

PROFESSIONAL PERSPECTIVES ON DIGITAL TRANSFORMATION IN HERITAGE TOURISM SITE

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ABSTRACT

Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) are promoting innovation and enhancing efficiency in multiple sectors. It helps to preserve cultural legacy for future generations. This study examines Malaysian heritage tourism professionals' views on the digital transformation of XR technology. The study questions professionals about Malaysia's heritage tourism industry's digital evolution. The goal is to learn about cultural heritage and architecture professionals' views on XR technology integration in heritage tourism. Semi-structured interviews and thematic analysis were used to identify themes and insights. Findings indicate that professionals strongly agree about the potential advantages of AR, VR and MR technologies in improving tourist engagement at cultural sites. The professionals value these technologies for their capacity to engage in urban landscapes through digital story design. However, significant issues include lack of experience, infrastructure, development expenses, and improper information display. To overcome these challenges, providing focused training, improving facilities, adopting efficient cost-control management, and fostering multidisciplinary collaboration is necessary. The need to form collaborative partnerships with higher education institutions and industry to reduce costs and access essential skills, ensuring that initiatives are highly competent and culturally authentic. Adopting XR technology is necessary for Malaysian cultural institutions.

1. Introduction

Digital technologies, specifically Extended Reality (XR) technologies, are revolutionising how businesses operate and engage with customers by driving innovation and improving efficiency across various sectors, including education, healthcare, retail, manufacturing, and tourism (Srivastava et al., 2023). XR encompasses Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR), each with significant transformative potential (Chang, Kuo, and Du, 2023; Sharma, 2021). In the tourism and heritage sectors, AR, VR, and MR offer immersive

experiences like virtual tours, enhancing pre-trip planning and on-site visits (Aboushal and Gharib, 2020). These technologies revolutionise heritage tourism by innovatively presenting historical and cultural information, making artefacts and sites more engaging and accessible to a broader audience (Katika et al., 2022; Scianna, Gaglio, and la Guardia, 2019; Shin, 2019).

AR enriches visitor experiences by overlaying digital information onto the physical world, allowing for enhanced interpretation of artefacts and exhibits (Bekele et al., 2018; Shehade and Stylianou-Lambert, 2020). VR provides a fully immersive virtual environment where users can experience historical events or explore recreated heritage sites (Bekele et al., 2018; Roumana, Georgopoulos, and Koutsoudis, 2022). MR combines AR and VR, enabling seamless interaction between real and virtual elements (Bekele et al., 2018; Michaelsen, 2021). The impact of these digital technologies on visitor engagement is profound, leading to increased interactivity, accessibility, inclusivity, educational value, and efforts towards preservation and conservation. Integrating AR, VR, and MR in tourism and heritage sectors fosters more interactive, inclusive, and educational experiences, ensuring the relevance and accessibility of cultural heritage for future generations.

Incorporating professionals' perspectives in the heritage tourism sector is essential for informed decision-making. Their insights provide valuable information about the practical challenges of implementing AR, VR, and MR technologies, offering context-specific details that help tailor digital solutions to the unique characteristics of their institutions, ensuring a better fit and more significant impact (Damala, Ruthven and Hornecker 2019). Additionally, professional input can guide the design of digital technologies to enhance user experiences, making exhibits more engaging, educational, and accessible. By identifying skills and knowledge gaps, professionals ensure that digital technology integration aligns with institutional goals, supporting their mission and vision. Leveraging professional networks with other institutions, technology providers, and industry experts further ensures that digital solutions are practical, effective, and aligned with institutional needs and objectives.

2. Methodology

This study employed a qualitative phenomenological approach to gain in-depth insights from professionals in heritage tourism, specifically experts from PADAT, PERZIM, and heritage architecture practice. Data were collected through semi-structured interviews, which continued until saturation was reached, and analysed using thematic analysis with the support of Atlas.ti software to facilitate systematic transcription, coding, and identification of recurring themes and patterns. As a researcher with a background in architecture and digital heritage, the author employed systematic coding procedures, grounded interpretations in verbatim participant quotes, and engaged in regular supervisory feedback to ensure objectivity and trustworthiness of the findings. As a preliminary study, the results provide an initial exploration of professional perspectives on digital transformation in heritage tourism, laying the groundwork for future research that may expand to a wider range of institutions, participants, and methodological approaches for broader validation.

