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EXPLORING THE ROLE OF METAVERSE ADOPTION IN PRESERVING AND PROMOTING VIETNAM'S CULTURAL HERITAGE THROUGH VIRTUAL TECHNOLOGY

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Abstract

Vietnam's ongoing challenges of rapid urbanisation, climate change, and technological disparities have created an urgent need for innovative approaches to preserving and promoting its cultural heritage. Emerging virtual technologies, particularly the metaverse, offer new avenues for engaging younger generations in heritage conservation and cultural promotion. This study investigates the impact of virtual technology and the mediating role of metaverse adoption on the conservation and promotion of cultural heritage in Vietnam. Employing a quantitative research design, data were collected from 357 respondents and analysed using partial least squares structural equation modelling (PLS-SEM) to test the proposed research model. The findings reveal that virtual technology positively influences metaverse adoption, which in turn significantly enhances behaviours related to cultural heritage conservation and promotion. In essence, metaverse adoption serves as a key mediating mechanism between virtual technology and heritage engagement outcomes. The study recommends that cultural organisations integrate metaverse platforms into exhibitions, educational initiatives, and tourism experiences to attract younger audiences and foster interactive participation. Furthermore, interdisciplinary collaboration is encouraged to create culturally authentic digital content, while investments in infrastructure, digital skills development, and user-centric design are highlighted as critical factors for ensuring the sustainability of digital heritage initiatives.

Keywords: Cultural engagement, cultural heritage conservation, cultural heritage promotion, metaverse adoption, virtual technology

Introduction

The rapid evolution of immersive digital technologies in recent years has reshaped multiple sectors worldwide, including education, healthcare, tourism, and manufacturing (Eswaran & Bahubalendruni, 2022; Abdelmaged, 2021; Delgado, 2020). Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and the metaverse now stand out as transformative platforms enabling highly interactive and immersive digital experiences. Within the field of cultural heritage, these technologies provide innovative methods to preserve, present, and promote both tangible and intangible heritage resources (Bekele et al., 2018; Marto, 2022; Fanini et al., 2023). According to UNESCO (2024), cultural heritage encompasses tangible

assets such as monuments and artifacts, intangible expressions such as language and traditions, and natural elements such as culturally significant landscapes and biodiversity. Preserving these resources is vital for sustaining national identity, fostering intercultural dialogue, and maintaining historical continuity (UNESCO, 1985). In response to threats posed by urbanisation, climate change, and generational disconnect, international organisations such as UNESCO have increasingly advocated for the integration of sustainable development concepts and advanced digital tools to safeguard heritage assets (United Nations, 2012). Scholars have already demonstrated the potential of VR, AR, and MR to create immersive experiences that simulate historical environments and enhance visitor interaction with cultural artifacts (Scavarelli et al., 2021; Hutson et al., 2024). AR overlays contextualised digital content on physical heritage sites; VR reconstructs inaccessible or lost cultural spaces; and MR blends AR and VR to enable highly interactive engagements supporting both education and conservation (Buhalis et al., 2022). Yet despite these developments, research has mainly focused on isolated technologies or single-case applications, leaving a gap in understanding their collective impact on cultural heritage (Boboc et al., 2022). This gap is even more pronounced for the metaverse, particularly in developing nations such as Vietnam

The metaverse, as an interconnected, persistent, and immersive virtual environment, offers unique opportunities to transform cultural heritage experiences beyond the capabilities of traditional digital technologies. By enabling users to navigate reconstructed heritage spaces, participate in simulated rituals, and interact with virtual artifacts in real time, the metaverse creates new possibilities for collaborative cultural storytelling and experiential learning. Unlike standalone VR or AR applications, the metaverse integrates spatial, temporal, and contextual layers into a seamless environment that can host scalable and socially engaging experiences. Eswaran and Bahubalendruni (2022) introduced a multidimensional framework of linearity, planarity, space, time, and context to analyse how virtual and physical heritage environments interrelate—providing a critical theoretical lens to assess metaverse adoption. This potential is particularly salient in Vietnam, a country with rich historical traditions and diverse ethnic cultures facing escalating challenges of urbanisation, climate change, and a widening technology gap. Although museums, heritage sites, and educational institutions in Vietnam have begun experimenting with digital initiatives, full-scale adoption of immersive technologies, especially the metaverse, remains limited due to technical, financial, and policy constraints. These conditions underscore the need for empirical research examining how virtual technologies—particularly the metaverse—can support documentation, revitalisation, and promotion of Vietnam's cultural heritage.

In response, this study investigates the impact of virtual technology on the conservation and promotion of cultural heritage in Vietnam, with a specific focus on the mediating role of metaverse adoption. Drawing on digital heritage theory and technology acceptance models, the research employs partial least squares structural equation modelling (PLS-SEM) to evaluate how metaverse adoption influences heritage engagement, preservation outcomes, and educational benefits. Additionally, it explores organisational and individual factors affecting metaverse adoption among heritage professionals, institutions, and the public. By combining

bibliometric analysis with empirical testing, this study fills a critical research gap and generates actionable insights for policymakers, cultural organisations, and technology developers. The findings are expected to inform strategies for deploying immersive technologies in Vietnam and similar emerging contexts, ensuring that cultural heritage remains accessible, relevant, and resilient in the digital age.

