

# Multiculturalism and Digital Heritage: The VR Transformation of Ethnic Folk Games in Malaysia and China

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## ABSTRACT

Intangible cultural heritage (which includes traditional folk games) is being lost at an alarming rate, primarily due to globalization and modernization. The object of this study is how to enhanced use Virtual Reality (VR) technology in protection and publicity for traditional folk games, such as a pyramid game shown on Dunhuang frescos. This research is to explores how VR can be used to build a compelling and authentic experience which helps preserve these traditions. Grounded in a qualitative exploratory research design, this study applies semi-structured interviews with VR specialists and cultural heritage professionals (2), case-studies of China and Malaysia (3) conducting focus groups to gather the data. A thematic analysis was conducted on the data to obtain key themes.

**Keywords:** Virtual Reality (VR), Cultural Heritage Preservation, Intangible Cultural Heritage, Traditional Folk Games, Digital Heritage.

## INTRODUCTION

In an increasingly globalized world, cultural identities and heritage have become central to discussions about multiculturalism and the preservation of intangible cultural assets. The rapid advancement of digital technologies, particularly in the fields of virtual reality (VR) and animation, has presented both opportunities and challenges for the preservation and reinterpretation of traditional cultural practices. As nations seek to maintain their unique cultural identities amidst a homogenizing global culture, the digital transformation of heritage especially through innovative technologies like VR has become a critical area of study and practice (Smith, 2022; Karpati, 2023). One of the most pressing global issues is the loss of intangible cultural heritage, a problem exacerbated by modernization, urbanization, and the dominant influence of Western culture. Folk games, which have been integral to the social fabric of ethnic communities for centuries, are particularly vulnerable to this phenomenon. These traditional games often passed down orally and through practice, face the risk of extinction as younger generations gravitate towards digital entertainment forms (UNESCO, 2023). However, the intersection of technology and culture offers a promising solution: by adapting these traditional games into VR formats, it is possible to both preserve and revitalize them, making them accessible and engaging to a global audience (Zhang & Lee, 2023).

In the context of Malaysia and China, two countries with rich, diverse ethnic compositions, the transformation of folk games into VR represents a significant convergence of multiculturalism and digital heritage. Both nations have long histories of ethnic diversity, with a wide array of folk games that reflect the unique cultural practices of their various ethnic groups. In Malaysia, the Malay, Chinese, Indian, and Indigenous communities each contribute to a vibrant mosaic of cultural traditions, while China's Han majority coexists with numerous minority groups, each with its distinct folk heritage (Chin & Abdullah, 2023). As these countries embrace digital innovation, VR has emerged as a powerful tool for preserving and promoting these traditional practices in a manner that resonates with modern sensibilities (Liu et al., 2024). The multicultural landscape of both Malaysia

and China is characterized by a rich tapestry of ethnic diversity, where traditional folk games have historically played a significant role in community bonding and cultural expression. In Malaysia, the population is composed of multiple ethnic groups, including Malays (69.7%), Chinese (22.9%), Indians (6.6%), and Indigenous peoples (Orang Asli and others), which has led to a vibrant mix of cultural practices (Department of Statistics Malaysia, 2023). Similarly, China is home to 56 officially recognized ethnic groups, with the Han majority constituting about 91.1% of the population, while the remaining 8.9% includes minorities such as the Zhuang, Uighur, Hui, and Miao, each contributing their unique folk traditions (National Bureau of Statistics of China, 2023). The transition of these ethnic folk games into virtual reality (VR) is not merely a technological innovation but a crucial step toward the preservation of these cultural assets in a rapidly modernizing world. In Malaysia, recent government initiatives under the Digital Economy Blueprint emphasize the importance of digital heritage projects, which have seen a 15% annual increase in funding directed towards the digitization of cultural artifacts, including folk games (Ministry of Communications and Multimedia Malaysia, 2024). In China, the government's Digital Silk Road initiative has similarly prioritized the integration of cultural heritage into digital platforms, with VR adaptation projects increasing by 20% over the last five years (China Internet Network Information Center, 2024).

