

PAPER

A Bibliometric Analysis Examining the Adoption of Augmented Reality in Tourism Research

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ABSTRACT

This study aims to identify the use of Augmented Reality technology and the trend of using AR in tourism with time limitation from 2013 until 2022. It also aims to determine the valuable contributions of documents, sources, authors, countries, and institutions worldwide in tourism. The qualitative method using bibliometric analysis is suitable for this study because it can provide an overview and classify. Data was collected from the Scopus database and then analyzed using VOSviewer software. The results show that (1) museum, (2) sustainable tourism, and (3) heritage tourism are the keywords most often used in research. The potential research of AR in tourism is directed at the development of underwater tourism, the application of virtual museums, ecotourism, culture heritage tourism, digital heritage and destination image. Sustainability (Switzerland), Current Issues in Tourism, and The International Journal of Human-Computer are the journals with the most publications. Tom Dieck M. C.M.C, Jung T, and Chung N are authors with a high degree of collaboration with other authors. United Kingdom, Spain, and Italy became the countries with the highest publications. Research trends and advances in augmented reality in tourism have been discussed in more detail in this paper.

KEYWORDS

augmented reality, tourism, bibliometric analysis

1 INTRODUCTION

The tourism sector is a crucial factor in boosting revenue in developed nations, and it also contributes to the growth of rural regions. However, based on UNWTO data, Asia Pacific is the region that has experienced the most significant decline in tourism, reaching 84 percent throughout 2020 [1]. The current state is a consequence of the Covid-19 outbreak, which means that the tourism sector is presently faced with the task of recuperating from the pandemic's effects and needs to implement significant modifications to create a more substantial impression on visitors [2] with

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a new approach that prioritizes collaboration between tourism and technology and, can provide convenience in accessing tourism that is out of reach [3].

The use of technology is now seductive to all industries, not only in the manufacturing, education, and economic sectors but also in the transformation of the tourism industry [4][5]. One of the technologies that currently has many enthusiasts is Augmented Reality [6][7]; augmented reality combines real and virtual environments. The goal is to support the interaction of these users to get an immersive and real-time experience [8], Although it is confined to exhibiting visual, auditory, or even tangible items that are showcased via a screen or other medium [9], by using AR, tourists can enjoy the real world virtually and observe virtual things that are displayed using smartphones or digital cameras [10].

AR in tourism can help tourists by providing information about these tours, such as physical structures, history, culture, exhibitions, and museums [11]. AR can increase tourist interest by delivering memorable experiences [12][13] as well as enhancing perceptions and cognitive processes of environmental, geological, and cultural awareness [14]. In particular, augmented reality (AR) can improve the visitor experience before, during, and after a vacation [15][16]. AR does not only provide experience tourism but also contributes toward sustainable tourism [17]. This increase in the use of AR is reinforced by an online article from Business Wire which states that AR technology has experienced significant growth, one of which is in the field of tourism. [18]

There has been a rise in both the quantity and the caliber of AR-related publications in tourism annually, drawing the attention of tourism researchers. This research aims to locate publications that pertain to AR usage trends in tourism from 2013 to 2022. Bibliometric reviews have been conducted in various fields, such as the effectiveness of digital technology in education during the COVID-19 pandemic [19], development in e-tourism research [20], mapping intelligent experiences in tourism [21], augmented reality research in education [22], the direction of research in applying augmented reality in the field of science education [23], and educational applications of augmented reality [24]. Kim, H. and So, K. K. F. have exemplified the use of bibliometrics in tourism. They tracked customer experience in the hospitality and tourism industry to gain a comprehensive understanding of customer experience, depict the scientific evolution of the topic, and uncover keywords for future research, particularly in the tourist experience [25]. The research by Cem Oktay Guzeller identified trends in tourism literature and revealed similarities and differences between publications of Turkish origin and other international publications [26]. Another study by Ana-Belén Bastidas-Manzano provided an overview of the evolution of smart tourism destinations [27].

However, previous research has yet to comprehensively describe the scientific evolution, future research keywords, and trends in using augmented reality in the tourism sector. Therefore, conducting a bibliometric investigation is important to fill this gap and gain insights into the trends and potential applications of augmented reality in tourism over the past decade. Our findings are expected to assist researchers in implementing AR technologies in the tourism industry by utilizing content mapping and comprehensive bibliometric analysis. The results derived from this analysis include Bibliographic Coupling of the Documents, Bibliographic Coupling of the Sources, Bibliographic Coupling of the Authors, Bibliographic Coupling of the Organization, and Bibliographic Coupling of the Countries, as well as the potential use of augmented reality in the tourism industry. The benefits obtained from the use of bibliometric analysis are: (1) understanding the trend and direction of science

in various disciplines, (2) evaluating the completeness of secondary literature, (3) understanding the subject or field of the domain, (4) understanding authorship, (5) studying the obsolescence and dissemination of scientific literature, and (6) forecasting the productivity of publishers, authors, organizations, and countries [28].

Based on the background, the following research questions are posed in this study, all related to entries in the online literature resource ‘Scopus’.

1. What results are from the most relevant mapping of the bibliographic document, source, authors, institutions, and country?
2. What are the emerging keywords for research trends in the field of tourism?
3. What is the potential use of AR in the field of tourism for future?

2 METHOD

This study aims to provide a wealth of data that depicts the current intellectual framework and emerging trends related to the application of AR in tourism over the past decade. The most suitable approach to achieve this goal is through bibliometrics. Bibliometric analysis is a well-known and rigorous technique to investigate and evaluate large amounts of scientific data [29]. The bibliometric analysis employs quantitative methods to analyze the data descriptively, revealing research trends and characteristics of published works. Figure 1 illustrates the comprehensive research design used in this bibliometric analysis.

