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Augmented Reality as a Marketing Tool: Assessing Its Influence on Tourist Satisfaction in Cultural Heritage Tourism Through Cross-Country Comparative Analysis of China and Malaysia

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Abstract
This study aims to investigate the influence of perceived augmented reality (AR) on tourist satisfaction and loyalty within the context of cultural heritage tourism. By examining AR as a marketing tool, the research explores how AR can enhance the visitor experience and promote long-term loyalty. A comparative analysis between China and Malaysia is conducted to assess the effectiveness of AR in diverse cultural settings. A quantitative research design was employed, using structured questionnaires distributed to tourists in both China and Malaysia. Data were collected from 200 respondents in each country and analysed using Structural Equation Modelling (SEM) with SPSS and Amos to explore the relationships between perceived

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AR, tourist satisfaction, and loyalty. Immersion was examined as a mediating variable in these relationships. The study revealed that perceived AR has a significant positive effect on both tourist satisfaction and loyalty. Immersion was identified as a key mediator, enhancing the impact of AR on tourist experiences. The comparative analysis highlighted cultural differences in the effectiveness of AR, emphasising the importance of developing culturally specific AR applications. This study contributes to the understanding of how AR can enhance tourist experiences and foster loyalty, with a particular focus on the mediating role of immersion. It offers valuable insights for tourism marketers and destination managers, recommending the design of culturally tailored AR applications to maximise tourist engagement and retention.

Keywords: Perceived Augmented Reality, Marketing, Immersion, Tourist Satisfaction, Tourist Loyalty.

Introduction

AR has revolutionised tourism and various other sectors by altering how tourists perceive and interact with their surroundings. By integrating digital content with real-world environments, AR creates immersive and engaging travel experiences (Dargan et al., 2023). In the tourism sector, AR enables the development of customised, educational, and interactive experiences. This study examines the impact of AR on tourist satisfaction and loyalty at cultural heritage sites in Malaysia and China. The potential of AR to enhance engagement and knowledge acquisition in tourism is significant. AR applications make tourist destinations more captivating and dynamic, allowing visitors to experience historical re-enactments, explore artefacts, and deepen their understanding of local community connections (Kwok et al., 2024). Furthermore, AR provides cultural heritage tourists with complex historical narratives and detailed stories about specific locations. As noted by Iranmanesh et al. (2024), AR applications enhance both cognitive and emotional engagement, offering diverse benefits for the tourism industry.

Cognitive engagement involves thinking about a place, while emotional engagement focuses on feeling it. AR provides dynamic, relevant information, enhancing the memorability and enjoyment of the experience. By offering customised, bilingual information, AR makes tourist sites more accessible for international visitors (Chaudhry et al., 2023). The findings suggest that AR enhances tourist satisfaction by improving the accessibility and appeal of cultural heritage sites. In cultural tourism, where complex histories are difficult to convey through traditional media, AR can bridge this gap through interactive storytelling (Jadán-Guerrero et al., 2020). AR transforms static displays into interactive experiences, enriching visitors' emotional and educational engagement with a region's history and culture (Çalışkan et al., 2023). However, further research is needed to explore the impact of AR on visitor loyalty and satisfaction in China and Malaysia.

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Tourism has actively explored the use of AR to engage and satisfy visitors. Iranmanesh et al. (2024) investigated the application of AR at historical sites, finding that AR apps enhanced both cognitive and emotional engagement. Educational and interactive AR content was shown to improve cognitive engagement and facilitate learning about the location. In a study by Nortvig et al. (2020), the use of AR in museums was examined, revealing that AR apps enhanced visitors' recall and understanding by adding historical information and narratives to real-world displays, thus supporting various learning modes and increasing exhibit enjoyment, ultimately fostering greater inclusivity. Ramtohul and Khedo (2024) explored how AR enriches tourists' experiences at historical sites, with their research indicating that AR apps provided immersive and deeper experiences, leading to higher levels of tourist satisfaction. Furthermore, AR's ability to animate historical events and offer personalised experiences was found to enhance visitor enjoyment. The study also noted that tourists preferred using their smartphones for accurate information, further improving their experience (Do et al., 2020).

