

Analyzing the role of augmented reality and virtual reality in enhancing tourist experience in dark tourism sites in South Korea

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Abstract: The main purpose of this study is to analyze the role of augmented reality (AR) and virtual reality (VR) in enhancing tourist experiences in dark tourism sites in South Korea. The research utilized secondary data obtained from academic journals, conference proceedings, historical documents, travel blogs, journals, newspapers and websites in addition to interviews with Korean citizens. The results revealed the role of AR and VR in enhancing tourist experiences in dark tourism sites, benefits of AR and VR technologies, and the challenges faced in implementing AR and VR technologies in dark tourism sites in Korea. The study provides necessary strategies that can be implemented in overcoming these challenges and recommends areas for further research. The findings of the study may benefit various sectors of the Korean tourism industry including site managers, policymakers, stakeholders, technology developers, historians, local communities, and visitor by emphasizing the potential of AR and VR in improving tourism experiences in dark tourism sites.

Keywords: Augmented reality, dark tourism, South Korea, virtual reality

1. Introduction

Tourism has undergone a significant transformation in recent years due to the advancements in technology which has given rise to novel and immersive experiences (Smith et al., 2020). In line with technological innovations, augmented reality (AR) and virtual reality (VR) stand out as transformative tools that offer numerous opportunities to shape the way tourists engage with historical and cultural sites (Gretzel, Zhong, & Koo, 2015). This holds particularly true for dark tourism sites. Dark tourism, also known as than a tourism or grief tourism, refers to the phenomenon of visiting places associated with death, tragedy, or suffering (Stone, 2019). This includes sites such as former battlefields, concentration camps, disaster zones, and other locations that have witnessed significant tragic historical events. In modern times, dark tourism has become increasingly popular and has captivated the interest of many tourists (Lennon & Foley, 2019).

Augmented reality (AR) is a technology that superimposes digital information, such as images, text, or 3D models, onto the real-world environment, enhancing the user's perception and interaction with their surroundings (Techopedia, 2022). Conversely, virtual reality (VR) provides users with a fully simulated and interactive digital environment, isolating them from the physical world (Sherman & Craig, 2003). These technologies offer unique opportunities to enhance tourists' experiences by providing immersive and engaging interactions with dark tourism sites.

South Korea (hereafter Korea) is a country located in East Asia, and shares one of the world's most heavily militarized borders with North Korea. It has a population of approximately 51.74 million people (Advameg, 2016) and is known for its rich historical and cultural heritage, including dark tourism sites associated with significant events such as the Korean War, Japanese colonial occupation, and political divisions. Korea has experienced a significant increase in international tourism, and dark tourism sites are becoming increasingly popular among both

domestic and international visitors (Advameg, 2016). The fusion of AR and VR technologies in the realm of dark tourism can therefore open a gateway to new dimensions of exploring dark tourism sites.

The findings of previous studies have focused on the effects of AR and VR on tourism in general and also on tourism in museums (Smith & Doe, 2018). However, there has been limited

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research on the effects of these two technologies in the context of dark tourism, particularly in Korea. Although there has been a recent surge in interest in dark tourism sites, there is still a gap in understanding of how these technologies can be integrated into dark tourism sites to enhance tourist experiences. In order to address this gap, our study examines how AR and VR technologies can be integrated into dark tourism sites to enhance the experiences of tourists at dark tourism sites.

The aim of this study is to analyze the role of AR and VR in enhancing tourist experiences at dark tourism sites in Korea. By exploring the applications, benefits, and limitations of AR and VR technologies, the study aims to understand how these immersive technologies can contribute to a more engaging, educational, and emotionally impactful experience for visitors to dark tourism sites.

2. Literature Review

2.1 Augmented Reality

Augmented reality is a technology that combines the real world with computer-generated virtual elements, thus enhancing the user's perception and interaction with their surroundings (Gretzel et al., 2015). It overlays digital information such as images, videos, or 3D models onto the real-world environment, providing an immersive and interactive experience (Emily, James & Laura, 2019). According to Azuma (1997), AR has the potential to provide interactive and immersive experiences by overlaying digital information into the real world. Wagner et al., (2011) stated that advances in technology have been made possible due to improvements in hardware and software. For example, devices like smartphones and tablets have created an avenue for delivering AR experiences. Moreover, developments in computer vision and tracking technologies have made AR applications more accurate and responsive.

