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The Digital Past: Assessing University Students' Perception Toward VR Heritage Tours

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ABSTRACT

This paper explores the perception of university students towards the use of Virtual Reality (VR) in cultural heritage tourism. The research particularly focuses on students' perceived appeal, influence on physical visit intention, and potential to encourage cultural heritage appreciation. Using a cross-sectional survey of 82 respondents and 6 semi-structured interviews, the study applied descriptive statistics, and multiple regression models to examine the relationship between perceived VR benefits, concerns, adoption factors, and tourism-related outcomes. The findings indicate that respondents generally considered VR heritage tours as a positive addition to the tourism experience with 70.7% rated VR as moderately appealing or higher, 73.2% indicated that a high-quality VR experience would make them at least slightly more likely to visit a heritage site in person, and 87.8% believed that VR could encourage cultural heritage appreciation. The analysis identified accessibility as the most significant and consistent explanatory factor. The study concludes that VR should be placed not as a replacement for physical heritage tourism, but as a complementary smart design tool that supports accessibility, education, pre-visit engagement, and inclusive cultural participation. The findings of this research contribute to smart policy design by providing evidence for how evolving technologies can be governed and employed in ways that balance accessibility, advancement, cultural authenticity, and responsible heritage management.

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1. Introduction

The field of Cultural heritage today is advancing through the use of digital technologies. Various research, educational and tourist opportunities in the heritage field today were not possible thirty years ago or so. Among these technologies is Virtual Reality (VR). Traditionally, cultural sites were only experienced through physical visits, while nowadays virtual environments provide access and interactive experiences to heritage sites remotely from around the world. VR technology has emerged as an innovative force in cultural heritage tourism, offering exceptional opportunities to interpret, document, preserve, and experience cultural artifacts and sites. VR provides unique solutions for making heritage more accessible to broader audiences by enhancing visitors' experiences and addressing conservation challenges.

However, it remains unclear how these immersive technologies are perceived by younger generations, particularly as they increasingly engage with heritage through digital mediums. Do VR experiences

in the field of cultural heritage provide positive user engagement for this targeted age group? Could VR heritage tours replace physical visitation in the future, even for those able to travel? This paper explores those questions using sample from undergraduate university students in the Architecture major from University of Bahrain.

To better define the research questions, justify the sample choice and link the research to existing literature, the following section examines the current state of VR applications in cultural heritage tourism. It synthesizes findings from scholarly sources and critically evaluates technological approaches, user experience studies, research methodologies, in addition to identifying challenges and gaps for further research. The review focuses on peer-reviewed articles, conference proceedings, books and technical reports addressing VR applications in cultural heritage contexts. The analysis reveals a rapidly evolving research field dominated by case studies and prototypes reflecting potential for enhancing accessibility and engagement. It also reveals the need for more rigorous empirical research to establish evidence-based best practices.

2. Background and context

2.1 Definition, Role and Application of VR in Cultural Heritage

Starting with the basic question: what is meant by using VR in cultural heritage? VR in the context of cultural heritage refers to digitally generated 3D environments that allow the users to perceive, interact and navigate digital re-construction of historic sites, places, objects, or even old times and events (Champion, 2016). This could be done, either as desktop-based virtual gallery with 360-degree panoramas or as fully immersive experience with head-mounted display that includes audio effects and hand-tracking interaction.

There are different domains for the application of VR in the cultural heritage field that range from preservation and reconstruction, interpretation and education, to public engagement and tourism (Chong et al., 2022). Particularly, in preservation, VR allows the reconstruction of destroyed or endangered sites and places. On the other hand, using VR in education provides opportunities for experiential learning where historic contexts could be explored beyond just the visual information (Liritzis et al., 2021). When it comes to tourism, VR heritage tours could be used as pre-visit preparation that shapes expectations, on-site support to enrich the experience or post-visit experience to evoke memories and recall past experiences.

Generally, systematic review of literature on the use of VR in the field of cultural heritage demonstrates positive results in terms of user interaction and learning outcome. However, the literature also highlights challenges related to accessibility, evaluation criteria and authenticity (Radianti et al., 2020; Bekele et al., 2018).