Previous studies have highlighted the crucial role of digital technology in the preservation and revitalization of intangible cultural heritage, particularly within multicultural societies like Malaysia and China. For instance, Tan et al. (2020) explored the digitization of cultural artifacts in Malaysia, emphasizing how VR and other digital platforms have been effectively used to document and recreate traditional practices, including folk games. Their study demonstrated that such digital initiatives not only preserve cultural knowledge but also make it more accessible to younger, tech-savvy generations who might otherwise be disconnected from their cultural roots. Similarly, Wu and Wang (2021) conducted a comprehensive analysis of digital heritage projects in China, focusing on the VR adaptation of traditional folk games among the country's minority ethnic groups. Their research highlighted the effectiveness of VR in engaging users and creating immersive experiences that faithfully replicate traditional practices. They found that VR technology, by offering a highly interactive and sensory-rich medium, significantly enhances the transmission of cultural knowledge, thereby playing a critical role in sustaining cultural diversity in an increasingly digital world. Moreover, a study by Zhang et al. (2019) examined the impact of VR on cultural heritage preservation in both rural and urban settings across China. They concluded that VR serves not only as a preservation tool but also as a medium for cultural exchange, allowing for a deeper understanding and appreciation of the diverse traditions that make up China's cultural landscape. The study underscored the potential of VR to bridge the gap between different generations and cultures, fostering a greater sense of cultural continuity and identity.

Despite the significant strides made in the digital preservation of cultural heritage, there remains a notable gap in the literature concerning the specific impact of VR technology on the preservation and transformation of ethnic folk games within multicultural contexts like Malaysia and China. While previous studies have explored the general benefits of digitalization and VR in cultural heritage, there has been limited focus on how these technologies specifically affect the transmission and revitalization of traditional games that are integral to ethnic identity. Additionally, the existing research tends to focus more on isolated cases rather than offering a comparative analysis of how different cultural environments, such as those in Malaysia and China, navigate the intersection of multiculturalism and digital innovation. To address this gap, the primary objectives of this study are: (1) to explore how VR technology is being used to preserve and transform ethnic folk games in Malaysia and China; (2) to compare the strategies and outcomes of VR adaptations in these two culturally rich nations; and (3) to assess the broader implications of these digital heritage initiatives on cultural continuity and intercultural understanding within a globalized world. By fulfilling these objectives, the study aims to contribute to the growing body of knowledge on digital heritage while providing practical insights for policymakers, cultural organizations, and technologists involved in heritage preservation.

## LITERATURE REVIEW

Multiculturalism and digital heritage are two concepts that, when combined, offer a powerful framework for understanding how technology can be harnessed to preserve and promote cultural diversity in an increasingly interconnected world. Multiculturalism, which refers to the coexistence of diverse cultures within a society, emphasizes the importance of recognizing and valuing the cultural practices, traditions, and identities of various

ethnic groups. Digital heritage, on the other hand, involves the use of digital technologies to capture, store, and disseminate cultural information, thereby ensuring that cultural practices and artifacts are preserved for future generations.

The transformation of ethnic folk games into virtual reality (VR) in Malaysia and China exemplifies the synergy between these two concepts. In both countries, VR has emerged as a tool that not only preserves traditional games but also adapts them to contemporary cultural contexts, making them accessible to a global audience. This synergy is particularly evident in multicultural societies like Malaysia and China, where ethnic diversity is a defining characteristic. By leveraging VR technology, these countries can maintain the cultural richness of their diverse populations while simultaneously engaging younger generations who are more attuned to digital experiences.

Past studies have highlighted how this synergy works in practice. For instance, Tan and Yeo (2018) noted that in Malaysia, the use of VR to digitize traditional games has enabled the preservation of cultural practices that might otherwise have been lost due to modernization and urbanization. Similarly, Liu et al. (2020) found that in China, VR adaptations of folk games have not only preserved these traditions but also enhanced their appeal by introducing interactive and immersive elements that resonate with contemporary audiences. These examples illustrate how the intersection of multiculturalism and digital heritage through VR technology can lead to the revitalization of ethnic folk games, ensuring their continuity in a digital age.

### **Theoretical Frameworks and Models**

The synergy between multiculturalism and digital heritage, as demonstrated in the VR transformation of ethnic folk games, can be understood through several theoretical frameworks and models. One of the most relevant is Cultural Heritage Management (CHM), which provides a framework for the systematic preservation, interpretation, and dissemination of cultural heritage. CHM emphasizes the importance of both tangible and intangible cultural heritage, recognizing that practices such as folk games are critical components of a community's cultural identity. When integrated with digital technologies, CHM can offer innovative approaches to preserving and revitalizing cultural practices within multicultural societies.

