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Virtual tourism for cultural heritage: Transforming Generation Z's engagement and visit intentions

M. Farid Wajdi[a, *], Novel Idris Abas[b], Anton Agus Setyawan[c], Dewita Puspawati[d]

[a] Muhammadiyah University of Surakarta (Surakarta, Indonesia), Management Department; https://orcid.org/0000-0003-0564-1125; e-mail: farid.wajdi@ums.ac.id
[b] Muhammadiyah University of Surakarta (Surakarta, Indonesia), Digital Business Department; https://orcid.org/0000-0002-9696-620X; e-mail: nia679@ums.ac.id
[c] Muhammadiyah University of Surakarta (Surakarta, Indonesia), Management Department; https://orcid.org/0000-0001-9664-7818; e-mail: aas134@ums.ac.id
[d] Muhammadiyah University of Surakarta (Surakarta, Indonesia), Accounting Department; https://orcid.org/0000-0002-2426-2190; e-mail: dp123@ums.ac.id
[*] Corresponding author.

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ABSTRACT

Applying the stimulus-organism-response (S-O-R) framework, this study's main aim is to analyze the psychological mechanisms through which virtual reality (VR) experiences encourage Generation Z's physical visit intentions to cultural heritage sites. Specifically, the research investigates how key VR features (stimulus: interactivity and telepresence) influence internal states (organism: place satisfaction, perceived authenticity and mental image), and how these states subsequently drive visit intentions (response). The study addresses a critical gap by focusing on these emotional and cognitive pathways. Data from 415 Indonesian Gen Z respondents who experienced Borobudur Temple via VR were analyzed using PLS-SEM. Results reveal that interactivity and telepresence significantly enhance place satisfaction, authenticity and mental imagery. Furthermore, perceived authenticity and a strong mental image are powerful predictors of visit intention, while place satisfaction shows no significant direct effect. These findings highlight the importance of emotional and cognitive factors in engaging Gen Z with cultural heritage tourism (CHT). The study offers valuable theoretical and practical insights, while the findings encourage cultural managers and policymakers to adopt VR technologies.

KEYWORDS

virtual tourism, cultural heritage, Generation Z, visit intention, Indonesia

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1. Introduction

In recent years, virtual reality (VR) has rapidly advanced and emerged as a transformative technology across various sectors, including tourism. Virtual reality is renowned for its ability to deliver immersive experiences that significantly enhance individual engagement (Spielmann & Mantonakis, 2018). This technology allows users to actively interact with virtual elements and experience the illusion of physical presence in digitally

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rendered locations (Fox et al., 2009). These capabilities establish VR as a powerful tool for influencing human behaviour, particularly for enhancing behavioural intentions (Lee et al., 2022), including its potential to enhance behavioural intentions (Ramires et al., 2022). One of the most promising applications of VR is in tourism marketing, which enables potential travellers to "preview" destinations before making physical trips. This approach effectively builds destination appeal, fosters emotional connections, and increases visitor enthusiasm (Skard, Jørgensen, & Pedersen, 2021).

Although VR applications have been widely studied, research focusing on their role in cultural heritage tourism (CHT) remains scarce. Few investigations have examined how immersive technologies influence tourist behaviour before visiting cultural sites in person (Rodrigues et al., 2024). Scholars have emphasized the need for deeper insights into consumer behaviour within immersive experience contexts (Branca et al., 2024; Pantelidis et al., 2024). A remarkably underexplored topic is the relationship between VR use and CHT for specific generational cohorts, such as Generation Z (Feitosa & Barbosa, 2020). This study builds upon existing literature by focusing on Generation Z's use of VR to determine behavioural intentions related to CHT. Currently, we are dealing with new-generation cultural tourism, characterized by a multitude of needs and interests (Stasiak, 2022). Interestingly, prior research suggests that Generation Z lacks interest in CHT due to insufficient internal motivation and a perceived disconnect with cultural heritage (Agoes & Safari, 2024). Furthermore, this generation often finds traditional approaches to experiencing cultural heritage unappealing. These methods fail to offer engaging or relevant ways to explore historical sites (Sharma et al., 2024). To address this challenge, it is crucial to develop approaches that effectively enhance Generation Z's intention to visit cultural heritage sites through immersive and relevant experiences.