Conceptual Framework and Hypothesis Development

2.1 Virtual technology and its role in cultural heritage

Virtual Technology (VT) encompasses a spectrum of digital systems and tools designed to simulate, enhance, or augment reality through human–computer interaction. The most prevalent forms include Virtual Reality (VR) which creates entirely computer-generated environments and Augmented Reality (AR) which overlays digital elements such as images, sounds, or 3D models onto the real world (Hsieh & Lin, 2011). Both are rooted in the broader category of immersive Internet Technologies and have gained widespread use across fields such as education, healthcare, engineering, marketing, and increasingly, cultural heritage. VR technologies are characterized by three fundamental aspects: immersion, interaction, and visual realism (Rosenblum & Cross, 1997). Immersion involves the creation of a surrounding virtual environment that engages the user's senses through devices such as head-mounted displays (HMDs), motion-tracking gloves, surround sound systems, and haptic feedback tools (Wu et al., 2015). Interaction refers to the user's ability to respond to and manipulate elements within the virtual space in real time requiring instant feedback for movement, orientation, and sensory perception. Visual realism ensures the authenticity and credibility of the digital experience through high-fidelity modeling of geometry, textures, lighting, and physical properties. This sensory-motoric, cognitive, and emotional engagement enables users to feel "present" within an artificial but compellingly lifelike environment (Björk & Holopainen, 2004; Benford et al., 1998).

In contrast, AR extends rather than replaces the real world. It allows users to experience real-world environments augmented with digital content without full immersion resulting in a real-time mixed reality. These overlays can include historical reconstructions, interpretive information, or multimedia enhancements that enrich the visitor experience while preserving connection to physical heritage assets (Zhou et al., 2008). Importantly, the boundary between VR and AR is increasingly fluid. Milgram and Kishino (1994) introduced the concept of a reality–virtuality continuum, suggesting that virtual and real environments exist on a sliding scale rather than as discrete categories. This conceptual framework supports a wide range of hybrid applications in cultural heritage.

In the field of cultural heritage conservation and promotion, virtual technologies play an increasingly pivotal role by providing innovative methods to document, preserve, revitalize, and disseminate both tangible and intangible heritage. For example, VR has been used to digitally reconstruct destroyed or inaccessible heritage sites, simulate traditional festivals, and

recreate ancient environments for educational and tourism purposes. Through such reconstructions, users are immersed in time-travel-like experiences, gaining a deeper emotional and cognitive appreciation of the past that surpasses traditional museum exhibits or printed media (Riva, 2006). In parallel, AR enables interactive engagement with on-site artifacts or historical locations, enriching visitor experiences with contextual information, interpretive narration, or multilingual content. This is especially significant for young audiences and international tourists, who may lack background knowledge but benefit greatly from interactive digital storytelling. Mobile-based AR applications, for instance, can allow users to explore ancient Vietnamese temples while viewing animated reconstructions of rituals, royal processions, or architectural transformations through time. Moreover, virtual technologies support digital archiving and remote access, helping safeguard fragile or at-risk heritage assets. In countries like Vietnam, where rapid urbanization, climate change, and generational gaps threaten the survival of cultural traditions, VT can digitize endangered languages, folk practices, and community knowledge systems—making them available for future research, education, and revival. These digital records reduce wear-and-tear on original artifacts, extend outreach to remote communities, and foster inclusive participation across diverse population groups. Furthermore, VT enables new forms of participatory cultural production. Through interactive platforms and collaborative virtual spaces, community members, heritage professionals, and young creators can codesign, reinterpret, and promote their heritage stories in digital formats. This democratizes heritage and aligns with UNESCO's emphasis on inclusive, sustainable cultural development (UNESCO, 2024).

In the context of Vietnam, where cultural diversity is immense spanning 54 ethnic groups, multiple dynasties, and thousands of festivals, the strategic use of virtual technology holds transformative potential. Yet, its integration into heritage practice remains nascent, often limited to pilot projects in major museums or tourism hubs. By understanding the technological, social, and institutional factors that shape VT adoption, heritage stakeholders in Vietnam can better harness its potential to strengthen national identity, promote intercultural understanding, and enhance the resilience of cultural heritage in the digital age.