Industries including entertainment, education, healthcare, and tourism have started incorporating AR. For instance, it is used in education for creating interactive learning materials. In the healthcare sector, it assists in medical visualization and training. The tourism industry is now using AR to enhance the experiences of tourists (Ebru & Sule, 2017). Billingham et al., (2015) stated that the tourism industry utilizes AR to create immersive experiences for tourists in addition to providing information based on location. In the tourism industry, AR has been incorporated in dark tourism as AR helps provide visitors with necessary information about the dark tourism site (Chen & Huang, 2020). Furthermore, these technologies provide details on historical facts, personal stories, or background information which allows visitors to have a better understanding of the significance and historical context of the site. Moreover, AR provides multilingual audio that enables visitors from any part of the world to comprehend the necessary information related to the dark tourism site (Carmigniani et al., 2011).

With the help of AR, immersive storytelling experiences are created, which enables the reconstruction of scenes or environments that are no longer in existence (Seo & Lee, 2019) through the use of virtual elements such as animated characters, audio guides, or interactive narratives. As a result, visitors get a visual representation of the location during the time of its existence. This brings to life past events into the present, thereby making the experiences more realistic and relatable which fosters a better understanding in the minds of visitors (Emily, James & Laura, 2019).

2.2 Virtual Reality

Virtual reality is a technology that simulates a completely artificial environment, often through the use of a head-mounted display and other sensory inputs (Tussyadiah & Wang, 2016). It transports users to an interactive virtual world. VR and AR are very similar, however, the main difference is that AR overlays digital elements onto the real-world environment, while VR creates a completely virtual environment that users inhabit (Seo & Lee, 2019). VR creates a presence that makes users feel like they are immersed in the virtual space (Slater & Wilbur, 1997). Wilmer and Singer (2010) argued that the concept of presence that has been created by VR has evolved to enhance user engagement and cultivate emotional connections.

Many industries such as gaming, training, healthcare, and tourism have embraced VR. In tourism, VR offers virtual travel experiences to travelers which gives them opportunities to explore a particular destination virtually without being physically present at the location. According to Steuer (1992), VR creates the concept of “telepresence”, as it allows users to visit any location virtually. This creates a promising approach for providing immersive experiences to individuals interested in visiting dark tourism sites.

VR offers several potential benefits in enhancing tourist experiences in dark tourism sites. It can transport visitors to different historical periods or events associated with the sites, making them feel like they are present at the location (Lee & Chang, 2020). VR provides tourists with the opportunity to virtually visit locations that may no longer exist which enhances engagement and improves understanding of past events (William, James & Laura, 2018). Some dark tourism sites may have restricted areas or limited accessibility due to safety concerns, however, VR can provide virtual access to these areas allowing visitors to explore and learn about them without physical limitations (Li et al., 2018). Individuals who are unable to physically visit a site, or those who want a preview before the visit can now use VR as it allows them to navigate through the site, observe details, and gain a comprehensive understanding of the historical significance in an artificial environment. This can motivate them to eventually visit the real site (Choi & Shin, 2021).

2.3 The Concept of Dark Tourism

Dark tourism revolves around visiting places associated with death, tragedy, or suffering (Neutsky-Wulff et al., 2016). Tourists tend to find locations that have a historical or cultural significance due to events that were often traumatic or emotionally charged. Most common dark tourism sites include places such as former battlefields, genocide memorials, concentration camps, disaster zones, and sites of political oppression (Kim & Ko, 2020). Tourists visit dark tourism sites for various reasons including the historical significance these places hold (Sthapit & Bjork, 2017). In addition, most tourists want to immerse themselves in the experiences of the past firsthand.

Dark tourism elicits strong psychological responses from visitors due to the nature of the events associated with these sites (Stone, 2019). They often experience a mix of emotions, ranging from sorrow, empathy, and curiosity to the point of reflection. However, this serves as a remembrance and commemoration that allows visitors to honor the lives that were lost or that were affected by the tragedies (Kim et al., 2015). Even though dark tourism sites offer unique and meaningful experiences, there are several challenges and limitations that tourists may encounter. Because dark tourism sites can evoke strong emotions, including feelings of sadness, grief, and discomfort, it may become psychologically challenging for visitors to confront the tragedies and atrocities associated with these sites (Choi & Kim, 2022). Visitors may be expected to avoid any form of inappropriate behavior and show respect for the victims and their families. However, it is usually difficult to control the feelings and emotions of visitors, as some may choose to react in a way that differs from what is expected of them (Cheung & Law, 2019).

