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Bridging Technology and Heritage: Mobile AR Applications as Efficient Tools for Cultural Destination Promotion

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Abstract: The study examines the influence of three product attributes—authentic experiences (AE), social influence (SI), and content richness (CR)—on visitors' intentions to adopt mobile augmented reality applications (MARA) in promotional events for Asian cultural heritage destinations. Grounded in the Technology Acceptance Model (TAM), a theoretical model was developed and empirically validated through a field survey conducted at an urban cultural heritage event in Macau, China. Analysis of 297 valid responses using Partial Least Squares Structural Equation Modeling (PLS-SEM) reveal that AE and SI enhance both perceived usefulness (PU) and perceived ease of use (PEOU), subsequently affecting MARA adoption intention. Conversely, CR impacts adoption intention solely through PU. This research fills knowledge gaps in the application of TAM to immersive technologies like MARA within Asian cultural contexts, highlighting the significant role of product attributes. Furthermore, it provides insights on effectively leveraging MARA in cultural destination promotion.

Keywords: Mobile augmented reality applications, immersive technology adoption, Asian cultural heritage tourism, authentic experiences, content richness, social influence

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Introduction

Augmented reality (AR), a distinctive interactive technology that overlays virtual objects and information onto the real world (Javornik, 2016), has emerged as an impactful innovation in various tourism sectors, including cultural tourism, shopping tourism, and water tourism (Garbin Praničević, 2021; Kaźmierczak et al., 2021; Punzon, 2021). Specifically, its application in cultural heritage tourism, a growing segment of the global travel industry, has gained significant traction by enhancing interactive experiences for travelers (Shin & Jeong, 2021; Zhu et al., 2022). For

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instance, Li et al. (2022) found that integrating AR technology with intangible cultural heritage actually can strengthen visitors' satisfaction and cultural awareness. Despite these advancements and AR's widespread integration into tourism marketing (Bostănică et al., 2022; Rahimi et al., 2020), significant knowledge gaps persist. The intersection of AR with heritage sites, its full potential as a promotional tool, and the underlying mechanisms driving tourist engagement with AR in cultural heritage contexts remain underexplored (Monteiro et al., 2023; Starčević et al., 2022; Yoo & Yu, 2024; Zhu et al., 2022). Furthermore, only 15% of AR research in tourism literature focuses on Asian destinations (Liang & Elliot, 2021), constraining the understanding of visitors' AR interactions across diverse cultural contexts (Jung et al., 2018; Lee et al., 2015).

To address these knowledge gaps, it is crucial to examine the mobile applications of AR technology in cultural heritage contexts. With powerful yet affordable smart mobile devices, mobile AR apps (MARA) have gained widespread adoption as a mobile extension of AR technology (Balasubramanian & Konar, 2022; Saprikis et al., 2020) and are increasingly used as experiential enhancement tools in tourism (Shin & Jeong, 2021). However, studies on MARA usage in cultural heritage settings are limited, particularly from non-Western perspectives. This study therefore aims to fill these knowledge gaps by exploring the interrelationships among three context-specific product attributes—authentic experience (AE), social influence (SI), and content richness (CR)—as determinants of visitors' intentions to use MARA (ARI), guided by the technology acceptance model (TAM). These factors were selected for their ease of implementation, enabling MARA developers and event promoters to efficiently incorporate the study's insights. The specific research questions are:

1. To what extent does TAM, extended with context-specific product attributes, explain MARA adoption in cultural heritage settings, particularly in non-Western contexts?
2. How do content richness, authentic experiences, and social influence impact visitors' intentions to use MARA in cultural heritage settings across diverse cultural backgrounds?
3. How does MARA utilisation affect visitors' intention to visit cultural heritage destinations?
4. What specific design principles and promotional strategies can be derived from the findings to optimise the design and implementation of MARA for cultural heritage destination promotions?

This study contributes to the literature by providing a contextualised examination of utilising MARA as an effective promotional tool for cultural heritage destinations, bridging the knowledge gaps with non-Western empirical evidence. The insights revealed in this study can guide event managers and AR developers to better leverage immersive technologies for promoting cultural heritage destinations.