2.2 Metaverse

The notion of the "Metaverse" has undergone various scholarly interpretations and can be traced back to Neal Stephenson’s seminal 1992 novel Snow Crash, which introduced the idea of a virtual universe operating parallel to physical reality marking one of its earliest conceptualizations (Joshua, 2017). At its essence, the Metaverse represents an evolutionary stage of the internet: a three-dimensional, immersive digital space where users engage with other individuals, environments, and a broad spectrum of virtual experiences. Unlike conventional internet functions such as website navigation, the Metaverse offers a heightened level of interactivity, enabled through the convergence of augmented reality (AR) and virtual reality (VR). These technologies facilitate multisensory engagement, allowing users to interact dynamically with virtual entities, objects, and co-participants in a shared environment (Dwivedi et al., 2022; Buhalis et al., 2023). Early visions of the Metaverse often portrayed it as a virtual realm where instantaneous movement or "teleportation" between digital locations

was possible. Fundamentally, it is a co-created 3D digital ecosystem that evolves through user participation (Knox, 2022; Zyda, 2022). Within this environment, individuals have the capacity to construct and explore parallel digital realities, fostering social interaction and personalized experiences (Han et al., 2022; Hollensen et al., 2022). Although a universally accepted definition of the Metaverse remains elusive, it is widely regarded as an integrated digital-physical continuum that blends spatial presence with interactive content. It encompasses aspects of online gaming, social networking, and immersive visualization technologies. The accelerated development of extended reality (XR), which unifies VR and AR, has attracted significant investment and strategic interest from leading technology firms such as Meta, Google, and Samsung. Notably, the Acceleration Studies Foundation (ASF) in 2007 proposed a comprehensive framework outlining four distinct categories of Metaverse constructs: virtual worlds, mirror worlds, lifelogging environments, and augmented reality applications (Joshua, 2017). In recent developments, the concept of "Digital X" has emerged as a broader paradigm encompassing XR, digital twin technologies, and personalized digital avatars, referred to as "digital ME" (Xi et al., 2022). This framework underlines a convergence of immersive, real-time experiences delivered via multi-platform systems that leverage head-mounted displays, thereby facilitating deeper engagement in virtual environments.

Within the domain of cultural heritage, the metaverse introduces transformative possibilities for conservation and promotion by offering new forms of virtual engagement with history, tradition, and identity. The metaverse introduces distinctive features including interactivity, corporeity, and persistence that differentiate it from conventional digital tools. These features provide new opportunities to engage with, preserve, and promote intangible and tangible heritage through dynamic and participatory virtual experiences. The interactivity of the metaverse enables real-time communication and collaboration among users through digital platforms. In heritage conservation, this feature allows for interactive storytelling, virtual tours, and participatory archives that enrich public engagement. Corporeity, characterized by the use of customizable avatars, enhances immersion by offering users a sense of presence within cultural or historical reconstructions. This helps simulate realistic visits to heritage sites or events, especially when physical access is limited. The persistence of the metaverse ensures that digital assets, interactions, and shared cultural content remain available over time, supporting long-term educational and promotional efforts (Ando et al., 2013; Díaz et al., 2020) Adopting metaverse technologies for cultural heritage purposes requires not only technical infrastructure but also a shift in management and leadership models. These models must align with emerging digital environments and support cross-sector collaboration between cultural institutions, educators, and technology developers (Ahmad et al., 2021). Virtual technologies also offer the possibility to explore how users interact with cultural content differently in virtual environments compared to physical settings, enabling richer data collection and behavioral analysis (Salloum et al., 2021). Unlike traditional classrooms or museum spaces, metaverse platforms offer high levels of flexibility. Cultural education, for instance, can take place in fully virtual environments where learners explore reconstructed heritage sites and participate in community-driven activities. These immersive experiences may contribute to increased awareness and appreciation of cultural values, especially among younger generations.

From a methodological standpoint, earlier research primarily relied on linear models such as Structural Equation Modeling (SEM), which often failed to capture the complex, non-linear relationships between variables (Sim et al., 2014). Recent studies have adopted hybrid approaches combining SEM with Artificial Neural Networks (ANN) to improve accuracy and predictive power (Leong et al., 2013). However, in this study, the Partial Least Squares (PLS) approach is employed due to its suitability for exploratory research, especially when dealing with new technologies and conceptual models related to metaverse adoption. Furthermore, this research builds upon but moves beyond the traditional Technology Acceptance Model (TAM). A more contextspecific conceptual framework is adopted to reflect the unique factors influencing the acceptance of virtual technology for cultural heritage in Vietnam. These include perceptions of usefulness in heritage preservation, the role of immersive engagement, and the socio-cultural significance of digital heritage platforms. In recent years, studies have also emphasized the role of emerging tools—such as eye-tracking and virtual reality simulations in assessing user interaction with educational and cultural materials (Chen et al., 2022), which further validates the growing importance of metaverse applications in this field. In short, the integration of metaverse technology holds transformative potential for preserving, promoting, and revitalizing cultural heritage. By leveraging immersive environments and user-centered design, institutions in Vietnam can reimagine how cultural narratives are experienced and sustained in the digital era.