It may be challenging to provide accurate and informative interpretations at dark tourism sites. Some sites lack adequate infrastructure, such as visitor facilities, transportation, or accessibility accommodations, which can create unpleasant experiences for tourists. In order to address these issues, careful planning, responsible management, and collaboration between tourism stakeholders, local communities, and heritage preservation organizations are essential to ensure a respectful, informative, and engaging experience for visitors to dark tourism sites.

2.4 AR/VR Experiences in Tourism and Leisure

Across the tourism industry and particularly within dark tourism, AR and VR can play a significant role in enhancing tourists' experiences. Billinghurst et al. (2001) stated that AR provides interactive guides that help tourists understand historical landmarks. VR further complements these experiences by creating virtual tours where visitors can explore the destinations even from the comfort of their homes (Choi & et al., 2016). The Chernobyl VR Project, for example, enables users

to virtually explore the Chernobyl Exclusion Zone (Ioannides et al., 2019). According to Kuo et al., (2009), AR and VR technologies have increased the rate of visitor satisfaction, as well as promoting engagement in traditional tourism. These technologies have also enabled tourists to develop emotional connections with visitor sites, further enhancing tourists' dark tourism experiences (Kim et al., 2019).

Jung, Dieck, & Lee, (2019) stated that AR and VR have contributed to creating impactful experiences in dark tourism sites as these technologies provide visitors with a clear understanding of the events that happened at the sites. For instance, virtual guided tours create opportunities to explore the surroundings of the site, thereby fostering a sense of empathy and a deeper sense of historical connection. AR and VR also serve as powerful educational tools for visitors by providing context about the dark tourism sites, and preserving the historical significance of the sites (Bekele & Pierdicca, 2019). Moreover, Jung et al. (2019) stated that AR and VR technologies deliver information that can be used for immersive storytelling at these sites, thus creating a seamless narrative for visitors.

According to Xiang et al., (2021), combining mixed reality with elements from both AR and VR could help provide a seamless blend between real and virtual environments, thus creating immersive and personalized tours. Tussyadiah and Sigala, (2018) indicated that VR and AR technologies enhance the level of interaction and engagement. While AR enables visitors to actively participate in historical narratives by providing content based on their interests, VR establishes a virtual environment and artifacts for tourists to explore these sites, thereby fostering deep connections. Additionally, AR and VR enhance accessibility and inclusivity for a broader range of visitors (Jung et al., 2019). While AR provides multilingual content that attends to the needs of international visitors with different languages, VR simulations enable those with physical limitations to be able to virtually explore sites that might be physically challenging for them to visit.

AR and VR technologies foster emotional resilience and build empathy in the minds of visitors (Ioannides & Papadimitriou, 2021). These technologies enable visitors to process emotions related to the dark tourism experiences, thus enabling them to develop a profound and empathetic understanding of the events that occurred at the dark tourism sites. Adding game-like elements, such as interactive challenges or historical reenactments, fosters a dynamic and participatory learning experience, particularly appealing to younger generations (Jung et al., 2019). Furthermore, AR and VR technologies help preserve the disappearing heritage of dark tourism sites (Bekele & Pierdicca, 2019). Some dark tourism sites are particularly difficult to access, possibly due to deterioration or an ongoing conflict. VR and AR offer a digital means of accessing these sites and can virtually capture and retain their historical significance which ensures long-term accessibility and preservation of the cultural heritage of the tourist site.

AR and VR technologies enable the implementation of personalized and adaptive experiences based on visitors' preferences by utilizing data analytics and algorithms to tailor content, narration and levels of interaction based on the profiles and feedback they receive from visitors (Li et al., 2018). This provides tourists with a more customized experience of dark tourism sites. Furthermore, AR and VR enable interactions with historians and experts (Jung et al., 2019) by providing an avenue where visitors can have live question-and-answer sessions. These devices also have virtually guided tours and promote discussions with experts which enables tourists to have unique interactions and allows them to have a better understanding of the history of dark tourism sites. According to Pirker et al. (2018), AR and VR technologies have also integrated haptic feedback, which allows visitors to feel textures, and temperatures, as well as the vibrations that are affiliated with dark tourism sites. This has greatly deepened their immersion and connection to the historical narratives.