Generation Z are known as digital natives who are very familiar with technology, including immersive technologies such as virtual reality (VR) and augmented reality (AR) (Abas & Puspawati, 2024; Loureiro et al., 2020). Previous studies have shown that technology-based experiences attract their attention more than traditional approaches (Buhalis & Karatay, 2022; Puspawati, Abas & Permatasari, 2024). Therefore, VR technology can potentially bridge the gap between Gen Z and cultural tourism by presenting relevant experiences digitally.

This research is particularly compelling and important as it investigates Generation Z's perspective on immersive technology and their engagement with cultural heritage. Understanding this relationship is crucial for future cultural heritage tourism development (Rodrigues et al., 2024). Generation Z is expected to dominate as primary visitors to cultural heritage sites in the coming years (Buhalis & Karatay, 2022; Puspawati, Abas & Ariani, 2024). This study seeks to extend the growing body of literature on the effects of VR on behavioural intentions for cultural tourism. Prior research has employed technology adoption models such as the theory of planned behaviour (TPB) (Huang, 2023), the unified theory of acceptance and use of technology (UTAUT) (Wen et al., 2023), UTAUT2 (Bilynets et al., 2023), and Bayesian network models (Cheng et al., 2014). These models provide valuable insights into the acceptance of new technologies. However, they predominantly focus on rational factors such as perceived ease of use and usefulness while failing to address deeper psychological mechanisms, such as emotional responses, highly relevant in VR and cultural tourism.

This research aims and contributes to understand how VR can be a pre-visit promotional tool to enhance Generation Z's intention to visit cultural heritage sites. No studies have examined the psychological mechanisms through which VR influences behavioural intentions in CHT (Gao et al., 2022). This study offers a novel contribution by examining Generation Z's behavioural responses to VR in CHT through the stimulus-organism-response (S-O-R) approach. It provides actionable recommendations for policymakers, such as tourism ministries, to guide VR adoption, technological advancement, and marketing strategies for cultural tourism. Additionally, it delivers practical insights for destination managers in designing VR experiences to enhance Gen Z's intention to visit cultural heritage sites.

2. Literature review and hypothesis

2.1. Stimulus-organism-response (S-O-R) model

The theoretical backbone of this study is the S-O-R framework, a seminal model in environmental psychology proposed by Mehrabian and Russell (1974). The model posits that external environmental factors (stimulus) trigger internal processes within an individual, encompassing both cognitive and affective states (organism), which in turn drive their final behavioural (response). The S-O-R model emphasizes causal relationships between stimuli and responses, mediated by cognitive and emotional processes (Duong & Nguyen, 2024). This framework is particularly suitable for understanding how specific stimuli, such as VR interactivity and telepresence, influence emotional and cognitive responses, ultimately shaping behavioural intentions (Elgammal et al., 2023). The S-O-R model has since been widely adopted to

explore online user behaviour (Islam & Rahman, 2017; Kim, Lee & Jung, 2020). In tourism research, it has been employed to investigate travel experiences (Chen et al., 2022; Min et al., 2020), travel intentions (Su et al., 2022), and user engagement (Ali et al., 2021; Yadav et al., 2022).

In alignment with this theoretical precedent, the present study operationalizes the S-O-R framework to deconstruct the Gen Z user journey from virtual experience to physical visit intention. The components are defined according to Sherman et al. (1997) as follows:

1. Stimulus (S): Represents the key technological features of the VR environment that users are exposed to. In this study, the stimuli are interactivity (the user's ability to manipulate the environment) and telepresence (the feeling of "being there"). These act as the primary environmental cues.
2. Organism (O): Encompasses the internal psychological states triggered by the stimuli. This study measures three crucial organismic states: place satisfaction (an affective evaluation), perceived authenticity (a cognitive evaluation of genuineness), and mental image (a cognitive representation of the destination).
3. Response (R): Is the ultimate behavioural outcome resulting from the organismic states. For this research, the primary response measured is the user's physical visit intention to the Borobudur Temple.

By employing this model, this study moves beyond simply asking *if* VR is effective to explaining *how* it works by charting the specific psychological pathways that link virtual features to real-world intentions.