2.2 The Transformation of Cultural Heritage by Digital Technologies

While direct physical engagement with monuments, archaeological sites, landscapes and museums was the common traditional way of experiencing cultural heritage, the rapid development of digital technologies over the last three decades changed how heritage is documented, interpreted and consumed. According to Addison (2000), early use of digital technologies in the heritage field functioned mainly as supporting tools rather than experiential medium. Those technologies included photographic documentation, GIS mapping and basic 3D modelling.

With the advancement of immersive environments, interactive media and real-time rendering technologies, the field of digital heritage emerged as a participatory paradigm that interacts and engages the public (Kapell & Elliott, 2013; Champion, 2022). Among digital heritage technologies, particularly VR, with its capacity to simulate spatial presence and its ability to embody multi-sensory immersion and interaction, emerged as a revolutionary tool that could change the whole game of tourism. VR challenged economic, geographical and physical barriers allowing users to experience inaccessible, fragile or even lost heritage sites that closely re-create the experience of physical visitation (Bekele et al., 2018).

In fact, this paradigm shift aligns with institutional agendas of UNESCO and ICOM who are increasingly emphasizing the important role of digital heritage in education, preservation, sustainability and accessibility. This is even more critical in response to threats such as armed conflicts, climate change, global crisis and mass tourism (UNESCO, 2018). Accordingly, VR tours, although may not be substitutes for physical visitations, are increasingly considered as complementary tools that support sustaining heritage and learning.

It is important however to mention that the literature highlights several concerns and limitations of VR heritage tours. For example, one of the top concerns is the issue of authenticity where it is argued that digital re-constructions of heritage sites and places risk separating heritage from its physical material and contextual qualities which may result in reducing their perceived authenticity (Jones, 2017). Some researchers go further to claim that VR heritage experiences may promote superficial engagement compared to critical interpretation in a real contextualized setting (Champion, 2016). Empirical studies also highlight emotional, physical and technical concerns experienced by users such as motion sickness, discomfort, visual fatigue or difficulty in using VR hardware (Radianti et al., 2020). In fact, the lack of access in the first place to VR equipment or lack of technical support limits the use of the technology in some circumstances.

It is widely argued across VR research that experience quality significantly shapes user perception. High-quality VR heritage experiences that combine spatial immersion, interactivity, and narrative coherence generate stronger emotional responses and positive attitudes (Škola et al., 2020). On the other hand, low-quality VR experiences characterized by poor resolution, limited interaction, or technical issues have negative impact on users' perception and may strengthen skepticism toward VR heritage applications (Radianti et al., 2020). This suggests that the impact of VR heritage tours cannot be evaluated independently of their design and execution quality.

2.3 VR Heritage Research and Current Study Population

There are several core theoretical constructs that relate to VR heritage research. For example, Slater (2009) highlights the concept of 'presence' which is commonly known as the subjective sensation of 'being there' in an intermediated environment. 'Immersion' on the other hand, is the technical capacity of a system to deliver spatial, sensory and interactive fidelity (Fernandez-Palacios et al., 2017). Both, presence and immersion play a vital role in shaping user experience, engagement and learning.

It is evident from empirical studies that users' emotional engagement with heritage content is significantly enhanced by high level of presence and immersion. For example, Škola et al. (2020), in their mixed-method study using questionnaires and electroencephalography concluded that the use of immersive VR in heritage provokes strong emotional responses and cognitive engagement, especially for non-expert users. Likewise, Makransky and Petersen (2021) research suggests that presence facilitates memory formation and attitudinal change in virtual contexts. Roussou and Katifori (2018) argue that narrative coherence is equally important in VR heritage applications as guided story-telling and interpretive engagement enhance reflective learning. This emphasizes the role of experiential quality as an influential factor in shaping user's perception of VR heritage tours.

In addition to the experiential quality, the acceptance of any new technology is generally strongly tied with the awareness of people about the potential uses of that technology. Particularly, higher education students represent a crucial demographic group in VR heritage research because of their acceptance of technological experimentation, advanced level of digital literacy and potential future roles as professionals, educators and decision-makers (Lin & Mawela, 2023; Baxter & Hainey, 2020). In fact, VR is increasingly used to support experiential learning in disciplines such as architecture, archaeology, museum studies and history (Radianti et al., 2020). Literature suggests that VR heritage experiences significantly enhance perceived usability, learning effectiveness and emotional involvement, especially among higher education students (Corrales-Serrano et al., 2024). However, general awareness of VR technologies in higher education and university students varies, even with the growing number of VR heritage projects. Students are often exposed to VR mainly

through gaming, while the use of VR as a cultural heritage tool remains considerably low (Radianti et al., 2020).