Literature Review

Utilisation of MARA for Promoting Cultural Heritage Destinations

Cultural heritage tourism is an important and growing segment of the global travel industry (Aryani Ramadhini et al., 2023; Atinafu & Muuz, 2017; Hameed, 2022; Starčević et al., 2022). Over the last decade, interdisciplinary studies have collectively indicated that AR technology has the potential to enhance cultural heritage tourism experiences, yet knowledge gaps remain. For instance, Han, Weber et al. (2019) concluded that while AR can enhance visitor experience in cultural tourism, further research and theoretical refinement are crucial for creating AR applications that site visitors find truly valuable.

While AR technology's potential to reshape tourists' experiences at heritage sites is recognised, the way to effectively implement AR technology for promoting heritage sites remains unclear (Bostănică et al., 2022). To address this challenge, researchers have turned their attention to MARA. The advent of smart mobile technology has positioned MARA as a promising, cost-effective, and engaging tool for enhancing and promoting cultural heritage tourism experiences (Antonica et al., 2022; Bhaskara & Sugiarti, 2019; Garipağaoğlu-Uğur & Akova, 2022; Konar et al., 2024; Lee et al., 2015; Lehto et al., 2020; Nikolarakis & Koutsabasis, 2024).

Raeburn and Tokarchuk (2022) demonstrated MARA's ability to offer novel, location-based immersive story-walk experiences by blending virtual elements with the real world. However, other studies (e.g., Han, Weber, et al., 2019; Jung et al., 2018) have highlighted the need for an empirically robust framework to investigate MARA user behaviours and acceptance across different cultural settings. To address this gap, this study used the technology acceptance model (TAM) to investigate visitors' intentions to use MARA in Asian cultural heritage destinations.

Theoretical Model and Hypotheses Development

TAM (Davis, 1989), originally developed to explain computer usage behaviour, is a robust and widely used framework that employs two primary constructs, perceived usefulness (PU) and perceived ease of use (PEOU), to investigate users' intention to adopt innovative technology (Sohn & Kwon, 2020; Venkatesh & Bala, 2008). PU refers to the perceived utility of the technology, while PEOU measures the expected cognitive effort to learn and use it (Gefen et al., 2003). Over time, TAM has been expanded to incorporate various external factors, enhancing its explanatory power across diverse technologies. These factors include trust in mobile wallets (To &

Trinh, 2021), content richness in online learning (Liu & Luo, 2022), and security in e-payments (Lai, 2017), significantly broadening the model's applicability.

Recent meta-analyses have reinforced TAM's significance and identified key external factors influencing technology acceptance. Abdullah and Ward (2016) analysed 107 e-learning TAM studies, identifying five primary external factors: self-efficacy, subjective norm, enjoyment, computer anxiety, and experience. Billanes and Enevoldsen (2021) reviewed 54 TAM studies, revealing 10 influential factors, including knowledge, awareness, and social influence. These studies underscore the value of incorporating context-specific external variables to enhance TAM's predictive power. Specifically, in the domain of AR research, Liang and Elliot (2021) validated the robust relationships between TAM's core constructs, affirming its application in future studies despite alternative theoretical approaches.

This study extends the basic TAM by investigating the relationships between its core constructs and three external factors: authentic experience (AE), social influence (SI), and content richness (CR). These factors have demonstrated significance in the adoption of immersive technologies, such as VR, AR, and Metaverse, across various contexts (e.g., Al-kfairy et al., 2024; Gao et al., 2022; Huertas & Gonzalo, 2020). By scrutinising the influences of these factors through the lens of TAM, our study addresses the knowledge gap in understanding MARA's potential as a promotional tool for cultural heritage sites, offering insights for developing more engaging and effective promotional events.

Based on the aforementioned theoretical foundations and research gaps, we have developed our research model (Figure 1) and proposed the initial hypotheses based on the core TAM constructs, which are:

H1: PU positively influences ARI.
H2: PEOU positively influences ARI.

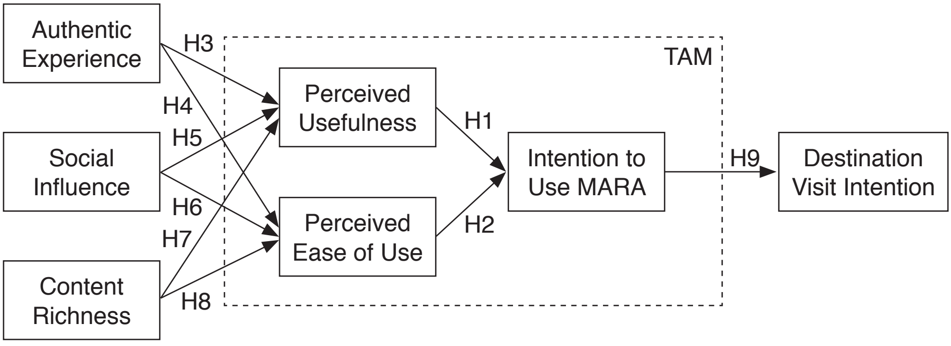

Figure 1. Research model

Authentic Experience (AE)