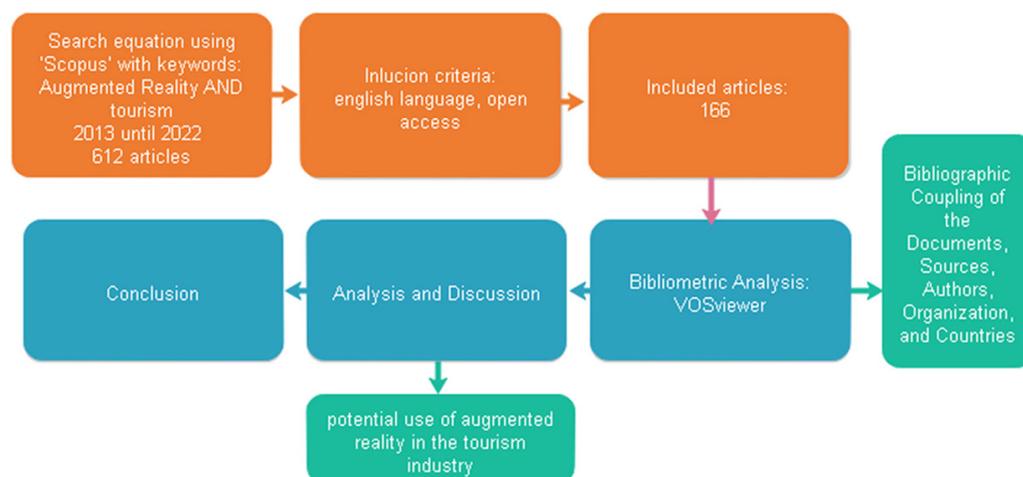


Fig. 1. Research design

2.1 Data collection

This data collection method uses PRISMA because of its systematic review and is often used in the bibliometric method. In the first stage, a search was carried out through the Scopus database (Q1–Q4) using the keywords “augmented reality” and “tourism”.

Keywords: TITLE-ABS-KEY (augmented AND reality AND in AND tourism) AND (LIMIT-TO (OA, “all”)) AND (LIMIT-TO (LANGUAGE, “English”))

The results obtained were 612 articles. The explanation for using the Scopus database is that it is connected to Mendeley and has the detailed data needed according to the necessities of the bibliometrics [30]. The next step is to provide restrictions on the data to be used, such as restrictions on the year that is in the range 2013–2022, only using English, and these articles can be accessed free of charge; the result is 166 articles (Access Month: October 2022). Data extraction from Scopus has been performed in comma-separated values (CSV), which will be further processed. Then we use VosViewer for qualitative analysis.

2.2 Analysis techniques and procedures

The analysis of techniques and procedures using VOSviewer software, which is popular, was used in this study for data visualization. VOSviewer offers a variety of data visualization techniques and is known for its attractive and easy-to-read visuals [20], [31]. The primary function of this software is to retrieve, analyze, and visualize information about publications in the studied field.

3 RESULT AND DISCUSSION

3.1 Main information about the data

Table 1. Main information about data

Period	2013:2022
Source	100
Documents	166
Annual Growth Rate	15.7%
Authors	562
Authors of single-authored docs	12
International Co-Authorship	24.7%
Co-Author per Doc	3.87
Author's Keywords (IDE)	511
Reference	7335
Document Average Age	2.87
Average citation per doc	18.92

The results of the analysis are presented in this section. While giving the various bibliometric categories of analysis results, the researchers followed a deductive way similar to that followed by Mehmet Karakus, Alpay Ersozlu, Aaron C. Clark [22]. The results are presented starting from the more general findings and flowing to the more specific ones: Bibliographic Coupling of the Documents, Bibliographic Coupling of the Source, Bibliographic Coupling of the Authors, Bibliographic Coupling of the Organization, and Bibliographic Coupling of the Countries. This flow of content allows the reader to follow relationships starting from more general information and then find specific details on each category.

3.2 Bibliographic coupling of the documents

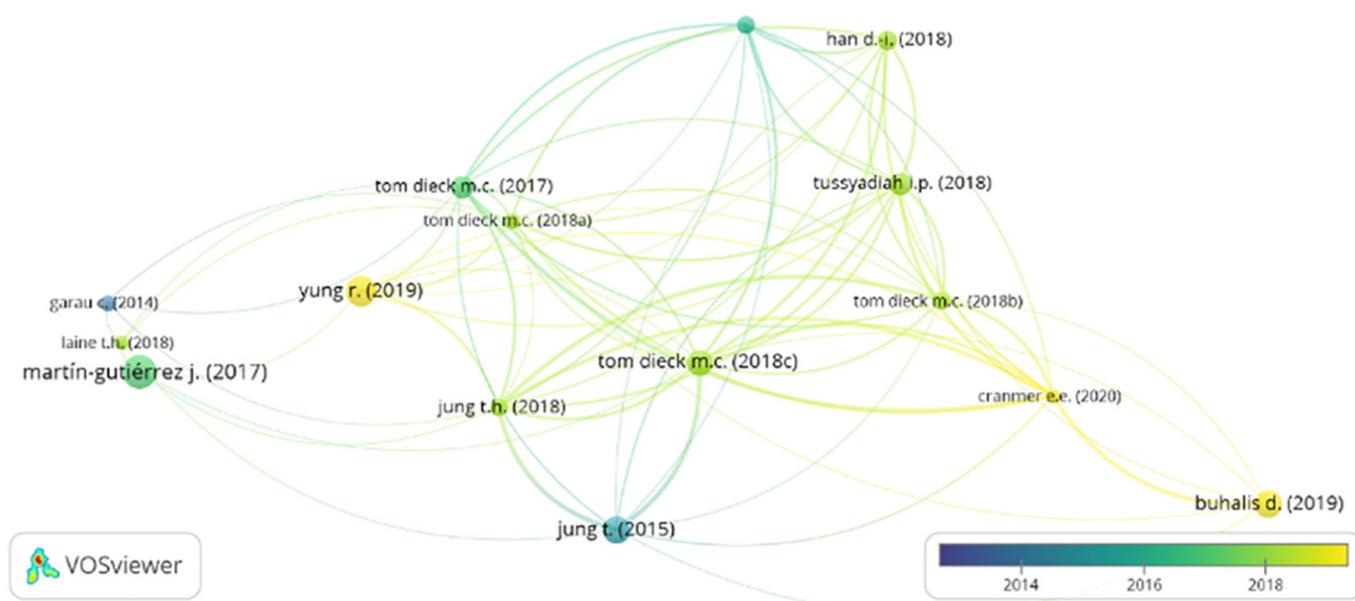


Fig. 2. Bibliographic coupling of the documents

A bibliographical clutch of publications is presented in Figure 1 with an overlay visualization. Only documents with a minimum of 50 citations are included in bibliometric data. Out of 166 documents, only 16 documents met the threshold. The 16 documents will still be counted for the number of citations and link strength. Later, a document with the most significant link strength will be selected. For each publication, the first number represents the number of citations, and the second represents the total link strength. The publications are ordered according to their total link strength in the bibliographical coupling. The first rank is Cranmer E.E. (2020), with 53 citations and 53 link strengths. Then Jung Th (2018) with 87 citations and 53 total link strengths, then Tom Dieck M. C.M.C (2018) with 195 citations and 45 total link strengths. Although Martin-Gutierrez (2017), Yung R. (2019), and Jung T. (2015) have the highest total citations, namely 327 citations, 269 citations, and 227 citations, the total link strength is still tiny. The total strength of links indicates the linkage of an item with other items. The bibliographical coupling of this publication shows the total strength of links where a particular researcher co-authored with other researchers.