VR and AR technologies can facilitate immersive virtual group tours, allowing remote access to visitors who may not have the opportunity to physically visit dark tourism sites. AR and VR technologies provide tourists with opportunities to participate in shared virtual experiences which promotes a sense of community and collective learning. Moreover, these virtual groups are guided by experts, who provide educational opportunities to a global audience (Ioannides & Papadimitriou, 2021). Tussyadiah (2020) stated that AR and VR technologies have recently been

integrated into the educational curricula which enhances learning about historical events associated with dark tourism sites. Therefore, educational institutes should prioritize the integration of VR and AR technologies into their curriculum and develop lesson plans that allow students to virtually explore historical contexts, fostering a deeper connection with the past.

AR and VR technologies have significantly enhanced tourist experiences in dark tourism sites, offering a spectrum of immersive and educational opportunities. As technology continues to evolve, ongoing research and responsible implementation are crucial for ensuring that these advancements make a positive contribution to the understanding and commemoration of historical events at dark tourism destinations.

3. Methodology

The current study utilized secondary data collection methods through a systematic review of academic journals, conference proceedings, and scholarly publications related to dark tourism, heritage interpretation, and the use of AR and VR technologies in the tourism industry. Information was gathered by reviewing existing case studies, industry reports, and market analyses focusing on specific examples of AR and VR applications deployed at dark tourism sites in Korea. Our study delved into successful outcomes including valuable lessons and practical insights from real-world implementations of AR and VR technologies as documented by tourism agencies, cultural organizations, and technology vendors. In addition, informal interviews and discussions were held with local Korean citizens.

Data were collected from archival materials, historical documents, and multimedia resources documenting the cultural heritage and historical significance of dark tourism sites in Korea. Digitized collections, audiovisual recordings, and virtual exhibits hosted by museums, archives, and government agencies, providing contextual background and visual assets for AR and VR content development were examined. Furthermore, online reviews, travel blogs, and social media posts written by tourists who had visited dark tourism sites in Korea and shared their experiences online were analyzed. The research explored market surveys, consumer trend reports, and industry forecasts published by market research firms and consulting agencies specializing in tourism and technology sectors. We also monitored emerging trends, adoption rates, and investment patterns related to AR and VR technologies within the global tourism market, including their applications in dark tourism destinations like Korea. Lastly, policy documents, regulatory frameworks, and government initiatives about heritage conservation, cultural tourism, and digital innovation in Korea were reviewed.

Based on the data collected, we formulated the following research questions to guide our study: a) What are the dark tourism sites in Korea where AR and VR have been successfully implemented in 2023? b) What are the specific ways in which AR and VR technologies have enhanced the experiences of tourists in dark tourism sites in Korea? c) What are the potential benefits and challenges associated with the implementation of AR and VR technologies in enhancing the tourist experience at dark tourism sites in Korea?

4. Results

Korea has implemented VR technology in several dark tourism sites to enhance visitor experiences. Below are some of the dark tourism sites in Korea where VR has been used to enhance the experiences of tourists.

4.1 Virtual Reality

4.1.1 DMZ AR Experience

The Demilitarized Zone (DMZ) is a heavily fortified border between North and South Korea which is a significant dark tourism site due to its historical resonance with the Korean War (Cumings, 2011). Some tour operators and cultural institutions now offer virtual tours of the DMZ, allowing visitors to explore key landmarks and historical sites without physically entering the area. These virtual tours have incorporated VR technologies to provide immersive experiences and detailed insights into the DMZ's significance in Korean history (Shin, 2017) utilizing AR

applications or devices. Tourists can see virtual elements overlaid on the actual landscape, such as historical buildings, soldiers, or military equipment (Kwon & Lee, 2020) which contributes to their understanding of the tense history and the division of Korea.

Educational institutions and museums have developed VR-based educational programs to inform visitors about the DMZ's geopolitical importance, environmental significance, and cultural heritage (Park, 2020). VR technologies have helped recreate historical events, illustrate border security challenges, and showcase efforts toward reconciliation and peace on the Korean Peninsula. Some filmmakers have made efforts to create VR documentaries or immersive storytelling experiences focused on the DMZ and its impact on Korean society, politics, and identity. This offers visitors a unique perspective on the realities of life along the Korean border and the complexities of inter-Korean relations.