Corrales-Serrano et al (2024) indicates that the students' first cultural exposure to VR heritage tours often occurs within academic settings, while many students report limited knowledge of the existence and purpose of VR heritage experiences. This gap between technological advancements and user awareness highlights the need for measuring students' baseline familiarity as part of empirical research. Methodologically, this could be done using a survey to measure awareness, knowledge, expectations, accessibility and sources of information.

From the above, one can conclude that there is a critical gap in understanding how concepts of presence, immersion, and engagement are accepted and perceived by younger generations, and specifically higher education students of design professionals, such as architecture students. One can question here; how do these students understand the educational depth and authenticity of VR experiences. Moreover, to what extent can these technologies be integrated into pedagogical frameworks that align with contemporary smart design policy and into the development, regulation, and management of cultural assets and systems ensuring that these technologies are used ethically, sustainably, and inclusively?

2.4 Defining the Research Gap: Impact of VR Tours on Intentions of Physical Visitation

A fundamental debate in digital heritage research focuses on whether virtual experiences encourage or discourage physical visitation to heritage sites. Empirical evidence suggests that VR digital experiences tend to raise rather than decrease visitation intention. For instant, Katz and Halpern (2015) demonstrated in their research that realistic and interactive virtual tours to museums substantially improved users' intention to visit the physical museums, facilitated by presence and cognitive engagement. Similarly, tourism studies indicate that VR tours functions as a pre-visit experience, shaping expectations, emotional bonds, and perceived value (Tussyadiah et al., 2018). Such findings could directly impact smart design policy and especially tourism regulations and governance. However, are these findings applicable to university students given usually the financial limitations characteristic of such demographic? Or would digital heritage experiences in their case be more cost-effective alternative that facilitates engagement with cultural sites that might otherwise be eliminated by travel costs?

Within the educational field, VR heritage tours often stimulate curiosity and motivate future travel among students, particularly when the experience involves details or narratives that are usually difficult to access during on-site visits. Accordingly, it might be tempting to think that the affordability of virtual experiences addresses the economic obstacles to travel that often hinder university students from participating in traditional heritage tourism, however, one cannot confirm this without evidence-based research that focuses on the correlation between VR experience quality and university students' likelihood of visiting physical heritage sites which is the main contribution of this paper.

2.5 Synthesis and Research Questions

Technology acceptance research particularly focuses on interest and attitude of users. There are numerous studies that conclude that the exposure of university students to VR heritage experiences results in positive attitude and increased interest in the topic, especially due to its interactive opportunities, the technology novelty, and experiential depth it provides (Makransky & Petersen, 2021). VR allows active exploration of cultural content instead of just passively receiving information (Kapell & Elliott, 2013; Champion, 2022). According to Roussou & Katifori, (2018), students perceive VR as more engaging and stimulating than traditional heritage interpretation media, especially for representing past historic periods or distant or destroyed places (Roussou & Katifori, 2018). The study shows that key attitudinal factors influencing students' interest include curiosity, emotional engagement and enjoyment. Radianti et al. (2020) argue that the attitude towards VR heritage tours is significantly influenced by factors such as prior VR experience, disciplinary

background and relevance to academic or personal goals. Based on these studies, both qualitative and quantitative methods are required to capture the range of differences in students' interest and motivation towards VR heritage tours.

Existing research shows that VR heritage tours provide substantial educational and experiential gains while also raising concerns related to access, authenticity, and technological interference. However, few studies adopt an integrated position that examines awareness, interest, benefits, concerns, and visitation intention within a single higher education student-focused framework.

The present study responds directly to this gap, providing both breadth and depth in understanding the perceptions of university students towards VR heritage tours. Through the examination of the perceptions of this specific population, this study seeks to contribute to the development of evidence-based design guidelines and governance frameworks, that bridge the gap between technological innovation and heritage preservation. Particularly, this study aims to answer the following research questions:

1. What key factors make VR tours appealing to university students of Architecture major for exploring cultural heritage sites?
2. How do prior experiences with VR and usual travel habits influence interest in virtual heritage tours?
3. Which specific benefits or concerns best predict whether someone will use a VR tour to help plan a physical visit?
4. Does VR act as a substitute or a catalyst for physical visitation to cultural heritage sites among the research population?