The most cited and influential article in this field is by Tom Dieck M. C.M. (2018), with 195 citations and 45 total link strength with the title *A theoretical model of mobile augmented reality acceptance in urban heritage tourism* published in *Current Issues in Tourism*. This article discusses the AR acceptance model in urban heritage tourism involving five tourist groups. The results reveal that seven dimensions must be included in the acceptance of Augmented Reality based on the respondents (young British female tourism): information quality, system quality, cost of use, recommendations, innovation, and personal risk and conditions that facilitate [32].

Next, based on the most citations, namely, Yung R. (2019), with the article title *“New realities: a systematic literature review on virtual reality and augmented reality in tourism research”* with a total of 269 citations and 17 total link strengths, this article discusses the use of augmented reality in terms of acceptance of AR applications in the tourism context. Yung R argues that VR and AR have great potential in the tourism sector (in the context of education, culture, cultural heritage, or sustainability);

by utilizing this technology, tourists gain new experiences in obtaining information; and this can be a consideration for future research on AR use in 360 degrees [33].

Cranmer E.E. (2020) is a writer with total link strength ranked first, with the title “Exploring the value of augmented reality for tourism”, which discusses the exploration of the perceived value of AR for the tourism industry from the perspective of tourism experts using qualitative studies. This research reveals that the potential of AR for the tourism industry lies in marketing, epistemic, economic, tourism, and organizational value. From a marketing standpoint, many interviewees identified the potential for AR to promote tourist facilities, tours, and destinations further. From a corporate perspective, AR is a suitable means of communication and provides opportunities to improve organizational processes, functions, and relationships between tourists. From an economic standpoint, AR can increase financial income if you know the process of using AR technology. From the tourist point of view, AR gives a better feel of the destination before going there, and tourists can have all the information about what activities to do in the tourist spot [34].

Of the three articles discussed based on the number of citations and the total strength of the links, current research concerning AR technology is directed more at how acceptance of AR is for tourists and how tourists benefit from using AR in tourism in terms of economics, organization, marketing, and tourism.

3.3 Bibliographic coupling of the source

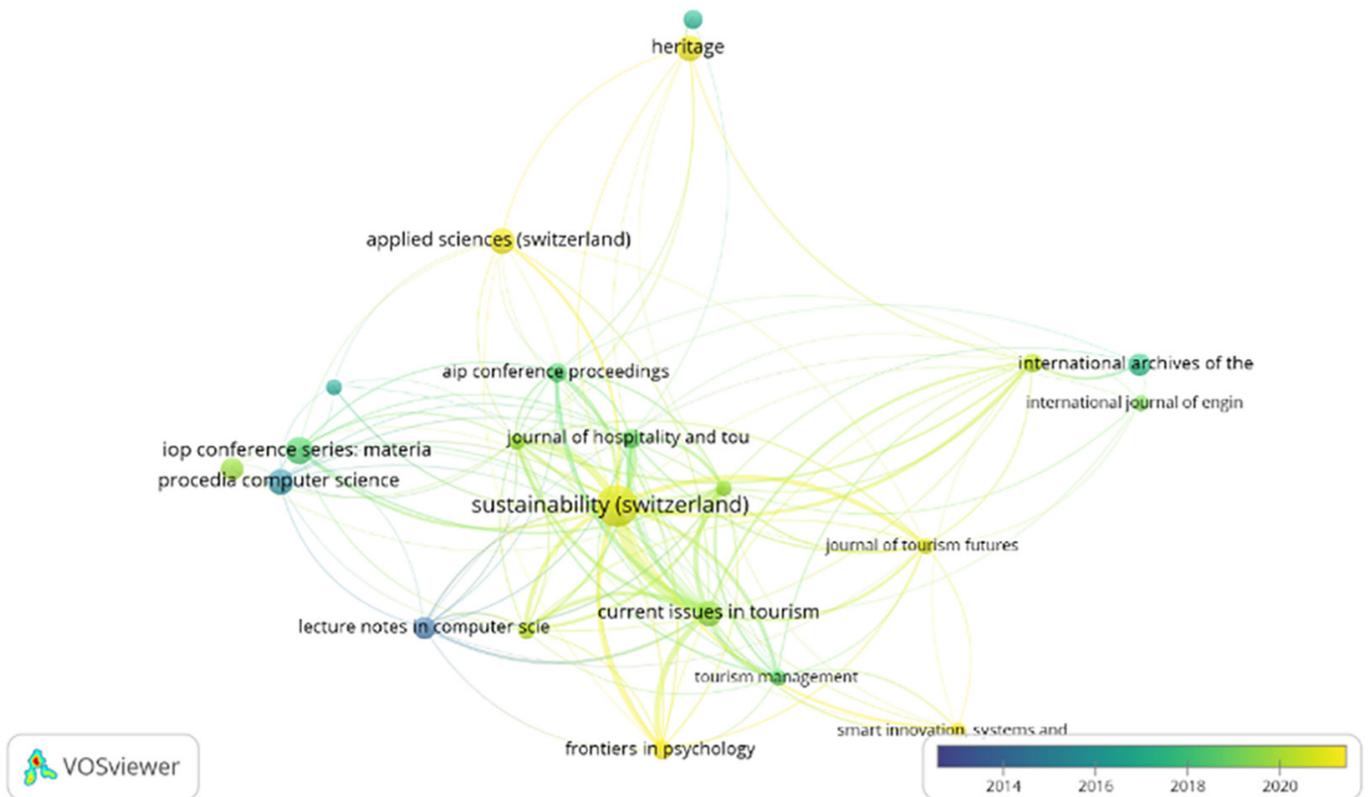


Fig. 3. Bibliographic coupling of the source

The bibliographic coupling from the source was presented in Figure 2 with an overlay visualization. Bibliometric data only starts with a minimum of 2 numbers of a basis. Out of 100 references, only 23 documents met the threshold. The 23 sources

will still be counted for the number of documents, the number of citations, and the strength of the link; later, the document with the most significant link strength will be selected. For each source, the first number represents the number of documents published over a ten-year range, the second number represents the citations, and the third represents the total link strength. In the bibliographic coupling, the sources are sorted based on the full power of the links obtained from the entire documents in the head. The first rank is the Sustainability journal (Switzerland), with 16 documents, 124 citations, and a link strength of 333.