2.2. Relationship among interactivity, place satisfaction, authenticity and mental image

In a virtual context, interactivity refers to the extent to which users can modify the form and content of an environment in real time (Fatahillah & Asfarian, 2020; Loureiro et al., 2019). According to Steuer (1995), high interactivity is shaped by three features: speed (system responsiveness), mapping (control similarity to real-world actions), and range (manipulability of content). These elements commonly define how interactivity is operationalized. Previous studies have examined the relationship between interactivity and user satisfaction in virtual experiences (Komarac & Ozretić Došen, 2022).

Interactivity is crucial in shaping emotional responses in virtual tourism. Research indicates that user-driven interactivity fosters positive attitudes toward destinations by empowering users to influence their experiences, thereby strengthening their emotional connection to the virtual places they explore (Pantelidis, 2024). Furthermore, engaging and entertaining interactive elements contribute significantly to satisfaction (Bilynets et al., 2023), which highlights the importance of designing interactive features that enhance user experience in virtual environments.

H_1: The interactivity quality of VR experiences positively impacts Generation Z's place satisfaction in the context of cultural heritage tourism.

Interactivity also plays a crucial role in perceived authenticity (Pallud, 2017). Interactivity builds on presence to actively explore and experiment while manipulating virtual objects and environments and makes abstract concepts tangible and memorable, reinforcing the authenticity of the experience (Yim et al., 2017). Furthermore, a study on virtual museum tourism found that VR interactivity boosts engagement and perceived authenticity (Dağ et al., 2024), suggesting that active user participation fosters a stronger sense of connection to the content.

H_2: The interactivity quality of VR experiences positively impacts Generation Z's authenticity in the context of cultural heritage tourism.

Mental imagery is influenced by interactivity (Schlosser, 2021), which is particularly important in helping VR users form mental images, as interactive features encourage active engagement with the environment. This encourages active engagement, producing more vivid mental images than passive observation (Bogicevic et al., 2019). Virtual reality enhances this process by combining vivid visuals and interactivity (Steuer, 1992), strengthening telepresence and users' ability to envision themselves at the destination.

While Hyun and O'Keefe (2012) noted that interactivity bridges virtual content and mental imagery, their focus was on evaluative outcomes (e.g., value for money) rather than the cognitive development of mental images, leaving the underlying process underexplored.

H_3: The interactivity quality of VR experiences positively impacts Generation Z's mental image in the context of cultural heritage tourism.

2.3. Relationship among telepresence, place satisfaction, authenticity and mental image

High presence in a virtual environment (VE) creates a perceptual illusion of non-mediation that means the user starts experiencing the VE as an actual, physical place, suspending disbelief and forgetting that the virtual environment is being viewed through a computer device (Kuswati & Saleha, 2018; Nicovich, 2017). For tourism, high presence leads users to recall the virtual environment as a real place, not just a series of images (Slater et al., 1999).

Telepresence has a positive connection with satisfaction and previous research has found a positive connection between presence and satisfaction (Sylaiou et al., 2010). In VR tourism, high presence enhances immersion and engagement. Visitors to virtual cultural sites form stronger emotional and cognitive ties, resulting in greater satisfaction through

meaningful experiences (Beck et al., 2019). In reality-based technology, a strong presence fosters emotional connection with the environment, leading to higher visitor satisfaction (Chung et al., 2018).

H_4: The telepresence of VR experiences positively impacts Generation Z's place satisfaction in the context of cultural heritage tourism.

Telepresence and authenticity are closely linked. A strong sense of telepresence enhances authenticity, as users are more likely to view a virtual environment as genuine when fully immersed. Conversely, perceiving an environment as authentic strengthens the feeling of presence within it (Hameed & Perkis, 2024). The interplay between presence and authenticity shows that while telepresence initially captivates users through sensory immersion, extended exposure prompts critical evaluation of the environment's authenticity. At physical sites, interactive and user-friendly displays enhance engagement (Moscardo, 2009). In contrast, VR struggles to replicate these but instead fosters presence to deepen immersion (Guttentag, 2010; Slater & Sanchez-Vives, 2022).

H_5: The telepresence of VR experiences positively impacts Generation Z's authenticity in the context of cultural heritage tourism.