Authenticity in cultural heritage sites is a culturally constructed, contextually variable, and observer-dependent value (Lawless & Silva, 2016). Recent studies highlight its crucial role in immersive technology and heritage tourism (Monteiro et al., 2023). In virtual reality tourism, visitors are seeking authenticity, which positively influences their overall tourism experience and visit intentions (Gao et al., 2022; Zhu et al., 2022).

While direct studies linking authenticity to PU and PEOU in TAM for heritage are limited, research in other contexts suggests significant relationships (e.g., Anke & Schumann, 2017; Nikou & Economides, 2016; Thanomsing & Sharma, 2024). Drawing parallels between these studies, we propose that authentic experiences through MARA in cultural sites influence users' perceptions of usefulness and ease of use. These experiences enhance PU through meaningful interactions and PEOU by improving MARA's intuitiveness in cultural heritage exploration. Thus, we hypothesise:

H3: AE positively influences PU.
H4: AE positively influences PEOU.

Social Influence (SI)

Social influence refers to how individuals modify their behaviour in response to others and often involves conforming to majority opinions when adopting mobile apps (Vahdat et al., 2021). Within TAM, SI can positively affect an individual's PU and PEOU, influencing adoption intentions (Billanes & Enevoldsen, 2021; Min et al., 2021). A recent study on Metaverse, an immersive technology that merges AR, VR, and the internet, confirmed that SI shapes user acceptance, perceptions, and behaviours (Al-Kfairy et al., 2024). However, SI's effects on PU and PEOU vary across contexts. For instance, SI enhanced guests' PU and acceptance of hotel self-service kiosks (Joe et al., 2022), while in digital learning, SI negatively affected PU but positively influenced PEOU (Bhattarai & Maharjan, 2020). Given these contrasting results, further investigation is needed. In the current context, we posit that visitors may incorporate their companies' perspectives when accessing MARA's usefulness and ease of use. Therefore, we propose:

H5: SI positively influences PU.
H6: SI positively influences PEOU.

Content Richness (CR)

Content richness in tourism encompasses diverse information, visuals, and interactive elements that enhance the tourist experience (Cassia et al., 2020; Lukáč et al., 2021;

Pachucki et al., 2022; Pasanen et al., 2019). This concept is particularly relevant in AR applications at destinations, where studies have demonstrated that rich and engaging content improves user satisfaction and overall tourism experience (Huertas & Gonzalo, 2020; Jung et al., 2015). Nevertheless, CR's influence on PU and PEOU varies across diverse contexts. Kumari (2022) found that CR affects PEOU but not PU, while Elnagar et al. (2022) reported the opposite. In digital museums, a context similar to heritage sites, Shi et al. (2023) found information richness significantly enhanced both PU and PEOU. Synthesising these studies, we propose:

H7: CR positively influences PU.
H8: CR positively influences PEOU.

Destination Visit Intention (DVI)

Past research has explored the relationship between innovative technology usage and destination visit intentions. El-Said and Aziz (2022) found that perceived enjoyment and usefulness of virtual tours (VTs) not only increased VT adoption but also enhanced the desire to visit actual Egyptian heritage sites. Similarly, Nguyen et al. (2023) demonstrated that tourists' VR experience influences their behavioural intentions, leading to increased visit intention. Therefore, we propose:

H9: ARI positively influences DVI.

Mediation Effects of PU and PEOU

In addition to the direct effects of PU and PEOU on behavioural intention posited in TAM, past research has also demonstrated their mediating roles across diverse contexts, including e-purchasing (Moslehpour et al., 2018) and mobile wallets (To & Trinh, 2021). While PU and PEOU are key extrinsic factors driving adoption, studies suggest that product attributes can serve as intrinsic motivations, indirectly influencing technology acceptance by shaping users' perceptions of usefulness and ease of use (Watchravesringkan et al., 2010). Following this reasoning, we propose that the three MARA attributes—AE, SI, and CR—function as intrinsic motivators, affecting behavioural intention through PU and PEOU. Consequently, we hypothesise:

H10: PU mediates the influence of AE on ARI.
H11: PEOU mediates the influence of AE on ARI.
H12: PU mediates the influence of SI on ARI.
H13: PEOU mediates the influence of SI on ARI.
H14: PU mediates the influence of CR on ARI.
H15: PEOU mediates the influence of CR on ARI.

