sustainable development (Miceli et al., 2021), especially since COVID-19, as the tourism or hospitality industry remains one of the least developed sectors in terms of sustainable tourism practices (Kim and Park, 2017). Korstanje and George (2020) noted that over-tourism is a chronic disease that mere temporary changes cannot treat; it can be minimized via education and training to raise awareness. The tourism industry needs to rethink how to develop in a sustainable and healthy direction (Higgins-Desbiolles et al., 2019), not only in terms of ecotourism or green tourism but also in terms of putting the concept of sustainability into practice at a deeper level as it faces multiple pressures and challenges of an overarching environment, economy, and society.

Sustainability is often cited as one of the reasons for improved competitiveness among different tourism destinations (Han et al., 2019). The United Nations 2030 (UN, 2030) Agenda for Sustainable Development has developed a Sustainable Development Goals (SDGs) plan, defined as a set of global goals for fair and sustainable health at every level, from the planetary biosphere to the local community. The aim is to end poverty, protect the planet, and ensure that everyone enjoys peace and prosperity now and in the future. The basic concept is that productivity can be preserved for future generations. Due to the general emphasis of the United Nations World Tourism Organization (UNWTO) on sustainable tourism and the industry's economic importance, the SDGs and its associated millennium development goals (MDGs) have become critical elements for research into tourism's contribution to sustainable development and overall sustainability (Saarinen et al., 2011; Saarinen and Rogerson, 2014). Winter et al. (2020) indicated that as sustainable tourism development needs to take complete account of the combined social, economic, and

environmental impacts, stakeholders are expected to integrate scientific management and practice for future sustainability using updated and innovative technologies that can provide more tourism opportunities for groups unable to travel directly while enhancing environmentally-friendly behavior. Bramwell and Lane (2011) suggested that effective policy support is also crucial to implementing sustainable tourism development, as the path to sustainable development is guided and monitored by excellent and progressive policies. From a postmodernist perspective, social media and place brand authenticity in smart tourism are essential to place trust, place identity, and place brand image, while the development of this brand authenticity is one of the critical indicators of the visitor experience (Handayani and Korstanje, 2017). As a result, Korstanje et al. (2022) contended that new paradigms and strategies must be created to confront risks to tourism in the 21st century and satisfy the SDGs by 2030.

Several studies are underway to determine the impact of various programs and strategies on the environmental component of sustainability practices (Goralski and Tan, 2020). Yalina and Rozas (2020) suggested that a digital workplace can promote environmental sustainability. Although there have been studies on the digitalization of tourism and environmental sustainability, such as Loureiro and Nascimento (2021), who reviewed digital technology on the sustainability of tourism using bibliometric methods, there is a need for a thorough examination of the impact of digital transformation on sustainable tourism growth, particularly in terms of economic and social dimensions (Feroz et al., 2021). Therefore, the objective of this study is to review the impact of tourism digital technology development on the economic and social sustainability of tourism development to offer future research guidance.

With the growing literature and the emergence of cross-disciplinary research related to sustainability and digitalization in tourism development, it is critical to analyze the changes in its research, summarize the focus of previous research content, and predict future research prospects. As a result, this study will address the above research gaps by answering the following three questions.

RQ1: What are the prominent documents, authors, sources, organizations, and keywords in digitalization for the economic and social sustainability of tourism development?

RQ2: What are the linkages based on bibliographic coupling, co-authorship, co-occurrence, and citation in digitalization for the economic and social sustainability of tourism development?

RQ3: What is the future research agenda based on the results of this study?

Literature review

Several review papers on tourism research are now available and relevant to this study. Ülker et al. (2023) assumed that there are currently 136 bibliometric studies in the tourism and hospitality industry, of which the literature review studies on overall trends in the tourism and hospitality industry are continuously being updated (Chang and Katrichis, 2016; Wang et al., 2023). Also, economic development in the tourism industry (Comerio and Strozzi, 2019), tourism marketing (Mwinuka, 2017), tourism and education (Goh and King, 2020), hospitality (Manoharan and Singal, 2017), Airbnb (Andreu et al., 2020), and even COVID-19 review articles related to tourism development are available (Bhatia et al., 2022).

With the emergence of cross-disciplinary digital-related technologies, the link between tourism and digitalization has become one of the hot topics of research, and as a result, several literature review articles on digitalization and tourism have been published, such as on robotics (Buhalis and Cheng, 2020; Ivanov et al., 2019;

Pizam et al., 2022), ICT (Buhalis and Law, 2008; Law et al., 2014), big data (Li et al., 2018; Stylos et al., 2021), smart tourism (Buhalis, 2020; Mehraliyev et al., 2020), social media (Buhalis and Inversini, 2014; Mirzaalian and Halpenny, 2019), eye-tracking (Muñoz-Leiva et al., 2019; Scott et al., 2019), AI (Buhalis and Moldavska, 2022; Doborjeh et al., 2022; Dwivedi et al., 2023), VR (Koohang et al., 2023; Wei, 2019), AR (Jingen Liang and Elliot, 2021; Tschue and Buhalis, 2016; Yovcheva et al., 2012), MR (Buhalis and Karatay, 2022), and the Metaverse (Ahuja et al., 2023; Buhalis et al., 2022, 2023; Go and Kang, 2023).

Due to the rise of sustainability research, the literature review on sustainability research in tourism has seen a stark increase (León-Gómez et al., 2021; Ruhanen et al., 2018; Streimikiene et al., 2021). The proliferation of studies related to digitalization and sustainable tourism development has led to a considerable number of review articles (Elkhwesky et al., 2022; Gössling, 2017; Loureiro and Nascimento, 2021; Nascimento and Loureiro, 2022; Rahmadian et al., 2022). Feroz et al. (2021) conducted a literature study on the environmental aspects of tourism sustainability and digitalization; however, there is a distinct lack of studies on the economic and social dimensions.

Therefore, the study's unique value is that it presents the first literature review in the field of digitalization and social and tourism economic sustainability development using a novel method of systematic literature network analysis (SLNA), filling a gap in the literature review landscape and addressing the need for more comprehensive, detailed, and up-to-date research endeavor.

Methodology

Colicchia and Strozzi (2012) proposed a systematic literature review analysis (SLNA) to identify past research trends more sophisticatedly, integrated, and scientifically. This method is currently used in reviews of sustainable development research (Afeltra et al., 2021) but is rarely used in reviews of tourism sustainability; therefore, SLNA is used in this study.