This study posits that the telepresence induced by VR stimulates active engagement in mental imagery processing. Mental imagery refers to "a process […] by which […] sensory information is represented in working memory" (MacInnis & Price, 1987, p. 473). Mental imagery is formed from prior experiences or available information and plays a key role in driving positive consumer responses in tourism (Lee & Gretzel, 2012).

Telepresence enhances mental imagery engagement (Skard, Jørgensen & Pedersen, 2021). Moreover, feeling present (telepresence) supports envisioning a trip (mental imagery) (Hyun & O'Keefe, 2012). Thus, immersive virtual experiences are likely to foster mental imagery.

H_6: The telepresence of VR experiences positively impacts Generation Z's mental image in the context of cultural heritage tourism.

2.4. Correlation among place satisfaction, authenticity, mental image and physical visit intention

Results about satisfaction and visit intention have shown inconsistencies, depending on the subject and object of the study. For instance, Van Kerrebroeck et al. (2017) suggested that satisfaction with VR significantly affects visit intention. In contrast, Ravichandran et al. (2024) found no significant impact of satisfaction on visit intention. Despite such divergence, satisfaction has consistently been highlighted as a dominant factor encouraging tourists to visit and revisit destinations (Tang et al., 2023).

Satisfaction is particularly critical in the museum experience, where meeting visitors' needs and enhancing their engagement are key objectives (Kang et al., 2022). In the cultural heritage tourism (CHT) context, museums represent an essential subset that often relies on satisfying visitor experiences to enhance engagement and attract repeat visits. Kang et al. (2018) demonstrated that satisfying technological experiences contribute significantly to overall museum satisfaction. However, different CHT contexts, such as historical sites, cultural festivals, and intangible heritage, may exhibit unique characteristics that influence the satisfaction-visit intention relationship.

Rahimizhian et al. (2020) emphasized that destination satisfaction shapes intention and behaviour, aligning with prior findings (Han & Hyun, 2015). As heritage and cultural (HC) destinations increasingly adopt new technologies to enhance visitor engagement, exploring how satisfaction influences visit intention across various CHT contexts becomes crucial.

H_7: Generation Z's satisfaction with cultural heritage sites through VR experiences positively influences their intention to visit physically.

Authenticity, characterized as the genuine, accurate or unique quality of an experience (Grayson & Martinec, 2004), has been shown to influence perceptions and behaviour in various tourism settings (Lee et al., 2020). Authenticity in VR applications provides users with immersive and credible representations, enhancing engagement.

In the CHT context, authenticity is critical in attracting visitors by offering meaningful connections to history and heritage (Beverland & Farrelly, 2010). Virtual environments with an authentic approach may replicate this effect by meeting consumer desires for historical accuracy and cultural significance. Given the established role of authenticity in fostering meaningful visitor engagement, this study proposes to investigate its impact in virtual environments as a driver of visit intention to authentic cultural heritage destinations.

H_8: Generation Z's authenticity of cultural heritage sites through VR experiences positively influences their intention to visit physically.

Destination image is a pivotal factor in influencing tourist behaviour and decision-making processes. Tourists' mental images of destinations, encompassing their subjective perceptions, significantly shape their behavioural intentions (Le et al., 2020). According to studies, like those by Chen and Tsai (2007), destination imagery significantly conditions tourists' future behavioural intentions, including destination choice and revisitation.

Recent studies show that in virtual tourism, vivid mental imagery boosts user expectations and visit

intentions (Zhu et al., 2023). This aligns with the findings of Ouerghemmi et al. (2023), who showed that vivid imagery can positively affect purchase intentions. Importantly, Xu et al. (2019) emphasized the systematic nature of the visit experience, underscoring the need to shape positive mental images before the visit to foster visit intentions and enhance in-visit interactions.

This study examines how mental images affect tourists' intentions to visit cultural heritage destinations. Building on the premise that mental imagery determines cultural behavioural intentions (Le et al., 2020), this study seeks to deepen understanding of its role in motivating tourists to engage with cultural heritage tourism.

H_9: Generation Z's mental image of cultural heritage sites through VR experiences positively influences their intention to visit physically.

All the hypotheses are related in Figure 1.

