

Virtual Reality – A Tool for Sustainable Development in Tourism or a Treat for the Future? A Systematic Review and a Swot Analysis

Abstract

The advancement of virtual reality (VR) necessitates substantial expertise and investment. As a result, it has been observed that the number of VR studies has increased in recent years. Accordingly, the primary objective is to elucidate the current state of studies on virtual reality (VR) within the context of sustainable development in tourism research. This study adopted a systematic review and SWOT analysis approach. The study findings indicated that most of the papers used quantitative research methods. Most of the research papers focused on tourism marketing, heritage, and destination management. Most of the documents had a significant environmental focus; environmental-oriented papers outnumbered those on economics and socio-cultural topics. The studies suggested that VR was a powerful digital tool for raising awareness of environmental issues and allowing visitors to experience the analogies, customs, and intellectual abilities of earlier civilisations.

Furthermore, VR presented opportunities, such as providing new standards for the tourism sector to address the challenges of COVID-19 and promote expansion. However, it was not without drawbacks. This study aims to compile sustainability-oriented research on VR and analyse it systematically to determine the current state of the field of inquiry.

Keywords: virtual reality, sustainability, sustainable development, tourism, technology

1. Introduction

Advancements in information and communication technologies have caused significant changes in various industries, including tourism (Kim et al., 2008). Virtual reality (VR), along with augmented and mixed reality technologies, has gained significant popularity in recent years. The pandemic is one of the factors enabling the widespread use of these applications (Schiopu et al., 2021; Talwar et al., 2022b), as is organisations' high priority to facilitate interaction with people due to travel restrictions worldwide. Furthermore, the ability to obtain VR headsets that allow consumers to experience this technology at a reasonable cost increase, indicating VR's growing popularity (Baker et al., 2023).

VR is the use of a three-dimensional (3D) environment created by a computer, in which the user can move around and interact with others, simulating one or more of their five senses in real time (Guttentag, 2010). As the definition implies, VR is to create an artificial environment that aims to provide a fully immersive experience for users who aren't physically present, allowing them to learn and grow while adhering to its constraints. On a computer screen, implicit exploration and expertise of products, intricate systems, and processes are all possible using VR (Taxén and Naeve, 2002). These systems facilitate understanding and communication

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through 3D virtual depictions, provide real-time familiarisation with the simulated environment, and enable the conceptualisation of ideas from a theoretical perspective (Salah et al., 2019). VR visualisation has provided a new perspective on various issues related to sustainable development. As a result, cutting-edge technologies such as VR and augmented reality (AR) are increasingly being utilised in more than just promotional activities within the tourism sector (Beck et al., 2019; Guttentag, 2010). Notably, it has become an essential driver for the development of innovative and sustainable cities (Jamei et al., 2017), which can be evaluated as a crucial concern for destination management.

Furthermore, VR has created a new tourism phenomenon called VR travel or virtual tourism, which offers users a realistic experience of any destination without requiring physical presence (Williams and Hobson, 1995; Talwar et al., 2022a). Virtual tourism is addressed in the literature as a potential remedy to over-tourism. According to Kouroupi and Metaxas (2023), the use of immersive technologies, such as VR, may aid decision-making, leading to more efficient and sustainable procedures that could serve as a solution to over-tourism. In their case study, Chaney and Seraphin (2021) also emphasised that integrating VR into mass events could help mitigate over-tourism. However, this crucial topic needs further assessment.

Furthermore, it can serve as a virtual tool for sustaining tourism activities during times of crisis, such as pandemics (Bec et al., 2021; Go & Kang, 2022). Another critical topic is cultural heritage. The global society has made the preservation and enhancement of cultural heritage a top priority (Younes et al., 2017). By using VR, visitors can experience cultural heritage sites that are inaccessible, highly protected, restricted, or no longer exist. Moreover, VR technology can be used for educational purposes, particularly at heritage sites, which can aid in the preservation of the sites.

Technology has become a strategic tool for the tourism and hospitality industries. It enables businesses to enhance internal business procedures and so establish and preserve a long-term competitive advantage (Seyitoğlu & Ivanov, 2022). Tourism and hospitality researchers have been vocal advocates for incorporating technology into the industry for some time (Sigala, 2018). These voices are interrupted by rare echoes, driving the attention of the academic community to the necessity of limitations on integration (Oktadiana and Pearce, 2020). These opposing viewpoints persist in the integration of technology into sustainable development. Some researchers assert that VR is a promising technology for sustainable development in tourism. As a non-toxic mode of transportation with low costs, VR can assist with sustainability (Wiltshire and Clarke, 2017). However, some studies posit that immersive technologies could pose a threat to the development of conventional tourism activities (Cheong, 1995; Beck et al., 2019). Given the current state of studies on VR as a developing sub-discipline in the integration of ICT technologies into the research field, we assert that there is a research gap in assessing its impact on sustainable development. Moreover, no study has been reached to reveal the current position of the inquiry. Accordingly, using a systematic review approach, this study aims to identify the most used methodologies, fields of research, and sustainability dimensions addressed by the studies. Moreover, a SWOT analysis has been conducted to find out the bright and dark sides of VR and gain knowledge about the opportunities and challenges in the future. The obtained results are discussed, along with the benefits and drawbacks of the technology.

2. Literature review

2.1. VR and VR applications in tourism

VR began with an entertainment-oriented design, but in subsequent years, applications were developed for a variety of purposes. It's a technology with numerous interaction opportunities, particularly in terms of an immersive approach involving 3D visuals and sound, as well as the incorporation of various sensory and perceptual sources (Rubio-Tamayo et al., 2017). There are numerous simulation methods, and computer-based

and 3D immersive technology simulations are among them. The degree to which these methods immerse the user in the virtual environment also varies (Servotte et al., 2020). Two main factors must be present regardless of the technology utilized to create a VR experience. The first is physical immersion, followed by psychological presence (Tussyadiah et al., 2018). There is a subtle distinction between them. Immersion aims to transport the user to the environment and cultivate the perception that the virtual environment and everything it contains are real. On the other side, presence focuses on engaging the user through a defined and fantasized environment (McMahan, 2013).