Systematic literature review (SLR) and bibliographic network analysis (BNA) are the two phases of SLNA. These actions comprise the first phase of SLR, which includes choosing the study's final selection, conducting a dialectical examination of the most pertinent articles, and evaluating the results. Next, citation analysis and bibliographic coupling of BNA are also included in this paper to investigate the relationship between the previous literature, assess the research trends, and aid in uncovering future research innovation opportunities. Bibliographic coupling is a scientific mapping technique regarding two articles with a common citation contentedly comparable. This technique permits the segmentation of publications into thematic clusters utilizing published references to understand the most recent developments in current research issues (Donthu et al., 2021). Citation analysis reveals which papers are influential and their authors and journals and aids in comprehending what past literature has contributed (Pilkington and Meredith, 2009).

First phase: systematic literature review (SLR)

Introduction of SLR. The most widely used and reputable databases are the Web of Science (WOS) and Scopus (Garrigos-Simon et al., 2018); thus, both were used in this study to eliminate data search omissions, broaden the search scope, and improve the accuracy of data outputs.

Figure 1 shows the flow diagram for systematic bibliometric analysis. Firstly, this paper takes “virtual reality or augmented reality or artificial intelligence or big data or mobile technology or internet of technology or social platform technology) and

(sustainable tourism development or sustainability of tourism or green tourism or ecotourism” as keywords. The search process began by searching topics (including article titles, abstracts, and keywords). The language of the articles was set to English and had to be published between 2012 and 2022. The search process resulted in 91 articles. The data were extracted on February 15, 2022, per Fig. 2.

A review article with scholarly worth and contribution is required to describe the literature's links and contents and examine and critique it precisely (Hart, 2018). As seen in Fig. 3, the following research topics are divided into two categories: economic sustainability (which includes topics such as economic benefit, industry development, and tourist consumption) and social sustainability (which includes topics such as tourist behavior, social development, cultural awareness, and participation).

The SLRs are used to locate, appraise, and synthesize existing, completed, and documented work (Cocchia, 2014), facilitating classification and summarization, particularly for micro-profiling within macro-level fields of study.

Digitalization's impact on economic sustainability

Digitalization's impact on economic benefits. Adequately improving the economic development of tourism is also one of the sustainable needs for developing tourism. At a time when tourism has been devastated by COVID-19, the tourism industry has almost ceased to exist. Therefore, one of the most popular research topics is maintaining substantial economic benefits while allowing the tourism industry to flourish sustainably.

Digital technology has piqued researchers' interest due to its potential benefit to the tourism industry. Technologies that directly improve the economic situation are classed as economic benefits, and per many studies, digitization positively impacts local economic development and may bring objective revenue to tourism (Tables 1–7).

Digital technology promotes economic development. The growth of information communication technologies (ICT) positively impacts China's tourism industry while promoting economic growth (Shehzad et al., 2019). As a rapidly evolving digital technology, mobile technology has significantly minimized asymmetric information, enhanced local GDP growth, and increased citizens' financial capital through tourism (Kim and Kim, 2017; Phoong et al., 2022). Technologies such as 3D virtual, mixed reality (MR), virtual reality (VR), or augmented reality (AR) applied in heritage tourism can effectively increase local economic income and the added value of tourism (Manglis et al., 2021; Martinez-Grana et al., 2019). Furthermore, marketing tools such as small programs and network technologies confer several advantages to tourism stakeholders, such as the ability to help local communities contribute value and support the tourism economy (Caciara et al., 2021; Lin et al., 2020a, b). Also, smart heritage city tourism technology tools can drive the tourism economy to inaccessible areas (Gomez-Oliva et al., 2019).

The increase in income is proportional to increased economic benefits. ICT is often used in the tourism industry, which has an essential impact on the tourism service industry, one of which is the improvement of tourism income (Gomez-Oliva et al., 2019; Koukopoulos and Koukopoulos, 2019). Virtual tourism technologies, such as AR and VR, are digital tools that can help overcome cultural heritage tourism challenges, such as reviving the tourism industry and resolving funding shortages (Lu et al., 2022). Mobile money, such as electronic traveler's checks and credit cards, can assist low-income people in taking advantage of their marginal savings and encourage implementing a cashless economy for tourism sustainability (Singh, 2017).

