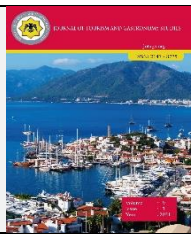
JOURNAL OF TOURISM AND GASTRONOMY STUDIES

ISSN: 2147 – 8775

Journal homepage: www.jotags.org



Augmented Reality Technologies From the Tourist Perspective: A Systematic Review

Burhan SEVİM [a], ***Gürkan ÇALIŞKAN** [a]

[a] Kastamonu University, Faculty of Tourism, Department of Tourism Management, Kastamonu/Turkey

Article History

Received: 13.06.2021

Accepted: 03.09.2021

Keywords

Augmented reality

Technology

Tourism

Tourist perspective

Scopus

Article Type

Conceptual Article

Abstract

Augmented reality technologies that have become widespread in the tourism sector are also among the innovations that have increased in recent years. Augmented reality is technologies that reflect the real world. The most important usage area in tourism is cultural heritage. The possibilities of using augmented reality technologies in tourism, their current situation, future, and tourists' value are discussed in this study. A systematic compilation method was used, and a "title-abs-key" search was done in the Scopus database. 238 studies have been reached. Accessible 181 articles on tourism were evaluated in the general findings section of our study. Thematic analysis was applied to 58 studies that selected tourists as samples. Seven themes have been identified. The findings of our study show that tourists have a positive approach to augmented reality technologies. It has been found that these technologies increase the quality of the tourists' experience and the purchasing and repeat visit intentions of the tourists.

***** *Corresponding Author*
E-mail: gcaliskan@kastamonu.edu.tr (G. Çalışkan)

DOI:10.21325/jotags.2021.851

INTRODUCTION

Augmented reality is not just a virtual world. It is the technology in which virtual objects are combined with real objects and images (Krevelen & Poelman, 2010, p. 1). Users can interact with this technology. Therefore, it should be perceived as different from virtual reality Technologies (Azuma, Bailot, Behringer, Feiner, Julier & MacIntyre, 2001). Virtual elements created in the computer environment can be added to the real world view (Do, Shih & Ha, 2020, p. 1). Thus, we can see and feel objects, animals, and places that we have not seen before in the real world.

Augmented reality technologies can be used as location-based or image-based. Location-based applications include obtaining digital information about the environment via GPS. This information can be about the location, accommodation businesses, historical sites, touristic areas, and restaurants. These applications can be used with a phone or a portable computer (Smirnov, Kashevnik & Ponomarev, 2017, p. 298). Augmented reality applications also include wearable devices or area-based applications (Krevelen & Poelman, 2010, p. 4). 3D and augmented visuals of a place or an object can be seen with a wearable device. Besides, users can interact with the device through physical movement, vision, and speech (Hammady, Ma, Strathern & Mohamad, 2020, p. 3474). Area-based applications involve the projection of the visual of a specific area or surface (Recupero, Talamo, Triberti & Modesti, 2019).

Augmented reality technologies are used in many different areas of tourism. Businesses in the service sector can apply alternative innovations to gain a competitive advantage (Uygur, Öğretmenoğlu & Çalışkan, 2019, p. 3009). Augmented reality applications can be help increase the attractiveness of tourism destinations and products and marketing and promotional activities (Ozdemir, 2021). In the relevant literature, it is seen that an application is designed especially in the cultural heritage and presented to the experience of tourists. Durand, Merienne, Pere and Callet (2014) developed and tested an application for cultural heritage, and Pendit, Zaibon and Abubakar (2015) examined the usability level of digital media in heritage sites.

Roongrungsi, Namahoot and Brückner (2017), Dijaya and Suprayitno (2018), and Jung, Nguyen, Piscarac and Yoo (2020) examined the cultural heritage experience through augmented reality technology. Han, Dieck and Jung (2019) discussed visitor adoption of smart glasses. Graziano and Privitera (2020) developed an augmented reality-based smart tourism project for cultural heritage. When the tourists' views on augmented reality applications were examined, it was found that the technology acceptance levels were positive, and the applications increased their experience and visit quality.

Dieck and Jung (2017), Recupero et al. (2019), Hammady et al. (2020), and Kaghat, Azough, Fakhour and Meknassi (2020) examined the use and experience of augmented reality in museums. Studies have revealed that technologies can be used in museums and positively affect visitors' experiences.

Kourouthanassis, Boletsis, Bardaki and Chasanidou (2014), Kourouthanassis, Boletsis and Lekakos (2015), Tahyudin, Saputra and Haviluddin (2015), Koo, Kim, Kim, Kim and Cha (2019), and Flores, Dolores, Cayabyab, Palaoag, Angeles, Corpuz and Mamaril (2019) examined the mobile augmented reality experience of tourists. Kourouthanassis et al. (2014) and Koo et al. (2019) discussed an augmented reality application that can be used on tours. Kourouthanassis et al. (2014) examined a travel guide called CorfuAR, which supports personalized behavior. Kourouthanassis et al. (2015) and Tahyudin et al. (2015) examined an interactive mobile augmented reality

application. Flores et al. (2019) aimed to develop a application that offers innovation, information, portability, and performance. The studies show that the experiences of the tourists are positively affected.

Shin and Jeong (2021) aimed to determine the motivating factors in travelers to adopt augmented reality applications at tourism destinations. The results of the study show that utilitarian and hedonic motivations affect attitudes towards augmented reality applications. Wu and Lai (2021) aimed to determine the factors affecting the acceptance of the augmented reality application by movie tourists. According to the findings of the study, performance expectation and personal innovativeness affect behavioral intention. Chiu, Wei, Lee and Lu (2021) discussed the production and design of mobile materials for cultural heritage tourism. The findings revealed that the experimental group's learning outcomes were more positive. Yin, Jung, Dieck and Lee (2021) examined tourists' needs and attitudes towards participation in mobile augmented reality applications. The study findings indicate that the applications should be designed according to the tourists' needs and that they should be included more in the processes.

Studies are examining different usage areas of augmented reality technologies in tourism. However, studies examining the place of augmented reality technologies in tourism, their usage levels, and tourists' perspectives are limited (Cranmer, Dieck & Fountoulaki, 2020; Lacka, 2020; Little, Bec, Moyle & Patterson, 2020; Liang & Elliot, 2020). This study discussed using augmented reality technologies in tourism, the future, and tourists' perspectives. The main questions of our research are as follows:

- Are the augmented reality technologies suitable for the tourism industry?
- What is the purpose of using augmented reality technologies in tourism? Where is it used?
- Can augmented reality technologies be adopted by tourists?
- Can augmented reality technologies contribute to the tourist experience?
- What is the current state of the technologies in the tourism literature?

Augmented Reality

The first augmented reality prototype was presented in the 1960s by Ivan Sutherland. This prototype featured transparent 3D graphics (Sutherland, 1968, p. 759-760). The first study in which the term augmented reality was used was presented in the early 1990s. This study, which developed an experimental augmented reality system to connect cables, was conducted by Caudell and Mizell (Caudell & Mizell, 1992, p. 660). An early prototype for mobile augmented reality was presented by Feiner, MacIntyre, Höllerer & Webster (1997). The prototype includes a mobile augmented reality system that records buildings and artifacts.

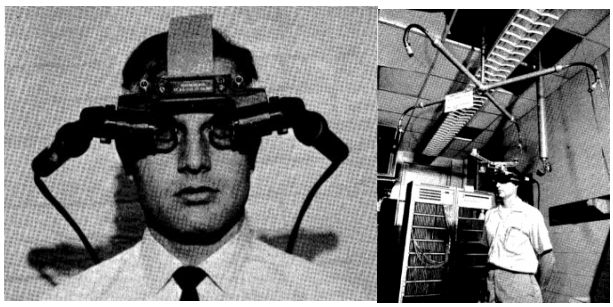


Figure 1. The world's first head-mounted display (Sutherland, 1968, p. 759-760)

Milgram and Kishino (1994) defined augmented reality technologies as a part of mixed reality in their studies and put forward the concept of virtual continuity. The real environment and the virtual environment are shown at opposite ends. Mixed reality has been described as a mixture of virtual and real environments (Figure 2).