Methodology

Sample

Data were collected in Macau, China, from December 2021 to January 2022 during the *Arraial na Ervanários* event, promoting the *Rua dos Ervanários* heritage district. This district, originally established in the 16th century as a Portuguese customs service managing foreign trade, exemplifies Macau's unique blend of Chinese and Portuguese cultural heritage. The site was chosen for its pioneering implementation of MARA technology in cultural destination promotion.

Using purposive sampling (Andrade, 2021), data were gathered from visitors at various AR installations throughout the site. Participants interacted with AR via their mobile apps and could share their AR-enhanced photos online. 297 valid samples were collected, exceeding Kothari's (2004) recommendation of at least 30 participants per variable, ensuring adequate statistical power. Of these respondents, 64.6% were female, 72.7% were under 31 years of age, and 34.7% were married. The detailed demographic information is presented in Table 1.

Table 1. Participants' demographic information

Category	Variable	Frequency	Percentage (%)
Gender	Male	105	35.4
	Female	192	64.6
Age	Under 31	216	72.7
	31-40	57	19.2
	41-50	20	6.7
	Above 50	4	1.3
Marital Status	Single	194	65.3
	Married	103	34.7

Measures

All measurement scales were adapted from previous studies. AE (4 items) was adapted from Kim et al. (2020), SI (3 items) from Saprikis et al. (2020), and CR (4 items) from Hsiao and Tang (2021). PEOU (4 items) was adapted from Vahdat et al. (2021) as well as Wallace and Sheetz (2014), while PU (4 items) was from Chung et al. (2015) and Vahdat et al. (2021). ARI and DVI (3 items each) were adapted from Chung et al. (2015). These 25 scale items were evaluated using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Items were adapted to align with the study's context and translated from English to Chinese by a bilingual researcher. Following cross-cultural research practices (Morales & Ladhari, 2011), a back-translation procedure was employed to ensure semantic equivalence. A pilot test involving 20 university students was conducted to refine the questionnaire.

Common Method Bias (CMB)

Common method bias (CMB), which arises from variance attributed to the measurement method rather than the constructs under study (MacKenzie & Podsakoff, 2012), was systematically diagnosed employing the full collinearity test developed by Kock (2015). Results presented in Table 2 indicate that all Variance Inflation Factor (VIF) values were below the conservative threshold of 3.3, and no correlations exceeded the recommended level. These findings suggest that CMB did not significantly threaten the validity of the results.

Data Analysis Procedure

Data analysis was conducted using SmartPLS 4 software, employing Partial Least Squares Structural Equation Modeling (PLS-SEM). This method was chosen for its suitability in exploratory studies, robustness with smaller sample sizes, and effectiveness in handling non-normal data distributions (Hair et al., 2012). The PLS-SEM results were evaluated using a two-stage procedure, following the thresholds and criteria recommended by Sarstedt et al. (2021). First, the reliability and validity of the measurement model were assessed. Subsequently, the hypotheses were evaluated based on the significance of the corresponding path coefficients. The results and their implications are presented and discussed in the following sections.

Findings

Measurement Model Assessment

According to Sarstedt et al. (2021), the study's construct reliability was established through Cronbach's alpha (CA) and composite reliability (CR) coefficients surpassing the threshold of 0.7 for each latent variable. Convergent validity was demonstrated by average variance extracted (AVE) values exceeding 0.5 for all constructs and factor loadings higher than 0.7 for each measurement item. To assess discriminant validity, the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio of correlations were employed, yielding satisfactory results (Sarstedt et al., 2021). The assessment results of the measurement model are presented in Tables 2–4.