Boediono et al. (2023) explored the use of AR for the preservation and dissemination of culture, highlighting that AR apps can effectively convey the cultural and historical significance of heritage sites on a global scale. By providing bilingual information tailored to visitors' preferences, AR allows global travellers to gain a deeper understanding and appreciation of cultural heritage sites. The study found that AR can enhance interactions with historical monuments and help bridge cultural divides. Lim et al. (2024) examined the use of AR in various tourist settings, particularly in hotels, and identified how cultural factors influence the impact of AR on visitor satisfaction and loyalty. While some tourists found AR informative, others regarded it as entertaining or even unusual. This research emphasised the role of cultural differences in shaping the development and deployment of AR tourism apps. The findings suggest that AR can enhance tourist enjoyment and loyalty. Cranmer et al. (2020) studied frequent tourist visits, revealing that AR users were more likely to recommend and revisit destinations. AR's immersive and unique features were shown to increase engagement with locations and foster loyalty. Additionally, Do et al. (2020) found that AR apps can create distinctive and irreplaceable experiences, with an unusual resort environment motivating travellers to share their experiences online.

This study explores the role of immersion in influencing the outcomes of AR tourism and its potential to enhance tourist satisfaction. However, further research is required to examine how varying levels of immersion impact visitor experiences. This includes investigating the benefits of AR apps and their influence on user engagement, as addressing this gap could provide deeper insights into the psychological effects of AR (Melo et al., 2022). Additionally, there is a lack of research on the ethical and privacy concerns associated with AR in tourism. The security and privacy risks linked to the collection of personal and location data by AR apps necessitate a comprehensive investigation to assess how these concerns affect AR adoption and visitor perceptions.

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Understanding these issues is crucial for developing ethical and practical guidelines for AR tourism (Li et al., 2023). Further research is also needed to ensure the inclusion of diverse populations in the design and deployment of AR apps.

This cross-country comparative study examines the impact of perceived AR on visitor satisfaction and loyalty in cultural heritage tourism in China and Malaysia. It explores how AR apps enhance visitor experiences and foster loyalty, with a focus on how immersion mediates this relationship. The findings will provide insights into how AR creates engaging experiences, offering practical recommendations for tourism stakeholders in both countries. This research contributes to the growing knowledge of AR in cultural heritage tourism and is crucial for destination managers and marketers. The comparative analysis highlights cultural differences, helping stakeholders develop culturally relevant AR strategies to meet diverse tourist needs. Furthermore, the study places a strong emphasis on immersion, aiming to deepen our understanding of how AR influences visitor experiences on a psychological level. This knowledge is vital for the development of AR apps that enhance engagement and optimise AR's potential in tourism marketing. By exploring immersion, the research could guide the creation of interactive and visually compelling AR content that strengthens visitors' emotional connection to cultural heritage sites. The findings of this study will have implications for both governments and visitors, as they can inform the development of AR strategies that increase visitor satisfaction, encourage repeat visits, and promote positive word-of-mouth. The study underscores the importance of investing in AR to maintain competitiveness in the tourism industry. Moreover, it addresses key economic and accessibility concerns surrounding AR in tourism, filling a gap in the existing literature. By providing objective data on the benefits and challenges of AR in cultural heritage tourism, this research will inform future studies and practical applications. Ultimately, the study advocates for the ethical, private, accessible, and purpose-driven development of AR technology in tourism.