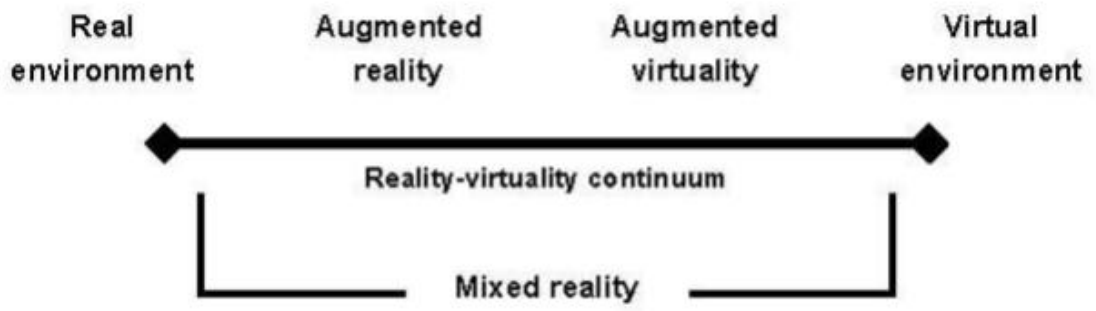


Figure 2. Reality-Virtuality (Source: Milgram and Kishino, 1994)

Benford, Greenhalgh, Reynard, Brown and Koleva (1998) classified augmented reality technologies separately from virtual reality technologies. According to Benford et al., an area's artificiality can change according to how much it belongs to the synthetic or physical world. While video technologies contribute to capturing and reproducing physical scenes, 3D graphics contribute to abstract scene synthesis (Figure 3).

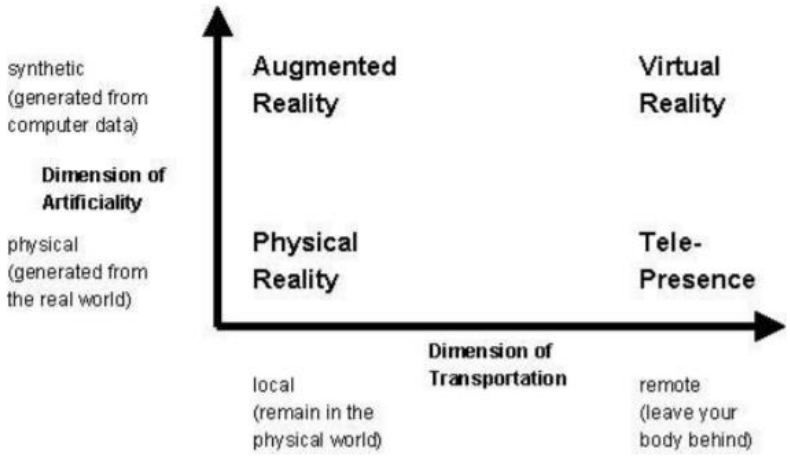


Figure 3. An area's artificiality **(**Source: Benford et al., 1998)

Augmented reality technologies are not limited to display technologies. It is a technological process that can interact with the physical world and includes all senses such as smell and touch (Krevelen & Poelman, 2010, p. 1). In other words, augmented reality technology can be described as a set of technological components that support the real world with virtual objects, objects, images, or senses.

Method

We aim to discuss the application and future of augmented reality technologies in tourism and tourists' perspectives. First, studies examining the augmented reality issue in tourism have been identified. The identified studies were analyzed by the systematic review method. Systematic reviews are an analysis method in which studies conducted in a specific subject or field are examined in detail. The inclusion and exclusion criteria are used in the analysis process, and the findings are synthesized (Bown & Sutton, 2010, p. 675; Gough, Thomas & Oliver, 2012, p. 1). This review approach is mostly preferred in health sciences (Bastian, Glasziou and Chalmers, 2010; Moher,

Shamseer, Clarke, Ghersi, Liberati, Petticrew, PRISMA-P Group, 2015), but its use in social sciences increases day by day (Littell, 2006, p. 535; Petticrew & Roberts, 2006, p. 20). It is not yet used extensively in tourism studies (Carter, Thok, O'Rourke & Pearce, 2015, p. 800).

The systematic analysis method used in the study includes the steps suggested by Berrang-Ford, Ford and Paterson, (2011) and Berrang-Ford, Pearce and Ford (2015). Secondary data were used in the study. The Scopus database was used because it is an up-to-date, powerful, widely used, and comprehensive database for interdisciplinary literature (Falagas, Pitsouni, Malietzis and Pappas, 2008, p. 341). "TITLE-ABS-KEY" has been scanned in the database ["TITLE-ABS-KEY ("augmented reality" AND ("travel" OR "tourism" OR "tourist" OR "hospitality" OR "leisure")].

The screening took place in October 2020. 238 studies were reached. It was determined that 39 studies were not related to tourism, and 1 study did not contain augmented reality technology. 17 studies could not be accessed. As a result, 181 accessible articles on tourism were included in the analysis. In the general findings, the publication years of the article, published journals, authors, keywords, examples, and the purposes and usage areas of augmented reality technologies were examined. MAXQDA program was used in the analysis of the data. Maps were created using "MAXMaps" in the program. 58 studies examining tourist behavior and perceptions were determined in the second stage, and thematic analysis was conducted. The studies are divided into 7 themes according to their fields of study. The flow chart used to collect data in the study is shown in Figure 4.

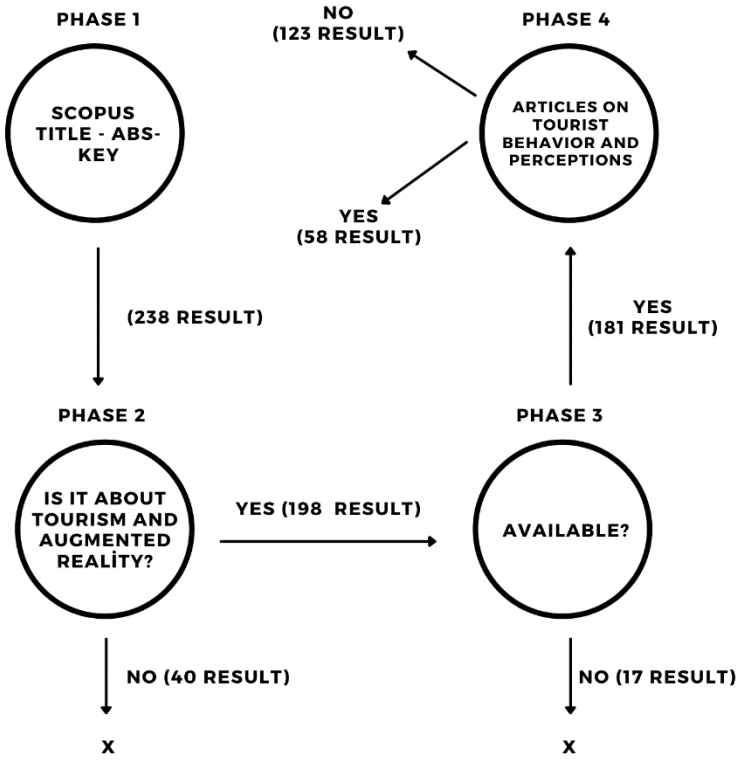


Figure 4. Flow Chart for Obtaining Data (Source: own elaboration)

Findings

The findings were analyzed under two headings: general findings and studies examining tourist behavior.

General Findings

The general findings include the publication years of the articles, journals, authors, samples, keywords, and the purposes and areas of augmented reality technologies.

Table 1. The Publication Years

Year	Frequency	%
2019	50	27,62
2020	33	18,23
2018	30	16,57
2017	20	11,05
2016	13	7,18
2015	12	6,63
2014	11	6,08
2012	4	2,21
2013	3	1,66
2010	2	1,10
2021	2	1,10
2003	1	0,55

It is seen that studies examining augmented reality technologies in tourism have increased in recent years. Most articles (n = 50) on this subject were published in 2019. This year is followed by 2020 with 33 articles and 2018 with 30 articles. The number of research is likely to increase in the coming years (Liang & Elliot, 2020, p. 7). Since the data were collected in October 2020, there was not enough data for 2021 (Table 1).