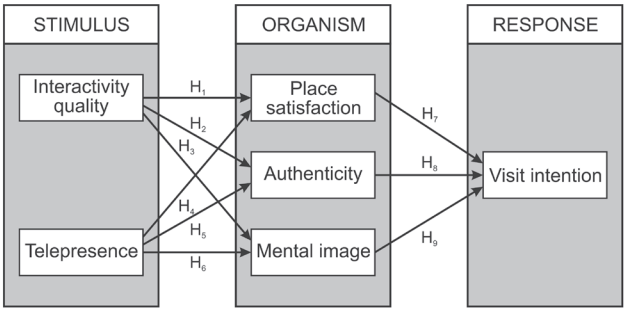

Figure 1. Research model

Source: authors

3. Method

3.1. Sample and data collection

This quantitative study examines variable relationships using non-probability sampling of Indonesian Generation Z participants. Indonesia is recognized as a country rich in cultural tourism due to its diverse ethnicities, traditions, and cultural practices that attract visitors from around the globe (Prajnawrdhi et al., 2015). The minimum required sample size was determined using the inverse square root table proposed by Hair et al. (2013) and Kock and Hadaya (2018). Given that the research model contains nine arrows leading to constructs, the minimum sample size was calculated to be 181 participants. The sample size was increased accordingly to address the large population and avoid heterogeneity (Hair et al., 2019).

Data was collected online using a Google Form questionnaire through WhatsApp, Instagram and email. The process involved several stages. First, an instruction document was prepared in Google Docs, including survey guidelines, a consent form, a VR content provider's website link, and the survey form itself. Second, this document was shared on social media, targeting Generation Z individuals who had not visited cultural heritage sites in the past two years. Third, respondents who agreed to the instructions completed the consent form, confirming their eligibility and participation. Finally, eligible respondents explored Indonesia's cultural heritage via VR platforms, including virtual tours of Borobudur Temple on sites like *360Indonesia* ("Candi Borobudur", n.d.), *Indonesia Virtual Tour* ("Candi Borobudur", 2022), and *360Cities* (Broomfield, 2009).

Borobudur Temple was selected for its prominence as one of Indonesia's most iconic cultural heritage sites. Finally, after exploring the VR content, respondents completed the post-exploration survey. The data collection process lasted three months, yielding 430 completed questionnaires. However, after excluding incomplete responses, the final dataset consisted of 415 valid responses.

The demographic details of respondents are presented in Table 1. Most were female (57.1%, 237 respondents), while males accounted for 42.9% (178 respondents). A majority (63.9%, 265) had prior VR experience, while 36.1% (150) did not, indicating general familiarity with VR. Notably, only 49.6% (206) had participated in virtual tours, while 50.4% (209) had not, suggesting that VR's use for virtual tours is still underutilized despite familiarity with the technology.

Table 1. Respondent information

Question	Information	Total	Percent
Gender	Male	178	42.9
	Female	237	57.1
Have you ever tried virtual reality technology?	Yes	265	63.9
	No	150	36.1
Have you ever tried virtual tour?	Yes	206	49.6
	No	209	50.4

Source: authors.

3.2. Measurement

A 21-item questionnaire was used to assess participants' intentions to visit Indonesian cultural heritage sites, stimulated by a VR experience. All items were rated on a five-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*), allowing participants to express agreement positively. The items were adapted from previous studies: interactivity and telepresence (Yim & Park, 2019), place satisfaction (Dağ et al., 2024), authenticity (Kim, Lee & Preis, 2020), mental imagery (Skard, Knudsen et al., 2021), and physical visit intention (Atzeni et al., 2022).

3.3. Data analysis

The data were analyzed using partial least squares structural equation modelling (PLS-SEM), which effectively captures complex relationships among variables. PLS-SEM is a reliable method commonly used in marketing and management information systems effectively estimating causal models across theoretical frameworks and empirical data contexts (Hair et al., 2011). Additionally, PLS-SEM is suitable for complex model validation and is known for its ability to "capture reality", reflecting statistical results in practical terms (Akter et al., 2017). SPSS software was also utilized to calculate descriptive statistics and respondent characteristics.

4. Results

Table 2 summarizes the results of the measurement model assessment. All constructs demonstrated strong internal consistency, with composite reliability (*CR*) values exceeding 0.7, Cronbach's alpha values ranging from 0.762 for authenticity to 0.893 for place satisfaction, confirming high reliability across all variables. Additionally, the average variance extracted (AVE) values ranged from 0.601 (authenticity) to 0.765 (mental image), surpassing the 0.5 threshold and supporting the convergent validity of the constructs.