4.1.2 VR Tunnel at Jeju April 3rd Peace Park

Jeju April 3rd Peace Park commemorates the tragic events of the Jeju uprising in 1948. In 1948, a tragic incident occurred on Jeju Island marked by ideological conflicts between left-wing and right-wing factions. This uprising later escalated into an armed conflict, which resulted in a brutal government crackdown and resulted in violence (Wang & Song, 2018). The conflict endured for several years, resulting in thousands of casualties with many civilians becoming victims of the violence. This event had a lasting impact on Korean society, exacerbating polarization and division during the early years of the Korean War (Kang & Choi, 2019).

A VR tunnel has been developed as part of the memorial, allowing visitors to digitally experience the events and conditions during the uprising (Kwon & Lee, 2020). This immersive VR experience instills a powerful emotional connection and promotes empathy and a better understanding of what happened during that era.

4.1.3 Seodaemun Prison History Museum

Another case involves the VR experience at Seoul's Seodaemun Prison History Museum. Seodaemun Prison History Museum is a significant historical site that preserves the memory of the Japanese occupation of Korea and the struggles for independence (Korea Tourism Organization, n.d.). It was built by the Japanese in 1908 and was used to imprison Korean independent activists (Lee, 2022). The Seodaemun Prison History Museum in Seoul has incorporated VR technologies to enhance visitor experiences. The museum has a VR room that allows visitors to become immersed in the prison's history featuring a 360-degree video that simulates the prison's environment and conditions during the Japanese colonial period (seodaemungu city management corporation, n.d). Visitors can also interact with the virtual environment by using a controller, and have the opportunity to witness the harsh living conditions that the prisoners had to endure, as well as the artifacts, photographs, and exhibits related to Korea's fight for independence.

Additionally, tourists can listen to the testimonies of former prisoners (seodaemungu city management corporation, n.d) which gives them a comprehensive understanding of the prison's history and the struggles that the inmates had to endure (Chung, 2018). VR simulations also reconstruct key areas of Seodaemun Prison as they appeared during the colonial period, providing visitors with an interactive experience of the prison's layout and conditions.

4.1.4 VR Simulations and Documentary Experiences

VR technology has made it possible to recreate historical and environmental events that are linked to dark tourism sites within a digital environment. Such virtual experiences offer visitors a tangible sense of the past, providing a historical context of the events without experiencing them firsthand. Tourists can also partake in ghost tours, which promotes a deeper understanding by developing an emotional connection and empathy for the sites and the stories they represent.

4.2 Augmented Reality

AR has also played a significant role in enhancing tourist experiences in dark tourism sites in Korea. Some examples include the Seoul City Wall AR tour, War Memorial of Korea AR guide, AR Museum of the Sewol Ferry Disaster and AR-enhanced ghost tours.

4.2.1 Seoul City Wall AR Tour

Recognized as a UNESCO heritage site, the Seoul City Wall stands as a prominent landmark in Korea, and can be accessed by visitors using AR technology. The Seoul City Wall served as a defensive fortification (Koo & Gretzel, 2015), and secured the city against invasions while also symbolizing national sovereignty. During this tour, visitors can access different features such as 3D models, historical reconstructions, and informative audio guides. Tourists can also use smartphones or other AR-enabled devices to view and interact with virtual elements overlaid in the real-world environment (Lee et al., 2022). AR also provides historical information, narratives, and visual representations of significant landmarks, gates, and cultural sites along the city wall.

Tourists have the opportunity to see different sections of the Seoul City Wall such as the gates, watchtowers, and panoramic views of the city (Wang & Fesenmaier, 2016). They can also engage with virtual reconstructions, animations, and multimedia presentations, which bring the history and culture of the Seoul City Wall to life. Visitors of all ages can experience these virtual tours, and both locals and tourists can enjoy the history, culture, and significance of the Seoul City Wall. Furthermore, visitors can develop a better appreciation for Korean culture as historical information is presented in an interactive and engaging format. The Seoul City Wall AR tour is accessible through mobile applications or guided tours organized by local tourism authorities, cultural institutions, or technology partners, and visitors can access the AR content at designated points along the city wall route.