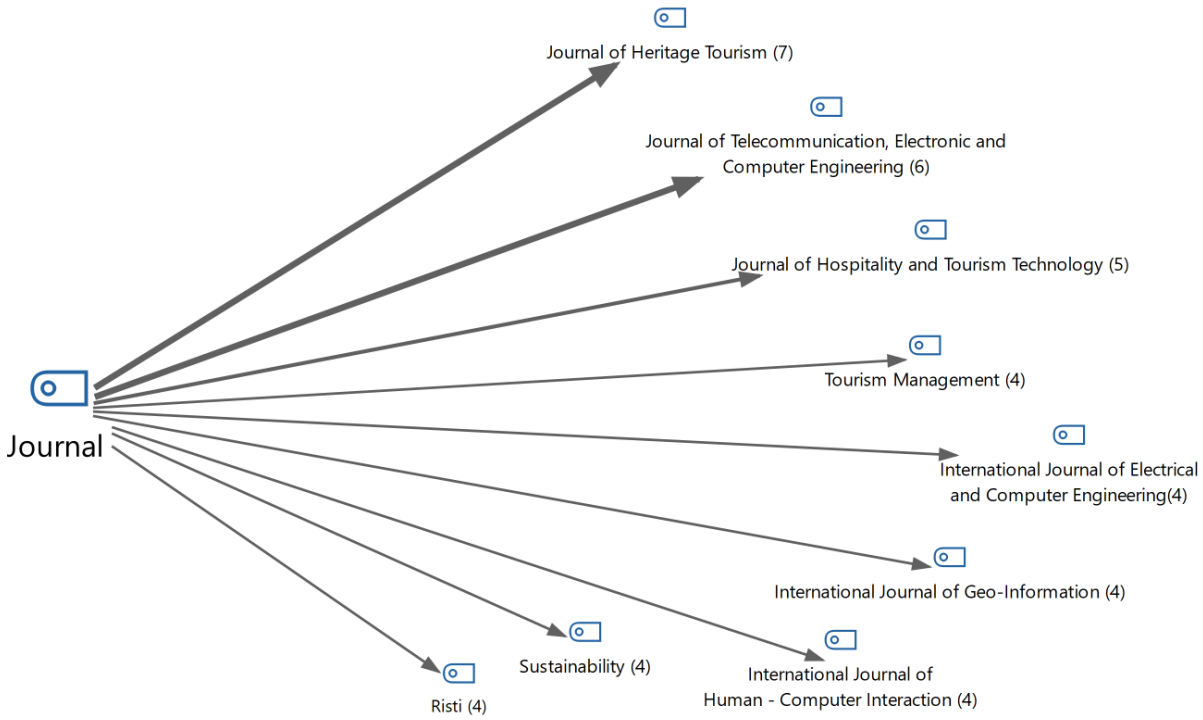


Figure 5. Most Publishing Journals (Top 9)

One hundred eighty-one studies have been published in 117 different journals. The most published magazine with seven articles is the "Journal of Heritage Tourism." The second place is the journal of "Journal of Telecommunication,

Electronic and Computer Engineering" with six articles. The third place is the "Journal of Hospitality and Tourism Technology" with five articles (Figure 5).

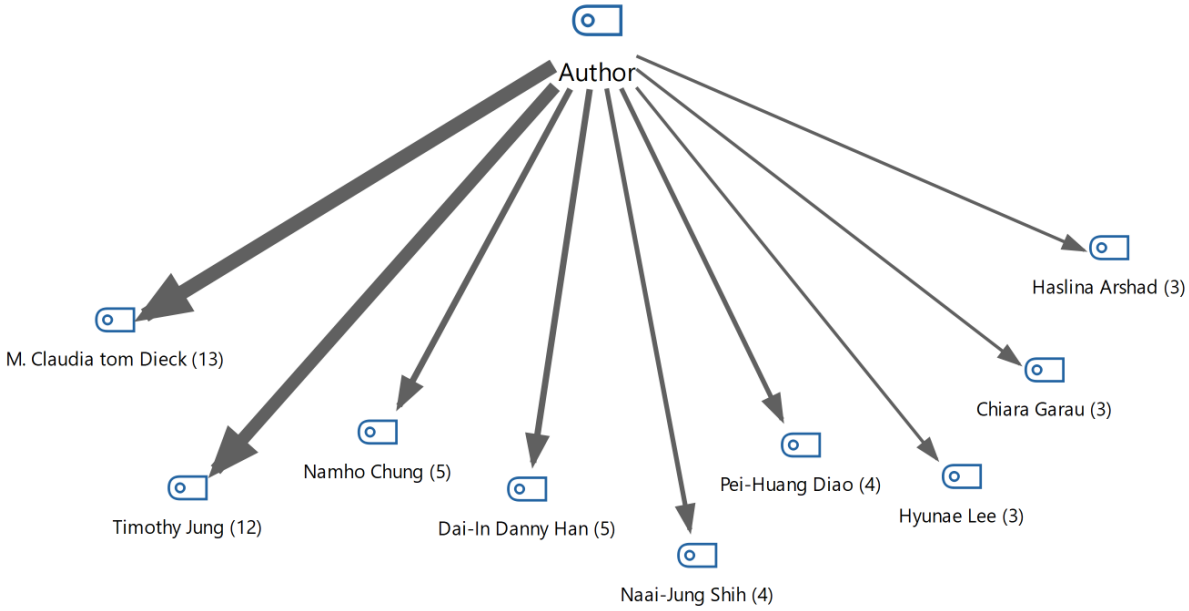


Figure 6. Most Publishing Authors (Top 9)

It is seen that there are 501 authors in the articles. The author with the most publications with 13 studies is "M. Claudia tom Dieck." Second place was "Timothy Jung" with 12 studies. "Namho Chung" and "Dai-In Danny Han" take third place with five works each (Figure 6). If researchers examine the augmented reality-tourism relationship, it would be useful to examine these authors' studies.

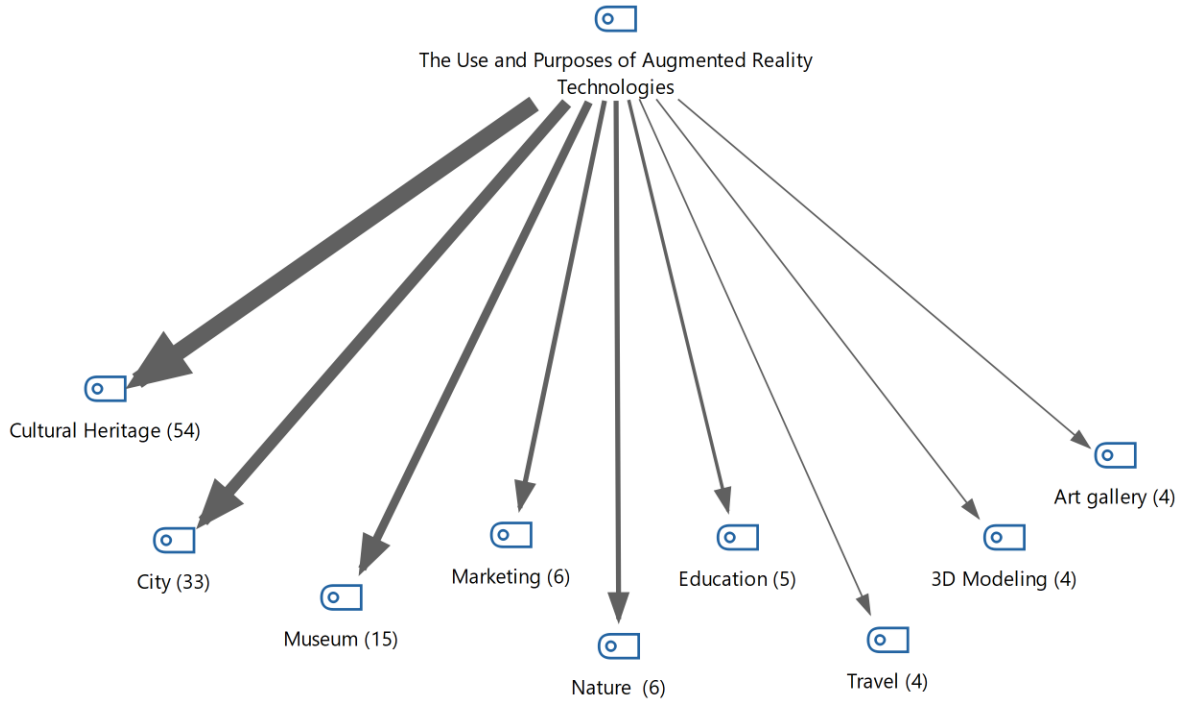


Figure 7. The Fields and Purposes where Augmented Reality Technologies are Most Used (Top 9)

Forty-two different uses and purposes of augmented reality technologies in tourism have been identified. The most study area is "cultural heritage," with 54 articles. The second is "city" with 33 articles, and the third is

"museums" with 15 articles (Figure 7). Based on related studies, it can be said that augmented reality technologies can be widely used in the field of tourism. These technologies can be used to protect cultural heritage and increase tourists' experience quality (Durand et al., 2014; Pendit et al., 2015; Roongrungsi et al., 2017; Dijaya and Suprayitno, 2018; Han, Jung & Dieck, 2019). It can be predicted that these technologies will be more associated with the tourism sector soon.