3 Materials and Methods

3.1 Study Design

This study adopts mixed-methods design. The primary phase involved a quantitative survey to identify broad trends and correlations of university students' perception of VR heritage tours. This was followed by a qualitative phase consisting of in-depth semi-structured interviews to triangulate, validate, and give a deeper insight to the statistical data. The interviews particularly further investigated the underlying motivations, psychological barriers, and 'lived experiences' behind the survey trends.

To examine the intersections of VR technology adoption and cultural heritage tourism, a structured questionnaire was developed for this research. The survey instrument was designed to capture quantitative ordinal data and categorical multi-select responses to establish user profiles, technological fluency, and behavioral intentions. The questionnaire consisted of three different sections:

- Section 1: Demographics and Baseline Behavioral Profiles
This section established the demographic and behavioral baseline of the study participants. In addition to standard demographic data (Age), this section assessed the respondents' existing engagement with cultural heritage and their technological fluency and engagement. Particularly, it measured the following:
 - Physical visitation frequency to heritage sites: Measured on an ordinal scale (ranging from "Never" to "Once a month or more") to establish the participants' baseline heritage tourism behavior.
 - Technological fluency: Assessed respondents' prior ownership and frequency of using VR headsets to control technological familiarity in subsequent analyses.
- Section 2: Awareness and perceptions of virtual heritage tours
This section examined the cognitive and affective responses to VR applications in the heritage contexts.
 - Baseline awareness: A binary measure capturing whether participants were aware of VR heritage tours prior to the study.

- Overall appeal of VR heritage tours: Assessed on a 5-rating scale (ranging from ‘Not at all appealing’ to ‘Extremely appealing’) to measure general receptiveness to virtual exploration.
- Perceived value and barriers: Identified the primary benefits of VR (e.g., educational value, accessibility, spatial visualization) and their primary concerns (e.g., perceived lack of authenticity, graphic quality, data privacy, and equipment costs) according to the research population.
- Section 3: Behavioral Intentions and Potential Impact
This final section of the survey contained the primary dependent variables of the research, assessing how VR experiences impact future decisions regarding physical tourism.
 - Influence on physical visitation: Measured on a directional ordinal scale to determine if high-quality VR tours act as a substitute for or a catalyst to physical visitation (ranging from ‘Less likely to visit’ to ‘Significantly more likely to visit’).
 - Adoption criteria: A multi-selection question determining the most critical factors (e.g., realism, cost, narrative storytelling) that would encourage a user to actively choose a VR tour.
 - Wider cultural Impact: A concluding scale measuring participants' belief in the efficacy of VR to promote broader societal appreciation for cultural heritage. In addition, an open-ended question was also included to capture qualitative nuances not restricted by the predefined categorical variables.

3.2 Data Collection and Sample

Data was collected via the above discussed structured questionnaire which yielded $N=82$ valid responses. distributed through two digital platforms at the University of Bahrain to Architecture students.

To explore future the findings of the survey, interviews were conducted ($N=6$) participants were selected via purposive sampling, ensuring a mix of ‘VR enthusiasts’ and ‘VR skeptics.’ The interviews were conducted in person, lasting 15–30 minutes each.

The Interview Protocol focused on three core aspects:

- The sensory limitations of VR
- The concept of ‘Digital Authenticity’
- VR as a psychological medium for physical travel.

The data integration occurred at two stages, the intermediate stage, where survey results informed and guided the interviews, and at the final interpretation stage, where qualitative findings were used to provide depth to the statistical results. Figure 1 below summarises the research design, sampling strategies and methods used.

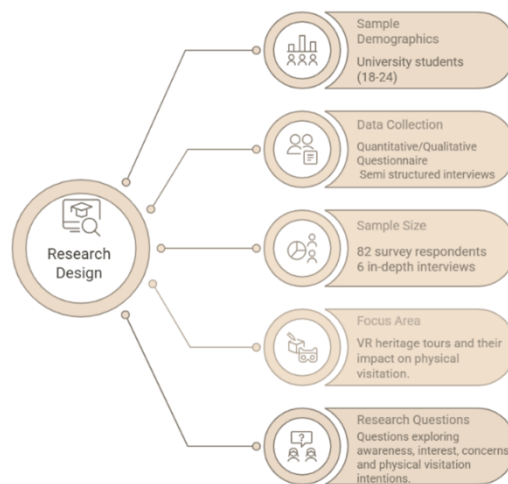


Figure 1. Research Design (Developed by the Authors).