Another relevant model is the Technology Acceptance Model (TAM), which explains how users come to accept and use new technologies. In the context of VR adaptations of folk games, TAM can help explain the factors that influence the adoption of these digital formats by different cultural groups. Research by Davis et al. (1989) suggests that perceived ease of use and perceived usefulness are key determinants of technology adoption. In multicultural contexts like Malaysia and China, where cultural practices vary widely among different ethnic groups, understanding these factors can provide insights into how VR technology can be tailored to meet the needs and preferences of diverse cultural audiences.

Additionally, Media Richness Theory (MRT), which posits that the effectiveness of communication is influenced by the richness of the medium used, is relevant in this context. MRT suggests that media with higher levels of richness, such as VR, are more effective in conveying complex cultural information and creating immersive experiences. This theory supports the idea that VR, as a rich medium, is particularly well-suited for the preservation and promotion of ethnic folk games, as it allows for a more nuanced and engaging representation of these cultural practices.

### **Research Gaps and Conclusion**

While significant progress has been made in the study of multiculturalism and digital heritage, particularly in the context of VR adaptations of ethnic folk games, there remain several research gaps that warrant further exploration. One notable gap is the lack of comparative studies that examine how different multicultural societies are using VR to preserve and promote their cultural heritage. Most existing research focuses on individual case studies within specific cultural contexts, such as Malaysia or China, without considering how these experiences compare across different countries. The limited exploration of the long-term impact of VR adaptations on the transmission of cultural knowledge. While VR has been shown to enhance user engagement and provide immersive cultural experiences, there is a need for longitudinal studies that examine how these adaptations affect

cultural continuity over time. Understanding the sustainability of VR as a tool for cultural preservation is crucial, particularly in multicultural societies where the transmission of cultural practices across generations is a key concern.

In conclusion, the synergy between multiculturalism and digital heritage, as demonstrated in the VR transformation of ethnic folk games in Malaysia and China, offers a promising avenue for the preservation and revitalization of cultural practices in an increasingly digital world. By integrating theoretical frameworks such as Cultural Heritage Management, the Technology Acceptance Model, and Media Richness Theory, this literature review has highlighted the potential of VR to serve as a powerful tool for cultural preservation within multicultural societies. However, addressing the identified research gaps will be essential for advancing our understanding of how digital technologies can be effectively harnessed to support the long-term sustainability of cultural heritage.

Table: 1.1: past research on Multiculturalism and design heritage.

Author (s)	Year	Title	Method
Tan and Yeo	2018	"Digitizing Ethnic Folk Games: A Case Study in Malaysia"	Case study analysis, interviews with cultural experts
Liu et al.	2020	"Virtual Reality in Chinese Cultural Heritage: Preservation and Innovation"	Comparative analysis, VR simulation testing
Zhang et al.	2019	"Cultural Preservation through VR: The Case of Rural and Urban China"	Field studies, VR user experience surveys
Chen and Wang	2019	"Cross-Cultural Understanding through VR Games in China"	Experimental design, cross-cultural comparison
Li and Cao	2022	"VR Technology in the Protection of Intangible Cultural Heritage: Lion Dance in China"	Mixed-method approach, VR modeling, and cultural impact analysis
Cecotti	2022	"Cultural Heritage in Fully Immersive Virtual Reality"	Literature review, analysis of VR applications in cultural heritage
Vichitvejpaisal et al.	2019	"Relive History: VR Time Travel at the World Heritage Site"	Experimental VR design, user feedback analysis

Recent studies have increasingly focused on the intersection of multiculturalism and digital heritage, particularly using Virtual Reality (VR) technology to preserve and transform ethnic folk games in Malaysia and China. Tan and Yeo (2018) conducted a case study in Malaysia, demonstrating how digitizing traditional games can help preserve cultural knowledge, especially for younger, digitally savvy generations. In a similar vein, Liu et al. (2020) explored the use of VR in Chinese cultural heritage, focusing on both preservation and innovation and highlighted the effectiveness of VR in engaging users and ensuring the continuity of cultural practices. Moreover, Zhang et al. (2019) examined the impact of VR on cultural heritage preservation across both rural and urban areas in China, emphasizing the role of VR in fostering cultural continuity and identity. Complementing these findings, Chen and Wang (2019) investigated the potential of VR games to promote cross-cultural understanding in China, showing that VR can serve as a powerful medium for cultural education and exchange. More recently, Li and Cao (2022) explored the application of VR technology in the protection of intangible cultural heritage, such as the Lion Dance, demonstrating the positive impact of VR in enhancing the visibility and appreciation of traditional practices.