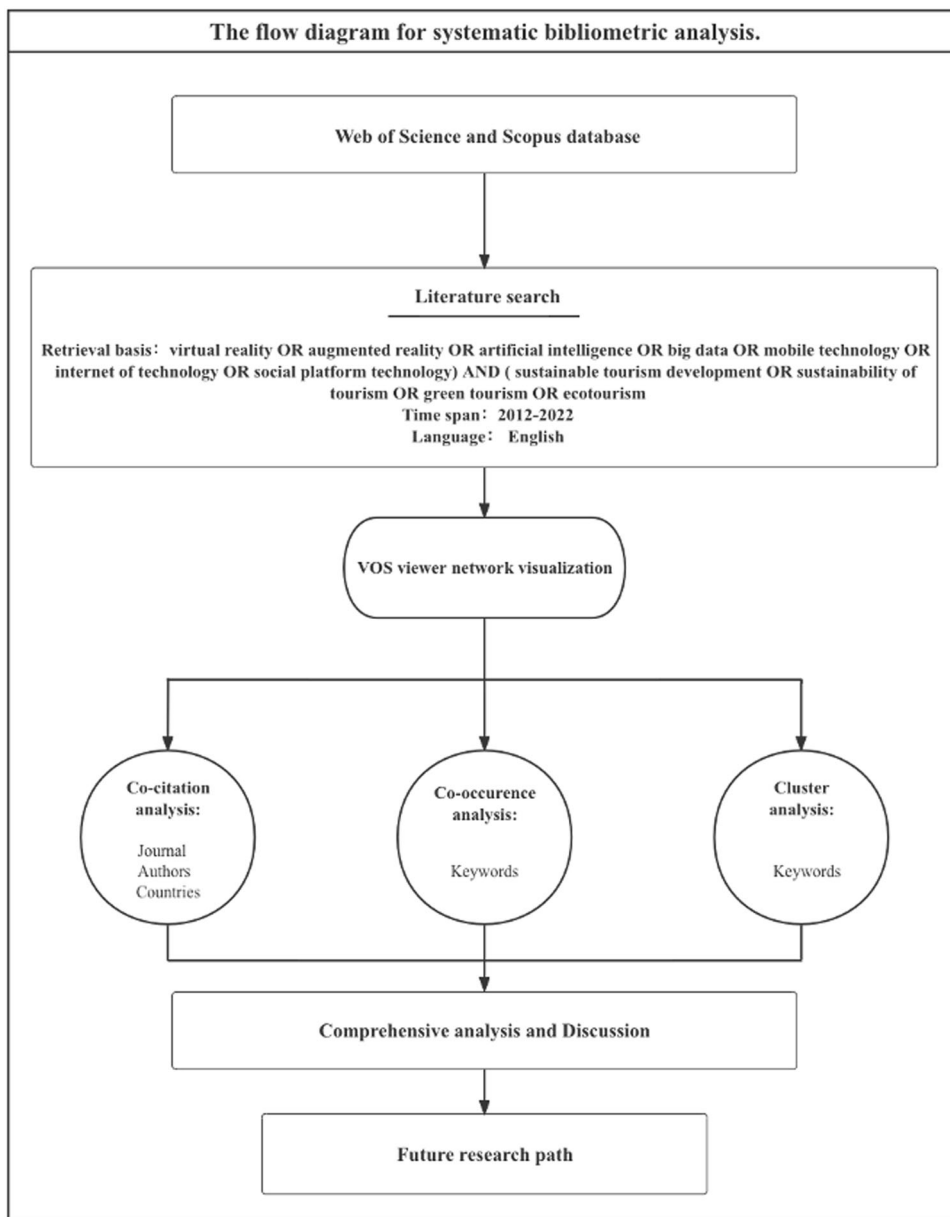


Fig. 1 The flow diagram for systematic bibliometric analysis. This figure shows the overall process of this study from database selection until suggestions for future research. Source: Own elaboration.

Second, digital marketing technologies are frequently utilized by hotels to improve hotel performance, which increases profit (Theocharidis et al., 2020; Vitezic et al., 2015). Another example is Muslim-friendly apps promoting the international trade of products during the tourism process (Cuesta-Valiño et al., 2020),

Digitalization’s impact on tourism industrial development. Technological development has driven the tourism industry in local tourist cities, organizations, businesses, and governments. From the perspective of industrial market development, ICT, extensive data network marketing, and other virtual tourism technologies can create market development potential and improve market positioning for companies (Ammirato et al., 2021; Filipiak et al., 2020; Ma et al., 2021).

Adopting and applying information in the tourism industry are commonly regarded as a source of corporate innovation. The implementation of ICT can increase the profitability of tourism enterprises while also increasing organizational productivity

(Croitoru and Manoliu, 2016; De Lucia et al., 2021; Duy et al., 2020; Obonyo et al., 2018). VR, AR, 3D digital technology, and mobile technology can all be used to improve a company’s performance and competitiveness in the tourism industry (Cranmer et al., 2021; Koukopoulos and Koukopoulos, 2018; Pavlidis et al., 2022; Yuce et al., 2020), and these technologies have made significant economic contribution to economic sustainability.

The application and implementation of ICT play an essential role in developing the tourism industry (Adeola and Evans, 2020; Tan et al., 2019; Zhou and Sotiriadis, 2021). Also, digital advanced technologies, such as MR technology adopted by museums, AR technology adopted by destinations, and smart tourism products and tourism ecological reservation systems have made significant contributions in the front-end development stage, providing opportunities to monitor the future development of tourism, as well as being beneficial to the formulation and implementation of tourism industry strategies

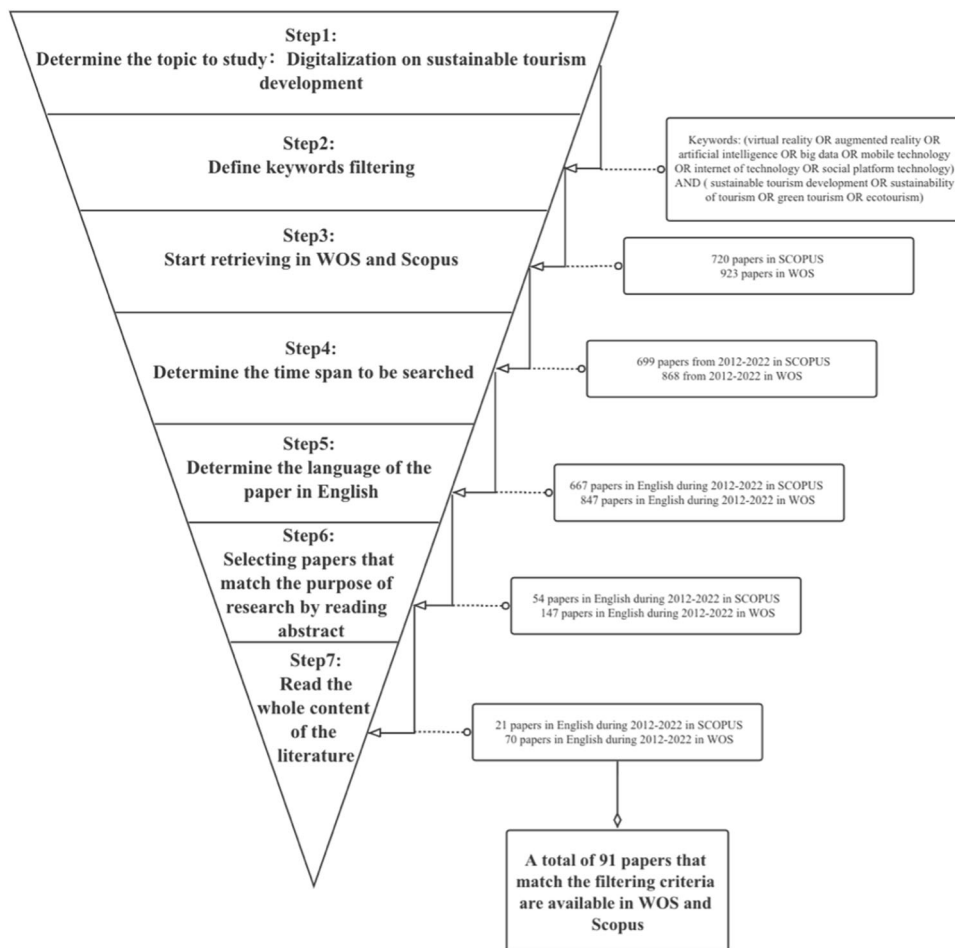


Fig. 2 Selection criteria and search process. The criteria and steps used to identify the selected target literature are explained in this diagram. Source: Own elaboration.