2.3 Current state of virtual technology and metaverse adoption in cultural heritage in Vietnam

In recent years, Vietnam has made notable strides in applying virtual technologies such as Virtual Reality (VR), Augmented Reality (AR), and the metaverse to the preservation and promotion of cultural heritage. The rapid development of digital platforms, coupled with changing demands in heritage engagement during and after the Covid19 pandemic, has prompted cultural institutions, tourism bodies, and tech enterprises to explore immersive technologies as innovative tools for heritage communication and conservation.

Figure 1 illustrates the gradual increase in the frequency of key terms associated with virtual technologies and cultural heritage from January 2014 to June 2024 (Zhang et al., 2024). The findings underscore notable progress in the development and application of VR, AR, and MR within the field of cultural preservation, highlighting the ongoing need to refine related methodologies. In the early stages particularly in 2014, terms such as “historic preservation” appeared infrequently, indicating limited attention to this domain. However, interest has steadily grown, culminating in a peak of 135 mentions by 2024, which reflects a heightened awareness of the importance of safeguarding historic sites and structures. In parallel, the rising prominence of terms like “3D modeling” and “three-dimensional computer graphics” points to the increasing use of advanced visualization technologies for documenting and representing cultural heritage. Moreover, keywords such as

“museums,” “intangible cultural heritages,” and “human computer interaction” have shown significant growth, signaling a shift toward the inclusion of non-material heritage and interactive user experiences in digital platforms. This upward trend in terminology emphasizes

the critical role of virtual technologies in enabling more immersive, detailed, and engaging approaches to cultural heritage interpretation and conservation. In alignment with this global trajectory, Vietnam has also begun integrating these technologies into local initiatives, aiming to enhance both heritage preservation efforts and tourism development.

For instance, the case study is about Hoi An's metaverse initiative for cultural heritage promotion. In March 2024, the Center for Culture, Sports, Radio, and Television of Hoi A City (Quang Nam Province) initiated a pioneering partnership with Bizverse to integrate virtual technology into cultural tourism. This collaboration marked a significant step in leveraging Metaverse platforms comprising interconnected 3D environments built upon Virtual Reality (VR) and Augmented Reality (AR) as a strategic tool for preserving and promoting cultural heritage. The joint project, titled "Hoi An Metaverse", reflects a broader shift toward digital transformation in heritage management. It focuses on creating immersive 3D models of historical monuments, ancient streets, and traditional craft villages, which are digitally reconstructed and displayed within a 360-degree virtual environment on the Bizverse World platform. These models are accompanied by AI-generated local voiceovers, enhancing user engagement and offering a realistic, informative virtual exploration of the city's cultural assets. This initiative emerged as a response to the challenges posed by the Covid-19 pandemic, which drastically reduced physical tourist visits and forced local tourism authorities to seek alternative ways to connect with audiences. By digitizing heritage content and introducing interactive virtual tours, Hoi An has positioned itself at the forefront of cultural innovation in Vietnam. It not only ensures the continuity of heritage appreciation during global disruptions but also expands outreach to global audiences, supporting Hoi An's status as a UNESCO World Cultural Heritage Site. This case demonstrates how virtual technologies, when accepted and implemented effectively, can contribute significantly to the dual mission of heritage conservation and public engagement—core to the sustainable development of cultural tourism in the digital age.

Challenges and opportunities

The adoption of virtual technology and the metaverse in cultural heritage offers innovative avenues for preservation and engagement, but it also raises significant challenges. Foremost among these is the need to ensure authenticity and historical accuracy in virtual representations. When using 3D modeling and VR to recreate heritage artifacts and sites, oversimplification or incomplete data can lead to misrepresentations that distort historical understanding (Palčák et al., 2022; Banf et al., 2021). Important details such as material texture, color, or symbolic elements may be lost, especially under current technological limitations (Kantaros et al., 2023). Moreover, interpretation choices by digital creators are influenced by personal or cultural biases, potentially altering the perceived significance of heritage sites (Cuomo et al., 2021). Technological constraints also limit the ability to replicate environmental dynamics like lighting, aging of materials, or spatial evolution leading to representations that lack contextual depth (Happa & Artusi, 2020). This becomes particularly problematic in educational settings, where inaccuracies in virtual models can reinforce myths or incorrect narratives that are hard to correct. Ethical considerations are equally critical. Without community consultation, virtual

heritage risks cultural appropriation or misrepresentation, especially when sacred or symbolic elements are used out of context (Lojacono, 2022). A respectful and accurate representation demands collaboration with cultural experts and local communities to ensure ethical data use and proper acknowledgment of cultural ownership. In addition, the digital divide poses structural barriers to access. High costs of VR devices and the need for robust internet infrastructure disproportionately exclude rural and low-income populations (Wu et al., 2023). Digital literacy is another barrier, particularly for older generations or those lacking formal technological training. If not designed inclusively, virtual heritage experiences may overlook cultural and linguistic diversity, thereby marginalizing global audiences.