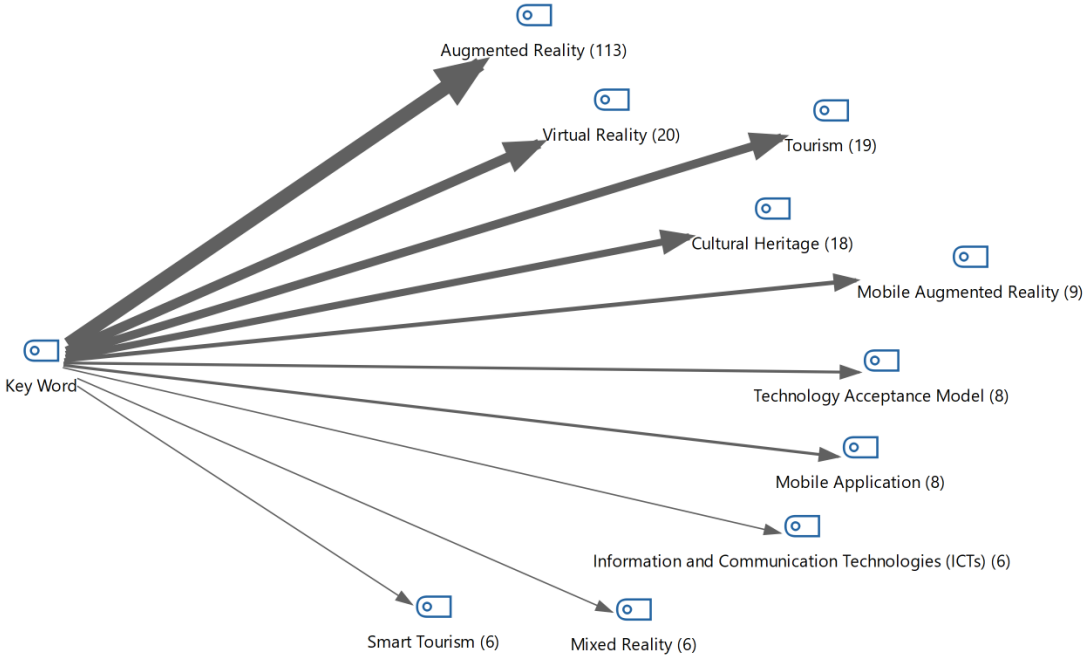


Figure 8. Most Used Key Words (Top 9)

Five hundred eighty-seven different keywords were used in the studies. It is seen that the most used keyword is "Augmented Reality," with 113 repetitions. It is seen that the second most repeated word is "Virtual Reality" with 20 repetitions, and the third is "Tourism" with 19 repetitions (Figure 8). It is seen that the articles examined are suitable for the scope of the study.

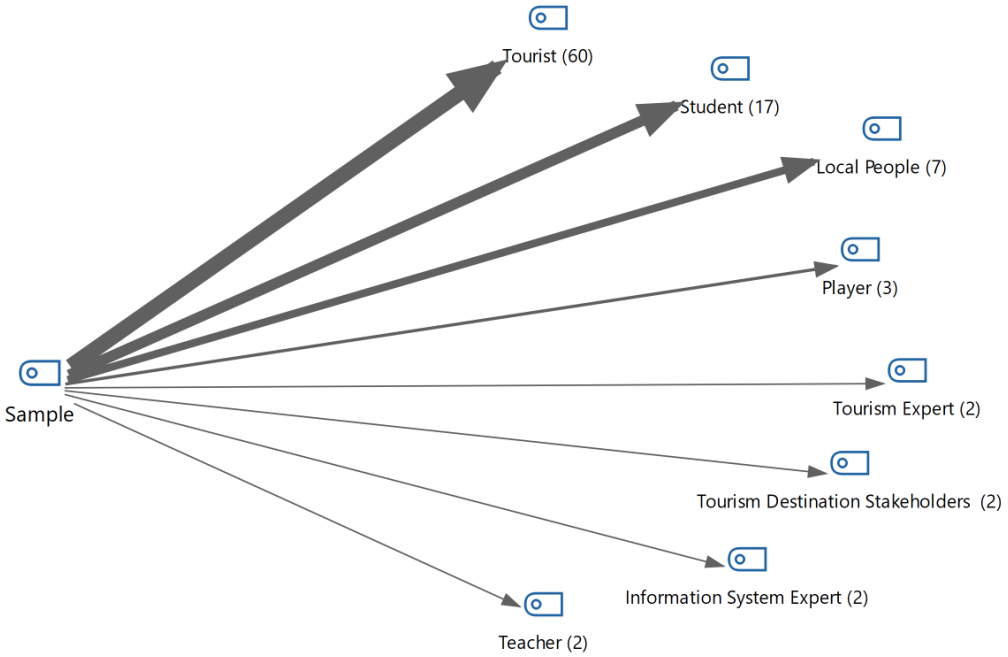


Figure 9. Most Used Samples

It is seen that the most chosen population for the sample is tourists with 60 repetitions. Students follow the tourists with 17 reps and locals with seven reps (Figure 9). These data show that tourist behavior and perceptions were chosen as a research topic or problem.

Studies Examining Tourist Behaviors and Perceptions

In this section, 58 studies examining tourist behavior and perceptions were identified, and thematic analysis was conducted. The studies are divided into seven themes according to their fields of study. Themes are as follows; purchase intention, intention to visit again, changes of attitude, technology acceptance, cultural heritage, museum/art gallery, and experience. The number of articles included in the themes is shown in table 2.

Table 2. Number of Articles Included in Themes

Themes	Article Number
Purchase Intention	3
Intention to Visit Again	6
Change of Attitude	7
Technology Acceptance	11
Cultural Heritage	12
Museum / Art Gallery	6
Experience	13

According to table 2, the Experience theme is the one with the most articles. It can be deduced that studies examining tourists focus on tourist experiences.

Purchase Intention

He, Wu and Li (2018) examined how augmented reality technologies can help willingness to pay in museums. The study's findings show that dynamic verbal cues positively affect visitors' voluntariness to pay more.

Do et al. (2020) stated that mobile augmented reality application features encourage tourists to buy. It has been determined that the users' perceived enjoyment and satisfaction affect the benefit, ease of use, and interaction of the application. Thus, it leads to buying behavior with a stronger impulse. Huang (2021) investigated the psychological dimension that encourages purchasing behavior in his travel experiences. It has been determined that augmented reality applications strengthen tourists' environmental awareness, and thus tourists are willing to pay more.

It has been determined that augmented reality applications positively affect purchasing behavior. Applications can be an income-increasing factor in tourism.

Intention to Visit Again

Chung, Han and Joun (2015) analyzed tourists' intention to use augmented reality apps, the factors that encourage tourists, and how tourists perceive the apps. The elements that encourage tourists are as follows; technology readiness, visual and situational factors. The study's findings show that the technology readiness factor is an important factor and the attitude to use augmented reality applications affects a destination visit.

Oh, Park and Oh (2018) examined the effects of augmented reality technologies on sports tourists. It was seen that augmented reality technologies had a positive effect. Dieck, Jung and Rauschnabel (2018) examined the effects of augmented reality technologies on education, aesthetics, escape, entertainment experience, and visitor satisfaction. The findings show that the experience affects satisfaction, memory, and visitors' intentions.