VR technology has become increasingly popular in the travel, tourism, and hospitality industries due to its enormous potential to enhance the experience. It provides users with a realistic preview of how the actual destination or hotel would look, thereby lowering potential risk and facilitating consumers' purchase decisions (Flavián et al., 2019). It appears that destinations, companies, and associations responsible for promoting tourist attractions are placing greater emphasis on giving potential customers a taste of what it would be like to visit those locations (Jung and tom Dieck, 2017). As a result, it is becoming progressively essential for companies to have a position in the virtual environment. According to Beck et al. (2019), VR in tourism is formed by fully, semi or non-immersive versions which stimulate visual and other senses to offer a virtual touristic experience, and it can be used for a variety of purposes, including tourism or destination management or marketing, cultural or natural heritage protection, enriching educational quality, and empowering entertainment. By emphasizing the highlighted purposes in the definition of VR in tourism, it is possible to express that VR technology can be classified as a tool for sustainability.

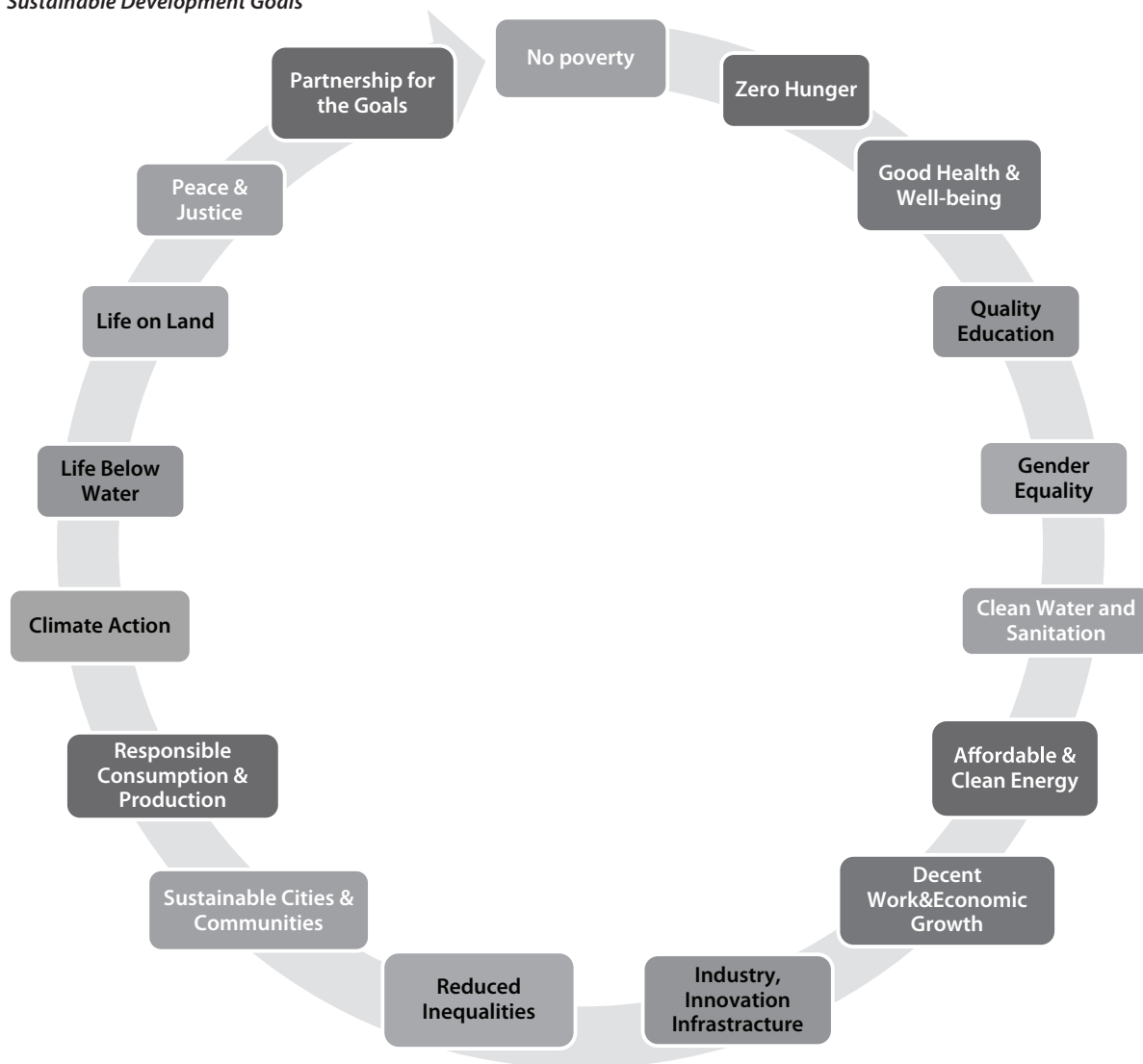
2.2. Sustainable development in tourism and 2030 Agenda

Sustainable development in tourism has received intense research attention from tourism academics since the early 1990s (Hall, 2010; Bramwell, 2015; Niñerola et al., 2019). Adopting more environmentally and host-friendly development strategies has become a key requirement for tourism management. The initial studies on sustainability in the tourism literature have relied heavily on outlining the concept (Butler, 1999; Hardy et al., 2002). However, developing a framework has not always been easy. This is primarily due to tourism's significant role in the global financial system. The relationship between sustainability and tourism is particularly intriguing (Niñerola et al., 2019). To fill the gap and establish a framework, the World Tourism Organisation / UNWTO (2005) has made a significant effort towards sustainable development in tourism. It has also assigned a particular focus on taking measures to balance the environmental, economic, and sociocultural aspects of tourism development, particularly in fragile areas, considering that these destinations require careful planning to transform into sustainable tourism destinations. Furthermore, a sole focus on environmental resource protection may limit the potential for economic growth. As a result, it is necessary to strike a balance between expected profits and the continued functionality of ecological resources (Mura and Ključnikov, 2018; Chen, 2020).