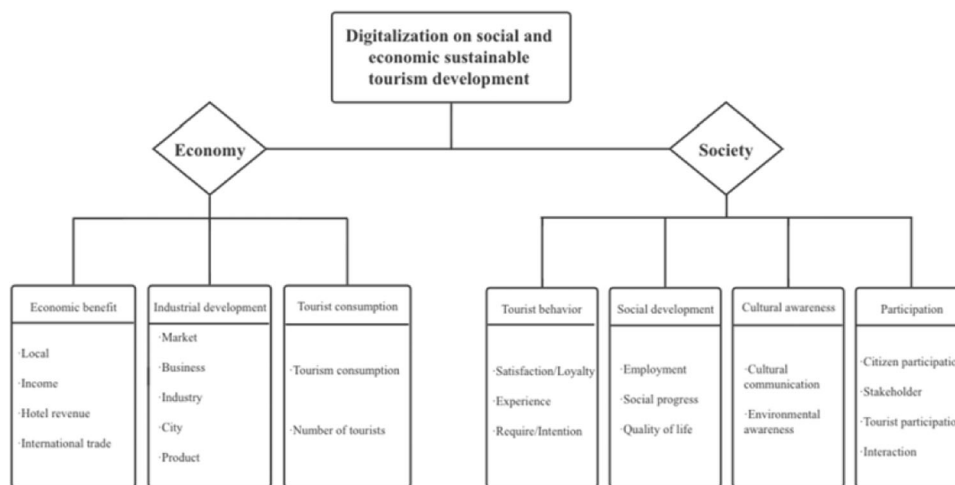


Fig. 3 Criteria from social and economic sustainability perspective. The research topics are divided into two categories: economic sustainability (which includes topics such as economic benefit, industry development, and tourist consumption) and social sustainability (which includes topics such as tourist behavior, social development, cultural awareness, and participation). Source: Own elaboration.

at later stages (Graziano and Privitera, 2020; Tsai et al., 2018). The abovementioned electronic environment is an excellent lubricant for tourism’s active and healthy development (Mairescu et al., 2016). Moreover, apps can help customers understand legacy cities more from the standpoint of heritage

preservation and help cities promote tourist city development (Briciu et al., 2020).

From the perspective of products sold and variations in product types, online services in Muslim-friendly apps can be helpful for market segmentation and promotion of product

Table 1 Economic benefit.

Category	Main influence	Related paper
Local	Tourism development is aided by digital technology, which can generate local economic benefits, create competitive advantages, improve value, and directly impact local economic development, making tourism a significant contributor to local economic growth.	Martinez-Grana et al. (2019), Hammady et al. (2021), Lin et al. (2020a, b), Manglis et al. (2021), Shehzad et al. (2019), Kim and Kim (2017) Caciora et al. (2021), Zubiaga et al. (2019)
Income	Digital technology products positively impact tourism-based economic affairs, offering considerable benefits to both the public and private sectors, raising savings, and most likely being one of the solutions to overcome the problem of a lack of finances and resuscitating the tourism industry.	Martinez-Grana et al. (2019), Ko and Song (2021), Yuce et al. (2020), Shafiee et al. (2013), Chaudhary et al. (n.d.), Boboc et al. (2019), Singh (2017), Shehzad et al. (2019), Anser et al. (n.d., p.), Lu et al. (2022), Kim and Kim (2017), Gomez-Oliva et al. (2019), Koukopoulos and Koukopoulos (2019)
Hotel revenue	Adopting innovative technology, a digital management structure, and digital marketing tools will drive the development of hotel performance, which benefits the hotel industry's economic promotion.	Theocharidis et al. (2020), Vitezic et al. (2015)
International trade	Muslim-friendly apps promote the international trade of products during the tourism process.	Cuesta-Valiño et al. (2020)

Table 2 Industry development.

Category	Main influence	Related paper
Market	The contribution of digital technology to the improvement of market potential and market position, particularly for the sustainability operation of a business model, cannot be ignored.	Ma et al. (2021), Ammirato et al. (2021), Filipiak et al. (2020)
Business	Digital innovative products such as Internet products, big data, virtual reality technology, and ICT play an essential role in improving the productivity and economy of local tourism institutions and SMEs.	Duy et al. (2020), Croitoru and Manoliu (2016), Cranmer et al. (2021), Obonyo et al. (2018), Yuce et al. (2020), Koukopoulos and Koukopoulos (2018), Pavlidis et al. (2022), De Lucia et al. (2021)
Industry	Innovative digital information technology products can favorably impact the tourism industry's orderly and healthy development.	Hammady et al. (2021), Maiorescu et al. (2016), Graziano and Privitera (2020), Tan et al. (2019), Tsai et al. (2018), Zhou and Sotiriadis (2021), Adeola and Evans (2020)
City	The innovation and application of information technology is one of the conditions that positively affect the performance development of tourist cities	Briciu et al. (2020)
Product	Digital technology has an essential role in encouraging the quantity growth of tourism products and enhancing the diversification of product types, which is one of the goals of sustainable tourism development.	Cuesta-Valiño et al. (2020), Martins et al. (2017), Palumbo (2021), Kaźmierczak et al. (2021)

Table 3 Tourism consumption.

Category	Main influence	Related paper
Tourism consumption	The advancement and innovation of network information technology benefit tourists by extending their travel time and increasing their consumption.	Lin et al. (2020a, b), da Silva (2021), Pehlivanides et al. (2020)
Number of tourists	Digital technology helps to attract more tourists and increase the number and flow of tourists.	Manglis et al. (2021), Kim and Chang (2020), Gajdosik (2019), Pica et al. (2018), (Cai et al. (2021), Graziano and Privitera (2020), Pitoska (2013), Adeola and Evans (2020), Kumar and Kumar (2020), Muthuraman et al. (2019), Pavlidis et al. (2022), Bae et al. (2020), Martins et al. (2017), Fernandez-Lores et al. (2022), Kabassi (2017), Wang et al. (2020)

positioning and sales (Cuesta-Valiño et al., 2020). Furthermore, virtual multi-sensory technologies can improve the company's potential, increase public awareness, and sell products (Martins et al., 2017). Undeniably, the development of digitalization enriches the cultural service products of museums in developing heritage tourism (Palumbo, 2021), and AR technology also increases the diversification of products in water tourism (Kaźmierczak et al., 2021).