Fusté-Forné (2020) examined the development of cultural heritage, virtual technology, and tourism in the Vall de Boí region. The study revealed that cultural heritage could be preserved with the help of technology, the missing parts of buildings can be displayed, and encourage tourists to visit again.

Jung et al. (2020) examined the perceptions of cultural heritage visitors to visualization technology. Visualization technology's ease of use affects the visit intention.

Lacka (2020) studied the effect of location-based games on the intention of visiting. The study results reveal that the game's information has a significant effect on visiting intentions.

Related studies reveal that augmented reality technologies have a positive effect on tourists' repeat visit intentions. It was emphasized that ease of use and quality of experience are important factors.

Change of Attitude

Kourouthanassis et al. (2014) has presented a travel guide called CorfuAR that supports personalized recommendations. CorfuAR is a augmented reality application. Findings show that tourists are satisfied with the functional features.

Tahyudin et al. (2015) offer an interactive mobile application for promotion. Most of the targeted users were excited while using the application. Tahyudin and Saputra (2017) evaluated the performance of the mobile augmented reality application. The participants were satisfied and enjoyed using the application.

Jung, Chung and Leue (2015) used a quality model. A model is used to test satisfaction and augmented reality applications' suggestion intention. The study's findings showed that *"the personalized service, content, and system quality affected satisfaction and the intention."*

Chung, Lee, Kim and Koo (2017) studied the effect of augmented reality technologies on behavioral intentions and customers' attitudes. The study's findings show that augmented reality technologies' perceived advantage and aesthetics affect satisfaction and behavioral intention.

Jiang, Scott and Tao (2019) studied the augmented reality experiences of visitors at Jiang Shangri-La Potatso National Park. The study's findings show that augmented reality experiences can increase the perceived value, quality of experience, and tourists' social perception.

Wu, Chiu and Chen (2020) examined the relationships between external factors, technology perceptions, users' attitudes, behavioral intentions, and augmented reality technology experiences. Factors affecting users' behavioral intentions were determined in the study. These; visual elements, ease of use, content diversity, the friendly atmosphere, and the staff's help.

Certain criteria are required to be successful in augmented reality applications and to influence tourists. These; refer to the functional features, contents, personalized services, system quality, ease of use, perceived advantage, and aesthetics of the application.

Technology Acceptance

Achieving success in augmented reality applications is only possible if the target users accept and adopt the innovation.

Chu, Lin and Chang (2012) and Fukada, Kasai and Ohtsu (2015) emphasize two titles for adopting technology in augmented reality applications. These; functionality and ease of use. Chu et al. (2012) discussed the implementation of Yehliu Geopark mGuiding. The application was redesigned according to the preferences of the tourists. The application's new features are; a clear Geopark map, a global positioning system, and a user-friendly guide interface.

Fukada et al. (2015) proposed a tourism information system used with augmented reality. In the findings of the study, it was stated that ease of use creates a positive impression on tourists. It was underlined that tourists are ready for technology acceptance.

Yovcheva, Buhalis and Gatzidis (2014), Obeidy, Arshad and Huang (2018) and Han, Dieck and Jung (2019) discussed how augmented reality applications should be designed for user acceptance. Yovcheva et al. (2014) adopted a user-centered design approach. They examined how tourists were able to learn about the urban environment using augmented reality scanners. The findings of the study reveal two important points that should be taken into account in the design. These; visual clarity and readability of physical objects.

Obeidy et al. (2018) examined the smart glass-based augmented reality application named "TouristicAR." They aimed to identify the application's group experiments, user acceptance factors, and specific touring needs. The research findings reveal that the application must be interactive and user-oriented to be used by tourists. Han et al. (2019) evaluated the design process of augmented reality applications. They examined the importance of users' psychological and behavioral indicators. The findings of the study show that user experience should be given importance while preparing applications.

Abidin, Arshad, Shukri and Ling (2018) proposed a location-based application. The application utilizes an interactive multi-modal interface for Islamic tourism. The application was perceived positively by the tourists. Park and Stangl examined the augmented reality application experiences of travelers. The findings of the study show that the applications should be designed for a specific travel group.

Siang, Aziz and Ahmad (2016) studied tourists' intention in Melaka to use the augmented reality mobile app. The gender softening effect was discussed. Findings showed that female tourists had higher levels of performance and game expectation. Aziz, Tan and Ahmad (2017) developed a holistic solution proposal for the iMelaka 360 Project. The proposal was developed to increase the competitiveness and strengthen local tourism. The findings revealed that innovative, holistic, and interactive virtual and augmented reality technologies could be an important tool in competitiveness.

Paulo, Rita, Oliveira and Moro (2018) studied a mobile application in tourism. The findings show that these services provide efficiency and convenience. Rončević, Gregorić and Horvat (2019) examined the possible reactions of potential tourists to new promotional channels. The findings of the study showed that potential tourists are ready to adopt new promotional methods.

Hausmann and Schuhbauer (2020) discussed the information communication technologies used by visitors. The findings of the study reveal that visitors often use websites or multimedia stations. Other information and communication technologies are hardly used at these stages. This result shows the importance of the website.

Some factors need to be considered in augmented reality applications. These factors are important for tourists' acceptance and use of applications. These; functionality, content, ease of use, and user-oriented design of

applications. Besides, tourists displayed positive attitudes towards augmented reality applications. Studies show that augmented reality applications can be developed more and can be used widely in tourism.

Cultural Heritage

Durand et al. (2014) presented an application using realistic photometric visuals. The application was used to immerse participants in the virtual world. These devices are efficient. The guiding profession became more descriptive, and visitors were moreable to enjoy the cultural heritage.

Pendit et al. (2015) examined digital media availability in heritage sites. It has been found mostly in traditional media types such as leaflets, brochures, and books rather than digital media. It was suggested that technologies such as personal stereo-guided tours, virtual reality, and augmented reality applications should be used.

Roongrungsi et al. (2017) studied the ARCH-TOUR application. It has been determined that the users' feedback is very satisfying and motivated to learn more about the temple. Dijaya and Suprayitno (2018) studied an interactive experience. The study show that the quality of the tourists' experience has increased.

Han et al. (2019) examined visitor adoption of smart glasses in cultural tourism. The study's findings show that a holistic approach should be used for its adoption and social acceptability is a significant factor.

Graziano and Privitera (2020) examined the perceptions of technological development and augmented reality application of tourism stakeholders. The findings of the study show that the opinions of the stakeholders are important. The augmented reality application could offer a different opportunity to develop the tourism industry, explore cultural heritage, and increase visitors' number.

Jung, Lee, Chung and Dieck (2018) examined the aesthetic and hedonic features of the augmented reality used in cultural tours. It was stated that aesthetics strongly affect perceived enjoyment, and cultural differences must be understood when developing the tourism industry's applications.

Koo et al. (2019) discussed the development, design, and evaluation of an application for a tour guide. The findings of the study reveal that the proposed device-assisted tour mechanism improves the tourists' experiences. Flores et al. (2019) aimed to develop a application that offers innovation, information, efficiency, and portability. The results of the studies show that the experiences of the tourists are positively affected. Chiu et al. (2021) studied the production and design of mobile materials for cultural heritage tourism. Experimental and control groups took part in the study. The mobile application developed was applied to the experimental group. The findings revealed that the experimental group's learning outcomes were more positive.

Tsai and Lee (2017) proposed using a crowdsourced strategy to preserve cultural history and educate people through universal participation. A gamified navigation system has been developed within the scope of the study. It was stated that the developed system could positively affect the sustainable development of cultural heritage and increase awareness.

Hta and Lee (2020) discussed an interactive augmented reality application on Myanmar's cultural heritage. It has been found to provide an interactive and immersive experience for users and effectively preserve cultural heritage.

It is stated that augmented reality applications can be used in cultural tours. The cultural heritage experiences of tourists can be increased through these practices. The applications have been used more widely recently. It can be an important tool for the sustainability.

Museum / Art Gallery

Dieck, Jung and Han (2016) examined the possibility of using wearable technology. They examined the needs of the visitors in art gallery and the museum. It has been stated that wearable augmented reality technology is still in its infancy. Technical and design problems are important factors for adoption. It was emphasized that content, functionality, comfort, and experience are important in these applications.