3. Results

Table 1. Participant background

Participant ID	Role	Experience	Background
R01	Exhibition Curator	Management, preservation, and conservation of Selangor cultural heritage	Emphasis on preservation and conservation; regional expertise in Selangor
R02	Museum Curator	Management, preservation, and conservation of Malacca cultural heritage	Emphasis on preservation and conservation; regional expertise in Malacca
R03	Director	Academic and industrial practice in architecture and cultural heritage architecture	Combines academic and practical experience; a strong foundation in architecture and cultural heritage

The analysis of professional backgrounds in cultural heritage tourism, as shown in Table 1, reveals a diverse range of roles, from curatorial to directorial positions, with a strong emphasis on preservation and conservation. Professionals possess regional expertise in Selangor and Malacca, highlighting unique challenges and opportunities within these cultural contexts. Additionally, the combination of academic and industrial practice, particularly in architecture and cultural heritage, underscores a blend of theoretical knowledge and practical application.

Table 2. Participant familiarity with AR, VR, and MR technologies

Participant ID	Familiarity	Experience	Familiarity with XR
R01	Very basic	Tested VR device in VR development lab	Basic exposure to VR; initial exposure but limited practical application
R02	Not familiar	Not familiar	Lack of familiarity; potential barriers to adopting technologies
R03	Experienced	Conducted research on cultural heritage using VR	Advanced understanding of VR; substantial experience in research application

Table 2 shows the analysis of familiarity with AR, VR, and MR technologies among heritage tourism professionals, revealing varied levels of exposure. The exposure ranges from very basic to experienced. Some professionals have only initial exposure to VR technology, such as testing devices in development labs. In contrast, others are unfamiliar with these technologies, indicating potential barriers to adoption. Conversely, some professionals have substantial experience in using VR for cultural heritage research, demonstrating advanced understanding and application.

3.1 Potential of AR, VR, and MR Technologies

Table 3. Professional opinions regarding the potential of AR, VR, and MR to improve visitor

Code	Professional Opinion	Benefit Digital Technologies
<i>General Opinion on Digital Technologies</i>	Digital technologies are beneficial for enhancing museum and heritage site exhibitions (R01)	Beneficial for enhancing exhibitions
	They can attract public interest, particularly among school students (R02)	Attracts school students
<i>Attractiveness to Visitors</i>	Digital exhibitions are a practical approach to draw visitors to museums and heritage sites (R01)	Effective for drawing visitors
	These technologies serve as a compelling attraction for visitors (R03)	Compelling attraction
<i>Diversification of Exhibition Activities</i>	Digital technologies diversify exhibition activities, making them more engaging (R01)	Diversifies exhibition activities
<i>Heritage Tourism Promotion</i>	Digital technologies are valuable in promoting heritage urban landscapes (R03)	Promotes heritage urban landscapes
	They aid in the preservation and conservation of heritage elements (R03)	Aids preservation and conservation
<i>Educational Value</i>	Digital narrative design enables users to gain a deep understanding of the existence of heritage urban landscapes (R03)	Deep understanding of heritage through narratives

The research findings in Table 3 highlight the consensus among professionals on the potential of AR, VR, and MR technologies to enhance visitor engagement at heritage sites. Digital technologies are valuable for enhancing museum and heritage site exhibitions, particularly effective at drawing school students and increasing public interest. These technologies are praised for their ability to diversify exhibition activities, making them more engaging and appealing to visitors. In this field of study, digital tools play a crucial role in heritage tourism, being particularly effective at promoting and preserving historical urban areas. Through digital narrative design, users can better understand heritage elements, contributing to preservation efforts and educational experiences. Overall, the findings strongly support integrating advanced digital technologies to enrich visitor interactions and promote cultural heritage.

3.2 Challenges in Integrating AR, VR, and MR Technologies

Integrating AR, VR, and MR technologies into heritage tourism faces several significant challenges, as highlighted by the interview data shown in Chart 1. A major obstacle is the lack of expertise among curators and other professionals in handling advanced digital technologies. The lack of necessary skills is intensified by insufficient infrastructure and facilities. At the same time, the high costs of developing AR, VR, and MR applications create additional challenges, making it hard for heritage organisations to afford these technologies. Outsourcing development adds complexity and expense, as heritage organisations must provide substantial input, such as information and 3D models, even when external consultants are involved. Additionally, there is a risk of inaccurate information presentation due to over emphasising programming and hyperrealism, which may not align with the proper historical narrative. Addressing these challenges through targeted training, facility upgrades, effective cost

management, collaborative development approaches, and a focus on accurate storytelling will be crucial for the successful digital transformation of heritage tourism in Malaysia.