Digitalization's impact on tourism consumption. Tourists' spending power can reflect the overall economic development of the tourism industry as one of the contributing variables, and the number of tourists and the value of tourist flow are two measurement criteria of tourism consumer spending. Tourism apps, for example, can make traveling more convenient for tourists, increasing tourism consumption (Lin et al., 2020a, b). Virtual tourism products or augmented reality technology allow tourists

Table 4 Tourist behavior.

Category	Main influence	Related paper
Satisfaction/ Loyalty	Innovative digital information technology will positively impact tourists' satisfaction and loyalty.	Lin et al. (2020a, b), Duy et al. (2020), Ko and Song (2021), Lim et al. (2017), Bruno et al. (2020), Yuce et al. (2020), Vitezic et al. (2015), Xie and Zhang (2021), Muthuraman et al. (2019), Sharmin et al. (2021), Pavlidis et al. (2022), Bae et al. (2020), Lu et al. (2022), Van et al. (2020), Lou et al. (2017), Jamshidi et al. (2021), Um et al. (2021)
Experience	It is beneficial to enhance tourists' digital experience through digital technology from a new perspective.	Hammady et al. (2021), Garzon et al. (2018), Huang and Liu (2021), Ma et al. (2021), Graziano and Privitera (2020), Lim et al. (2017), Bruno et al. (2020), Lee and Kim (2021), Briciu et al. (2020), Talafubieke et al. (2021), Lopes et al. (2019), Ramos-Soler et al. (2019), Koukopoulos and Koukopoulos (2018), Cai et al. (2021), Bec et al. (2019), Boboc et al. (2019), Yin et al. (2021), Franco and Mota (2021), Muthuraman et al. (2019), Pavlidis et al. (2022), Bae et al. (2020), Lu et al. (2022), Zubiaga et al. (2019), Gomez-Oliva et al. (2019), Martins et al. (2017), Kotsopoulos et al. (2019), Ammirato et al. (2021), Fernandez-Lores et al. (2022), tom Dieck et al. (2016), Pehlivanides et al. (2020)
Require/Intention	Under the influence of digitalization, tourism digital products, and marketing tools can help to increase tourist interest, demand, and intention to travel.	Monterroso-Checa et al. (2020), Manglis et al. (2021), Kim and Chang (2020), Tussyadiah et al. (2018), Lin et al. (2020a), Theocharidis et al. (2020), Gajdosik (2019), Cranmer et al. (2021), Pica et al. (2018), Ramos-Soler et al. (2019), Del Vecchio et al. (2018), Xie and Zhang (2021), Balakrishnan et al. (n.d.), Cuesta-Valiño et al. (2020), Caciora et al. (2021), Ammirato et al. (2021), Kang (2020), Wang et al. (2020), Kaźmierczak et al. (2021)

Table 5 Social development.

Category	Main influence	Related paper
Employment	Using digital tools in tourism will help improve the local employment rate and increase the employment opportunities of enterprises.	Chaudhary et al. (n.d.), Franco and Mota (2021), De Lucia et al. (2021)
Social progress	Digital information technology helps strengthen the relationship between tourists and society, improve the sense of social responsibility and belonging, and contribute to the progress of tourism and society.	Encalada et al. (2017), Koukopoulos and Koukopoulos (2019)
Quality of life	Digital products have a positive impact on tourism and improve the quality of life of residents.	Lemmi and Deri (2020), Shafiee et al. (2013), Kim and Kim (2017), Zubiaga et al. (2019), Tom Dieck et al. (2016)

Table 6 Cultural awareness.

Category	Main influence	Related paper
Cultural communication	Digital technology can help tourists better understand local tourism culture and promote cultural communication.	Graziano and Privitera (2020), Pica et al. (2018), Boboc et al. (2019), Bonacini et al. (2018), Giaccone and Bonacini (2019), del Vecchio et al. (n.d.), Permatasari et al. (2020), Bec et al. (2019), Caciora et al. (2021), Zubiaga et al. (2019), Gomez-Oliva et al. (2019)
Environmental awareness	Digital technology helps enhance tourists' awareness of natural environment protection, low-carbon environmental protection, and heritage protection.	Manglis et al. (2021), Ma et al. (2021), Haque et al. (2021)

to spend more leisure time, increasing consumption (da Silva, 2021; Pehlivanides et al., 2020).

The application of virtual tourism technology is also helpful in improving the attractiveness of tourists (Cai et al., 2021; Manglis et al., 2021; Martins et al., 2017). Meanwhile, big data analytic tools, e-marketing (WOM), and mobile applications positively influence customers' intention to travel and contribute to improving tourism sustainability (Gajdosik, 2019; Kim and Chang, 2020; Pica et al., 2018). With the application and construction of ICT, the demand for tourism has increased, and the number of tourists has also increased (Adeola and Evans,

2020; Kabassi, 2017; Kumar and Kumar, 2020). In addition to enhancing tourists' imagination, virtual tourism technology and 3D digital technology can also be used as practical tools to further develop tourism and increase the number and flow of tourists (Bae et al., 2020; Graziano and Privitera, 2020; Pavlidis et al., 2022). Word-of-mouth marketing has increased the number of tourists (Fernandez-Lores et al., 2022; Wang et al., 2020).

Digitalization's impact on social sustainability

Digitalization's impact on tourist behavior. Virtual tourism technology is gradually being implemented in the tourism industry,

Table 7 Participation.

Category	Main influence	Related paper
Citizen participation	Digital products can further deepen user participation, promote citizen participation, and influence tourism choices, thus strengthening local ties.	Briciu et al. (2020), Permatasari et al. (2020), Muthuraman et al. (2019), Camilleri (2018), Caciora et al. (2021), Haque et al. (2021), Bonacini et al. (2018), Koukopoulos and Koukopoulos (2019), Giaccone and Bonacini (2019)
stakeholder	Tourism digital technology also affects the management and participation of stakeholders, thus strengthening the links between stakeholders.	Gajdosik (2019), del Vecchio et al. (n.d.), Camilleri (2018), Kim and Kim (2017), Giaccone and Bonacini (2019)
Tourist participation	Digital social media platform helps to enhance tourists' participation in the tourism experience.	Haque et al. (2021)
Interaction	The interaction between users and destinations and the positive interaction between residents and tourists will be affected by the development of digital technology.	Dionisio et al. (2019), Muthuraman et al. (2019), Mohd et al. (2020)

focusing on increasing the satisfaction of the elderly and disabled (Lu et al., 2022). Artificial intelligence and virtual reality are integrated into human-computer interaction system equipment, boosting service quality and increasing tourist satisfaction (Van et al., 2020). The mixed experience helps enrich tourists' feelings about the surroundings, thereby boosting tourists' contentment (Bae et al., 2020), and the succinct information and dependable system offered by VR can promote tourists' satisfaction (Yuce et al., 2020). 3D digital technology to build innovative and appealing tourism items can help boost consumer satisfaction and positive feedback (Pavlidis et al., 2022).