Dieck and Jung (2017) examined the perceived value of augmented reality application in museums. The study was carried out in a small museum in the UK. The findings reveal that the application can preserve history, increase visitor satisfaction, and contribute to learning experience.

Dieck et al. (2018) conducted a study of the visitors to the art gallery. The findings reveal that the wearable application helps to personalize the visitor experiences.

Recupero et al. (2019) examined the visitor's tour experience. The findings show that virtual and augmented reality integration based on temporal metaphor can promote an unforgettable tourism experience. These technologies need to be designed according to the characteristics of museums.

Hammady et al. (2020) discussed the design of a new museum guidance system. Their findings reveal that the mixed reality technology-based tour guide system is seen as positive and functional.

Kaghat et al. (2020) proposed augmented reality as a new immersion and stimulation system for the museum. The study findings show that the system is usable. This technology can be used as an excellent information tool in the museum.

It is seen in related studies that applications can be used in museums and art galleries. These technologies increase the quality of the visitors' experience. It contributes to the protection of the artworks. In this context, these technologies can be used more in museums.

Experience

Kang (2013) examined the levels of interest and awareness of the users. In the study, an application called AR Teleport was examined. Motion-based interactions can be experienced with the application. The findings show that the application has a positive effect on experiencing culture and history.

Kourouthanassis et al. (2015) proposed design principles. Principles is used to applications. The study show that the proposed principles can be used in practice. It is seen that an interactive application evokes positive emotions in users.

Garcia-Crespo, González-Carrasco, López-Cuadrado, Villanueva and González (2016) presented a framework for building cloud-based mobile augmented reality using real-time interaction. The proposed framework includes new elements such as route planning, gamification, geographic location. Thus, the application can be integrated into the smart city environment and improve the user experience. Lee, Chen and Su (2017) presented a cloud-based mobile

augmented reality system that can be accessed via a theme park entrance ticket. The findings of the study show that the application becomes visualized and interactive. Interactive applications are stated to have a positive effect on travel experiences.

Chung, Pagnini and Langer (2016) studied the navigation system of applications. Suggestions have been developed to reduce system errors and improve the quality of experience. The overall experience will increase when the application is user-controllable. Chiu and Lee (2018) wanted to develop a navigation application that could be used on a smartphone or tablet computer. The application can be used to promote arts and cultural activities. Hsieh, Jylhä, Orso, Andolina, Hoggan, Gamberini and Jacucci (2019) enabled motion interaction with real-world landmarks. They studied the connection between people and their environment. Their findings show that the interaction technique facilitates visual attention to the environment, and provides high mobility.

Tussyadiah, Jung and Dieck (2017) studied the use of wearable technology in tourism. The technology has a multidimensional nature and increases the experiences of tourists. Litvak and Kuflik (2020) examined the effect of smart glasses on the visitor experience. The findings of the study show that the visitors have positive thoughts about using the glasses.

Corrigan-Kavanagh, Scarles and Revill (2019) examined the effect of an travel guide on travel experiences. Findings show that with the digital travel guide, travelers can interact and improve the experience's quality.

Jung et al. (2020) examined the experience of applications and perceived value. The work was carried out in An Post Museum. Findings show that cultural differences must be considered, and the application affects the experience's quality.

Gonzalez-Rodriguez et al. (2020) discussed the quality of virtual tour experience for tourists. The findings show that virtual reality technology can be used in promotional activities. Castillo et al. (2020) examined the augmented reality mobile app. The findings reveal that the practice can increase the tourist experience.

Augmented reality technologies can be applied in different tourism activities and can positively affect the quality of experience. Augmented reality applications can be an important tool for tourists' satisfaction levels.

Discussion and Conclusions

Augmented reality technology is a set of technological components that connect the real world. Such as virtual objects, objects, or images and stimulate the senses. It is used in location-based applications, area-based applications, game-based applications, wearable technology, and 3D. It is also widespread in the tourism sector. The number of research and applications on this subject has been increasing in recent years, which is considered a research problem.

Studies are examining different usage areas of augmented reality technologies in tourism. However, studies examining augmented reality technologies in tourism, their usage levels, and tourists' perceptions are limited. We discussed the use of augmented reality technologies in tourism, the future, and the tourists' perspectives.

The study was based on augmented reality studies in the tourism literature. A "title-abs-key" search was performed in the Scopus database. 238 studies were reached. Systematic review principles were used. 181 studies related to tourism were evaluated in the general findings. There has been a significant increase in augmented reality studies in recent years. 181 studies were examined, and it was determined that the journal with the most publications on this

subject was "Journal of Heritage Tourism." Prominent authors in the relevant literature are as follows: "M. Claudia tom Dieck" and "Timothy Jung." It was determined that augmented reality technologies in tourism are mostly applied in the cultural heritage.

In the second part of our study, 58 studies examining tourist behavior and perceptions were identified, and thematic analysis was conducted. The studies are divided into 7 themes according to their fields of study. Themes are as follows; purchase intention, intention to visit again, changes of attitude, technology acceptance, cultural heritage, museum/art gallery, and experience. In the findings, it was determined that augmented reality technologies encourage tourists to buy and re-visit. Some criteria have been identified for the change of tourists' attitudes and technology adoption. These are the content of the application, ease of use, user-oriented, and functional features. Augmented reality technologies can be used in tourism, especially in cultural heritage, museums, and art galleries, and can also increase tourists' experience quality.

The findings of the study support the studies in the literature. It has been determined that the technology acceptance levels of tourists for augmented reality applications are positive (Han et al., 2019; Graziano and Privitera, 2020), and the applications increase the experience and visit quality (Roongrungsi et al., 2017; Dijaya and Suprayitno, 2018; Jung et al., 2020). It has been determined that augmented reality technologies contribute positively to the user experience in museums (Dieck and Jung, 2017; Kaghat et al., 2020; Hammady et al., 2020) and cultural areas (Durand et al., 2014; Pendit et al., 2015; Koo et al., 2019). Ease of use and perceived usefulness seem to be essential for technology acceptance (Chu et al., 2012; Yovcheva et al., 2014). The applications should be designed according to the tourists' needs, and that tourists should be included more in the processes (Shin & Jeong, 2021; Yin et al., 2021). The findings of our study showed similarity with previous studies. It is seen that the studies on the application of augmented reality focus on the tourist experience, cultural heritage, and technology acceptance.

Suggestions have been developed for researchers and practitioners.

According to the results of the study, augmented reality technologies can be used in the tourism sector. Tourists are positive about these innovations. Therefore, these innovation-oriented technologies are likely to be used more in tourism. Technology is improving every day. Inevitably that the tourism sector will also be affected. These technologies can become more adaptable and widespread. Therefore, tourism businesses that adapt to changes quickly and effectively can make a difference. These innovations can lead to an increase in demand. It may be beneficial to make planning and structuring throughout the country and the region in this context.

The technological change process is an ongoing change in all areas of life. It is determined that current problems are generally examined in the tourism literature. Although studies on the COVID-19 pandemic have become widespread recently, the impact of technological change on the service sector continues to be the subject of research. Many studies have been conducted on augmented reality technologies in the service sector, their use in tourism services, application development, and tourists' attitude. However, it would be beneficial to conduct studies on different usage areas in tourism, service quality, value, acceptance, and tourists' perceptions. Technological developments are a dynamic process. Therefore, the value of augmented reality technologies in the tourism sector can be examined. Analysis of service process change can contribute to the literature.

Declaration

The contribution of all authors of the article to the article process is equal. The authors have no conflict of interest to declare.

REFERENCES

Abidin, R., Arshad, H., Shukri, S., & Ling, M. (2018). Leveraging Multimodal Interaction and Adaptive Interfaces for Location-based Augmented Reality Islamic Tourism Application. *International Journal on Advanced Science Engineering and Information Technology, 8*(4-2), 1784-1791.

Aziz, K., Tan, G., & Ahmad, Z. (2017). Holistic interactive system for empowering local tourism businesses: consumer acceptance of the iMelaka 360 System. *International Journal of Business Excellence, 13*(2), 256-284.