Next, there are five current issues on tourism, with 545 citations and 271 total link strengths. Next is the International Journal of Human-Computer [2:22:141], Sensor (Switzerland) [2:28:114], Journal of Hospitality and Tourism [3:117:92], and Journal of Heritage Tourism [2:100: 87]. Even though two articles have been published, there is a high total link strength, which indicates that the author of the article collaborated with other countries to publish 1 article in the Journal. The importance of collaborating between authors, countries, and institutions is not only to increase link strength but also to increase the number of citations in articles 22:141], Sensor (Switzerland) [2:28:114], Journal of Hospitality and Tourism [3:117:92], Journal of Heritage Tourism [2:100:87]. However, the article published two articles but has high total link strength, which indicates that the author collaborated with other countries to publish 1 article in the Journal. The importance of collaborating between authors, countries, and institutions is not only to increase link strength but also to increase the number of citations in articles [22:141], Sensor (Switzerland) [2:28:114], Journal of Hospitality and Tourism [3:117:92], Journal of heritage tourism [2:100:87]. However, the article published two articles but has high total link strength, which indicates that the author collaborated with other countries to publish 1 article in the Journal. Collaborating between authors, countries, and institutions is important to increase link strength and the number of citations in articles. [19].

3.4 Bibliographic coupling of the authors

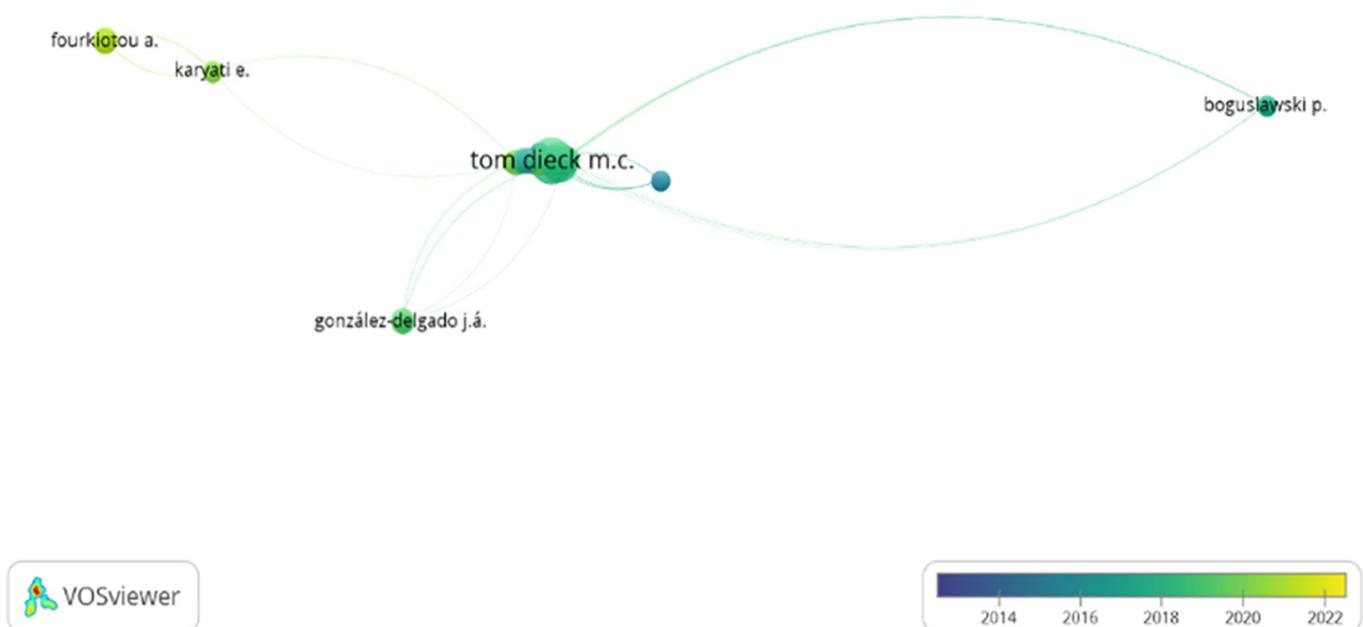


Fig. 4. Bibliographic coupling of the authors

The author’s bibliographical clutch is presented in Figure 3 with an overlay visualization. In bibliometric data, only authors with a maximum of 25 authors per document and a minimum of 2 documents of the author. Out of 561 authors, only 48 authors met the threshold. The 48 authors will still be counted for the number of documents, the number of citations, and the strength of the links. Later, a document with the most significant link strength will be selected. For each author, the first number represents the number of documents published over a ten-year range, the second number represents the citations, and the third represents the total link strength. In the bibliographic clutch, the authors are sorted based on the link strength obtained from the total number of documents in that author. The first rank is Tom Dieck M. C.M.C., who has nine articles, with 955 citations and 2962 link strengths. Then Jung has as many as eight articles, 652 sources, and 2230 links strength. They were followed by Chung N. with as many as four articles, 335 citations, and 1506 links strength. Then Jung Th [5:485:1344], Lee H. [3:108:1318], Han D.-I. [2:186:507], Han D.-id [2:22:417], Yung R. [3:272:359], Rau Schnabel pa [2:78:334]. This shows that authors collaborate with other authors in relevant fields so that they have a high link strength. For example, Tom Dieck has collaborated with seven writers: Chung N., Han D.-I., Jung T., Jung T.H., Lee H., and Rauschnable Pa. One of Tom Dieck’s articles, in collaboration with Jung T., is entitled “Enhancing art gallery visitor’s learning experience using wearable augmented reality” [35].