Tourism stakeholders' use of tourism apps is critical to increasing tourist satisfaction (Lin et al., 2020a, b). For example, tourism management in Ho Chi Minh City's use of Web 4.0 can increase customer satisfaction and loyalty in the long run (Duy et al., 2020). The mobile usability and ease of use of social media as a suitable medium directly impact satisfaction (Sharmin et al., 2021). It can also serve as a platform for tourists to communicate and contribute to increased satisfaction (Jamshidi et al., 2021). Simultaneously, tourism safety is an essential factor that influences tourist satisfaction, and the use of closed-circuit television (CCTV) and unmanned aerial vehicles (UAVs) can help to improve tourism safety (Ko and Song, 2021). The use of mobile technologies and payment mechanisms in the tourism process is also a fascinating study. Through electronic technology, two-dimensional code payment techniques improve tourists' pleasure (Lou et al., 2017). Furthermore, incorporating digital innovation into hotel management structures increases hotel performance and client satisfaction (Vitezic et al., 2015).

Tourism satisfaction is directly related to tourism experience, and tourism experience is one of the most important criteria to measure in the tourism process. The findings suggest that using virtual immersion technologies such as AR, VR, and MR in the tourism process can significantly improve the tourist experience (Bae et al., 2020; Fernandez-Lores et al., 2022; Franco and Mota, 2021; Lee and Kim, 2021; Yin et al., 2021).

Additionally, the intention and motivation of tourism drive tourism behavior from the psychological aspect. Digital innovative technology can boost tourists' interest in tourism products and locations, enrich their understanding of tourism culture, attract more tourists, enhance tourists' preferences, and strengthen their desire to visit (Caciora et al., 2021; Cranmer et al., 2021; Gajdosik, 2019; Kang, 2020; Kaźmierczak et al., 2021; Manglis et al., 2021; Monterroso-Checa et al., 2020;). Digital marketing tools can ramp up customers' desires and habits (Theocharidis et al., 2020), and digital mobile programs can increase tourists' attention, influencing their overall view of the tourism experience (Wang et al., 2020). Big data can also be utilized to foresee client wants and expectations, allowing for a

better understanding of customer needs (Del Vecchio et al., 2018). For example, Internet of Things technology can scientifically guide and divert tourists to alleviate the problem of local saturation and overload in scenic sites, thus improving the tourist experience (Xie and Zhang, 2021). It can also provide various cultural tourism content to enhance and support the experience of active tourists (Ammirato et al., 2021).

Digitalization's impact on social development. Tourism planners and governments can use the analytic hierarchy process (AHP) and geographic information system-remote sensing (GIS-RS) technology to accurately select sites, develop eco-tourism activities, relieve the burden of tourism in the region, and thus help the locals create new employment opportunities (Chaudhary et al., n.d.). Virtual tourism technology, such as AR, can also aid in analyzing tourist flow and conditions, improve safety, and expand job chances (Franco and Mota, 2021). Advances and innovations in tourism ICT can benefit enterprises enough to increase job prospects (De Lucia et al., 2021). Virtual tourism, ICT, mobile technology, smart heritage tourism technology, and innovative marketing methods improve stakeholders' quality of life, increasing the tourism system and community awareness (Lemmi and Deri, 2020).

Digitalization's impact on cultural awareness. Virtual technologies, such as AR, VR, and mobile augmented reality (MAR), are now widely used in cultural heritage tourism, with the potential to protect cultural heritages and enhance the potential of heritage management, thereby contributing to cultural communication (Bec et al., 2019; Caciora et al., 2021; Graziano and Privitera, 2020). Some studies indicate that online engagement platforms, mobile application technologies, and smart tourism models can all support the socially sustainable growth of culture (Bonacini et al., 2018; Pica et al., 2018; Zubiaga et al., 2019).

AR, VR, and other techniques can promote tourists' behavior in underwater cultural tourism and raise public awareness of natural heritage protection among tourists (Manglis et al., 2021). Research on low-carbon travel modes is frequently concerned with tourism sustainability, and big data marketing technology can supply tourists with more low-carbon transport schemes, thus increasing tourists' environmental consciousness (Ma et al., 2021). As a common medium for cultural communication, social media can raise tourists' awareness of environmental protection (Haque et al., 2021).

Digitalization's impact on participation. Tourists' active participation in cultural heritage can be enhanced by digital technology, as can people's feeling of belonging and responsibility to society (Koukopoulos and Koukopoulos, 2019; Permatasari et al., 2020).

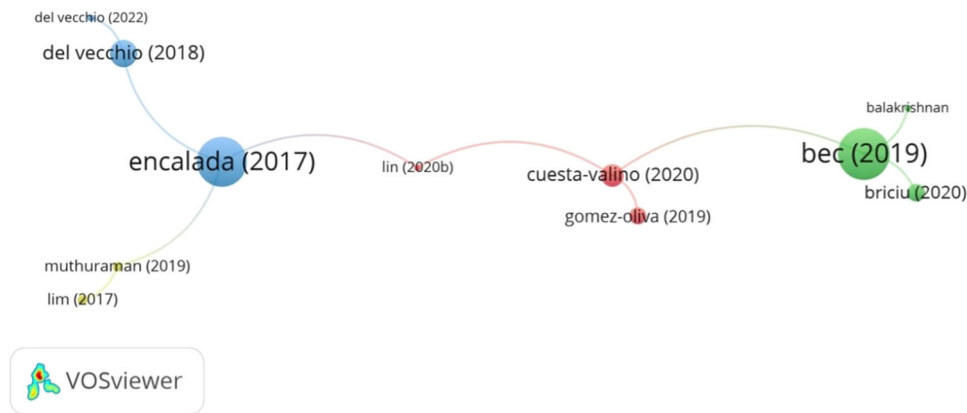


Fig. 5 Citation network of documents. Cluster size indicates the degree of connection and influence of the literature and research area. There are four groups, with the blue (Encalada et al., 2017) and green (Bec et al., 2019) groups representing the two articles that are relatively most influential. Source: Own elaboration.