Table 2. Test results of measurement model

Constructs	Items	Loadings	CA	CR	AVE	VIF
PEOU	PEOU1	0.900	0.917	0.942	0.802	1.428
	PEOU2	0.919				
	PEOU3	0.916				
	PEOU4	0.845				
PU	PU1	0.875	0.896	0.928	0.762	1.482
	PU2	0.877				
	PU3	0.859				
	PU4	0.881				
AE	AE1	0.912	0.908	0.936	0.784	1.446
	AE2	0.839				
	AE3	0.895				
	AE4	0.894				
SI	SI1	0.905	0.924	0.952	0.868	1.464
	SI2	0.948				
	SI3	0.942				
CR	CR1	0.897	0.917	0.941	0.800	1.273
	CR2	0.910				
	CR3	0.890				
	CR4	0.879				
ARI	ARI1	0.905	0.907	0.941	0.842	**1.719**
	ARI2	0.915				
	ARI3	0.933				
DVI	DVI1	0.922	0.935	0.958	0.885	**1.204**
	DVI2	0.944				
	DVI3	0.955				

Table 3. Discriminant validity matrix (Fornell–Larcker criterion)

	PEOU	PU	AE	SI	CR	ARI	DVI
PEOU	**0.895**						
PU	0.191	**0.873**					
AE	0.382	0.229	**0.886**				
SI	0.420	0.236	0.426	**0.931**			
CR	0.011	0.258	-0.011	-0.171	**0.894**		
ARI	0.416	0.504	0.438	0.266	0.135	**0.918**	
DVI	0.134	0.237	0.061	0.003	0.365	0.197	**0.941**

Note: All the values shown in diagonal and bolded represent the square root of AVE.
All the off-diagonal values shown represent correlations.

Table 4. Heterotrait-monotrait correlation matrix (HTMT)

	PEOU	PU	AE	SI	CR	ARI	DVI
PEOU							
PU	0.209						
AE	0.411	0.251					
SI	0.452	0.261	0.462				
CR	0.038	0.280	0.043	0.184			
ARI	0.452	0.558	0.484	0.285	0.146		
DVI	0.145	0.256	0.067	0.023	0.397	0.211	

Structural Model Assessment

The structural model explains 41.3% ($R^2 = 0.413$) of the variance in the intention to use MARA (ARI), indicating sufficient explanatory power. The model's predictive power (Q^2) was assessed using the PLSpredict procedure in SmartPLS with ten folds and repetitions. The results (shown in Table 5) indicate Q^2 values larger than zero for the key target constructs, establishing predictive relevance (Sarstedt et al., 2021). Hypotheses were evaluated through bootstrapping with 10,000 resamples on the structural model (Becker et al., 2023). Detailed results are presented in Tables 6 and 7 and discussed in detail next.

Table 5. Model's predictive power

Constructs	Q^2 predict
ARI	0.165
DVI	0.021
PEOU	0.211
PU	0.138

Table 6. Path analysis

Hypotheses	β	t-value	p-value	95% CIBC	f^2	Remarks
H1 PU → ARI	0.441	8.512	0.000***	[0.351, 0.521]	0.293	Supported
H2 PEOU → ARI	0.332	6.183	0.000***	[0.245, 0.421]	0.166	Supported
H3 AE → PU	0.133	2.086	0.019*	[0.027, 0.237]	0.017	Supported

Table 6. (con't)

Hypotheses	β	t-value	p-value	95% CIBC	f²	Remarks
H4 AE → PEOU	0.243	3.815	0.000***	[0.135, 0.345]	0.062	Supported
H5 SI → PU	0.231	3.764	0.000***	[0.128, 0.329]	0.050	Supported
H6 SI → PEOU	0.328	5.500	0.000***	[0.228, 0.423]	0.111	Supported
H7 CR → PU	0.299	5.586	0.000***	[0.207, 0.383]	0.103	Supported
H8 CR → PEOU	0.070	1.282	0.100	[-0.022, 0.156]	0.006	Not supported
H9 ARI → DVI	0.197	3.360	0.000***	[0.099, 0.293]	0.041	Supported

Note: ***p < 0.001; **p < 0.01; *p < 0.05
95% CIBC = 95% Confidence Interval Bias Corrected

Table 7. Mediation analysis

Hypotheses	β	t-value	p-value	95% CIBC	f²	Remarks
H10 AE → PU → ARI	0.059	1.898	0.029*	[0.012, 0.114]	0.004	Supported
H11 AE → PEOU → ARI	0.081	2.854	0.002**	[0.041, 0.134]	0.007	Supported
H12 SI → PU → ARI	0.102	3.583	0.000***	[0.058, 0.151]	0.010	Supported
H13 SI → PEOU → ARI	0.109	4.382	0.000***	[0.072, 0.155]	0.012	Supported
H14 CR → PU → ARI	0.132	4.597	0.000***	[0.088, 0.183]	0.018	Supported
H15 CR → PEOU → ARI	0.023	1.252	0.105	[–0.06, 0.054]	0.001	Not supported