The integration of virtual technology and the metaverse into cultural heritage preservation presents a range of promising opportunities, particularly in the post-pandemic context. The COVID-19 outbreak served as a significant turning point, accelerating the adoption of digital solutions due to widespread physical immobility and the temporary closure of heritage sites (Sokolovskiy et al., 2023). This disruption spurred the need for alternative methods of cultural engagement, leading to an increase in demand for virtual access and subsequently advancing the application of immersive technologies such as 3D scanning, virtual reality (VR), and augmented reality (AR) (Siddiqui et al., 2022).

These technologies enabled the development of highresolution digital replicas, immersive storytelling, and interactive virtual tours, making cultural heritage more accessible and engaging than ever before.

One of the most significant opportunities is the expansion of cultural accessibility. The metaverse has the potential to overcome physical and geographical barriers, allowing global audiences to explore historical and cultural sites that are remote, endangered, or otherwise inaccessible (Anastasovitis et al., 2024). In the Vietnamese context, where certain cultural heritage sites are located in mountainous or rural regions, metaverse-based experiences can democratize access to cultural resources, ensuring inclusivity across regions and socioeconomic groups. Additionally, this technology offers new pathways for cultural education, especially among younger generations. By integrating virtual heritage experiences into school and university curricula, learners can engage with culture and history in interactive and meaningful ways, thus fostering deeper appreciation and intergenerational transmission of heritage knowledge (Achille et al., 2022). Moreover, the metaverse provides a powerful platform for safeguarding both tangible and intangible cultural heritage. Through advanced 3D modeling, it is possible to digitally preserve physical artifacts and architectural structures in meticulous detail. For Vietnam, where certain cultural sites are vulnerable to environmental degradation, urbanization, or conflict, such digital preservation ensures long-term protection and documentation. Simultaneously, the metaverse allows for the revival and transmission of intangible cultural heritage such as traditional music, dance, language, and rituals by enabling their performance and participation in virtual environments. This not only aids preservation but also contributes to the cultural continuity and vitality of communities in the digital age. In addition to preservation, the metaverse opens avenues for dynamic and collaborative

knowledge production. Virtual platforms facilitate cooperation between museums, universities, cultural organizations, local communities, and technologists on a global scale (Hutson et al., 2023). This interdisciplinary and transnational approach enriches the authenticity and inclusiveness of cultural representation. For example, researchers and curators can codevelop interactive exhibitions or virtual reconstructions with input from indigenous and local knowledge holders, ensuring accurate and respectful portrayals of cultural narratives. Furthermore, the metaverse can serve as a robust digital repository for academic research and heritage management. Detailed scans and dynamic 3D models hosted in virtual environments allow scholars to examine artifacts and architecture in unprecedented ways, offering insights that may not be possible through traditional fieldwork. In the Vietnamese setting, this creates opportunities for documenting lesser-known heritage elements and integrating them into national and international scholarly discourse (Allam et al., 2022). As technology continues to evolve, so does the potential of the metaverse to enhance cultural engagement, education, and preservation. For countries like Vietnam, with rich and diverse cultural traditions, embracing these technologies can serve as a catalyst for revitalizing heritage in innovative ways, ensuring that both current and future generations can experience, appreciate, and contribute to the cultural legacy.

2.4 Hypothesis development

Virtual technologies such as virtual reality (VR), augmented reality (AR), 3D simulations and interactive digital platforms are increasingly being applied in how individuals experience and engage with cultural heritage. These technologies allow users to access historical and cultural content in immersive and innovative ways, including virtual museum tours, reconstructed historical environments or digitally enhanced heritage exhibitions. As individuals become more accustomed to using these technologies, their familiarity and comfort with digital interactions also improve. This growing exposure contributes to a readiness to engage with more advanced and interactive digital environments such as the metaverse. The metaverse offers a unified virtual space where users can explore, interact and co-create in real time. It builds upon existing virtual technology foundations by allowing deeper social interaction, more personalized experiences and multi-sensory engagement with cultural assets. For many users who are already comfortable with virtual technology, metaverse adoption represents a natural and appealing progression. Therefore, this study proposes the following hypothesis:

H1: There is a significantly positive relationship between virtual technology and metaverse adoption in cultural heritage in Vietnam.

The metaverse, as an immersive and interactive virtual environment, provides new opportunities for preserving and transmitting cultural heritage in more dynamic and sustainable ways. Through virtual spaces, cultural sites, artifacts, and intangible practices can be digitized, reconstructed, and maintained in formats that are not subject to physical degradation or loss. Users can access historical reconstructions, participate in simulated rituals, or explore virtual museums regardless of geographical or temporal limitations. By enabling constant accessibility and detailed documentation, the metaverse supports the long-term safeguarding of heritage

elements that may be threatened by time, conflict, urbanization, or climate change. Moreover, metaverse platforms allow institutions and communities to archive and share cultural knowledge interactively, promoting awareness and appreciation among younger generations in innovative formats. As individuals engage more deeply with the metaverse, their exposure to and interaction with these preserved digital heritage forms increase, which may, in turn, foster a stronger appreciation for the importance of cultural conservation. Hence, it is proposed that higher levels of metaverse adoption are positively associated with efforts and attitudes toward cultural heritage conservation. Therefore, this study proposes the following hypotheses:

H2: Metaverse adoption is positively associated with cultural heritage conservation in Vietnam.