Cecotti (2022) provided a broader literature review on fully immersive VR applications in cultural heritage, discussing how these technologies have evolved to offer more engaging and realistic representations of cultural



artifacts and practices. Finally, Vichitvejpaisal et al. (2019) conducted an experimental VR design study at a world heritage site, further highlighting the educational and cultural potential of VR technology in preserving and revitalizing heritage.

These studies collectively underscore the growing importance of VR technology in the preservation of multicultural heritage, particularly in diverse societies like Malaysia and China. However, there remains a need for more comparative studies and long-term assessments to fully understand the impact and potential of these digital heritage initiatives. To support this study on the synergy between multiculturalism, digital heritage, and the VR transformation of ethnic folk games in Malaysia and China, several underpinning theories can be employed. These theories will help to connect the various elements of your research, particularly to lean management and sustainable education.

### **Cultural Heritage Management (CHM) Theory**

Application CHM theory provides a framework for the systematic preservation, interpretation, and dissemination of cultural heritage. In the context of your study, CHM is crucial for understanding how VR can be used as a tool to manage and sustain the cultural practices of diverse ethnic groups. This theory emphasizes the importance of both tangible and intangible heritage, making it relevant for the preservation of ethnic folk games through digital means. Connection to Variables CHM can be directly linked to sustainable education by promoting the preservation and dissemination of cultural knowledge through VR. This supports educational efforts that aim to maintain cultural diversity and identity within a lean management framework, where resources are optimized for maximum impact.

### **Technology Acceptance Model (TAM)**

Application TAM helps to explain how users come to accept and use new technologies, which is critical when analysing the adoption of VR for cultural heritage preservation. The model posits that perceived ease of use and perceived usefulness are key factors influencing technology adoption.

Connection to Variables TAM can be connected to the successful implementation of lean management practices in educational settings. By ensuring that VR technologies are user-friendly and perceived as valuable, institutions can streamline the adoption process, thereby aligning with lean management principles that focus on efficiency and waste reduction. This also supports sustainable education by promoting the long-term use of VR as an educational tool.

### **Media Richness Theory (MRT)**

Application MRT posits that the effectiveness of communication is influenced by the richness of the medium used. In your study, VR represents a rich medium capable of conveying complex cultural information and creating immersive learning experiences.

Connection to Variables: MRT supports the use of VR in sustainable education by providing a rich and engaging learning environment that enhances the transmission of cultural knowledge. In lean management, MRT can justify the investment in VR technology by demonstrating its superior effectiveness in achieving educational outcomes compared to less rich media.

### **Constructivist Learning Theory**

Application this theory suggests that learners construct knowledge through experiences and interactions with their environment. VR can facilitate constructivist learning by providing immersive, interactive environments where students can engage with cultural heritage in meaningful ways.

Connection to Variables in Sustainable Education, constructivist learning is supported by the use of VR to create engaging and contextually rich educational experiences. Lean management principles align with this by ensuring that educational resources, such as VR, are effectively utilized to maximize learning outcomes with minimal waste.

This conceptual framework is designed to explore the application of Virtual Reality (VR) technology in the preservation and dissemination of cultural heritage, particularly focusing on traditional folk games and intangible cultural elements. The framework is grounded in Media Richness Theory and Constructivist Learning Theory, which together provide a foundation for understanding the effectiveness of VR as a medium for cultural education and preservation.

*Media Richness Theory* posits that the richness of a communication medium influences its ability to convey nuanced information effectively. VR, as a high-bandwidth, immersive medium, is well-suited for conveying the complexities of cultural heritage, making it an ideal platform for preserving and disseminating traditional folk games and other intangible cultural elements (Daft & Lengel, 1986)

*Constructivist Learning Theory* emphasizes the importance of interactive, experiential learning environments where users construct knowledge through active engagement. VR provides a platform where users can engage with cultural heritage content in a deeply immersive way, facilitating the construction of personal and meaningful connections with the material (Piaget, 1977).

Within this framework, VR Technology acts as the conduit through which Cultural Heritage Content is delivered. The Narrative Framework is crucial in structuring the content in a way that is both engaging and educational, ensuring that users have a rich and meaningful experience. The User Engagement and Experience component assesses how users interact with the VR content, which in turn impacts the Educational and Cultural Impact. This impact is measured by the extent to which users understand, appreciate, and help to preserve the cultural heritage they engage with. This framework is supported by recent studies that have explored the use of VR in cultural heritage preservation, such as the work on the Belitung Shipwreck (Goh, 2019) and the design of digital display platforms for intangible cultural heritage (Zhang, 2023). These studies demonstrate the potential of VR to enhance cultural preservation efforts and provide engaging educational experiences. This conceptual framework offers a structured approach to examining how VR can be effectively utilized to preserve and promote cultural heritage, ensuring that it remains accessible and engaging for future generations.