3.5 Bibliographic coupling of the institution

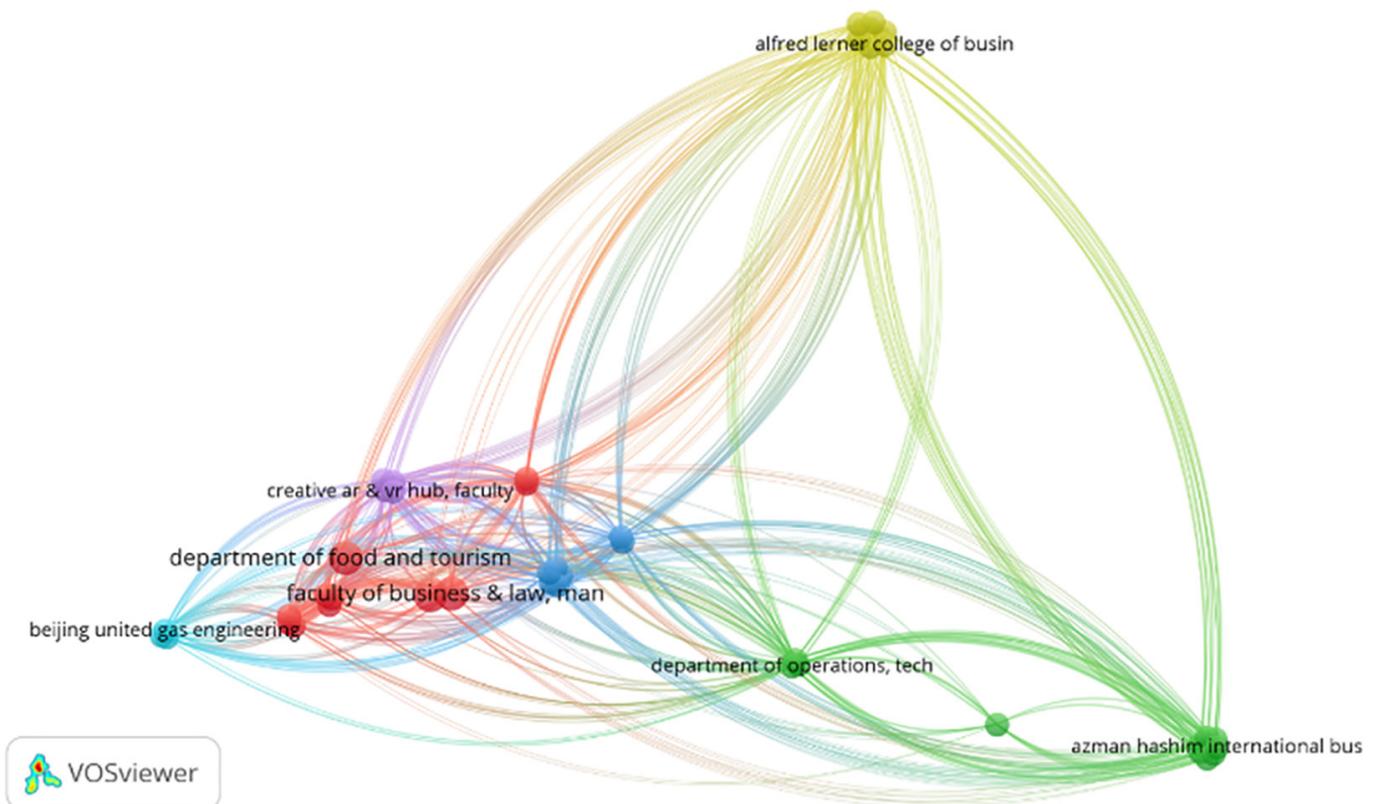


Fig. 5. Bibliographic coupling from the institution

The bibliographical clutch of the institutions is presented in Figure 4 with an overlay visualization. In bibliometric data, only institutions with a maximum of 25 institutions

per document and a minimum of 2 documents of an institution. Out of 352 institutions, only seven authors met the threshold. The seven institutions will still be calculated for the number of documents, the number of citations, and the strength of the link. Later, the institution with the most significant link strength will be selected. For each institution, the first number is the number of documents issued over a ten-year range, the second is the citations, and the third is the total strength of the links. In the bibliographical clutch, the institutions are sorted based on the number of documents issued each year—Kyung Hee University and Polytechnic di Milano with 5 documents, Universidad de Salamanca and Breda University of Applied Sciences with 4 documents. Manchester Metropolitan University carries the names of the authors Jung T. and Tom Dieck with 8 documents, Chung N. and Jung T.H. with 4 documents, and Lee, H. with 3 documents. The article with the most citations at Manchester Metropolitan University is entitled “The determinants of recommendations to use Augmented Reality technologies: The case of a Korean theme park”, with a total of 118 citations from 2015 [14]. Next, the Faculty of Business and Law has the highest number of citations with the author Tussyadiah entitled “Embodiment of Wearable Augmented Reality Technology in Tourism Experiences” with 132 citations and published in 2018 [8]. Lastly, Kyung Hee University has the highest number of citations (87 citations) with the title “Cross-Culture differences in adopting mobile augmented reality at cultural heritage tourism sites” published by Jung T.H. in 2018 [36]. Looking at the 3 writers who are most active in the field of augmented reality in the field of tourism, it is clear that Tom Dieck, Jung T., and Jung T.H., who are from different universities, have collaborated and explored the use of technology and its application in the tourism sector.