H3: Metaverse adoption plays a mediating role in the relationship between virtual technology and cultural heritage conservation in Vietnam.

Beyond conservation, the metaverse also presents significant potential for enhancing the visibility and appeal of cultural heritage to a broader and more diverse audience. By leveraging immersive technologies, heritage content can be showcased in engaging, interactive, and experiential formats that appeal to modern digital users, particularly younger generations. Virtual exhibitions, gamified heritage experiences, and real-time guided tours in three-dimensional cultural spaces can significantly improve public access and stimulate interest in both tangible and intangible cultural assets. Metaverse platforms support user-generated content and social interaction, enabling communities to create and share heritage narratives, thereby promoting cultural diversity and inclusion. This digital environment allows for the storytelling of local identities and traditional practices in new, attractive ways, removing spatial and cultural barriers that often hinder cultural outreach in conventional settings. As individuals become more involved in metaverse environments, their opportunities to engage with and disseminate cultural content increase. This leads to a higher likelihood of active participation in promoting cultural heritage through digital channels. Therefore, this study proposes the following hypothesis:

H4: Metaverse adoption is positively associated with cultural heritage promotion in Vietnam.

H5: Metaverse adoption plays a mediating role in the relationship between virtual technology and cultural heritage promotion in Vietnam.

3. Methodology

3.1 Research design and measurement

This study employed a structured questionnaire to investigate the relationship between virtual technology, metaverse adoption, and cultural heritage conservation and promotion in Vietnam. The questionnaire was divided into three main sections: demographic information, core constructs, and measurement items. All items were measured on a five-point Likert scale ranging from 1 (“Strongly disagree”) to 5 (“Strongly agree”). The measurement items were adapted from previous studies to suit the research context. Virtual Technology (VT) was measured using 3 items from Chung et al. (2018) and Anwar et al. (2025). Metaverse Adoption

(MA) included 4 items developed by Anwar et al. (2025). Cultural Heritage Conservation (CHC) and Cultural Heritage Promotion (CHP) were measured with 5 and 6 items respectively, based on scales from Chung et al. (2018), Zhu et al. (2023), and Boboc et al. (2022). PLS-SEM was employed to test the research model and hypotheses due to its suitability for exploratory research and prediction-oriented analysis (Hair et al., 2019).

3.2 Sampling and data collection

The data for this study were collected through direct questionnaires. The survey remained open for a period of three weeks, during which 357 participants successfully completed the questionnaire. After data cleaning, all responses were found valid and included in the final analysis. To facilitate analysis, participants were classified according to several demographic variables. Gender was divided into two categories: male and female. Age was grouped into four ranges: less than 18 years, 18–25 years, 26–35 years, and 35 and above. Education level was categorized as high school or below, college/university, and postgraduate. Occupation was classified into five categories: student, office worker/public employee, freelancer/business owner, those working in the cultural or educational sector, and other. Participants were also asked about their past experiences with cultural heritage, which were categorized as in-person visits, online formats (e.g., VR, 3D, livestream, etc.), both, or never. Lastly, the level of interest in cultural heritage was recorded on a five-point scale: very low, low, moderate, high, and very high.

4. Results and Discussion

4.1 Descriptive statistic results

To gain a comprehensive understanding of the background and cultural engagement of respondents, demographic data was collected and analyzed. The survey primarily targeted individuals who are likely to interact with or be influenced by digital technologies in the context of cultural heritage, with a particular focus on young adults and working professionals in Vietnam. Out of 357 respondents, a majority were female (59.4%), while 40.6% were male. In terms of age distribution, the majority fell within the 18–25 age range (30% aged 18–25 and 33.3% aged 26–35), indicating a strong representation of Generation Z and Millennials demographics recognized for their digital literacy and openness to technological innovation such as virtual reality and the metaverse. About 29.7% of participants were aged 35 and above, and only 7% were younger than 18. Regarding educational background, 59.7% of the participants had completed college or university, and 24.1% held postgraduate degrees, suggesting a well-educated sample with likely awareness and interest in cultural and technological trends. Only 16.2% had a high school level education or below. In terms of occupation, students made up the largest group with 46.3% of the total respondents, followed by 27.2% who identified as office workers or public employees. Freelancers and business owners accounted for 16.5%, while those working directly in cultural or educational sectors made up 10.1%. This occupational structure reflects a population with both academic exposure and practical experience relevant to cultural heritage and digital innovation. When asked about their prior experience with cultural heritage, nearly half (49.9%) reported engaging with heritage both through in-person visits and online platforms such as VR, 3D virtual tours, or