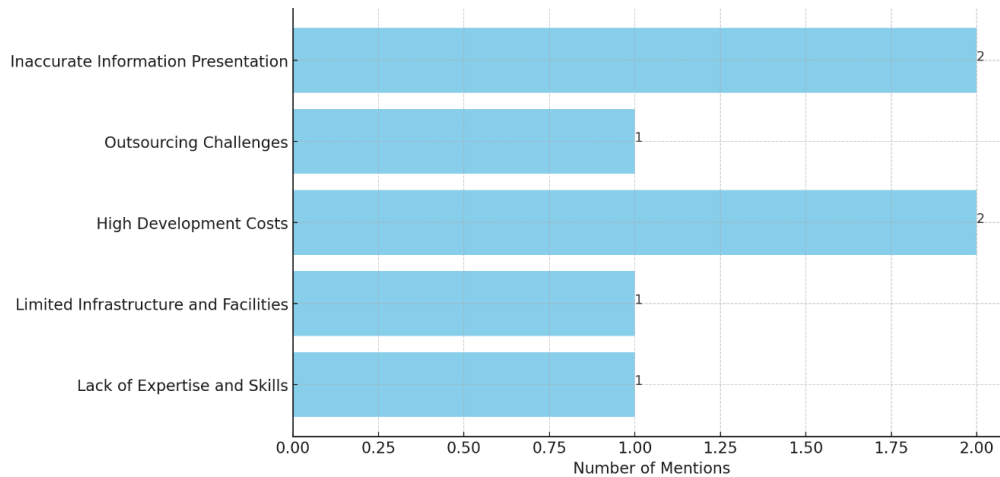


Figure 1. Main Challenge in integrating AR, VR and MR technologies in cultural heritage tourism.

3.3 Recommendations for Implementing AR, VR, and MR Technologies

Chart 2 illustrates the analysis of professional recommendations for effectively implementing AR, VR, and MR technologies in heritage tourism, revealing several key themes. The value of collaboration in heritage tourism is highlighted by suggesting that partnerships with external organisations, such as universities and industry experts, can lower costs and provide essential skills, thereby improving the quality and cost-efficiency of digital transformation projects. Combining expertise from fields like information and communication technology (ICT), cultural heritage, and architecture is crucial for ensuring that digital projects are technically proficient and culturally accurate, ultimately enhancing the visitor experience. Effective resource management is also critical; managing budgets and leveraging external resources can help heritage organisations overcome financial and technical barriers to project realisation. Finally, addressing issues like dissonance and hyperrealism through interdisciplinary collaboration ensures that digital content aligns accurately with cultural narratives, enhancing the educational value and integrity of digital heritage tourism projects. These insights imply that strategic partnerships, expert involvement, effective resource management, and interdisciplinary collaboration are essential for the successful digital transformation of the heritage tourism industry.