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE Computer Graphics and Applications, 21*(6), 34-47.

Bastian, H., Glasziou, P., & Chalmers, I. (2010). Seventy-Five trials and eleven systematic reviews a day: How will we ever keep up? *PLoS Medicine, 7*(9), 1-6.

Benford, S., Greenhalgh, C., Reynard, G., Brown, C., & Koleva, B. (1998). Understanding and constructing shared spaces with mixed-reality boundaries. *ACM Transactions on Computer-Human Interaction, 5*(3), 185-223.

Berrang-Ford, L., Ford, J., & Paterson, J. (2011). Are we adapting to climate change? *Global Environmental Change, 21*(1), 25-33.

Berrang-Ford, L., Pearce, T., & Ford, J. (2015). Systematic review approaches for climate change adaptation research. *Reg Environ Change, 15*, 755-769.

Bown, M. J., & Sutton, A. J. (2010). Quality control in systematic reviews. *Eur J Vasc Endovasc Surg, 40*, 669-677.

Carter, R., Thok, S., O'Rourke, V., & Pearce, T. (2015). Sustainable tourism and its use as a development strategy in Cambodia: A systematic literature review. *Journal of Sustainable Tourism, 23*(5), 797-818.

Castillo, A., Chantre, V., Velasco, E., & Villalba, K. (2020). Ecosistema Virtual Gamificado de Francisco José de Caldas. *Revista Ibérica de Sistemas e Tecnologias de Informação, E28*, 139-150.

Caudell, T., & Mizell, D. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. *Hawaii Int'l Conf. on Systems Sciences*, 659-669.

Chiu, C.-C., & Lee, L.-C. (2018). System satisfaction survey for the App to integrate search and augmented reality with geographical information technology. *Microsyst Technol, 24*, 319-341.

Chiu, C.-C., Wei, W.-J., Lee, L.-C., & Lu, J.-C. (2021). Augmented reality system for tourism using image-based recognition. *Microsystem Technologies*, 27, 1811-1826.

Chu, T.-H., Lin, M.-L., & Chang, C.-H. (2012). mGuiding (Mobile Guiding) – Using a Mobile GIS app for Guiding. *Scandinavian Journal of Hospitality and Tourism, 12*(3), 269-283.

Chung, J., Pagnini, F., & Langer, E. (2016). Mindful navigation for pedestrians: Improving engagement with augmented reality. *Technology in Society, 45*, 29-33.

Chung, N., Han, H., & Joun, Y. (2015). Tourists' intention to visit a destination: The role of augmented reality (AR) application for a heritage site. *Computers in Human Behavior, 50*, 588-599.

Chung, N., Lee, H., Kim, J.-Y., & Koo, C. (2017). The role of augmented reality for experience-influenced Environments: The case of cultural heritage tourism in Korea. *Journal of Travel Research*, 1-17.

Corrigan-Kavanagh, E., Scarles, C., & Revill, G. (2019). Augmenting travel guides for enriching travel experiences. *e-Review of Tourism Research (eRTR), 16*(2/3), 127-141.

Cranmer, E., Dieck, M., & Fountoulaki, P. (2020). Exploring the value of augmented reality for tourism. *Tourism Management Perspectives, 35*.

Dieck, M., & Jung, T. (2017). Value of augmented reality at cultural heritage sites: A stakeholder approach. *Journal of Destination Marketing & Management, 6*, 110-117.

Dieck, M., Jung, T., & Dieck, D. (2018). Enhancing art gallery visitors' learning experience using wearable augmented reality: Generic learning outcomes perspective. *Current Issues in Tourism, 21*(17), 2014-2034.

Dieck, M., Jung, T., & Han, D.-I. (2016). Mapping requirements for the wearable smart glasses augmented reality museum application. *Journal of Hospitality and Tourism Technology, 7*(3), 230-253.

Dieck, M., Jung, T., & Rauschnabel, P. (2018). Determining visitor engagement through augmented reality at science festivals: An experience economy perspective. *Computers in Human Behavior, 82*, 44-53.

Dijaya, R., & Suprayitno, E. (2018). Digital pamphlet of domestic tourism based on augmented reality: The promotion of sidoarjo urban tourism site. *International Journal of Engineering & Technology, 7*(4.28), 392-395.

Do, H.-N., Shih, W., & Ha, Q.-A. (2020). Effects of mobile augmented reality apps on impulse buying behavior: An investigation in the tourism field. *Heliyon*, 1-9.

Durand, E., Merienne, F., Pere, C., & Callet, P. (2014). Ray-on, an on-site photometric augmented reality device. *Journal on Computing and Cultural Heritage, 7*(2), 1-13.

Falagas, M., Pitsouni, E., Malietzis, G., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *The FASEB Journal, 22*(2), 338-342.

Feiner, S., MacIntyre, B., Höllerer, T., & Webster, A. (1997). A Touring Machine: Prototyping 3D mobile augmented reality systems for exploring the urban environment. . *Personal and Ubiquitous Computing, 1*(4), 74-81.

Flores, N., Dolores, L., Cayabyab, G., Palaoag, T., Angeles, J., Corpuz, G., & Mamaril, M. (2019). Rebuilding cultural and heritage space of corregidor ısland using GPS-Based augmented reality. *International Journal of Recent Technology and Engineering (IJRTE), 8*(2S11), 2799-2804.

Fukada, H., Kasai, K., & Ohtsu, S. (2015). A field experiment of system to provide tourism information using ımage recognition Type AR technology. *Lecture Notes in Electrical Engineering, 312*, 381-387.

Fusté-Forné, F. (2020). Mapping heritage digitally for tourism: An example of Vall de Boí, Catalonia, Spain. *Journal of Heritage Tourism, 15*(5), 580-590.

Garcia-Crespo, Á., González-Carrasco, I., López-Cuadrado, J., Villanueva, D., & González, Á. (2016). CESARSC: Framework for creating cultural entertainment systems with augmented reality in smart cities. *Computer Science and Information Systems, 13*(2), 395-425.

Gonzalez-Rodriguez, M., Diaz-Fernandez, M., & Pino-Mejıas, M. (2020). The impact of virtual reality technology on tourists' experience: A textual data analysis. *Soft Computing, 24*, 13879–13892.

Gough, D., Thomas, J., & Oliver, S. (2012). Clarifying differences between review designs and methods. *Systematic Reviews, 1*(1), 1-9.

Graziano, T., & Privitera, D. (2020). Cultural heritage, tourist attractiveness and augmented reality: Insights from Italy. *Journal of Heritage Tourism*.

Hammady, R., Ma, M., Strathern, C., & Mohamad, M. (2020). Design and development of a spatial mixed reality touring guide to the Egyptian museum. *Multimedia Tools and Applications, 79*, 3465–3494.

Han, D.-I., Dieck, M., & Jung, T. (2019). Augmented Reality Smart Glasses (ARSG) visitor adoption in cultural tourism. *Leisure Studies, 38*(5), 618-633.

Han, D.-I., Jung, T., & Dieck, M. (2019). Translating tourist requirements into mobile AR application engineering through QFD. *International Journal of Human–Computer Interaction, 35*(19), 1842-1858.

Hausmann, A., & Schuhbauer, S. (2020). The role of information and communication technologies in cultural tourists' journeys: The case of a World Heritage Site. *Journal of Heritage Tourism.*

He, Z., Wu, L., & Li, X. (2018). When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions. *Tourism Management, 68*, 127-139.

Hsieh, Y.-T., Jylhä, A., Orso, V., Andolina, S., Hoggan, E., Gamberini, L., & Jacucci, G. (2019). Developing hand-worn input and haptic support for real-world target finding. *Personal and Ubiquitous Computing, 23*, 117-132.

Hta, A. C., & Lee, Y. (2020). Interactive spatial augmented reality book on cultural heritage of Myanmar. *Journal of Information and Communication Convergence Engineering, 18*(2), 69-74.

Huang, T.-L. (2021). Restorative experiences and online tourists' willingness to pay a price premium in an augmented reality environment. *Journal of Retailing and Consumer Services, 58*(8).

Jiang, S., Scott, N., & Tao, L. (2019). Antecedents of augmented reality experiences: Potential tourists to Shangri-La Potatso National Park, China. *Asia Pacific Journal of Tourism Research, 24*(10), 1034-1045.