live streams. In-person visits alone accounted for 23.8%, while 14.3% had only experienced heritage through digital means. However, 12% had never engaged with heritage in any form. In terms of interest in cultural heritage, a majority of respondents expressed high engagement, with 40.6% rating their interest as "high" and 19.6% as "very high." Only a small fraction reported "very low" (3.4%) or "low" (7.3%) levels of interest. These findings suggest that the sample includes a digitally aware and culturally engaged population, well-suited for exploring the adoption and impact of virtual technologies and the metaverse in cultural heritage conservation and promotion in Vietnam.

In this study, 5 hypotheses were formulated and tested using the bootstrapping procedure in SmartPLS. The results = 0.500) and a moderate level of explained variance (R^2 = 0.333) confirm that virtual technology plays a critical role in predicting metaverse adoption. This underlines the importance of technological familiarity and experience in influencing behavioral intentions related to emerging cultural heritage platforms.

Second, metaverse adoption was positively and significantly associated with cultural heritage conservation (H2), with a path coefficient of $\beta = 0.238$, $t = 4.210$, and $p < 0.001$. This result indicates that individuals who engage with and adopt metaverse technologies are more likely to support the safeguarding of both tangible and intangible cultural heritage. These individuals may participate in virtual heritage conservation campaigns, explore digital reconstructions of vulnerable sites, or develop stronger preservation attitudes through emotionally engaging immersive experiences. Although the effect size of this path is modest compared to others, its statistical significance highlights the meaningful contribution of immersive environments to cultural preservation behaviors. This aligns with findings from Chung et al. (2018), who emphasized that digitally mediated experiences in heritage contexts can create emotional resonance, increase perceived authenticity, and strengthen users' sense of connection and responsibility toward cultural conservation. Thus, metaverse adoption contributes not only to access and interaction but also to developing preservation-oriented mindsets.

of the analysis are presented in Table 4 and Figure 3. The primary objective of the structural model evaluation was to examine the strength and significance of the relationships between the key constructs in the proposed model, namely virtual technology (VT), metaverse adoption (MA), cultural heritage promotion (CHP), and cultural heritage conservation (CHC), as well as to assess the model's explanatory power. As shown in Table 4, several key statistical indicators were used to evaluate the structural paths, including path coefficients (β), t-statistics, p-values, R^2 (Cohen, 1988), and f^2 effect sizes.

First, the relationship between virtual technology and metaverse adoption (H1) was found to be positive and strong ($\beta = 0.577$, $t = 9.947$, $p < 0.001$). This result suggests that the more individuals engage with or are familiar with virtual technologies such as virtual reality (VR), augmented reality (AR), 3D modeling, and interactive digital platforms, the more likely they are to adopt metaverse platforms. This finding is in line with previous research indicating that prior exposure to immersive digital tools contributes to users' digital competence and enhances their willingness to adopt more advanced, integrated virtual environments (Chung et al., 2018;

Boboc et al., 2022). In particular, such exposure improves technological readiness, reduces perceived risk, and increases user confidence when transitioning into novel ecosystems like the metaverse.

Structural Equation Modelling Results Estimates Third, the mediation analysis revealed that metaverse adoption significantly mediates the relationship between virtual technology and cultural heritage conservation (H3). The indirect effect was statistically significant ($\beta = 0.137$, $t = 3.823$, $p < 0.001$), indicating that virtual technology does not directly influence conservation-related attitudes or behaviors, but rather does so indirectly through its effect on increasing metaverse engagement. In practical terms, individuals who are exposed to and familiar with virtual technology are more likely to adopt metaverse platforms, and it is this adoption that fosters stronger conservation intentions. The result affirms the mediating role of metaverse adoption as a behavioral bridge between digital familiarity and heritage preservation. Consistent with the findings of Chung et al. (2018), immersive technologies can facilitate emotional bonding and raise awareness, leading users to value and advocate for heritage protection. This pathway demonstrates how exposure to digital innovation is translated into meaningful cultural responsibility through the mediating function of metaverse experiences.

Fourth, a very strong and highly significant relationship was observed between metaverse adoption and cultural heritage promotion (H4), with a path coefficient of $\beta = 0.661$, $t = 17.102$, and $p < 0.001$. This suggests that individuals who adopt metaverse platforms are considerably more likely to participate in activities that promote cultural heritage, such as attending virtual exhibitions, sharing cultural narratives through avatars or user-generated content, and engaging in interactive educational simulations. The high magnitude of the effect, supported by a large effect size ($f^2 = 0.776$) and a substantial R^2 value (0.437), demonstrates that metaverse adoption is a key driver in the digital dissemination of cultural values. These findings resonate with prior research by Boboc et al. (2022), who reported that the metaverse provides an effective and engaging medium for cultural communication, especially through co-creation and storytelling features. It enables not only passive learning but also active participation, allowing individuals to serve as digital ambassadors of their heritage in innovative and far-reaching ways.