3.6 Bibliographic coupling of the countries

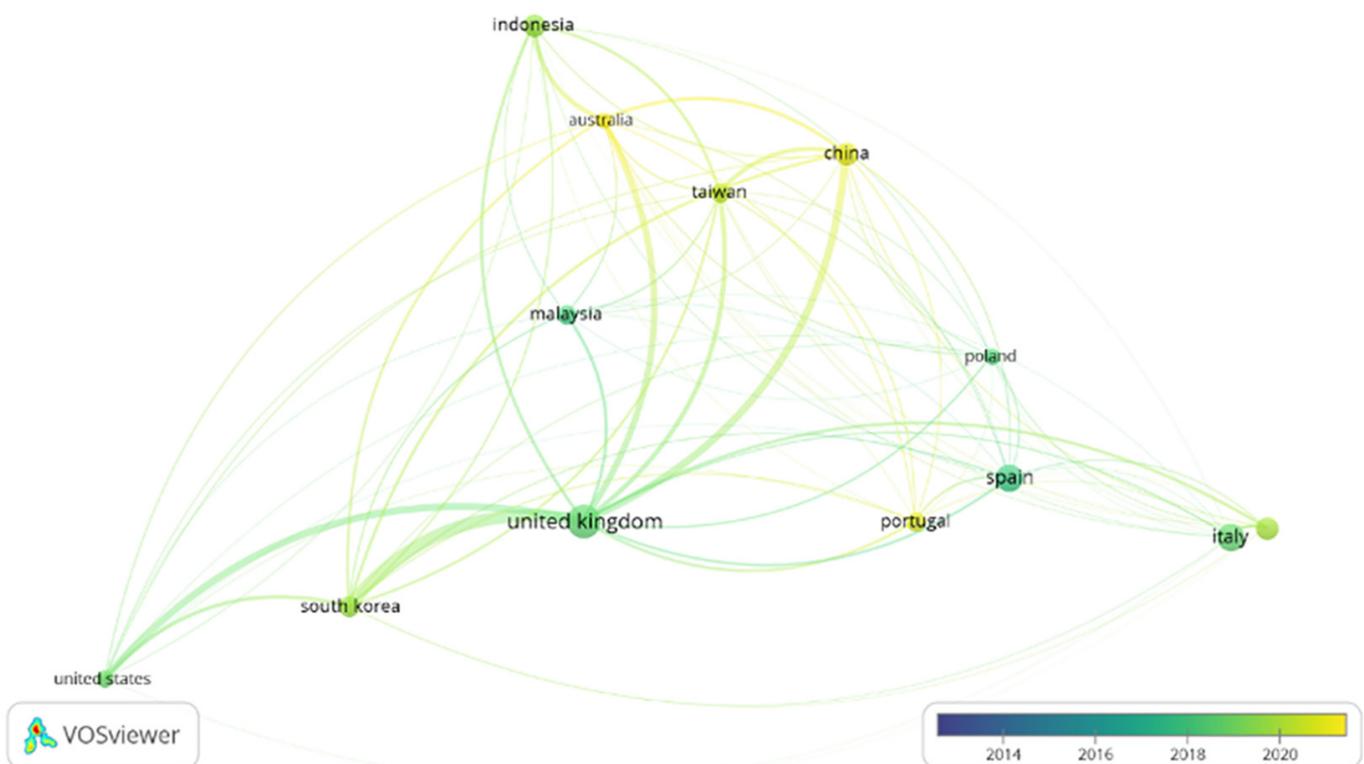


Fig. 6. Bibliographic coupling from the countries

The bibliographic coupling of the countries is presented in Figure 6 with an overlay visualization. In bibliometric data, only countries with a maximum of 25 countries per document and a minimum of 2 documents of an institution. Out of 53 countries, only 31 countries met the threshold. The 31 countries will still be counted for the number of documents, the number of citations, and the links' strength. In the future, institutions with the greatest link strength will be selected. For each country, the first number represents the number of documents published over a ten-year range, the second number represents citations, and the third represents the total strength of the link. In the coupling, the bibliography of the countries is sorted based on the number of documents published each year. First is the United Kingdom, with 32 documents, followed by Spain, with 21 documents [37].

3.7 Trends research augmented reality in tourism

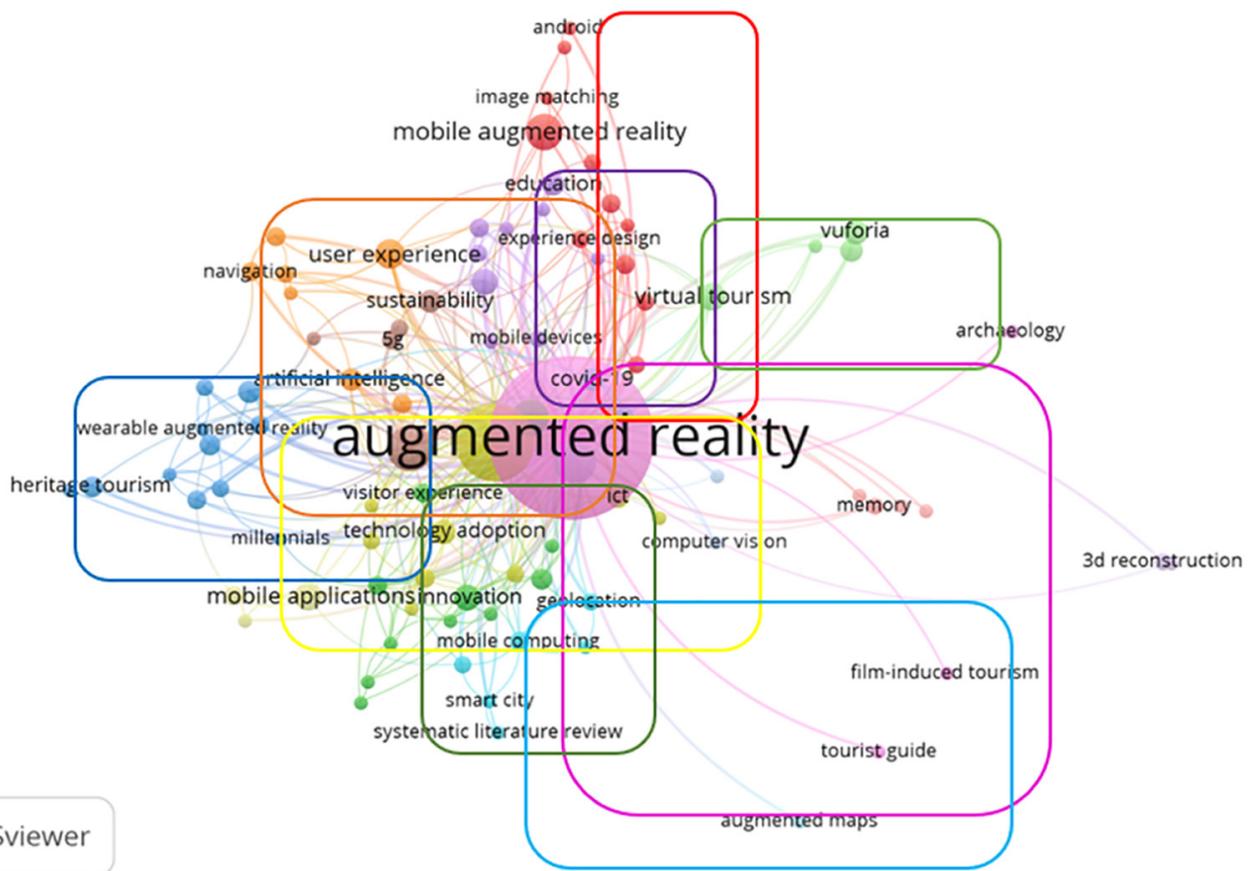


Fig. 7. Trends research in augmented reality

Figure 7 shows a network diagram of the relationship between the keywords given by the author. Figure 7 illustrates a map made of the most frequently used terms. These keywords are divided into 15 groups, as shown in the diagram. The most related keywords fall into one cluster when grouping in VOS viewer: 'Augmented Reality'. This indicates that all of these keywords are related to AR. Based on these keywords, the following are the fifteen closest grouping keywords (1) museums, (2) sustainable tourism, (3) heritage tourism, (4) technology adoption, (5) 3D models, (6) digital tourism, (7) ecotourism, (8) tourism marketing, (9) Augmented Reality, (10) satisfaction, (11) virtual tourism, (12) mixed reality, (13) tourist experience,

(14) 3D reconstruction, and (15) Augmented Maps. Based on the results of this grouping, presenting several proposals is the intention of the research for the development of Augmented Reality in the field of tourism such as the use of AR in underwater culture heritage, which is still little published, acceptance of AR in museum visitors by looking at the visitor experience, the use of artificial intelligence in e-tourism, development of virtual tours using Unity and Vuforia software, the impact of using digital tourism after the Covid-19 pandemic, the development of smart cities towards agriculture, and experience design applied to the development of immersive technology.