4. Data analysis and Interpretation

This section discusses data analysis and interpretation. Data cleaning, coding of survey responses, descriptive statistics, correlation and regression analysis, and generation of figures were supported using Microsoft 365 Copilot. The tool was used to assist with organizing the dataset and preparing visual outputs. All analytical decisions, interpretation of findings, verification of results, and final conclusions were thoroughly reviewed and approved by the author.

Table 1 below summarizes the main outcome variables and reveals that respondents generally had positive perceptions of VR heritage tours, particularly regarding VR potential to encourage physical visits and cultural heritage appreciation.

Table 1. Summary of main outcome variables

Outcome	Scale	Mean	Key interpretation
Appeal of VR heritage tours	1–5	3.0	70.7% moderately appealing or higher
Influence on physical visit likelihood	1–5	3.92	73.2% at least slightly more likely to visit
Belief VR encourages heritage appreciation	1–4	3.23	87.8% yes, to some extent/significantly

Note. Higher values indicate more positive perceptions.

4.1 General Profile of Respondents

A total of 82 valid responses were included in the analysis. All respondents were university students from the Architecture major. In terms of heritage-site visitation, 50.0% of participants reported visiting heritage sites once a year or less, while 42.7% visited heritage sites a few times a year. This indicates that the majority of participants had at least some interest in heritage sites, although frequent visits were limited. In terms of VR experience, 56.1% of respondents had used VR at least once, while 36.6% had not used VR but were interested in it. Only 7.3% reported that they had not used VR and were not interested. This indicates that the sample was generally open to VR technology, even among those without direct experience. Figure 2 below summarizes the study sample profile in terms of heritage sites visitation frequency, VR experience and awareness of heritage tours.

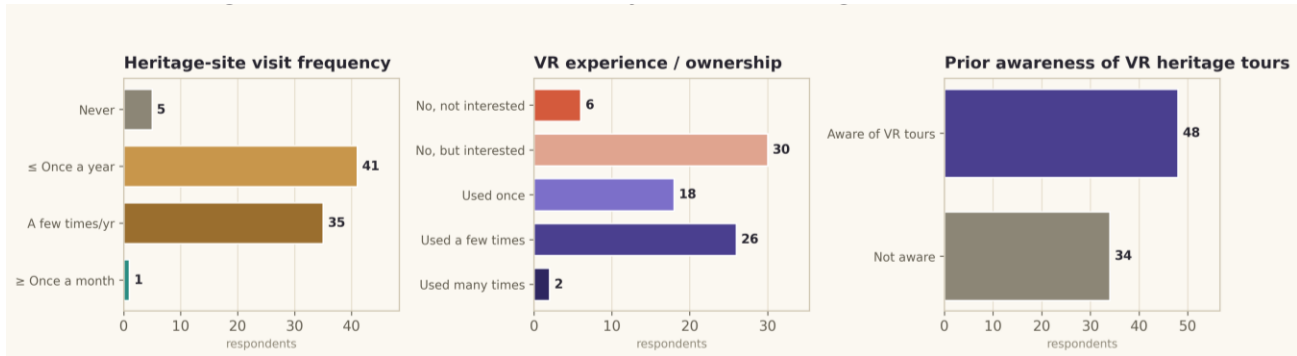


Figure 2. Sample profile - prior VR experience and awareness across the 82 respondents.

4.2 Appeal of VR Heritage Tours

The results show that the participants generally viewed VR heritage tours as positive experience. In fact, around 70.7% of respondents rated the idea of using VR to explore a heritage site as moderately appealing or higher. However, only 30.5% rated it as very or extremely appealing.

These findings suggest that VR heritage tours are acceptable and interesting to many participants, but they may not yet be considered highly attractive by all users. In other words, most respondents were open to the idea, but not everyone was strongly enthusiastic about it.

The regression model for appeal explained only a small proportion of the variation in responses, with an R^2 value of 0.148 and an adjusted R^2 of -0.062. This means that the independent variables included in the model did not strongly explain why some participants found VR more appealing than others.