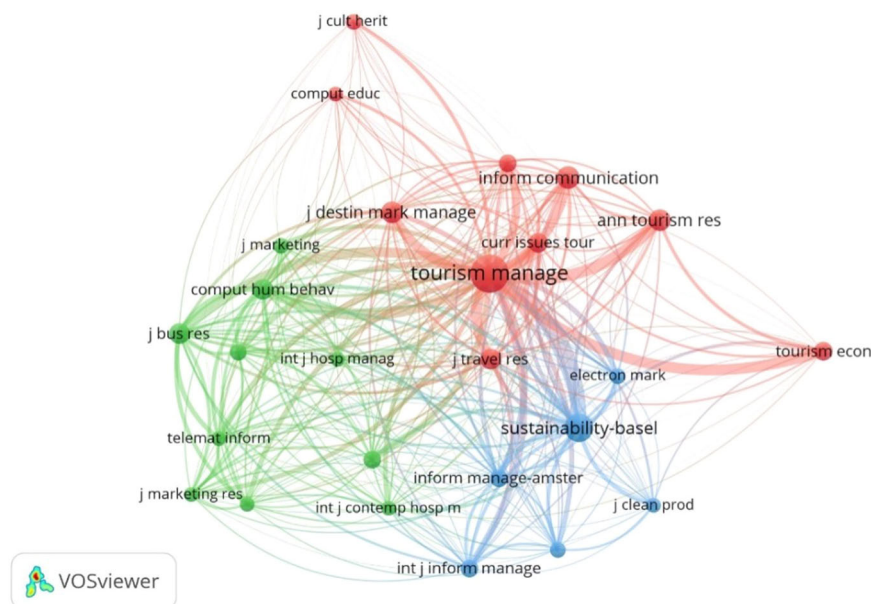


Fig. 6 Co-citation network of sources. This figure represents the citation strength of publications. The circle distance represents relevance. Source: Own elaboration.

consumption (Tussyadiah et al., 2018). Simultaneously, this article presents the finding, which illustrates that combining history with cutting-edge technology in immersive spaces can preserve and manage legacy and enrich the visitor experience and, as a result, engagement with history (Bec et al., 2019).

Co-occurrence network of Keywords and titles. The significance of keyword co-occurrence analysis in bibliometrics resides in an intuitive understanding of hot subjects in the study field through the frequency and relevance of terms (Phoong et al., 2022). Before that, the following considerations must be made.

To begin, each node in the network map indicates a keyword, and the size of the ball represents the number of keywords that appear. The larger the ball, for example, indicates the higher frequency of keywords occurring. Second, the larger the co-occurrence rate between terms, the thicker the curve between the second keywords. In the third, on the network map, different color groups reflect different theme collections, while the same color represents similar subjects (Loureiro and Nascimento, 2021).

Figures 7 and 8 illustrate overlay visualization (Fig. 8) and network visualization (Fig. 7). From Fig. 7, the keywords of high frequency include tourism (37 occurrences), technology (35 occurrences), tourist (32 occurrences), experience (31 occurrences), information (25 occurrences), application (23 occurrences), data (22 occurrences), analysis (21 occurrences), impact (21 occurrences), sustainability (14 occurrences) and sustainable development (9 occurrences). Some of Red Network Group’s primary keywords are tourism, information, impact, communication technology, virtual reality, new technology, and cultural tourism. The study’s content focuses on the impact of the relationship between information technology and tourism. Yellow Network Group’s primary keywords are destination, tourism destination, environment, and AR, mainly concentrated on destination environment and AR application research. The green network group comprises tourists, analysis, process, big data, management, stakeholders, case studies, innovation, and other topics. This group has conducted more studies on the effect of digital technology on enterprise management from stakeholders’ perspectives. The Blue Network Group focuses on technology,

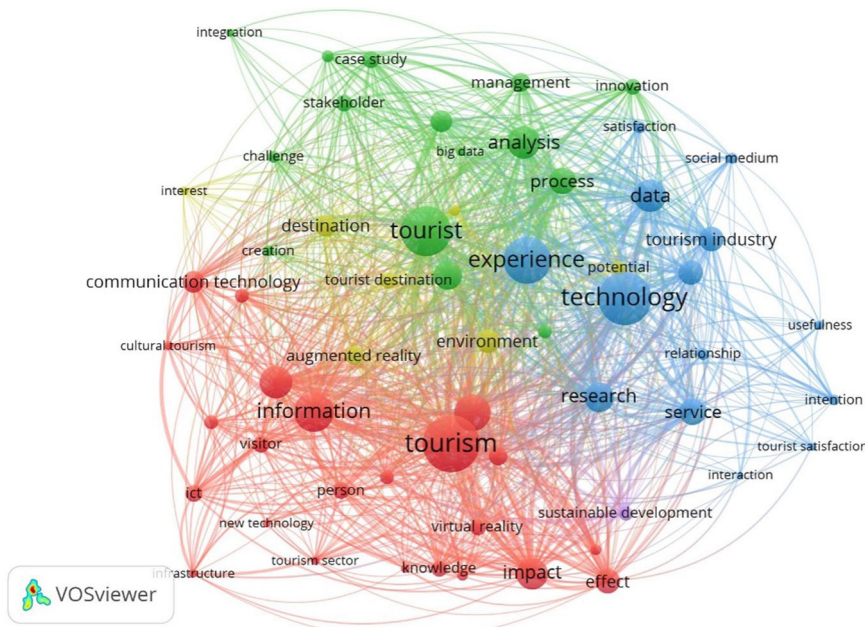


Fig. 7 Co-occurrence network of keywords and titles. The same color indicates a close relationship between the keywords. The red network group focuses on tourism and information technology, the yellow network group concentrates on destinations and the environment, and the blue group emphasizes tourists and technology, the green group concerns tourists and analyses. Source: Own elaboration.