With an enormous increase in the number of studies conducted on sustainability in tourism, it is fair to say that sustainability literature has become a dominant topic in the field of tourism. Additionally, there is a tendency to adopt ICT technologies within the field of research to mitigate the effects of the COVID-19 pandemic. This is also highlighted by the World Travel and Tourism Council (WTTC). The WTTC (2020) emphasises that health, sustainability, security, and technology must be aligned to ensure tourism's successful recovery in the post-pandemic world. Thus, studies on sustainable development that integrate technology have become critical. Following the announcement of Sustainable Development Goals (SDGs) in 2015 by the United Nations (UN) as a global call for change to eradicate impoverishment, safeguard the environment, and guarantee that by 2030, everyone lives in a prosperous and peaceful world, United Nations World Tourism Organization announced the integration of SDG Agenda 2030 into tourism. The agenda is an evolving philosophy that seeks to engage others in positive change. It is neither a

goal to be attained nor a search for balance (Liburd et al., 2022). It serves as a guide on how the tourism industry can contribute to implementing and achieving the 17 Sustainable Development Goals (SDGs). A global look into sustainable development, the 2030 Agenda adopts a holistic approach that integrates different thematic fields ranging from decent work to the quality of education. Figure 1 illustrates the 17 sub-thematic fields of the SDGs.

Figure 1
Sustainable Development Goals



Source: United Nations (2015).

To achieve a solution and make progress in each of the categories shown in Figure 1, the UN (2015) has announced that it must utilise resources such as funds, data, innovation, and technological advances. In line with these ideas, the incorporation of VR into sustainable tourism development has gained traction. Accordingly, this study aims to identify the position of sustainability-oriented VR studies in tourism literature and to determine the opportunities and challenges associated with this technology. In line with the study's aim, the research questions are presented in Figure 2.

Figure 2
Research questions



3. Methodology

In the study, a systematic review approach was adopted. To filter studies from the Web of Science (WOS) and Scopus databases, keywords were used. In the WOS and Scopus, the exact keywords were utilized. Coded as topics for each category, keywords such as “Virtual Reality” OR “VR” AND “Sustainability” OR “Sustainable Develop*” AND “Tourism” OR “Hospitality” were entered into the search engine. Articles and Early Access were selected for further analysis, and 35 studies from Web of Science (WOS) and 44 studies from Scopus were obtained. In the second phase, these studies were compared, and similar studies were eliminated. 28 studies out of 79 were indexed in both the WOS and Scopus databases. Thus, 51 studies were selected for further analysis. Examining each study’s title, keywords, and abstracts, 11 studies were found out of scope. As a specific field of research restricted to the keywords identified during the scanning process, a total of 40 studies were selected for further analysis. In the following stage, the studies were categorised into environmental, economic, and socio-cultural components, as sustainability relies on three interconnected aspects: environmental, sociocultural, and economical. Furthermore, these categories are listed as the basic principles of UNWTO sustainable development.

Following the systematic review, a SWOT analysis was conducted to assess the contributions of VR studies to sustainable development. The strengths, weaknesses, opportunities and threats of the technology were presented. The research steps are formed similarly to those of da Silva et al. (2022) and depicted in Table 1.

Table 1
Research steps

Steps	Activities
Step 1: Problem definition	<p>Step 1-1: Identifying the research gap.</p> <p>Steps 1-2: Formulating the research questions.</p>
Step 2: Systematic literature review	<p>Step 2-1: Adapting the PRISMA technique formed by Liberati et al. (2009) for systematic literature review.</p> <p>Step 2-1-1: Search (Keyword selection)</p> <ul style="list-style-type: none"> • “Virtual Reality” OR “VR” AND “Sustainability” OR “Sustainable Develop*” AND “Tourism” OR “Hospitality” were inserted into the WOS database. The number of studies obtained: 35 • “Virtual Reality” OR “VR” AND “Sustainability” OR “Sustainable Develop*” AND “Tourism” OR “Hospitality” were inserted into the Scopus database. The number of studies obtained: 44

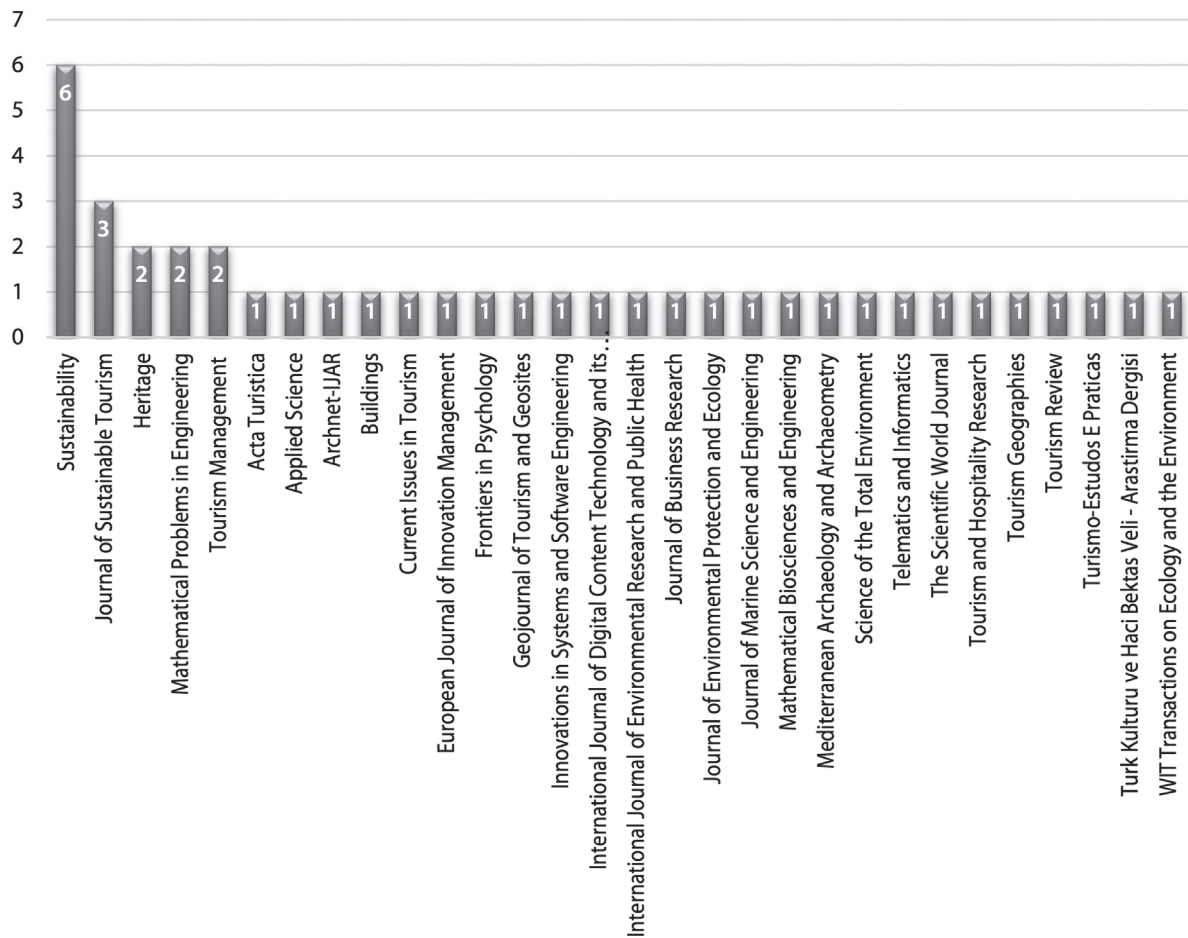
Table 1 (continued)