Discriminant validity was evaluated using the Fornell-Larcker criterion, as presented in Table 3. Each construct's square root of AVE exceeded its correlations with other constructs. For example, place satisfaction had a square root of AVE of 0.863, which was higher than its correlations with telepresence (0.635) and visit intention (0.369). Similar patterns were found for authenticity, interaction quality, mental image, telepresence and visit intention, confirming that all constructs are conceptually distinct and meet the criteria for discriminant validity.

The hypothesis testing results, summarized in Table 4, strongly support most proposed hypotheses. Information quality (IQ) significantly influenced place satisfaction (PS), authenticity (AU) and mental imagery (MI), with *p*-values of 0.000 for H_1, H_2, and H_3. Telepresence (TE) also significantly affected PS and MI, supporting H_4, H_5, and H_6, with *p*-values of 0.000.

Table 2. Model measurement assessment

Variables	Items	Loading factor	Composite reliability (*CR*)	Cronbach's alpha	Average variance extracted (AVE)
Authenticity	AUT1	0.768	0.857	0.778	0.601
	AUT2	0.782			
	AUT3	0.762			
	AUT4	0.788			
Interaction quality	IQ1	0.810	0.879	0.817	0.646
	IQ2	0.772			
	IQ3	0.841			
	IQ4	0.791			
Mental image	MI1	0.857	0.907	0.846	0.765
	MI2	0.877			
	MI3	0.889			
Place satisfaction	PSAT1	0.890	0.898	0.828	0.745
	PSAT2	0.893			
	PSAT3	0.804			
Telepresence	TL1	0.850	0.894	0.822	0.737
	TL2	0.884			
	TL3	0.841			
Visit intention	VII1	0.875	0.904	0.859	0.703
	VII2	0.862			
	VII3	0.827			
	VII4	0.787			

Source: authors.

Table 3. Fornell-Larcker criterion

Variables	Authenticity	Interaction quality	Mental image	Place satisfaction	Telepresence	Visit intention
Authenticity	0.775	–	–	–	–	–
Interaction quality	0.380	0.804	–	–	–	–
Mental image	0.638	0.375	0.875	–	–	–
Place satisfaction	0.668	0.390	0.571	0.863	–	–
Telepresence	0.599	0.306	0.454	0.635	0.858	–
Visit intention	0.466	0.401	0.443	0.369	0.279	0.838

Source: authors.

Table 4. Hypothesis test

Hypothesis	Coefficient	Relationship	*p*-value	Finding
H_1	0.216	IQ → PS	0.000	Supported
H_2	0.217	IQ → AU	0.000	Supported
H_3	0.260	IQ → MI	0.000	Supported
H_4	0.569	TE → PS	0.000	Supported
H_5	0.532	TE → MI	0.000	Supported
H_6	0.374	TE → MI	0.000	Supported
H_7	0.041	PS → VI	0.532	Not supported
H_8	0.288	AU → VI	0.000	Supported
H_9	0.236	MI → VI	0.000	Supported

Notes: IQ – interaction quality, TE – telepresence, PS – place satisfaction, AU – authenticity, MI – mental image, VIS – visit intention.

Source: authors.

An unexpected result emerged for H_7. Place satisfaction (PS) did not have a statistically significant direct effect on visit intention (VI), as indicated by a *p*-value of 0.532. In contrast, both AU and MI had strong and statistically significant positive effects on VI. These relationships were confirmed by *p*-values of 0.000 for H_8 and H_9.

5. Discussion

The findings of this study provide compelling empirical support for the proposed S-O-R framework in the context of virtual heritage tourism. The discussion is structured around the two core linkages of the model. First, we will discuss the stimulus → organism (S → O) pathway, examining how technological stimuli (interactivity and telepresence) successfully shaped the internal organismic states of Gen Z users (H_1–H_6). Subsequently, we will analyze the organism → response (O → R) pathway, detailing how these internal states translated into physical visit intentions (H_7–H_9).