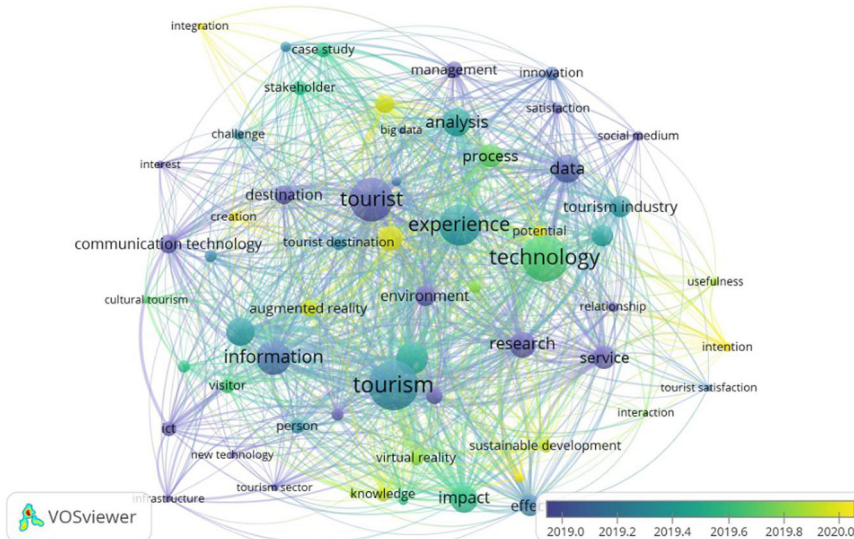


Fig. 8 Co-occurrence overlay of keywords and titles. Darker colors indicate older keywords such as tourists, information, data, research, etc. and lighter colors show the recent hot keywords such as big data, AR, VR, sustainable development, etc. Source: Own elaboration.

experience, data, service, research, relationships, social media, sustainable development, tourist satisfaction, intention, and other related topics, and this group study is particularly interested in the influence of technology on tourist experience and satisfaction.

After conducting a literature review on digital technology’s economic and social implications on sustainable tourism development over the last ten years and creating a density visualization network map, it can be concluded that tourist experience, information technology, augmented reality, and data are research hotspots. As a result, most studies on tourism sustainability in social and economic dimensions focus on the impact of digital technology on the tourist experience.

Even though they are all co-occurrence analyses of keywords in literature, the emphasis in each network map is different.

Generally, overlay visualization and network visualization are comparable to a certain extent; however, the color differs in overlay visualization (Fig. 8). In the lower right corner, there is also a quantification table. Purple indicates that the keywords are older, while yellow indicates that they are more modern. For example, keywords such as big data, augmented reality, sustainable development, creation, and intention are yellow, indicating a recent research hotspot, but keywords such as communication technology, information, environment, and service are purple, indicating that these themes were formerly popular.

Results and discussion

The data were collected from 2012 until February 2022. Analysis of the published articles shows a significant increase in

publications on digitalization and tourism sustainability development. In 2017, seven articles were published, 10 in 2018, 16 in 2019, and 23 in 2020 and 2021. Furthermore, there are 6 published in the first two months of 2022. These findings illustrate a rise in data availability for digitalization and sustainable tourism development research and suggest that researchers are considering this topic more seriously, demonstrating its value to academic research.

According to the findings, *Sustainability* was the top journal in published digital and tourism sustainability-related articles. This is followed by the *International Journal of Tourism Research*, *Tourism Management*, and *Current Issues in Tourism*. The number of publications on the relevant subject has increased steadily, particularly in recent years, indicating that this form of research is increasingly gaining attention. Research over the last decade has shown the existence of a certain number of empirical studies on the relationship between digitalization and tourism social and economic sustainability, and from the bibliometric analysis, it emerges that the current research direction on tourism social and economic sustainability has shifted from exploring ICT to AR and VR. Moreover, *Tourism Management and Sustainability* have the highest citation.

In summary, this study answers RQ1 using the bibliometric literature analysis, while a systematic literature review used to answer RQ2 and RQ3 is discussed in the conclusion and further recommendation sections.

Conclusion

The content of relevant articles published in WOS and Scopus in this research area over the last decade was visually analyzed through bibliometric and systematic literature analysis, and a total of 91 articles meeting the research criteria were selected to provide information on the status of the impact of digitalization on the social and economic aspects of sustainable tourism development, as well as to identify specific research fields and research topics. It can be concluded that the digitalization of the social dimension of tourism sustainability is more richly studied and explored from a more diverse perspective, considering not only the tourists' but also the residents' perspectives. There are two implications in the present study. The first is that this study pinpointed the knowledge gaps. Systematic literature review analysis is used in this study to identify the gaps in the existing body of research in tourism development. By reviewing the previous literature and synthesizing the findings, researchers can identify the areas receiving limited or much attention. This insight is valuable for policymakers, tourism planners, and researchers when dealing with specific areas where future research is warranted. Furthermore, the publication trend and popular research themes were also discussed in this study. This enables the policymaker and tourism planner to understand tourism development and the potential for improved policies and practices. The second implication is enabling evidence-based decision-making in tourism development. Researchers can identify patterns, trends, and best practices by synthesizing the findings from multiple studies. This evidence-based approach helps policymakers, destination managers, and tourism stakeholders make informed decisions and develop strategies grounded in research. However, there is a lack of a more comprehensive perspective to explore in an integrated manner. For example, social and economic sustainability development sometimes does not increase simultaneously, and perhaps there is a particular imbalance between the two when using certain digital technologies. Therefore, it can be observed from this study that there is a lack of research in the past ten years that has explored both the economic and social sustainability of tourism

comprehensively and that future research could emphasize the integration of social and economic sustainability, even a synthesis study of three dimensions: environmental social, and economic.

Therefore, when considering future developments, several challenges were raised.

1. Lack of integration study of social and economic dimensions.
2. Lack of cooperative research among other disciplines.
3. Lack of suitable theory and conceptual model for sustainable development research in the tourism area.
4. Lack of universality in different regions based on proposed digital technology.
5. Lack of research from the perspective of subject education or particular population as the research object.

Based on this literature study, relatively few research topics about this research area are suggested, and the following research scope and questions can be referred to as a priority in the future research process so that research trends can be accurately grasped more quickly and efficiently.

1. What is the impact of digital technologies on the economic and social sustainability of destinations?
2. How do digital technologies used in cultural heritage tourism impact tourism sustainability?
3. What is the impact of digital technology on education?
4. How can tourism companies improve employee satisfaction, loyalty, and sustainable performance through digital technology?
5. How can we create a globally accessible and digital system for tourism destinations for sustainable development goals?
6. How does digitalization impact sustainable development from stakeholders' perspectives?

The above suggestions and research direction recommendations can provide new research inspiration to researchers in the same field for future research, and this study is expected to help other researchers understand the current research trends related to the digitalization of sustainable tourism development.

Received: 25 April 2023; Accepted: 11 September 2023;

Published online: 07 October 2023

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Acknowledgements

This research is supported by the Universiti Malaya International Collaboration Grant, grant number ST013-2022.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information

Correspondence and requests for materials should be addressed to Seuk Wai Phong.

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