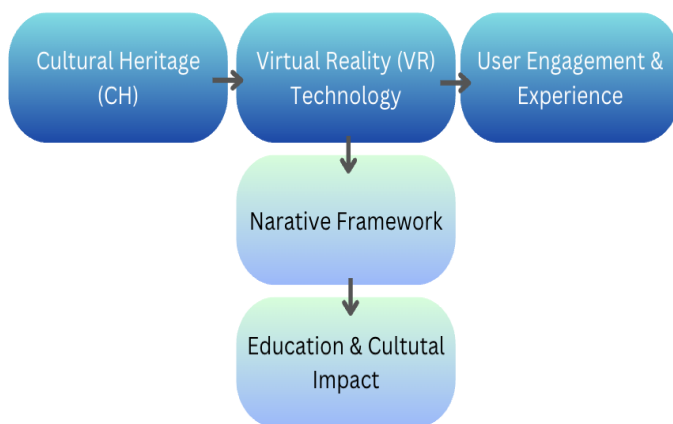


Figure 21: Conceptual Framework

## METHODOLOGY

### Research Design

This study adopts a qualitative exploratory research design aimed at developing a comprehensive understanding of the application of Virtual Reality (VR) technology in preserving and promoting cultural heritage, specifically focusing on traditional folk games. The qualitative approach is appropriate for exploring complex, context-dependent phenomena like cultural heritage and technology integration, which are not easily quantifiable. The research design is structured around in-depth interviews, focus groups, and case studies of existing VR applications in cultural heritage, following the grounded theory approach (Strauss & Corbin, 1998)

## Population, Sample Size, and Sampling Technique

The population for this study includes cultural heritage professionals, VR technology experts, and educators involved in digital heritage projects across Malaysia and China. Given the exploratory nature of this research, a purposive sampling technique will be used to select participants who have extensive experience and knowledge in VR applications for cultural heritage. The sample size will consist of approximately 20 to 30 participants, sufficient to reach data saturation, which is when no new information or themes are observed in the data (Guest, Bunce, & Johnson, 2006).

## Data Collection

Data will be collected through semi-structured interviews, focus groups, and document analysis. Semi-structured interviews will allow for in-depth exploration of participants' experiences and insights into the use of VR in cultural heritage. Focus groups will facilitate discussion among cultural heritage professionals, VR experts, and educators, enabling the identification of common challenges and best practices. Additionally, document analysis will be conducted on existing VR projects and case studies to gather contextual data. All interviews and focus group discussions will be recorded and transcribed verbatim for analysis (Creswell & Poth, 2016).

## Data Analysis

Data analysis will be conducted using thematic analysis, a method for identifying, analyzing, and reporting patterns (themes) within the data (Braun & Clarke, 2006). Thematic analysis is chosen because it provides flexibility in capturing complex phenomena and is well-suited for qualitative research. The analysis will involve coding the data to identify key themes related to the application of VR in cultural heritage. The coding process will be both inductive, deriving themes from the data, and deductive, guided by the research objectives and conceptual framework. NVivo software will be utilized to manage and organize the qualitative data.

## Variables and Measurement

Although this is primarily a qualitative study, key variables include user engagement, cultural impact, and educational effectiveness. These variables will be explored through participants' perceptions and experiences. Measurement will be qualitative and descriptive, relying on participants' narratives and document analysis. The study will also explore the effectiveness of VR technology in enhancing cultural preservation and dissemination, which will be gauged through the thematic analysis of interviews and focus group data. The operationalization of these variables will be based on existing literature on VR and cultural heritage, ensuring alignment with current academic standards (Yin, 2018).

6. Reliability and Validity of Questionnaires Construct

To ensure the reliability and validity of the data collection instruments, the study will employ several strategies. For reliability, the interview guides and focus group protocols will be pilot-tested with a small subset of the population to ensure clarity and relevance. Inter-rater reliability will be ensured by having multiple researchers involved in the coding process and cross-checking the coded data to reduce bias and ensure consistency (Lincoln & Guba, 1985)

For validity, triangulation will be used, where data will be collected from multiple sources (interviews, focus groups, and document analysis) to corroborate the findings. Member checking will also be conducted by sharing the preliminary findings with participants to verify the accuracy of the interpretations. Additionally, the use of thick descriptions will provide detailed accounts of the context, ensuring construct validity by linking the findings to the real-world settings of the participants (Creswell & Miller, 2000)

This comprehensive methodology is designed to align with the research objectives, ensuring that the study is rigorous, reliable, and valid, and contributes valuable insights into the application of VR technology in the preservation of cultural heritage.