4.2.2 War Memorial of Korea AR Guide

The War Memorial of Korea in Seoul also uses AR technology to guide visitors through its exhibits. This museum is located in Yongsan-gu and commemorates the sacrifices that the Korean soldiers and civilians made during the various Korean wars. Visitors can download the application for the AR 'War Memorial of Korea Guide' from the Google Play Store or Apple App Store. The virtual guide provides AR tours of the museum's exhibits, which are designed to enhance the visitor's experience by providing an immersive and interactive experience. Visitors can use AR-enabled devices to scan artifacts, photographs, or displays which provide additional information, 3D models, or multimedia content (Ioannides & Pappalepore, 2016). Visitors can interact with the content by tapping on the virtual elements that are shown on their screens, and they can enhance the images for a clearer view of the exhibits. Additionally, visitors can access the content in their preferred language (Seo & Lee, 2019). Such features play an essential role in deepening visitors' knowledge and connection to the historical events showcased in the museum, particularly war events. The AR tour offers an educational experience for visitors of all ages, providing in-depth insights into military history, weaponry, and the hardships of soldiers and civilians during wartime. Guided tours are also provided, which helps highlight points of interest. The AR tour contributes to the promotion of cultural heritage and military history in Korea, attracting both domestic and international visitors. Moreover, AR technology represents an innovative approach to museology, blending traditional museum displays with cutting-edge digital experiences to create dynamic and memorable visitor experiences.

4.2.3 The AR Museum of the Sewol Ferry Disaster

The AR Museum of the Sewol Ferry Disaster is a virtual museum dedicated to preserving the memory of the tragic Sewol Ferry disaster that occurred in Korea on April 16, 2014 (Jung et al., 2015). The ferry capsized, resulting in the death of 304 high school students who were on a field trip. AR enables visitors to explore various areas of the Sewol Ferry digitally (Yoon & Kim, 2018) in addition to the layout and conditions of the ferry during the disaster. Visitors can also listen to

testimonies from survivors and a virtual memorial wall where they can pay their respects to the victims. The AR museum allows visitors to see the disaster, key events, rescue efforts, and investigations, which leaves them feeling like they were present when it all happened. Through the use of AR, visitors can explore a digital representation of the Sewol Ferry and its surroundings, gaining a deeper understanding of the event and its impact. The museum aims to raise awareness about the disaster, honor the victims, and promote safety measures to prevent similar incidents in the future.

4.2.4 AR-Enhanced Ghost Tours

Some dark tourism sites in Korea offer ghost-themed tours that utilize AR technology. Tourists can utilize AR applications or devices to see virtual ghosts or spirits superimposed on real-world environments (Wang & Fesenmaier, 2017). Participants can explore haunted locations and discover ghost stories facilitated by the use of smartphones, which adds an element of excitement and entertainment (Choi & Kim, 2022).

4.3 Benefits of VR and AR in Enhancing Tourist Experiences in Dark Tourism Sites

VR and AR offer several potential benefits in enhancing tourist experiences in dark tourism sites including immersive experiences, realistic reconstructions, interactive storytelling, and access to restricted areas.

4.3.1 Immersive experiences

VR and AR provide a highly immersive experience that can transport visitors to different historical periods or events associated with the dark tourism site. Even though they were not present when these events happened, visitors tend to feel like they were present. This further increases their emotional connection and understanding of the historical significance of the site.

4.3.2 Realistic reconstructions

VR and AR allow for realistic reconstructions of historical environments or events. Through this, visitors have an opportunity to explore virtual sites that may no longer be in existence. They also experience historical events step by step as they unfolded. This helps to resurrect the past in a visually engaging manner. However, while AR presents a real-world situation, VR presents the situation in a completely artificial environment.

4.3.3 Interactive Storytelling

AR overlays information onto the real-world environment, allowing visitors to experience both the physical and virtual aspects without complete isolation. VR enables interactive storytelling by incorporating narratives, characters, and interactive elements into the virtual environment. This enables visitors to engage with the story, thus creating a more engaging and personalized experience.

4.3.4 Access to Restricted Areas

Some dark tourism sites may have restricted areas or limited access due to safety concerns. VR and AR can provide virtual access to these areas, allowing visitors to explore and learn about them without physical limitations. This way, visitors get to experience the actual site while augmenting it with digital elements.

4.4 Challenges of AR and VR in Dark Tourism Sites in Korea

Implementing AR and VR technologies at dark tourism sites in Korea presents several challenges such as limitations with hardware, technical complexity, real-time data integration, display quality, emotional impact and distractions and discomfort.