Step 2: Systematic literature review	<p>Step 2-1-2: Screening and Eligibility</p> <ul style="list-style-type: none"> Duplications were deleted. Twenty-eight studies were indexed in both the Web of Science (WOS) and Scopus databases. Twenty-eight studies were eliminated from Scopus. Examining each study's title, keywords and abstracts, 11 studies were found out of scope in WOS (N=24) No change after screening title, keywords and abstract in Scopus (N=16) <p>Step 2-3: Evaluation of the Selected Studies</p> <ul style="list-style-type: none"> The studies were thoroughly reviewed, and no study was excluded from either database. <p>Step 2-4: Inclusion</p> <ul style="list-style-type: none"> All studies were collected, and a total of 40 studies were selected for further analysis.
Step 3: Content analysis	Selected studies were categorized according to the published journals, methodologies adopted, field of research, and sustainability dimensions.
Step 4: SWOT analysis	The strengths, weaknesses, opportunities, and threats mentioned in the studies were determined and categorized. Each study was evaluated independently by the researchers. Since the study aimed to assess the current state of the inquiry, a SWOT analysis was conducted, taking into account the findings of the selected studies.
Step 5: Assessment	The researchers made an interpretation and evaluation based on the obtained results.

4. Findings

4.1. Journal list

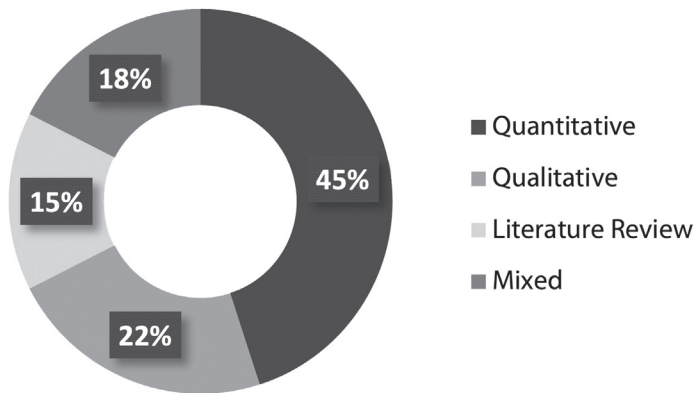
Figure 3
Journal list



4.2. Mostly adopted methodologies

Most studies employed quantitative research methods (45%). As a field of research in the evolving process, 22% of the studies adopted qualitative research. Detailed information on the research methods is presented in Figure 4.

Figure 4
Research methods in VR studies



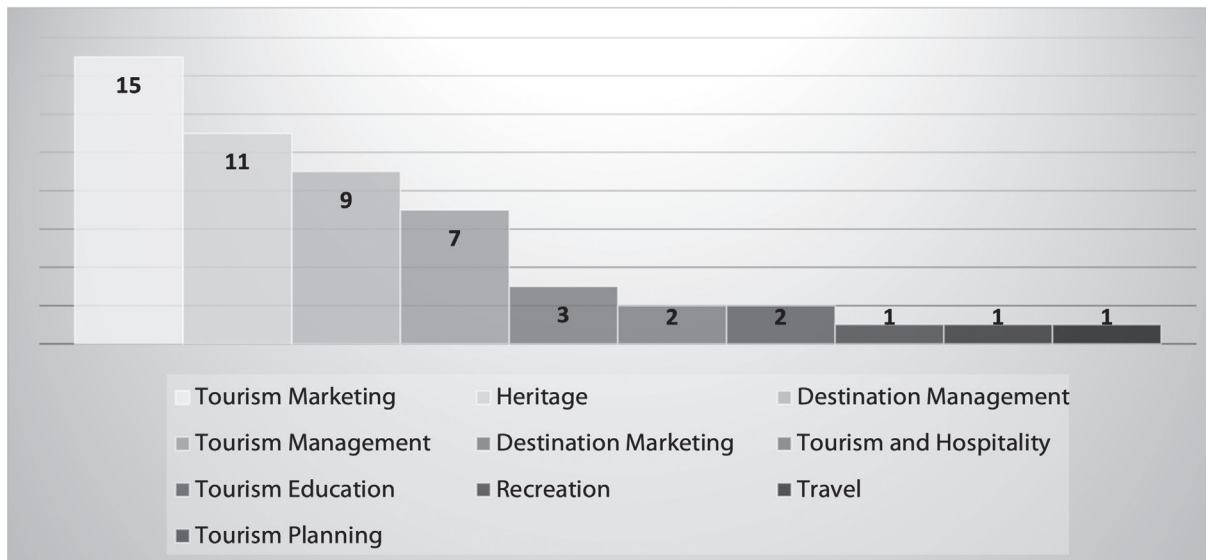
It is worth noting that quantitative research methods have predominated over other research methodologies (such as qualitative, mixed, or experimental) in tourism research for decades. This is a well-known yet controversial issue that has evolved into an ongoing academic debate. Decrop (1999) has mentioned that positivism remains the dominant theoretical framework in tourism studies. According to Mehmetoglu (2004), researchers in the tourism and hospitality fields may not fully appreciate the benefits of statistical analysis, which may also reinforce the dominance of quantitative research methods. In a more recent article, Truong et al. (2020) have determined that quantitative research methods have been dominant in the research field for some time. The researchers have argued that mixed methods would provide a solution to counteract the tendency towards quantitative approaches.