However, one could further investigate the following predictors of appeal, being the strongest based on this research:

- Prior VR experience,
- Concern about data privacy,
- Concern about poor-quality VR experiences,
- Educational value.

Overall, one cannot ignore the fact that appeal of VR heritage tourism could be influenced by factors beyond those measured in this survey, such as personal interest in technology, previous travel experiences, expectations of realism, etc. and thus further investigation on this is needed.

4.3. Influence on Physical Heritage Visitation

One of the most important findings of this research is that VR heritage tours do not seem to discourage physical tourism for most respondents. On the contrary, it may increase interest in physical visitation of heritage sites. Around 73.2% of respondents indicated that a high-quality VR tour would make them at least slightly more likely to visit the site physically. Additionally, 39.0% stated that it would make them significantly more likely to visit. This indicates that VR can act as a promotional and motivational tool. Rather than a replacement for physical visits. VR may help people become more interested in heritage sites and encourage them to experience the place in real life instead of being satisfied with the virtual visits only. The regression model for visit intention was the strongest among the other tested models. It yielded an R^2 value of 0.483, which means that the independent variables explained approximately 48.3% of the variation in participants' likelihood of visiting a heritage site after experiencing a VR tour. The adjusted R^2 was 0.290, which means that after adjusting for the number of predictors, the model explained about 29.0% of the variation.

The most important predictor was 'Accessibility' for those unable to travel, with a standardized beta coefficient of $\beta = 0.293$ and a statistically significant p-value of $p = 0.020$. This means that participants who saw accessibility as a benefit of VR were more likely to say that VR would increase their intention to visit the heritage site physically.

The research also highlighted other important predictors such as, the ability to see restricted or fragile places, existing heritage-site visit frequency, and the belief that VR helps people decide whether they want to visit physically or not.

The correlation analysis supported these findings. Accessibility had a positive and significant correlation with physical visitation intention, $\rho = 0.373$, $p = 0.001$. The number of benefits selected also had a significant positive correlation with physical visitation intention, $\rho = 0.354$, $p = 0.001$.

These findings mean that the more benefits respondents found in VR heritage tours, the more likely they were to say that VR would encourage them to visit a heritage site in person.

Accordingly, VR tours seem to be considered as means that make heritage more accessible, provide a preview of a site before visiting, explore fragile or restricted places and collect information before deciding to visit. Table 2 below summarizes the strongest regression predictors for the visit intention model.

Table 2. Strongest regression predictors.

Model	Predictor	Standardized β	p-value
Visit intention	Accessibility for those unable to travel	0.293	0.02
Visit intention	Ability to see places that are restricted or too fragile to visit	0.24	0.075
Visit intention	Heritage-site visit frequency	0.227	0.061
Visit intention	It helps me decide if I want to visit in person	0.207	0.109

Note. Standardized β values allow comparison of predictor strength.

4.4 Does VR Heritage Tours Encourage Cultural Heritage Appreciation?

From the survey, most participants believed that VR heritage tours can make people more interested in and appreciative of cultural heritage in general. Specifically, 87.8% of respondents answered either ‘Yes, to some extent’ or ‘Yes, significantly.’ This is important because it indicates that the educational value of VR heritage tours is acknowledged by most participants and it is not only looked at as an entertainment technology.

The regression model for this outcome produced an R^2 value of 0.358, meaning that the independent variables explained 35.8% of the variation in participants’ belief that VR can encourage cultural heritage appreciation. However, the adjusted R^2 was lower, at 0.118, meaning that the explanatory power became weaker after accounting for the number of predictors.

The strongest positive predictor was again accessibility for those unable to travel, with $\beta = 0.239$, $p = 0.011$. This shows that participants who valued VR’s accessibility function were more likely to believe that VR can increase cultural heritage appreciation.

The strongest negative predictor was the concern that VR could reduce the value of physically visiting heritage sites, with $\beta = -0.331$, $p = 0.021$. This means that participants who worried that VR might reduce the importance of real visits were less likely to believe that VR supports cultural appreciation. This result is important because it shows a tension in participants’ views. On one hand, many respondents believe VR can make heritage more accessible and educational. On the other hand, some are concerned that VR may weaken the authenticity or value of real-life heritage experiences.