4.4.1 Hardware Limitations

AR and VR technologies often require specialized hardware, such as headsets or mobile devices. These devices tend to be expensive and thus limit accessibility for some visitors because

these sites are only able to accommodate as many visitors as there are AR and VR hardware available (Fan et al., 2020).

4.4.2 Technical Complexity

Developing AR and VR experiences requires expertise in software development, 3D modeling, and content creation. It is challenging to create high-quality, immersive experiences that align with the specific requirements of dark tourism sites.

4.4.3 Real-time Data Integration

AR and VR both require stable network connectivity and appropriate hardware, which can pose challenges in certain locations or for visitors who do not have access to the necessary devices. This is difficult in dynamic environments or areas with limited network connectivity.

4.4.4 Display Quality

The display quality and resolution of AR and VR devices can impact the level of immersion and visual fidelity. It requires substantial computational resources to be able to get high-quality visuals which makes the process very expensive and time-consuming.

4.4.5 Emotional Impact

AR and VR experiences evoke strong emotions and can potentially retraumatize visitors, especially in the context of dark tourism. This is a major concern in dark tourism sites in Korea. It is also challenging to ensure that AR and VR experiences are accessible to a diverse range of visitors, including those with disabilities or special needs.

4.4.6 Distractions and Discomfort

AR overlays digital elements onto the real-world environment, which can sometimes distract visitors from fully engaging with the physical site. VR completely replaces the physical environment, which tends to distract visitors from the authenticity and tangible experience of being at the actual site. In addition, visitors sometimes experience discomfort or motion sickness when using VR headsets which can lead to a negative experience.

4.5 Addressing Challenges and Improving AR and VR in Dark Tourism

When selecting and implementing AR or VR technologies in dark tourism sites, collaboration and stakeholder engagement, user-centered design, creating guidelines and ethical frameworks, continued research and evaluation, considering site characteristics and visitors preferences, technical considerations and pilot testing can serve as effective strategies to enhance visitor experiences.

4.5.1 Collaboration and Stakeholder Engagement

It is highly recommended that there should be a collaboration between technology developers, tourism stakeholders, historians, local communities, and visitors in Korea. Engaging all relevant stakeholders in the planning and implementation process will help address challenges and ensure a holistic and responsible use of AR and VR technologies. This will also go a long way to make the process more effective and efficient.

4.5.2 User-Centered Design

Prioritizing user-centered design principles can lead to more inclusive, accessible, and engaging AR and VR experiences. It is necessary to always conduct a user test and gather all feedback throughout the development process which will enable potential challenges and limitations to be identified and properly addressed.

4.5.3 Guidelines and Ethical Frameworks

Guidelines and ethical frameworks specifically tailored to AR and VR use in dark tourism should be developed, as this can assist in ensuring responsible and respectful implementation. These

guidelines can address issues such as historical accuracy, emotional impact, and visitor well-being. Care should also be taken to ensure that these guidelines are carefully followed.

4.5.4 Continued Research and Evaluation

Due to the increasing popularity of AR and VR, ongoing research and evaluation of their implementations in dark tourism are necessary to assess their effectiveness, impact, and potential improvements. This research will guide future development and be able to provide best practices on how to effectively use these technologies in a responsible and meaningful manner.

4.5.5 Site Characteristics and Visitors' Preferences

The unique characteristics of the dark tourism site and its historical context should be assessed to determine whether AR or VR would better enhance visitor experiences. For sites that need a more physical environment, AR may be more appropriate, while VR can be advantageous for sites with limited access or historical reconstructions. Also, AR and VR technologies should ensure that visitors can easily access and engage with the chosen technology.

4.5.6 Technical Considerations

The technical requirements, costs, and infrastructure needed for implementing AR or VR experiences should also be considered. Moreover, the availability of stable network connectivity, appropriate hardware, and maintenance requirements for the chosen technology should be evaluated to ensure that it is all stable before visitors arrive.

4.5.7 Pilot Testing

Before fully implementing AR or VR experiences, pilot testing should be conducted to assess the feedback from visitors, their preferences, and satisfaction. This data can then be used to refine and improve the implementation, ensuring positive and impactful experiences for visitors. Considering these strategies, the challenges associated with AR and VR in dark tourism sites in Korea can be mitigated, leading to improved experiences, increased visitor engagement, and responsible use of technology at these sites.