Furthermore, mixed methods may allow the use of beneficial aspects of both methods. Aside from the position of the tourism inquiry, there is another point that must be discussed. The use of VR in sustainable development may necessitate a holistic approach in research, as social and technical disciplines collaborate to achieve the research goals. This implies that mixed methodologies may be appropriate to gain a deeper understanding of people's perspectives while allowing for the improvement of the technology.

4.3. Field of research

Considering the number of studies on the use of VR, the majority focused on tourism marketing (N = 15), heritage (N = 11), destination management (N = 9), and tourism management (N = 7). Figure 5 visualizes the focal research fields in the studies.

Figure 5
Research fields in VR studies

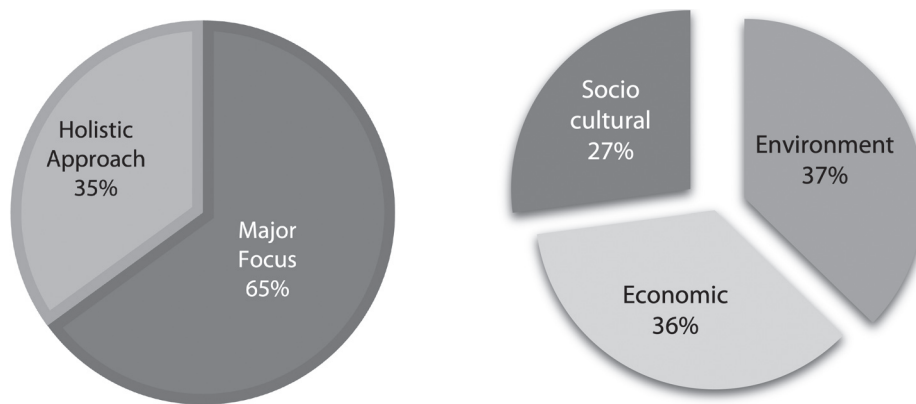


The widespread adoption of VR technologies is driving economic growth and uncovering new possibilities (Grewal et al., 2017). The evolution of technology appears to be affecting marketing and overall business actions (Loureiro et al., 2019). Accordingly, it suggests that researchers in tourism marketing have made a special effort to incorporate VR into Their studies. The obtained findings confirm that tourism marketing studies are at the forefront of the research field. Furthermore, starting from the early attempts at technology-integrated tourism studies, heritage conservation has been a significant concern. VR has garnered research attention for its ability to provide remote access and create digital content for heritage sites (Cai et al., 2021). According to some research, a strong connection exists between tourism and cultural heritage preservation (Lai, 2020), which necessitates a comprehensive strategy that incorporates technology integration to benefit all parties involved in the long term (Iliopoulou-Georgudaki et al., 2017).

4.4. Sustainability dimensions of VR studies

In the studies, it was also considered that sustainability has three components: economic, social-cultural, and environmental. First, the studies were grouped into two categories. Most studies (65%) adopted a major focus approach. That means 65% of the studies were constructed with either economic, socio-cultural, or environmental concerns. However, 35% of the studies adopted a holistic approach, referring to these three interconnected components (economic, social-cultural, and environmental), as shown in Figure 6. In the second phase, studies with a primary focus (the only element of sustainability) were grouped. Thirty-seven per cent of the studies focused on the environment, 36% on the economy, and 27% on socio-cultural issues.