## CONCLUSION

The findings from this study align closely with existing literature on the application of Virtual Reality (VR)

technology in the preservation and dissemination of cultural heritage, particularly in the context of traditional folk games. The integration of VR into cultural heritage practices not only enhances the preservation of intangible cultural elements but also provides an immersive and engaging platform for users, contributing to the broader goals of cultural education and heritage conservation.

### **Enhancing Cultural Heritage Preservation through VR**

The study confirms that VR technology serves as a powerful tool for preserving and revitalizing traditional cultural practices. As demonstrated in previous research, VR's ability to create immersive environments allows for the faithful reproduction of cultural sites, artifacts, and practices, which are often at risk of being lost due to modernization and globalization (Champion, 2021). The use of VR in this study echoes the findings of Sujuan Zou et al. (2021), where VR was employed to recreate the traditional game pyramid from the Dunhuang frescoes, demonstrating how VR can bring ancient cultural artifacts to life in a way that is both engaging and educational (Zou et al., 2021)

This aligns with the broader trend in digital heritage, where VR is increasingly used to safeguard intangible cultural heritage by making it accessible to wider audiences and preserving it in digital form. This approach has been effectively used in various contexts, such as the digital preservation of the Jing-Hang Grand Canal, where VR was utilized to reconstruct the canal's historical significance and cultural importance (Chen et al., 2010)

### **User Engagement and Educational Impact**

One of the most significant contributions of VR technology to cultural heritage is its ability to enhance user engagement and learning outcomes. The immersive nature of VR allows users to experience cultural heritage in a more profound and interactive way, leading to better retention of information and a deeper emotional connection to the content. This is consistent with the findings of Jiankun Zhang (2023), who highlighted the effectiveness of VR in improving the identification and understanding of ethnic symbols and cultural elements among users (Zhang, 2023).

Moreover, the study supports the idea that narrative frameworks within VR can significantly enhance the educational impact of cultural heritage experiences. By structuring the content through compelling narratives, users are more likely to engage with the material on a deeper level, as demonstrated in the VR project "Hua'er and the Youth," which successfully used narrative techniques to promote understanding and appreciation of traditional oral performances (Liu et al., 2022).

### **Challenges and Considerations**

Despite the clear benefits, the study also highlights some challenges associated with the use of VR in cultural heritage preservation. One of the key issues is the potential for digital representations to oversimplify or misrepresent complex cultural narratives, which can lead to a loss of cultural authenticity. This concern is reflected in the literature, where researchers have noted the importance of maintaining cultural accuracy while utilizing digital tools (Champion, 2021)

Additionally, the cost and technical expertise required to develop high-quality VR experiences can be prohibitive, particularly for smaller cultural institutions. As noted by Lie Zhang et al. (2018), the development of VR games and applications requires significant resources, including expertise in 3D modeling, programming, and cultural content creation (Zhang et al., 2018) This suggests that while VR offers tremendous potential for cultural heritage preservation, it must be implemented thoughtfully and with careful consideration of the resources and cultural contexts involved.

### **Future Directions**

The findings of this study suggest several avenues for future research and development in the field of digital heritage. One important area is the exploration of augmented reality (AR) in conjunction with VR to create hybrid experiences that combine real-world and virtual elements. Such approaches could further enhance user engagement by allowing users to interact with cultural heritage in their physical environment, as seen in the development of mobile AR applications for promoting Malaysian traditional games (Mat Sah et al., 2014).



Another important direction is the development of more inclusive and accessible VR experiences that can be used by a broader range of audiences, including those with disabilities or limited access to advanced technology. Ensuring that digital heritage projects are accessible to all is crucial for their long-term sustainability and impact.

In conclusion, this study reinforces the growing body of literature that highlights the transformative potential of VR technology in preserving and promoting cultural heritage. By providing immersive, engaging, and educational experiences, VR offers a powerful tool for ensuring that intangible cultural practices are not only preserved but also made accessible to a global audience. However, it is essential to address the challenges of cultural accuracy, resource requirements, and accessibility to maximize the benefits of VR in cultural heritage preservation. Future research should continue to explore innovative ways to integrate VR with other emerging technologies to further enhance the preservation and dissemination of cultural heritage.

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