Note: ***p < 0.001; **p < 0.01; *p < 0.05
95% CIBC = 95% Confidence Interval Bias Corrected
v^2 = Indirect Effect Size

Upon examining the results, PU and PEOU significantly and positively influenced ARI with medium effect sizes ($f^2 \geq 0.15$) as suggested by Cohen (2013), supporting H1 and H2. This affirms Liang and Elliot's (2021) assertion of TAM's strength for AR research, notwithstanding competing theoretical frameworks.

Regarding the model's antecedents, analysis reveals that AE significantly affects both PU and PEOU, supporting H3 and H4. These findings align with recent research indicating tourists' increasing valuation of authentic experiences offered by immersive technology and their willingness to invest in deeper cultural integration (Gao et al., 2022; Zhu et al., 2022). Furthermore, AE's influence on ARI was found to be mediated through PU and PEOU, supporting H10 and H11. These results clarify the two-fold results reported by Han, Tom Dieck, et al. (2019) regarding user interaction with AR technologies in cultural tourism. While their study exhibited mixed opinions on interaction simplicity, our research reveals a more definitive pattern for MARA adoption at cultural heritage sites. Specifically, the results suggest that the authentic experience offered by MARA can enhance the perception of usefulness and ease of use, subsequently influencing intention to use MARA.

In addition to AE, the results demonstrate that SI significantly affects PU and PEOU, supporting H5 and H6, respectively. Within this framework, SI's impact on ARI is mediated through PU and PEOU, supporting H12 and H13. SI has emerged as an important driver, encouraging visitors to use MARA at cultural heritage site promotional events. Consistent with findings from studies across different contexts (e.g., Billanes & Enevoldsen, 2021; Min et al., 2021), this study reveals that evaluation or feedback from visitors' social groups is crucial to their MARA usage intentions. Consequently, facilitating seamless communication between visitors and their communities should be prioritised for successful MARA implementation.

Regarding the impacts of CR, the empirical results reveal that CR significantly influences PU directly and ARI indirectly, supporting H7 and H14, respectively. However, CR shows no significant effect on PEOU, rejecting H8 and consequently H15. These findings partially align with previous studies suggesting CR is a key design attribute for AR applications (e.g., Huertas & Gonzalo, 2020; Jung et al., 2015), while indicating that CR has no significant effect on the perceived ease of using MARA in cultural heritage sites. This divergence implies that, within the current framework, alternative factors may play a more prominent role in determining PEOU for MARA. The complexity of user interaction with MARA in cultural heritage contexts might contribute to this unexpected result. Consequently, further research, such as examining additional variables, is recommended to explore this non-significant relationship. Nevertheless, given CR's influence on PU and indirect impact on ARI, MARA designers should still prioritise comprehensive heritage site information as their design strategy, thereby enhancing visitors' perceptions of MARA's usefulness and, in turn, increasing their MARA usage intentions.

In examining MARA's broader impact, the relationship between ARI and DVI, while exhibiting a small effect size ($f^2 = 0.041$), is statistically significant ($t = 3.360$, $p < 0.001$), supporting H9. The Confidence Interval Bias Corrected (CIBC) [0.099, 0.293] indicates a consistently positive relationship between ARI and DVI, as the interval does not include zero. However, the small effect size suggests that ARI alone does not fully explain variations in DVI, implying other significant factors are involved. Future research should aim to identify these additional influencing factors and employ larger sample sizes to provide more precise estimates, thereby maximising MARA's potential as an effective promotional tool for cultural heritage sites.

Discussion and Conclusion

Conclusion

This study extends TAM by incorporating context-specific product attributes to explore MARA adoption in cultural heritage settings, with a focus on the non-Western context of Macau. Results indicate that the enhanced TAM offers valuable insights into MARA adoption in this setting. The study reveals that content richness, authentic experiences, and social influence significantly impact visitors' intentions to use MARA, primarily mediated by perceived usefulness and ease of use. Notably, content richness influences usage intention solely through perceived usefulness, hinting at other factors' prominence in MARA's perceived ease of use. Furthermore, MARA usage intention positively affects destination visit intention, albeit with a limited effect size. These findings illuminate the complexity of user interaction with MARA in cultural heritage contexts, providing a foundation for effective design and promotion strategies. This research bridges technology and heritage, shedding light on effectively employing MARA as an efficient tool for cultural destination promotion.