Figure 6
Dimensions of sustainability in VR studies

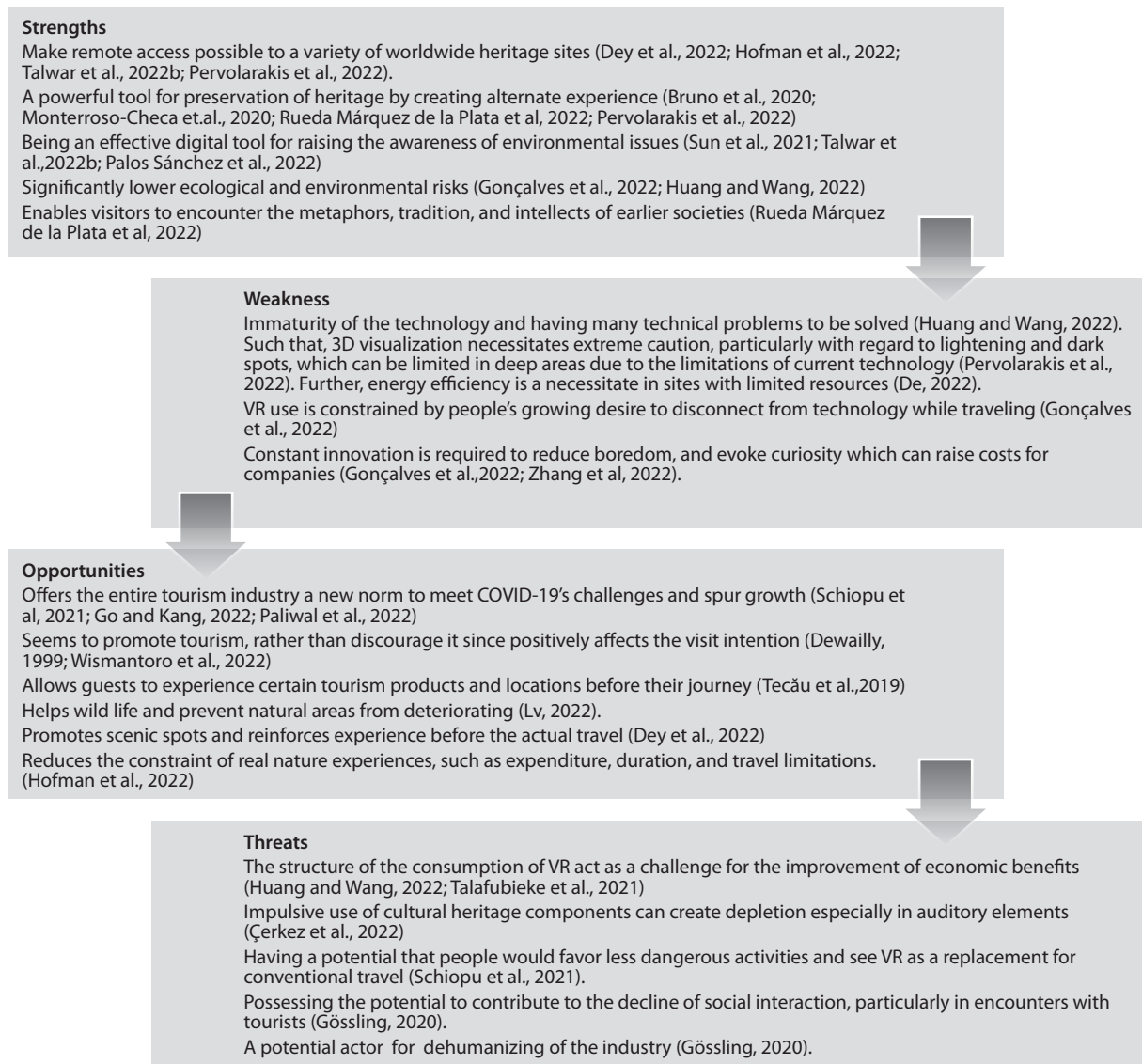


Obtained findings revealed that environment-focused sustainable development studies rose to the forefront. Environmental issues continue to play an essential role in VR-integrated sustainable development studies, consistent with the idea that a healthy and appealing environment must be maintained (Sharpley, 2009). Moreover, as an industry, VR-integrated sustainability studies with economic concerns received comparable levels of research attention. However, the sociocultural facet of sustainable development lagged behind others. This result is consistent with the other studies in the literature. Nugraheni et al. (2020) have emphasised that it is necessary to place more emphasis on the social aspect of sustainability, as the number of socio-cultural-focused studies on sustainable development in tourism has fallen behind those of other areas. However, it is indicated that the participation of all stakeholders can truly shape sustainability (Amerta et al., 2018).

4.6. SWOT analysis of VR technology through the sustainable development principles

Recent studies view VR as an effective tool for promoting environmental awareness among the public (Talwar et al., 2022b; Palos Sánchez et al., 2022), highlighting it as one of the technology's main strengths. Furthermore, some studies have indicated that VR can contribute to overcoming the challenges of COVID-19 and encourage the growth of the industry (Schioapu et al., 2021; Go and Kang, 2022), which presents a valuable opportunity for the industry. However, there are some concerns regarding the use of VR. Today's technology has the potential to overcome many obstacles, but there is still room for development. Furthermore, VR research is still in its early stages, with much more to be done. As a result, the content analysis results revealed that the researchers had anticipated threats. According to Huang and Wang (2022), the nature of VR consumption may harm the economic benefits of tourism, posing a significant long-term risk. The findings of the SWOT analysis are highlighted in Figure 7.

Figure 7
SWOT analysis results



When reviewing SWOT analysis results in the literature, it is worth noting that the use of VR is examined from the perspectives of planners, touristic product developers, and touristic product users. Using VR as a tool for environmental protection was the primary focus, which is a notable strength. The SDGs emphasize that careful ecological planning is essential for sustainable development. Fuso Nerini et al. (2019) also emphasise that climate change, as one of the key frontiers of environmental issues, is a significant impediment to achieving the SDGs. According to the researchers, it is necessary to strengthen the link between climate change and sustainable development management to increase their efficiency. VR can be a valuable tool for maximizing this cooperation.

It is also possible to assess the weaknesses of the technology. The immaturity of technology and technical flaws have emerged as weaknesses in the technology used for sustainable development. Furthermore, some tourists would prefer a digital detox on holidays (Hoving, 2017). This is also supported by Oktadiana and Pearce (2020). The researchers noted that technology-related problems (such as dysfunctionality, unclear signs, lack of information, and outdated content) could be frustrating for tourists.

Considering the opportunities, new growth opportunities for the tourism sector were signalled in the studies. Additionally, the decrease in pre-travel experience expenditures emerged as an opportunity. As for the threats, the focus was on the socio-cultural aspects. The reduction of social interactions and the leading role of a dehumanising industry were highlighted, which might be seen as a contradiction to the nature of tourism.

5. Discussion

Following the announcement of Agenda 2030, researchers and organisations have focused on utilising technology to support sustainable development in the tourism sector. Due to the COVID-19 pandemic, a new global standard has been established. Providing a safer environment for tourists and residents has become increasingly important, necessitating the consideration of sustainability principles (Afrić Rakitovac and Urošević, 2023). Furthermore, advances in technology are expected to play an even greater role after COVID-19 (Assaf et al., 2022). The study's findings revealed that a considerable number of VR-oriented sustainable development studies in tourism have been published in various journals. In keeping with the scope, Sustainability and the Journal of Sustainable Tourism emerged as leading journals. It is hardly surprising, given that both journals' scopes are linked to sustainability. However, the topic piqued the interest of other fields, such as business, engineering, innovation management, the environment, and ecology, among others. Due to the complex nature of these studies, which combine technology, tourism, and sustainable development, a wide range of journals would likely include them in their coverage. Given the number of studies and the diversity of journals, it is reasonable to predict that the number of research will increase, resulting in a general tendency among journals to publish technology-based studies, as the UN (2015) advocates the use of technology to achieve the SDGs.