The findings confirm hypotheses 1, 2, and 3, showing that interactivity quality in VR significantly impacts place satisfaction (H_1), perceived authenticity (H_2), and mental imagery (H_3). Respondents explored Borobudur Temple via interactive VR platforms, navigating 3D environments, interacting with virtual artifacts, and engaging with detailed cultural representations. These features fostered active involvement, enhancing satisfaction, authenticity perceptions and site visualization. For Generation Z, who prefer active participation over passive observation, such interactivity addresses their disconnect from CHT. The results highlight VR's potential to make cultural sites more engaging and relevant for this demographic.

Confirming the first link in our model, the technological stimulus of interactivity was found to significantly enhance place satisfaction (organism) (H_1). Loureiro et al. (2020) and Bilynets et al. (2023) emphasized that interactivity increases user involvement, a critical precursor to satisfaction in digital environments. As Komarac and Ozretić Došen (2022) noted, self-paced engagement amplified this effect by allowing respondents to tailor interactions to their interests, strengthening emotional and cognitive connections. Unlike general tourism, where satisfaction often hinges on entertainment or convenience, satisfaction in CHT arises from meaningful cultural engagement. This underscores the need for VR features that promote deep exploration.

Further validating the S → O pathway, interactivity (S) also strongly influenced perceived authenticity (O) (H_2). Respondents who could interact with Borobudur's artifacts and architecture reported greater trust in the representation's credibility. This result aligns with Dağ et al. (2024) and Pallud (2017), who noted that active exploration enhances perceptions of authenticity by enabling users to validate cultural narratives. For Gen Z, this is crucial as they favour participatory engagement over static representations. It is likely

that respondents found virtual cultural elements more authentic by directly assessing their realism and detail.

Mental imagery (H_3) was also significantly influenced by interactivity. Respondents reported vivid mental images of Borobudur Temple after engaging with the VR environment. Features like exploring intricate carvings or observing the temple's scale provided sensory and spatial cues that stimulated the imagination. Schlosser (2023) and Bogicevic et al. (2019) found similar effects in their work. Interactivity encouraged respondents to construct detailed mental representations by actively engaging with the environment. For Gen Z, this process is crucial. Immersive and interactive features transform abstract historical narratives into relatable and meaningful experiences. In CHT, mental images go beyond visualizing the site, creating emotional and cognitive connections to cultural heritage. These are essential factors for engaging younger audiences with cultural tourism.

The second technological stimulus, telepresence, also proved to be a potent driver of the organismic state of place satisfaction (H_4). Respondents who felt deeply immersed in the virtual environment reported higher satisfaction, as telepresence fosters a sense of "being there", enabling emotional connection with the destination. Realistic visual and spatial cues, such as navigating Borobudur's intricacies or observing its vast landscape, likely contributed to this immersive experience. Prior studies, such as those by Sylaiou et al. (2010) and Beck et al. (2019), have demonstrated that telepresence enhances satisfaction by deepening users' engagement with virtual environments. Telepresence gives Gen Z, who appreciate immersive content, agency and emotional participation, the ability to distinguish CHT from other virtual experiences.

Telepresence also significantly influences perceived authenticity (H_5). Respondents who felt "present" in the virtual environment were more likely to trust the representation of Borobudur as authentic. This connection is supported by research, such as Luo and Wang (2021), which found that telepresence immerses consumers in a credible and coherent virtual narrative, boosting authenticity. Participants presumably thought the elaborate virtual reconstructions and realistic spatial representations accurately depicted the cultural place. Telepresence balances aesthetics and cultural credbility for Gen Z and lets viewers experience cultural legacy in a realistic way, unlike static media. These findings demonstrate that CHT authenticity is not just about fidelity but also about how telepresence connects users to the site's cultural relevance.

Telepresence also affected mental images (H_6). Respondents of the virtual world reported vivid and detailed mental impressions of Borobudur Temple. Telepresence certainly provided sensory and spatial signals for imagining, while the sense of travelling within the temple or seeing its beautiful sculptures helped respondents create vivid mental images. This aligns with Hyun and O'Keefe (2012), who argued that telepresence bridges sensory engagement and cognitive processing to enhance mental imagery. Gen Z finds this process very meaningful as immersive VR experiences generate emotional and cognitive connections to the cultural location through precise visuals.