Fifth, metaverse adoption was also found to significantly mediate the relationship between virtual technology and cultural heritage promotion (H5). The indirect effect was relatively strong and statistically significant ($\beta = 0.382$, $t = 7.420$, $p < 0.001$). This result suggests that while virtual technology lays the groundwork for digital interaction with cultural heritage, it is through the adoption of the metaverse that individuals become actively involved in promoting cultural heritage. In other words, virtual technology enables users to become comfortable with immersive environments, and this familiarity leads to the adoption of metaverse platforms where broader and deeper forms of heritage promotion can occur. The finding is supported by Buhalis and Karatay (2022), who highlighted that immersive technologies—especially those targeting digitally native users like Generation Z—act as a catalyst for participatory, socially connected, and emotionally engaging heritage promotion within the metaverse. The result

underlines the importance of fostering both technological exposure and metaverse engagement to fully unlock the promotional potential of cultural heritage in the digital era.

In summary, all five hypotheses were supported with statistically significant and positive relationships. The results highlight the pivotal role of virtual technology in encouraging metaverse adoption and, subsequently, enhancing both cultural heritage conservation and promotion. Metaverse adoption not only functions as a direct influencer but also serves as a key mediating factor in translating digital familiarity into heritage engagement. These findings validate the research model and align with prior studies on immersive technologies in cultural contexts. Overall, the metaverse emerges as a promising tool for bridging digital innovation with cultural preservation.

5. Conclusions and Implications

This study advances the academic discourse at the intersection of digital technology and cultural heritage by empirically examining how virtual technology and metaverse adoption influence heritage related intentions. It contributes to theory by applying technology related constructs, specifically virtual technology usage, metaverse engagement, and behavioral intention, to the domain of cultural heritage, a field that has traditionally been underexplored in empirical technology studies, especially within emerging economies such as Vietnam. By conceptualizing metaverse adoption as both an outcome of virtual technology exposure and a mediator in shaping attitudes toward heritage conservation and promotion, the study extends the applicability of technology acceptance models to noncommercial and culturally significant domains. Moreover, the research framework offers a foundation for future theoretical development on how digital environments affect public participation and values in heritage and education, thereby enriching both cultural studies and digital behavior literature

This study also offers practical insights for cultural institutions, policymakers, and digital solution developers aiming to enhance public engagement with cultural heritage. The significant influence of virtual technology and metaverse adoption on both conservation and promotion intentions suggests that digital tools can be effectively employed to modernize heritage education and communication strategies. Cultural organizations are encouraged to integrate virtual content into exhibitions, tourism platforms, and learning programs in order to engage younger, technology oriented audiences. Through engaging digital storytelling and interactive formats, institutions can build stronger emotional connections between users and cultural values, thereby fostering positive attitudes toward heritage preservation. In addition, the findings emphasize the importance of cross sector collaboration between heritage stakeholders and technology providers. Such partnerships are crucial for developing culturally relevant and accessible virtual experiences that reflect the authenticity and diversity of local traditions. To ensure that digital heritage initiatives contribute to long term impact, efforts should be aligned with broader goals of cultural sustainability and inclusion. Lastly, the study underlines the need to promote digital literacy and public awareness, which are essential for increasing user adoption and maximizing the societal benefits of virtual heritage platforms. Continuous investment in digital infrastructure, training programs, and user centered design

will be key to ensuring that virtual technology applications remain effective, inclusive, and sustainable over time.

While this study provides important contributions to understanding the influence of virtual technology and metaverse adoption on cultural heritage engagement, several limitations must be acknowledged. First, the sample was limited to a specific demographic group and geographic region within Vietnam, which may affect the generalizability of the findings. Future studies should consider expanding the sample to include participants from other regions or conduct cross cultural comparisons to validate the model in different social and technological contexts. Second, the research employed a cross sectional design, which restricts the ability to observe how user perceptions and behaviors evolve over time. Longitudinal studies are recommended to assess whether exposure to virtual heritage environments leads to sustained changes in attitudes or deeper engagement with conservation and promotion practices. Third, the study focused on intention based outcomes, which may not fully reflect actual behaviors. To address this gap, future research could incorporate behavioral measures such as user tracking, usage logs, or in-depth qualitative methods like interviews and ethnographic observation to explore real world engagement and impact more comprehensively. Finally, as the landscape of digital technology continues to evolve, future research should explore emerging tools such as artificial intelligence, gamified heritage platforms, or blockchain based preservation systems. These technologies may offer new opportunities and challenges for cultural heritage management, including issues of authenticity, accessibility, and ethical use. By addressing these directions, future studies can contribute to a more nuanced and dynamic understanding of how digital innovation shapes the future of heritage conservation and promotion.

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