3.8 Potential research augmented reality in tourism

Based on Figure 7, there are several suggestions for conducting additional research on the development of augmented reality in tourism. Through overlay analysis using VOSviewer, several study patterns were found that have the potential for further research based on the themes that emerged. Breakthrough issues in this field show the potential for further research. Figure 8 illustrates the emerging research topics in this field by selecting the criteria of total link strength and occurrence. There are many possibilities for further study development that can be seen in the visualization, especially through the keywords used by the authors, as shown by the yellow nodes in Figure 8.

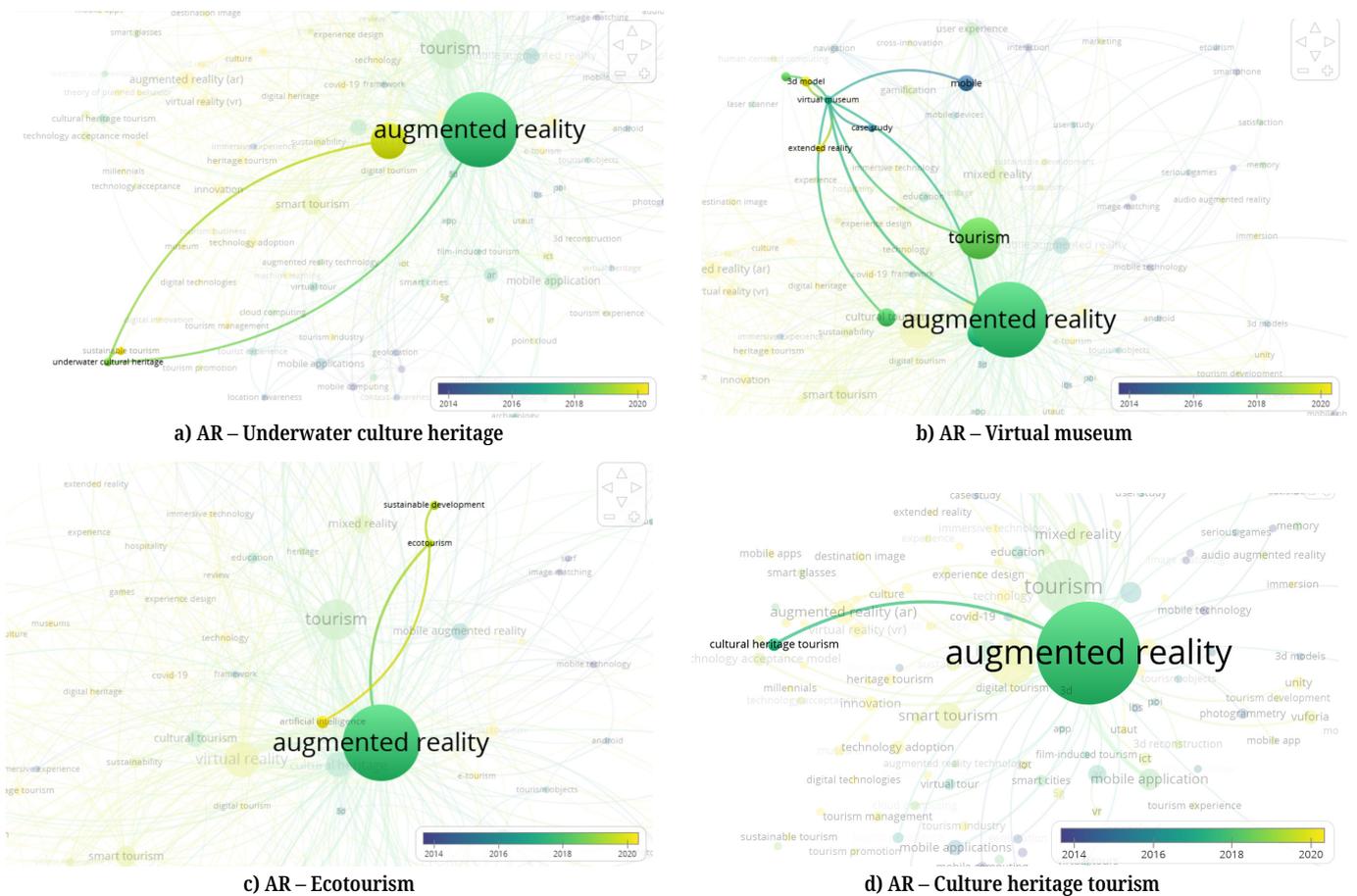


Fig. 8. (Continued)

2) *Virtual Museum*

A museum is a building where historical, scientific, artistic, or cultural objects are stored and exhibited [42]. The purpose of the development of the museum as a form of preserving regional culture is so that it is well documented and can be learned by future generations. Currently, the concept of a museum that has been developed is by displaying replicas of these objects or real, original objects. However, this concept requires further innovation. There are several conditions where visitors cannot always see the objects on display. Therefore, museums need to make innovations that are integrated with technology, such as the application of Augmented Reality and virtual reality [43].

Augmented reality can display information content in 3 Dimensional and 2 Dimensional forms, text or audio, and gamification. On the other hand, by using Augmented Reality, museums have implemented the concept of long-life learning where visitors do not have to come to the location but can explore using AR applications installed on smartphones when they want to learn about the museum. This can enhance the visitor experience [44].

Another advantage of implementing AR in museums is gaining digital interactivity capabilities, such as game features [45]. Providing a gaming experience increases visitors' interest and motivation and improves learning skills [46]. This follows research from Irene (2019), which states that visitors who use AR applications integrated with games feel more valued [44] [47].

Augmented reality can also overcome economic problems in museums still developing with low-income levels [48]. Using AR, of course, will attract tourists to come and study culture and experience the experience of using AR [49]. On the social side, increasing tourists coming to the museum will undoubtedly increase social interaction and a caring attitude toward the culture displayed [50].

In the future, the application of Augmented Reality can be developed for visitors with disabilities who have hearing or visual impairments by utilizing the audio-video feature to be involved in culture-based museum interactions.

3) *Ecotourism*

Articles discussing the development or use of Augmented Reality in ecotourism are still limited. However, several articles apply AR in agriculture, such as augmented reality technology is used to learn about the plants in the botanical garden by maximizing 2D and 3D graphics to enhance the botanical learning experience [51], the use of Augmented Reality to assist student learning in agriculture majors [52], the introduction of potential in agriculture to produce a new spatial dimension [53], the use of AR combined with other devices so that it can remotely monitor plants [54], to find out which plants are affected by pests but cannot be predicted by using the eye [55], as a means of conveying data to farmers related to autonomous machines, digitalization of viticulture, and the application of IoT that is overlaid with visualizations of crops [56].