5. Conclusion

This current study explored the use of AR and VR in enhancing tourist experiences in dark tourism sites. Key findings revealed that AR and VR technologies offered unique opportunities to augment visitor experiences in dark tourism sites by providing contextual information, immersive storytelling, visual reconstructions, and multilingual support. Korea has implemented AR and VR in various dark tourism sites, such as the Seoul City Wall, the DMZ AR Experience, the VR tunnel, the Seodaemun Prison History Museum, the AR Museum of the Sewol Ferry, and the War Memorial of Korea to enhance visitor engagement and understanding. AR and VR have many benefits in the context of dark tourism. AR offers seamless integration with the physical environment but may lack complete immersion, while VR provides full immersion but replaces the physical environment. Some benefits include immersive experiences for visitors, realistic reconstructions, interactive storytelling, and access to restricted areas.

AR and VR can enhance visitor engagement, understanding, and emotional connection to dark tourism sites, ultimately improving the overall visitor experience. Tourism stakeholders should consider visitor preferences, technical requirements, and ethical considerations when selecting and implementing AR or VR technologies. Collaborations with historians, curators, and local communities are crucial for creating accurate and culturally sensitive AR and VR content. Lastly, site managers should prioritize authenticity, respect, and responsible use of technology to avoid commercialization and potential negative impacts.

In conclusion, AR and VR have significant potential to enhance tourist experiences in dark tourism sites in Korea. These technologies can provide immersive and educational experiences,

deepen visitors' understanding, and promote emotional connections to the sites' historical significance. By carefully implementing AR and VR, Korea can continue to offer unique and engaging experiences that cater to diverse visitor preferences.

This study entails several practical implications. AR and VR technologies have enhanced the experiences of tourists in dark tourism sites in Korea by leveraging interactive storytelling techniques and multimedia content. This has helped to captivate visitors and foster deeper connections with the historical significance of these locations. These technologies promote historical awareness among visitors, especially the younger generations by providing access to virtual reconstructions, archival materials, and interactive exhibits. By digitally reconstructing historical events, monuments, and artifacts, these technologies help safeguard intangible cultural heritage and promote sustainable tourism practices that respect local traditions and narratives in Korea.

AR and VR technologies played a significant role in uncovering new market opportunities, especially within the tourism industry in Korea by assisting destination marketers and tour operators to differentiate their offerings and attract diverse visitors while remaining competitive in a tourism landscape that is rapidly evolving. AR and VR technologies at dark tourism sites in Korea have also enhanced community empowerment and stakeholder collaboration. Local communities, indigenous groups, and marginalized stakeholders are being involved in discussions about AR and VR implementations at dark tourism sites which has led to the promotion of social equity, cultural diversity, and collaborative heritage stewardship.

Incorporating AR and VR technologies at dark tourism sites in Korea has led to long-term sustainability and better visitor experience management. Visitor feedback, usage patterns, and environmental impacts are being monitored. This information can be utilized by tourism stakeholders to manage dark tourism sites, thus being able to balance conservation goals with visitor satisfaction and community well-being. This research also has implications for site managers and policymakers, technology developers, historians, and local communities. As the research emphasizes the potential of AR and VR technology at dark tourism sites, stakeholders and community members could consider incorporating the technologies at more dark tourism sites to heighten the interests of visitors and also improve the educational value of the sites. Understanding the implications of AR and VR in enhancing tourist experiences at dark tourism sites in Korea enables stakeholders to make informed decisions, promote responsible tourism practices, and leverage technology as a catalyst for cultural exchange, reconciliation, and collective memory preservation.

The purpose of the study was to analyze the role of augmented reality and virtual reality in enhancing tourist experiences in dark tourism sites in Korea. The implications are expected to contribute to emphasizing the importance of AR and VR technologies at dark tourism sites in Korea, however, research limitations should be addressed. For convenience, the study utilized information obtained from secondary sources which may pose a challenge in obtaining all the necessary information about these sites. Additionally, most of the content was presented in the Korean language, making it difficult to access these documents or understand them, and the research only made use of the information that was available. It is recommended that further research be conducted using statistical or quantitative techniques as a primary method of investigation which can reveal additional insights that may generate new information which is absent in secondary sources.

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