Moving to the second critical linkage of the framework, the organism → response (O → R) pathway, the findings reveal a more nuanced understanding of Gen Z's motivations. The findings reveal mixed results regarding the factors influencing visit intention to CHT. While the organismic states of perceived authenticity (H_8) and mental imagery (H_9) significantly contribute to visit intention (R), the organismic state of place satisfaction (H_7) does not show a direct effect on the final response. This divergence highlights a nuanced understanding of Generation Z's motivations. Unlike older models of tourism behaviour, such as those emphasizing satisfaction as a primary driver (Ying et al., 2022), these findings suggest that Gen Z prioritizes constructs that evoke emotional and cognitive engagement. Authenticity fosters trust in the site's cultural value, aligning with Beverland and Farrelly's (2010) argument that authentic representations provide meaningful connections in heritage tourism. Mental imagery, on the other hand, enables users to anticipate a more immersive experience, consistent with Le et al.'s (2020) view of imagery as a process that bridges sensory input and future behaviour.

Interestingly, authenticity and mental imagery reinforce each other in this context. Authentic representations in VR environments validate the site's cultural credibility and provide the sensory cues necessary to stimulate vivid mental imagery. For example, a VR experience of Borobudur Temple that accurately depicts its cultural and historical significance allows users to visualize themselves exploring the site, thus strengthening their intention to visit. This interplay contrasts with place satisfaction, which may lack the depth required to drive behavioural intentions while contributing to a positive evaluation of the VR experience. Hyun and O'Keefe (2012) proposed that constructs, which resonate with personal relevance and emotional immersion, are more likely to motivate action, particularly for Gen Z, who seek meaningful engagement rather than passive satisfaction.

Ultimately, this study empirically charts a clear path from S to O to R, demonstrating how specific technological stimuli effectively cultivate cognitive and affective organismic states, which in turn selectively predict the final behavioural response of a visit to a cultural heritage site. These findings collectively suggest that visit intentions among Gen Z are driven

by the integration of cognitive (mental imagery) and emotional (authenticity) factors, emphasizing the need for VR environments that are not only high in quality but also culturally accurate and emotionally engaging.

6. Conclusion

Virtual reality interactivity and telepresence can bridge Generation Z's gap in cultural heritage tourism, as shown in this study. Interactivity and telepresence improve place enjoyment, authenticity, and mental imagery (H_1–H_6). These constructs affect Generation Z's desire to visit tangible cultural heritage places (H_7–H_9). The data demonstrates that perceived authenticity and mental imagery influence visit intention the most, while place satisfaction does not. This suggests that Generation Z's CHT behaviour is influenced by their faith in the experience's cultural authenticity and their ability to visualize the site. The findings show that psychological involvement drives visitor intentions with VR technology, making cultural heritage accessible and interesting for younger audiences through active involvement and immersive experiences. Virtual reality is essential for digital cultural heritage tourism, according to these works.

This study provides valuable insights for tourism practitioners, cultural heritage managers, VR developers, and scholars as it emphasizes the importance of adopting VR technologies tailored to Gen Z, who favour immersive and interactive experiences. Features like virtual artifact manipulation, personalized navigation, realistic spatial renderings, and seamless movement enhance satisfaction, perceived authenticity, and mental imagery – key drivers of physical site visitation. Policymakers and cultural organizations can leverage VR to engage younger audiences, address accessibility challenges, and promote site preservation. Highlighting authenticity and vivid mental imagery supports cultural preservation and sustainable tourism goals. Theoretically, the study challenges behavioural models like TAM and UTAUT, showing that in CHT for Gen Z, emotional and cognitive factors such as perceived authenticity and mental imagery are more influential than ease of use or place satisfaction. Using the S-O-R framework, it underscores the central role of psychological engagement in shaping behaviour.

This study acknowledges several limitations that open avenues for future research. First, our findings are contextualized within a specific cultural setting (Indonesia). Future research should test our model in different cultural contexts (e.g., individualistic vs. collectivistic societies) to assess its generalizability. Second, this study did not account for individual differences; future work could explore how factors like prior VR familiarity or personal interest in history moderate the observed effects. Exploring these factors would provide a deeper understanding of how VR experiences can be tailored to diverse user profiles.

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