Regarding the position of VR studies, quantitative studies outnumbered other methods, such as qualitative studies, literature reviews, or mixed methods. Numerous studies have demonstrated that quantitative research has held a prominent position in the tourism literature (Riley and Love, 2000; Hoang et al., 2021; Pelit and Katircioglu, 2022). Tourism, as an interdisciplinary field of research, has been enriched by many disciplines as it has matured, which may explain both the dominance of quantitative studies in the field and the absence of unique methods. Furthermore, by frequently employing a positivist approach, some studies suggest that tourism scholars are hesitant to use qualitative research methods (Phillimore and Goodson, 2004).

Sustainability-oriented VR studies encompass various research fields, primarily in tourism marketing, heritage, and destination management, suggesting that VR could be a promising technology in these areas. It has significant strengths, such as 3D visualisation of cultural heritage sites that have since been lost. Moreover, VR-integrated cultural heritage websites can satisfy visitors to a certain extent. According to Boyd and Koles (2019), digital transformation is crucial for companies to maintain competitiveness in the market, and VR presents opportunities to capitalise on digital transformation. Aware of the importance of digitalisation, tourism marketing places a high priority on VR.

Furthermore, VR presented digital solutions to engage the public during the COVID-19 pandemic. Looking at the potential benefits of VR, several positive outcomes have been identified, including site promotion, the ability to assist tourist destinations in recovering from the pandemic, and the facilitation of remote audience engagement with cultural heritage (Lu et al., 2022), all of which can be evaluated in the context of tourism and destination marketing. In addition, heritage and destination management focus on digital strategies to prevent cultural heritage and destinations from overcrowding and its detrimental effects, which may necessitate extensive research in these fields. Furthermore, it can be argued that incorporating VR technology into cultural heritage for preventive and protective purposes can contribute to achieving the SDGs, notably the objective related to industry, innovation, and infrastructure. In line with the logic stressed by Labadi et al. (2021), the use of VR in heritage sites is a means of incorporating novel and creative techniques into the heritage preservation process, thereby protecting heritage resources from potential risks associated with profit-driven use.

Studies with a central focus on sustainability outnumbered those with a holistic approach to sustainability. The findings suggested that the environment was a critical issue that many papers placed significant emphasis on. The environment has been a key component of documents related to sustainable tourism. According to Sharpley (2009: 22), for tourism to succeed over a long period, both as a standalone industry and, more importantly, as a potential driver of economic and social growth across the entire tourism system, it is crucial that a healthy and appealing environment is maintained. In brief, environmental sustainability is a requirement for maximizing tourism's potential for growth. As a result of the studies' recognition of the importance of the environment and the concept of VR as a powerful tool for addressing it, they have begun to prioritise sustainable solutions for environmental issues and raise awareness about the threats. This approach can also be utilised to achieve the Sustainable Development Goals (SDGs), particularly those related to climate action, life below water, and life on land (Scurati et al., 2021; Sun et al., 2021).

VR has vital benefits that make it peculiar for sustainable tourism development. Many studies have highlighted that VR has enabled remote access to a variety of worldwide heritage sites (Dey et al., 2022; Hofman et al., 2022; Talwar et al., 2022a; Pervolarakis et al., 2022). According to Chan et al. (2022), travel restrictions during the COVID-19 pandemic have enabled the frequent use of VR content. VR can simulate the real world while also providing users with a sense of existence, empathetic thinking, communication, and engagement in a virtual world (Chan, 2010). With the ability to offer a real-life-like experience, VR can overcome obstacles and real-life constraints. Moreover, some studies indicate that VR is a powerful tool for preserving heritage by creating alternative experiences (Bruno et al., 2020; Monterroso-Checa et al., 2020; Rueda Márquez de la Plata et al., 2022; Pervolarakis et al., 2022). In museum sites or underwater, VR has been widely used to nourish the real experience. VR can also reduce problems in heritage sites. Several studies indicate that VR has the potential to educate people on environmental issues (Sun et al., 2021; Talwar et al., 2022b; Palos Sánchez et al., 2022). VR enhances the sense of presence by providing an astonishing, immersive experience (Newman et al., 2023). Due to its unique properties, it has been preferred for educational purposes, especially for raising awareness of the seriousness of environmental problems (Cho and Park, 2023).

Some studies also focus on the weakness of the technology. VR is a promising technology, but it still requires constant improvement. The immaturity of the technology has been underlined by some studies (Huang and Wang, 2022; Pervolarakis et al., 2022). Rahimi et al. (2018) propose a model for improving the quality of experience in spatial settings and highlight three critical issues: 1) adequate support to participate in the experience, 2) a clear connection with the context, and 3) motivation to engage in a specific behaviour. Without being fully immersed and having a sense of strong presence, it is not possible to use VR effectively, furthermore Gonçalves et al. (2022) express that VR needs to evoke curiosity, impelling constant innovation. This may result in higher costs and a reluctance to integrate technology into companies. Nonetheless, the price of VR technology has dropped in recent years, making it more affordable. Furthermore, without any implicit intention, a video may provide an opportunity for tourists to reconsider their roles in improving the lives of poor people (Griffin and Muldoon, 2022), making VR an invaluable tool for raising awareness among tourists and contributing to the long-term achievement of "No Poverty" which is one of the essential goals of 2030 Agenda.

Considering the opportunities offered by VR technology, which can serve as a new norm for the entire tourism industry to meet the challenges posed by COVID-19 and spur growth (Schiopu et al., 2021; Go and Kang, 2022; Paliwal et al., 2022), numerous studies have emerged. The pandemic is well-known for ushering in a new era for the tourism industry. The number of users has increased, and potential tourists have started to escape their realities with the help of VR. Some studies have indicated that VR encourages visit intention rather than discouraging it. According to Tecău et al. (2019), VR can be a helpful tool for guests to experience specific tourism products and locations before their trip. This could encourage tourists to go on actual vacations. Furthermore, it may help to avoid dissatisfying experiences.