Jung, K., Nguyen, V., Piscarac, D., & Yoo, S.-C. (2020). Meet the Virtual Jeju Dol Harubang—The Mixed VR/AR Application for Cultural Immersion in Korea's Main Heritage. *ISPRS International Journal of Geo-Information, 9*(6), 1-17.

Jung, T., Chung, N., & Leue, M. (2015). The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tourism Management, 49*, 75-86.

Jung, T., Dieck, M., Lee, H., & Chung, N. (2020). Moderating Role of Long-Term Orientation on Augmented Reality Adoption. *International Journal of Human–Computer Interaction, 36*(3), 239-250.

Jung, T., Lee, H., Chung, N., & Dieck, M. (2018). Cross-cultural differences in adopting mobile augmented reality at cultural heritage tourism sites. *International Journal of Contemporary Hospitality Management, 30*(3), 1621-1645.

Kaghat, F., Azough, A., Fakhour, M., & Meknassi, M. (2020). A new audio augmented reality interaction and adaptation model for museum visits. *Computers and Electrical Engineering, 84*, 1-13.

Kang, J. (2013). AR teleport: Digital reconstruction of historical and cultural-heritage sites for mobile phones via movement-based ınteractions. *Wireless Pers Commun, 70*, 1443-1462.

Koo, S., Kim, J., Kim, C., Kim, J., & Cha, H. (2019). Development of an Augmented Reality Tour Guide for a Cultural Heritage Site. *ACM Journal on Computing and Cultural Heritage, 12*(4).

Kourouthanassis, P., Boletsis, C., & Lekakos, G. (2015). Demystifying the design of mobile augmented reality applications. *Multimed Tools Appl, 74*, 1045-1066.

Kourouthanassis, P., Boletsis, C., Bardaki, C., & Chasanidou, D. (2014). Tourists responses to mobile augmented reality travel guides: The role of emotions on adoption behavior. *Pervasive and Mobile Computing, 18*, 71-87.

Krevelen, R., & Poelman, R. (2010). A survey of augmented reality technologies, applications and limitations. *The International Journal of Virtual Reality, 9*(2), 1-20.

Lacka, E. (2020). Assessing the impact of full-fledged location-based augmented reality games on tourism destination visits. *Current Issues in Tourism, 23*(3), 345-357.

Lee, I.-J., Chen, C.-H., & Su, C.-Y. (2017). App based souvenirs and entry tickets: A new means of enhancing post visit memories: A case study from Taiwan. *Tourism Management Perspectives, 24*, 177-185.

Liang, L., & Elliot, S. (2020). A systematic review of augmented reality tourism research: What is now and what is next? *Tourism and Hospitality Research*, 1-16.

Littell, J. (2006). Systematic reviews in the social sciences: A Review. *Evidence & Policy A Journal of Research Debate and Practice, 2*(4), 535-537.

Little, C., Bec, A., Moyle, B., & Patterson, D. (2020). Innovative methods for heritage tourism experiences: Creating windows into the past. *Journal of Heritage Tourism, 15*(1), 1-13.

Litvak, E., & Kuflik, T. (2020). Enhancing cultural heritage outdoor experience with augmented-reality smart glasses. *Pers Ubiquit Comput, 24*, 873-886.

Milgram, P., & Kishino, F. (1994). A Taxonomy of Mixed Reality Visual Displays. *IEICE Transactions on Information Systems, E77-D*(12), 1321-1329.

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., …..PRISMA-P Group. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews, 4*, 1-9.

Obeidy, W., Arshad, H., & Huang, J. (2018). TouristicAR: A smart glass augmented reality application for UNESCO world heritage sites in Malaysia. *Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 10*(3-2), 101-108.

Oh, S.-H., Park, J.-y., & Oh, J.-W. (2018). The effect of perceived sportainment, argumented reality technology contnents on spectator sport tourist's visit ıntention. *International Journal of Pure and Applied Mathematics, 118*(24).

Ozdemir, M. A. (2021). Virtual Reality (VR) and Augmented Reality (AR) Technologies for Accessibility and Marketing in the Tourism Industry. In *ICT Tools and Applications for Accessible Tourism* (pp. 277-301). IGI Global.

Park, S., & Stangl, B. (2020). Augmented reality experiences and sensation seeking. *Tourism Management, 77*.

Paulo, M., Rita, P., Oliveira, T., & Moro, S. (2018). Understanding mobile augmented reality adoption in a consumer context. *Journal of Hospitality and Tourism Technology, 9*(2), 142-157.

Pendit, U., Zaibon, S., & Abubakar, J. (2015). Digital interpretive media usage in cultural heritage sites at yogyakarta. *Jurnal Teknologi (Sciences & Engineering), 75*(4), 71-77.

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: A practical guide.* Blackwell Publishing.

Recupero, A., Talamo, A., Triberti, S., & Modesti, C. (2019). Bridging museum mission to visitors' Experience: Activity, Meanings, Interactions, Technology. *Frontiers in Psychology, 10*, 1-10.

Rončević, A., Gregorić, M., & Horvat, D. (2019). Primjena Virtualne I Proširene Stvarnosti U Promociji Turističkih Destınacija Sjeverozapadne. *PODRAVINA, 18*(36), 146-157.

Roongrungsi, A., Namahoot, C., & Brückner, M. (2017). Augmented reality application for cultural and historical tourist attraction display (ARCH-TOUR). *Journal of Telecommunication, Electronic and Computer Engineering, 9*(2-4).

Shin, H. H., & Jeong, M. (2021). Travelers' motivations to adopt augmented reality (AR) applications in a tourism destination. *Journal of Hospitality and Tourism Technology*, 12(2), 389-405.

Siang, T., Aziz, K., & Ahmad, Z. (2016). Determining Tourists' behavioural intention to use mobile tourism applications: Moderating effect of gender. *INFORMATION*, 3167-3172.

Smirnov, A., Kashevnik, A., & Ponomarev, A. (2017). Context-based infomobility system for cultural heritage recommendation: Tourist Assistant—TAIS. *Pers Ubiquit Comput, 21*, 297-311.

Sutherland, I. (1968). A head-mounted three-dimensional display. *Fall Joint Computer Conference*, 757-764.

Tahyudin, I., & Saputra, D. (2017). A response analysis of mobile augmented reality application for tourism objects. *International Journal of Electrical and Computer Engineering (IJECE), 7*(6), 3500-3506.

Tahyudin, I., Saputra, D., & Haviluddin, H. (2015). An ınteractive mobile augmented reality for tourism objects at purbalingga district. *TELKOMNIKA Indonesian Journal of Electrical Engineering, 16*(3), 559-564.

Tsai, T.-H., & Lee, L.-C. (2017). Location-based augmented reality for exploration of cultural heritage. *ICIC Express Letters Part B: Applications, 8*(12), 1577-1583.

Tussyadiah, I., Jung, T., & Dieck, M. (2017). Embodiment of wearable augmented reality technology in tourism experiences. *Journal of Travel Research*, 1-15.

Uygur, A., Öğretmenoğlu, M., & Çalışkan, G. (2019). Innovation and new product development: Delving into food and beverage managers' perspectives, *Journal of Tourism and Gastronomy Studies*, 7(4), 2993-3013.

Wu, X., & Lai, I. K. W. (2021). The acceptance of augmented reality tour app for promoting film-induced tourism: The effect of celebrity involvement and personal innovativeness. *Journal of Hospitality and Tourism Technology*, 12(3), 454-470.

Wu, S.-T., Chiu, C.-H., & Chen, Y.-S. (2020). The influences of innovative technological introduction on interpretive experiences of exhibition:a discussion on the intention to use augmented reality. *Asia Pacific Journal of Tourism Research, 25*(6), 662-677.

Yin, C. Z. Y., Jung, T., & Lee, M. Y. (2021). Mobile augmented reality heritage applications: Meeting the needs of heritage tourists. *Sustainability*, 13(5), 2523.

Yovcheva, Z., Buhalis, D., & Gatzidis, C. (2014). Empirical evaluation of smartphone augmented reality browsers in an urban tourism destination context. *International Journal of Mobile Human Computer Interaction, 6*(2), 10-31.