Therefore, VR should be presented as a complement to physical heritage tourism, rather than a replacement. Table 3 below summarizes the strongest regression predictors for the appreciation believe model.

Table 3. Strongest regression predictors for the appreciation belief model

Model	Predictor	Standardized β	p-value
Appreciation belief	It could reduce from value of physically visiting sites	-0.331	0.021
Appreciation belief	Accessibility for those unable to travel	0.239	0.011
Appreciation belief	The novelty of the technology	0.176	0.152
Appreciation belief	Concerns about data privacy	-0.17	0.522

Note. Standardized β values allow comparison of predictor strength.

4.5 Benefits, Concerns, and Choice Factors

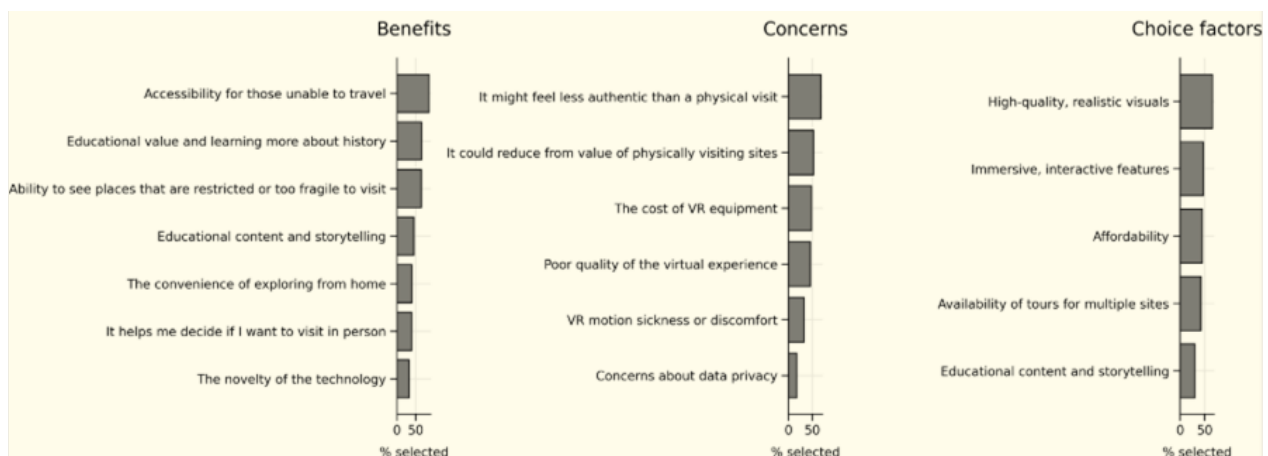
‘Accessibility for those unable to travel’ was the most frequently selected benefit of VR heritage tours, selected by 86.6% of respondents. This was followed by ‘educational value and learning more about history’ at 65.9%, and ‘the ability to see restricted or fragile places’ at 64.6%.

These findings suggest that participants appreciate VR heritage tours mainly for their ability to:

- provide access
- support education
- protect fragile sites
- and allow people to explore places that may otherwise be difficult to visit

However, participants also expressed some significant concerns. Authenticity concerns were at the top of this list selected by 68.3% of respondents. This was followed by the concern that VR could reduce the value of physical visits, selected by 52.4%, and the cost of VR equipment, selected by 48.8%. This means that although respondents are interested in VR, they are still aware of its limitations. The physical experience of visiting a heritage site remains important because of its sensory experience and the emotional attachment it could provoke, not to mention the scale and atmosphere that supports the experience.

The most important factor for choosing a VR heritage tour was high-quality realistic visuals, selected by 65.9% of respondents. This indicates that VR heritage tourism is highly dependent on the quality of the virtual experience. If the visuals are unrealistic or of low quality, users are probably less likely to accept it. These findings are illustrated in figure 3 below.


Figure 3. Multi-select comparison for Benefits, Concerns, and Choice Factors

4.6 Open-ended Responses and Interviews

Open-ended questions in the survey and the interviews provided additional insight into participants' opinions. Several comments emphasized that VR cannot fully replace the physical experience of visiting a heritage site.

At the same time, some respondents highlighted the educational value of VR, especially for students on a budget, people unable to travel, and those interested in learning about heritage sites before visiting them. Some also suggested that VR experiences should include more than just visual content, such as audio explanations, historical information, and possibly more sensory features.