VR doesn't come without its difficulties. According to several studies, the structure of VR consumption poses a threat to the improvement of economic benefits, particularly for underdeveloped tourism destinations (Huang and Wang, 2022; Talafubieke et al., 2021). Some tourist destinations would face economic difficulties if the number of visitors were to drop. According to Mura et al. (2017), the absence of tourists in a destination may lead to unsustainable business practices, which can be detrimental to populations that heavily rely on the tourism industry for their survival. This is also emphasized by Schiopu et al. (2021). VR could be a treat for conventional travel experiences. People who prefer less risky activities could view VR as a replacement for traditional travel, which could be a boon for the future of tourism. In addition to evaluating VR applications as a solution to over-tourism (Kouroupi and Metaxas, 2023), studies have shown that the technology promotes tourism (Dewailly, 1999; Gryphon and Muldoon, 2017; Wismantoro et al., 2022). This reveals a striking contradiction about the subject. The promotion of tourism through VR, which generates interest and encourages visitors, has the potential to contribute to overtourism. This raises new questions about the relationship between VR and sustainable tourism, which require further investigation.

6. Conclusion

The study aims to conduct a systematic review and a SWOT analysis to determine the position of VR studies in the scope of sustainable development. WOS and Scopus databases were used to obtain data. It was found that Sustainability and the Journal of Sustainable Tourism were the leading journals that published the most sustainability-oriented VR studies. Most of the papers adopted quantitative research methods. Furthermore, most of the research papers focused on tourism marketing, heritage, and destination management. Many of the documents had a significant environmental focus; environmental-oriented papers outnumbered those on economics and socio-cultural issues.

Based on the findings of the SWOT analysis, studies have demonstrated that VR offers numerous advantages in promoting sustainable tourism. Among them was being a powerful digital tool for promoting awareness of environmental issues and allowing visitors to encounter the metaphors, traditions, and intellects of earlier societies. Additionally, VR presents opportunities for the tourism sector, offering a new standard for the industry to address the challenges posed by COVID-19 and promote growth. According to the literature, VR appears to encourage rather than discourage tourism, which could be a boon for underserved tourist destinations. However, there were also some problems, such as the immaturity of the technology, which could ultimately diminish users' interest.

6.1. Theoretical implications

The study has some theoretical implications that should be addressed. It contributes to the literature by providing a general overview of the VR-oriented sustainable development studies in tourism. In the study, it was determined that the number of studies has been escalating, which could be a result of COVID-19. Furthermore, UNWTO has encouraged technology-integrated sustainable development in tourism. The study findings confirm that VR-oriented sustainable development studies will be a trending topic shortly. It is reasonable to expect a general trend in the literature examining the effects of VR on sustainable development. Because the study's core relies on systematically reviewing sustainability-oriented papers in tourism, sustainable-focused journals stood out as a key focus. Still, the diversity of the journals suggests that the number of journals publishing VR and sustainability-related papers will grow in the future. Moreover, the variety of journals that published such studies may indicate that it will receive more attention from different research fields of academia. Second, it can be expressed that quantitative research methodology in tourism inquiry is superior to other methods. This finding is consistent with other studies in tourism and hospitality research, regardless of the core topic (Manoharan and Singal, 2017; Pelit and Katircioglu, 2022).

Nevertheless, it could be argued that mixed methodologies are expected to provide more detailed information about technology-integrated sustainable tourism development studies. Third, sustainable development has three unique facets. However, the study findings highlight that the socio-cultural aspect of sustainable tourism is often overshadowed by environmental and economic considerations, presenting a potential research gap for future studies to address. Lastly, the study findings confirm that VR can be an influential tool for raising awareness about environmental issues, a protective measure against overcrowding, especially in highly protected heritage sites, and an affordable way to access information about remote destinations, which could be a solution to over-tourism.

6.2. Practical implications

The study also offers new insights for tourism practitioners. This study presents a review of research on the integration of VR technology and sustainable development in the tourism sector. It provides practitioners with information about the current state of the field, as well as the benefits and drawbacks of incorporating VR technology into sustainable development. One of the key findings from the study is that VR has a significant impact on visit intention, promoting tourism. A study conducted by Griffin and Muldoon (2022) has also concluded that VR use has had a substantial effect on tourists' desire to visit any location. Practitioners may utilize VR to promote any specific destination. They could also use VR-integrated flows to counteract negative stereotypes associated with locations or communities. However, by doing so, practitioners must consider the three facets of sustainable development. Aiming to raise the number of visitors can become a serious problem later. Creating engaging VR content that promotes sustainability for visitors can be beneficial to the sustainable development of any destination. Moreover, practitioners can use it to advertise before the actual travel starts. It could nourish the desire for the actual visit and act as a valuable promotional tool.

VR technology also assists practitioners in leading visitor behaviour, particularly at heritage sites. Especially at cultural heritage sites, VR can help avoid problems caused by disorganized visitors while also protecting the sites. One of the most significant problems facing tourist destinations worldwide is the degradation of natural and cultural heritage as well as the environment (Bec et al., 2021). Practitioners can offer creative educational VR content, especially for highly protected heritage sites, to overcome over-tourism. Destination management organisations can also utilise this technology to mitigate overcrowding. However, the research and development process requires time, energy and investment (Zhang et al., 2022).

Furthermore, it can be argued that VR could be a boon to conventional tourism activities, provided it is managed rationally (Schiopu et al., 2021). While seeking a solution to over-tourism, it could replace specific recreational tourism activities by providing a haven for users. Furthermore, VR offers opportunities for environmental issues. It could be a change vector. VR-integrated activities may help reduce CO2 emissions more than actual travel. Decision-makers could incorporate VR-integrated actions into their agendas (Schiopu et al., 2021).

6.3. Research limitations and future agenda

Several limitations in the study need to be addressed. First, WOS and SCOPUS were the selected databases for collecting data. Future researchers may consider adding other databases, such as ProQuest and Google Scholar, to access additional studies on the core topic. Second, only VR studies were included in the study. In future studies, the scope can be expanded by incorporating additional technologies such as augmented reality, mixed reality, and artificial intelligence. Lastly, researchers performed a SWOT analysis, considering the outcomes of the studies analysed. The researchers' views were limited in their interpretations reflected in the existed studies. Although the SWOT analysis was conducted within the selected study findings framework and offers some implications for visitors, tourism planners, and tourist product producers, it can be evaluated as a research gap in terms of the inclusion of sustainability philosophy in the integration of VR into tourism.

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