Theoretical Implications

This study refines TAM for immersive technology in the cultural heritage domain, addressing knowledge gaps in Asian and non-Western perspectives (Jung et al., 2018; Lee et al., 2015; Liang & Elliot, 2021). By empirically examining the influences of authentic experience (AE), content richness (CR), and social influence (SI), we establish novel relationships between these product attributes and TAM constructs. Notably, our findings reveal a significant link between authenticity and TAM constructs (PU and PEOU), extending TAM's application to this unique domain. This contribution enhances our understanding of MARA adoption in cultural heritage contexts, providing a theoretical framework that accounts for the novel aspects of immersive cultural experiences.

Our findings unveil complex interactions between product attributes and user behaviour, challenging simplistic views of technology adoption. The non-significant relationship between CR and PEOU, coupled with SI's significant impact on adoption intentions, underscores the need for context-specific approaches to understanding MARA acceptance. These findings demonstrate that technology adoption in cultural heritage settings involves intricate relationships between user perceptions, social factors, and content attributes. By illuminating these nuanced interactions, our study contributes to a more comprehensive theoretical understanding of how users engage with immersive technologies in cultural heritage settings. This advances our knowledge of MARA acceptance, paving the way for further theoretical and empirical exploration in diverse cultural heritage contexts.

Practical Implications

This research provides empirical insights for effectively utilising MARA as promotional tools for cultural heritage destinations. Our findings align with previous studies on adopting AR technology for cultural destinations (Jung et al., 2018; Zhu et al., 2022), suggesting that enriched MARA experiences can effectively promote these sites.

For MARA developers, our results emphasise that providing visitors with rich informational content and authentic cultural experiences should be the key MARA design principle. As demonstrated by Cisternino et al. (2021), multi-layered storytelling through images, sounds, and augmented reality can effectively promote cultural heritage sites. Our findings indicate that this strategy, when implemented through MARA, can fulfil visitors' desire for rich yet authentic cultural knowledge via immersive technology, thereby enhancing their visit intention. However, while MARA's product attributes influence visitors' intentions to adopt MARA and subsequently visit the site, the effect size of ARI on DVI is weak. This suggests that visit intention is influenced by additional factors beyond MARA, such as Wi-Fi connectivity, transportation ease, or promotional event appeal. Consequently, event organisers and destination managers should consider these factors comprehensively to optimise MARA's effectiveness in promoting cultural heritage sites.

Furthermore, while prioritising immersive MARA experiences, visitors' need for social connections should not be overlooked. The significant impacts of SI indicate that tourism marketers should facilitate both online and offline interactions for successful MARA deployment. Specifically, marketers should consider implementing infrastructure supporting community interactions, leveraging both location-based features (Chen & Tsai, 2019) and cross-platform social media capabilities (Islam et al., 2024; Vahdat et al., 2021) to enhance the MARA experience. To further elevate visitors' engagement and exploration, future MARA applications should explore adopting gamification elements (Pradhan et al., 2023), incorporating live streaming (Zamzuri et al., 2023) and integrating smart tourism technology (Yaghmour, 2024), as these have shown potential to enhance experiences and increase attraction in tourism contexts.

Limitations and Future Research Directions

While this study provides valuable insights, several limitations suggest avenues for future research. First, the narrow focus on a single Macau heritage event limits generalisability. Future studies could expand the research to multiple cultural heritage sites across different Asian countries, enabling cross-cultural comparisons and enhancing the generalisability of findings. Second, the sample's demographic skew towards participants under 31 may have influenced the results due to their presumed higher tendency to accept innovative technology. Future research should employ a more stratified sampling approach to better represent different age groups and potentially explore how MARA adoption varies across generations. Third, the study examined only three product attributes as drivers of MARA adoption. Future research could benefit from a more comprehensive exploration of additional factors, such as technological readiness, cultural sensitivity, or privacy concerns to provide a more holistic understanding of MARA adoption in cultural heritage contexts. Lastly, while statistical tests were performed to assess common method bias, future studies could enhance methodological rigor by supplementing surveys with qualitative methods (e.g., in-depth interviews or focus groups) for richer insights into user experiences and motivations.

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