Currently, AR is limited to assisting farmers in managing agricultural land. However, it has yet to be optimally utilized in agriculture within the tourism sector. For example, developing agricultural tour packages using Augmented Reality technology can allow tourists to enjoy scenic plantation landscapes and learn about planting, caring for, and processing agricultural products based on the area's potential. AR plays a crucial role in providing content on plant growth that cannot be observed rapidly and ensuring the sustainability of plant care practices when tourists return home. Incorporating AR into agricultural tour packages enhances tourist interest, contributes to the local community's economy, and improves gardening skills.

4) *Culture Heritage Tourism*

Based on UNESCO's definition, cultural heritage includes artifacts, monuments, groups of buildings and sites, and museums that have a diversity of values, including symbolic, historical, artistic, aesthetic, ethnological or anthropological, scientific, and social values, as well as tangible cultural heritage (movable, immovable, and underwater objects), intangible cultural heritage (ICH) attached to artifacts, sites, or monuments of cultural and natural heritage [57]. According to data from Scopus, 37 documents discuss using Augmented Reality in cultural heritage.

For example, some countries have applied AR to cultural heritage, such as research by Shan Jiang, who examined how Augmented Reality can improve memories of tourist experiences at the Great Wall of China's cultural site by applying a quasi-experimental design. This research aims to provide new understanding and insights from using Augmented Reality [58]. In China, Augmented Reality is used to popularize traditional musical instruments among young people and meet the interests of Chinese cultural tourists in an interactive form [59]. Furthermore, in Malaysia, the application of AR on historical buildings, namely Chenguang Temple, promotes ancient sites' culture and increases public awareness [60] or promotes traditional food in the area [61]. On the other hand, there is research on factors that can increase tourist interest, namely Performance Expectations, Social Influence, Facilitating Conditions, Price Value, and Habits that significantly affect individual Behavioral Intention to visit destinations [62]. Research on Culture Heritage in Tourism is yet to be done. Therefore, there is a need for research related to recommendations for what features can be applied using AR to increase tourist visits to cultural heritage [63].

5) *Digital Heritage*

Augmented Reality is considered a digital technology. According to Warschauer, digital technology involves using hardware, software, and digital infrastructure to acquire, store, manage, and communicate information [64]. Stamatios Papadakis argues that the use of digital technology has received positive responses from parents; however, there is a lack of "substantial educational value" for children's development [65]. The educational value can be applied to introducing digital heritage through Augmented Reality. By leveraging Augmented Reality, digital heritage initiatives can provide interactive and engaging experiences for visitors [66]. For example, museums and historical sites can use AR to overlay virtual information [67], such as historical context, 3D reconstructions, or multimedia content, onto physical objects or locations. AR enhances visitors' understanding and engagement with the cultural artifacts and sites they explore [49].

While there may be concerns about the potential overuse or lack of educational value in digital technologies for children, incorporating Augmented Reality into digital heritage can provide a balance by offering educational and informative experiences that foster a deeper appreciation and understanding of cultural heritage [68]. By harnessing the potential of Augmented Reality, digital heritage initiatives can create immersive and enriching experiences that bridge the gap between the physical and digital realms, providing educational value and fostering a sense of cultural appreciation. In conclusion, Augmented Reality is a significant component of digital technology, and when applied to digital heritage, it offers innovative ways to preserve, present, and educate audiences about cultural heritage.

6) *Destination Image*

Destination image refers to the perceptions, beliefs, and overall impressions individuals or groups hold about a specific tourist destination. The concept of destination

image relates to how the destination is understood, interpreted, and visualized in the minds and perceptions of potential tourists. The destination image can influence tourists' decision-making processes, interest in visiting a particular destination, and satisfaction during their visit [69]. Research specifically investigating the destination image facilitated by modern technologies such as Augmented Reality (AR) still needs to be completed. However, studies like the one conducted by Seng-Su Tsang have explored the factors influencing behavioral intentions in choosing travel packages. The findings of this research reveal that AR provides tourists with direct access to destination imagery, enhances the certainty of choosing group travel packages, and creates experiential value during the journey, thereby increasing behavioral intentions to select group travel packages [70].

Furthermore, studies have been conducted to examine the impact of AR technology on destination image and tourists' behavioral intentions. These studies demonstrate that AR can enhance tourists' interest in learning about historical sites. By leveraging AR, tourists can have more immersive and interactive experiences when visiting historical sites through visual reconstructions, multimedia content, or additional information provided through AR devices. Such utilization of AR technology can yield positive effects on the destination image, thereby influencing tourists' behavioral intentions to visit and delve deeper into these historical sites [60].

Although there are limitations in the current research exploring the relationship between AR and destination image, these studies highlight the potential of AR technology in enhancing destination image and tourists' interest. By creatively and effectively utilizing AR [71], tourist destinations can provide more engaging, informative, and interactive experiences for visitors [72], ultimately increasing awareness and appreciation of the destination.

4 CONCLUSION

In conclusion, this study has provided valuable insights into using Augmented Reality (AR) technology in the tourism sector and identified the associated trends from 2013 to 2022. Significant findings have been obtained through the application of bibliometric analysis using the Scopus database and VOSviewer software. The frequently identified keywords in AR research within the tourism field, such as museum, sustainable tourism, and heritage tourism, reflect the specific focus areas in this domain. Additionally, implementing AR technology in tourism was particularly emphasized in underwater tourism, the application of virtual museums, ecotourism, culture heritage tourism, digital heritage and destination image. Prominent journals, including *Sustainability* (Switzerland), *Current Issues in Tourism*, and *The International Journal of Human-Computer*, have played a crucial role in publishing and disseminating research on AR in tourism, contributing to advancing knowledge in this area. Collaboration among authors, exemplified by the active involvement of authors such as Tom Deck M. C., Jung T., and Chung N., has fostered the exchange of ideas and the field's growth. The United Kingdom, Spain, and Italy have emerged as leading contributors to AR research in the tourism sector, demonstrating their dedication to advancing the application of AR in the tourism industry.

While this study provides valuable insights into the current trends and advancements in AR utilization in tourism, it is essential to acknowledge the limitations. The time limitation of the study from 2013 to 2022 may have excluded more recent developments in AR technology. Additionally, the analysis was conducted based on the available data in the Scopus database, which may only encompass some relevant publications.

For future research, consider expanding the timeframe and incorporating more comprehensive databases to capture the latest trends and advancements in AR technology. Exploring emerging topics and technologies, investigating user experiences and perceptions of AR in tourism, and exploring the potential of AR in niche tourism segments are promising avenues for further investigation. Overall, this study provides a foundation for future research and development in AR in tourism while acknowledging the limitations and offering suggestions for further exploration.

5 ACKNOWLEDGMENT

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