The thematic analysis of the interviews could be summarized in the following three dominant themes:

1. 3D visuals vs. sensory experience: Interviewees noted that while VR can provide realistic 3D visuals of a heritage building or site, it lacks the contextual sensory experience (e.g. the smell of the sea at Bahrain Fort or the wind in the Pearling Path). One interviewee remarked: *"VR can provide the geometry, but it doesn't replicate the sense of the place."*
2. Accessibility: Participants particularly highlighted those with physical disabilities or vision impairments, VR was described as a freeing tool. However, the physical discomfort of the headset (weight and heat) in addition to motion sickness remains a barrier for prolonged educational use.
3. Pre-visit preview: Interviewees confirmed the survey trend that VR acts like a 'trailer' for a movie rather than a replacement of the actual experience. It increases familiarity with the travel destination by providing a safe and somehow elaborate preview.

The qualitative responses therefore support the quantitative findings. Participants are generally positive about VR experience, but at the same time prefer it to be used as an additional educational and promotional tool instead of considering it as a full replacement for physical heritage tourism.

A notable tension exists between the high educational value reported in the survey (65.9 %) and the authenticity concerns discussed in the interviews. This suggests that for VR to be successful, designers must move beyond visual reliability and incorporate multi-sensory cues (ambience, soundscapes, and narration) to bridge the 'authenticity gap.' Furthermore, the study identifies a 'Vision Barrier'; as noted by a survey respondent and echoed in the interviews, arrangements for those with vision deficiencies (e.g., glasses users) is not widely known or used, which results in a gap in the 'accessibility' benefit often publicized by developers.

4.7 Research Limitation

It is acknowledged that the sample size is relatively small, and thus the study could be considered as an exploratory study. Another limitation of this study is that it collected stated perceptual information rather than actual behavioral records of travel and heritage visitation which also could differ as sometimes people could think or say things that they would not do in real life. Accordingly, further research with a larger and more diverse sample collecting data about VR experiences and visitation records is recommended to further investigate the findings of this research.

5. Conclusion and Link to Smart Design Policy

This research indicates that VR heritage tourism is generally perceived positively by university architecture students, particularly because of the accessibility factor, educational potential, and ability to offer access to restricted or fragile heritage places. The findings propose that VR could increase interest in cultural heritage and encourage future physical visits but not replace them. Accessibility emerged as the most important explanatory factor influencing both visit intention and belief in heritage appreciation. Prior VR experience was only weakly associated with appeal, while usual heritage-site visiting habits were more closely related to the likelihood of using VR as a motivation for future physical visits. Significantly, the results suggest that VR functions more as a catalyst than a substitute for physical visitation, as the majority of respondents reported that a high-quality VR tour would make them more likely to visit a heritage site in person. However, concerns about authenticity, cost, poor-quality experiences, and the possible decrease in the value of physical sites remain

important obstacles. Therefore, VR should be considered as a complementary tool within cultural heritage tourism, supporting awareness, education, and facilitating pre-visit engagement while preserving the unique value of the original sites and experiences. This relates directly to Smart Policy Design objectives, particularly inclusive design, evidence-based decision-making, ethical technology use, and improved human access to cultural and built environments. The positive correlation between VR exposure and the increased likelihood of physical visits suggests that tourism sector in the Kingdom of Bahrain could leverage VR as a high-conversion marketing tool to drive tourism to its three UNESCO World Heritage Sites (WHS).

Based on the findings of this research, one can recommend to strategically position VR heritage tours in Bahrain as educational and accessibility tools that enhance heritage preservation efforts. Accordingly, policymakers could establish standards for VR content quality, historical accuracy, and cultural sensitivity while encouraging public-private partnerships for technology implementation. It is also important to emphasize that heritage experts should take the responsibility of reviewing VR content to ensure authenticity and cultural sensitivity.

In conclusion, this study supports the mission of Smart Design Policies by providing empirical evidence on how emerging digital technologies can be used responsibly in human and cultural environments. VR has strong potential to enhance cultural heritage tourism when guided by smart policies that balance innovation with accessibility, authenticity, sustainability, and social responsibility.

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Conflicts of Interest

The Author declare that there is no conflict of interest.

Data availability statement

The data that support the findings of this study are available from the corresponding author, D.S., upon reasonable request.

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