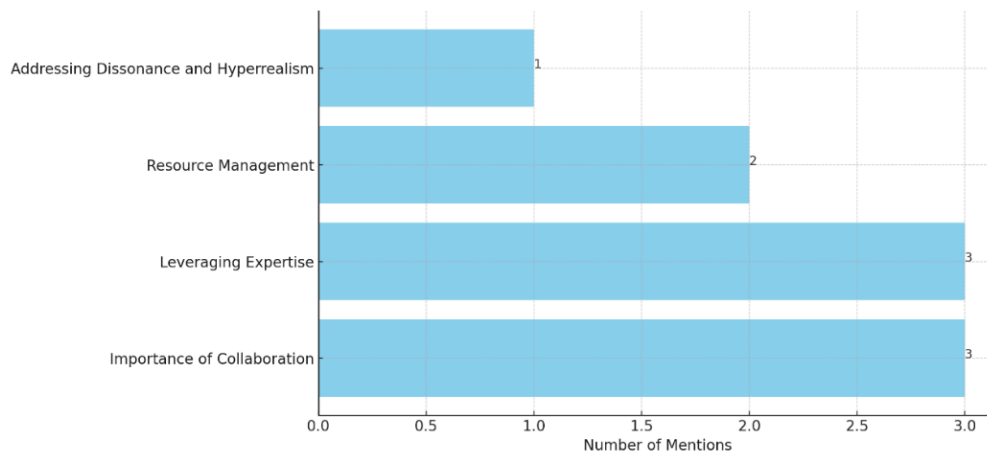


Figure 2. Recommendation AR, VR and MR implementation in Heritage Tourism

3.4 Predictions on Digital Transformation in Heritage Tourism

Table 4. Professional prediction on digital transformation in heritage tourism

Code	Professional Opinion	Future Digital Transformation in Heritage Tourism
<i>Attracting Younger Audiences</i>	Digital technology will be crucial in attracting younger visitors accustomed to interactive and digital experiences.	Heritage sites will become more engaging for younger audiences, increasing visitor numbers and educational impact.
<i>Staying Competitive Internationally</i>	Implementing digital technologies will help Malaysian heritage institutions keep up with international standards and practices.	Staying competitive globally will enhance Malaysia's reputation and attractiveness as a heritage tourism destination.
<i>Leveraging Global Trends</i>	Observing and benchmarking against successful digital implementations in heritage tourism overseas can guide Malaysia.	Learning from global trends will help Malaysian heritage institutions adopt best practices and innovative solutions.
<i>Impact of the COVID-19 Pandemic</i>	The pandemic has accelerated the adoption of digital technologies in heritage tourism, highlighting their importance for resilience and continued visitor engagement.	Digital transformation can ensure the sustainability and resilience of heritage tourism in the face of future disruptions.

Table 4 presents the thematic findings of professional predictions on digital transformation in heritage tourism. One of the primary themes is the necessity of digital transformation to attract younger audiences accustomed to interactive and digital experiences. This transformation is essential for heritage tourism to remain relevant and engaging to this demographic. Additionally, staying competitive internationally is crucial for Malaysian heritage institutions. These institutions can align with international standards and practices by implementing digital technologies, enhancing their global reputation and attractiveness.

Leveraging global trends is another significant theme. Malaysia can adopt best practices and innovative solutions by observing and benchmarking against successful digital

implementations in heritage tourism overseas, particularly in European countries. This approach can guide Malaysian heritage institutions in effectively integrating digital technologies into their exhibitions and activities. The impact of the COVID-19 pandemic has also been a critical driver for adopting digital technologies. The pandemic accelerated the need for digital transformation to ensure resilience and continued visitor engagement. Digital solutions can provide innovative ways to engage visitors, making exhibitions more interactive and educational, which is especially important in the post-pandemic era.

4. Discussion

The findings reveal varied levels of exposure to AR, VR, and MR technologies, yet a strong consensus on their potential benefits for enhancing visitor engagement, especially in attracting younger audiences and increasing public interest. From a theoretical perspective, these insights can be understood through the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). Constructs such as performance expectancy (perceived usefulness of XR in improving exhibitions and preservation), hedonic motivation (enjoyment and attraction for younger visitors), and social influence (perceived value in enhancing institutional reputation) explain the professionals' positive views on digital adoption. Conversely, barriers like lack of expertise, infrastructure limitations, and high costs align with effort expectancy, facilitating conditions, and price value, highlighting the factors that constrain adoption. In parallel, the educational value of XR resonates with Learning Theory, particularly experiential and constructivist approaches, where immersive technologies enable active, contextual, and engaging forms of cultural learning. Digital storytelling and interactive heritage environments provide opportunities for deeper understanding and long-term retention, reinforcing the dual role of heritage sites as cultural and educational spaces. Addressing challenges through targeted training, facility upgrades, interdisciplinary collaboration, and effective cost management will enhance the alignment of UTAUT2 constructs with positive adoption outcomes. Furthermore, the accelerated digital transformation triggered by the COVID-19 pandemic highlights the theoretical importance of adaptability and resilience, reinforcing XR technologies as a sustainable driver for continued visitor engagement and international competitiveness in heritage tourism.

5. Conclusion

The conclusion of this preliminary research study suggests that future research should focus on improving the implementation of digital technology in museums and heritage tourism through collaboration with various experts. This approach can provide cost-effective solutions and ensure cultural accuracy in digital representations. By leveraging interdisciplinary expertise, museums can enhance their digital exhibits' quality, engagement, and authenticity, ultimately enrich the visitor experience and preserve cultural heritage.

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