Literature Review

Marketing enhances tourist experiences through disruptive AR, which fosters immersive experiences that contribute to visitor satisfaction in cultural heritage tourism. The innovative combination of education and entertainment in AR brings historical events and artefacts to life, making them more engaging. AR can enrich visitor narratives by seamlessly overlaying digital content onto real-world locations (Arghashi & Yuksel, 2022). Contextual information and interactive storytelling enhance cultural heritage sites, transforming passive tours into educational experiences. Customisable AR apps tailored to individual learning styles and interests make cultural treasures more accessible and appealing (Sung et al., 2022). In a competitive tourism market, AR improves visitor experiences and enhances the visibility of cultural heritage sites. Lesser-known or underfunded locations can benefit from AR-based digital experiences, allowing them to compete with well-established

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attractions (Gasmi & Benlamri, 2022). Furthermore, AR enhances storytelling and encourages social media sharing, amplifying the impact of these experiences (Dwivedi et al., 2022). The study suggests that AR can positively influence visits, fostering favourable word-of-mouth and repeat visits. Additionally, AR helps preserve tourism by mitigating physical damage to endangered sites, thereby enhancing marketability, sustainability, and the overall tourist experience in cultural heritage tourism.

Perceived Augmented Reality and Tourist Satisfaction

The growing field of tourism research explores how perceived augmented reality (AR) influences tourist satisfaction. AR is transforming how tourists engage with cultural sites, with its ability to create compelling and immersive experiences playing a central role. User-friendly AR reduces the cognitive load required to gather and process information on-site, enhancing visitor satisfaction (Do et al., 2020). Additionally, the novelty and entertainment value of AR contribute to positive experiences. Well-designed AR tourism apps thus enhance value and enrich the overall visitor experience, supporting the broader growth of tourism (Lim et al., 2024). AR's educational capabilities also impact tourist satisfaction, as it provides detailed and relevant information about cultural heritage sites, enhancing visitor engagement (Abd Halim et al., 2024). Visitors to cultural heritage locations seek meaningful, informative experiences, and AR meets these expectations through captivating historical and cultural narratives (Innocente et al., 2023). AR enables tourists to become active learners, with features like virtual assistants or three-dimensional reconstructions of historical events, which visitors often find engaging and memorable (Kurniawan et al., 2023). The educational benefits of AR contribute to satisfying tourists' desire for informative and interactive experiences. Furthermore, AR boosts site engagement and satisfaction by encouraging visitors to interact with their environment rather than passively observe, enhancing involvement and enjoyment (Silva et al., 2023). By allowing visitors to explore at their own pace and according to their interests, AR personalises the experience. Additionally, AR can enhance the social aspect of tourism by providing shared experiences and discussion points. Interactive and social AR encourages greater engagement, making tourism more enjoyable and entertaining (Lim et al., 2024).

H1: Perceived augmented reality has a significant and positive impact on tourist satisfaction

Perceived Augmented Reality and Tourist Loyalty

The perceived impact of AR on visitor loyalty is significant, as it fosters positive word-of-mouth and repeat visits. AR enhances loyalty and satisfaction by offering immersive, interactive experiences that emotionally connect visitors to destinations (Park et al., 2019). Its ability to customise experiences increases enjoyment and loyalty, while educational benefits deepen engagement with cultural heritage sites (Berman &

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Pollack, 2021). AR's storytelling, historical re-enactments, and virtual tours improve learning retention, strengthening emotional attachment and the likelihood of return visits (Sharma et al., 2023). Social and interactive AR features also enhance visitor satisfaction, creating shared experiences that increase loyalty and promote social media engagement (Nawres et al., 2024; Serravalle et al., 2023). By fostering community and connection, AR helps generate repeat visits and positive word-of-mouth.

H2: Perceived augmented reality has a significant and positive impact on tourist loyalty

Immersion as mediator between Perceived Augmented Reality and Tourist Satisfaction

Establishing a strong connection between AR and full immersion in the virtual environment is likely to enhance visitor enjoyment. Immersion, defined as the extent to which users are fully engaged in augmented reality, plays a critical role in improving AR experiences. According to Loureiro et al. (2020), visitors who perceive AR as immersive are more engaged and derive greater satisfaction from the experience. AR enables travellers to explore different cultures and historical periods, deepening their connection to the site and potentially increasing their enjoyment. Interactive AR apps, such as those featuring storytelling or precise reconstructions, can further elevate user engagement by fostering a strong sense of presence (Innocente et al., 2023). The immersive nature of AR can also enhance perceptions of authenticity, which is highly valued by cultural heritage tourists. By replicating real-world landscapes and historical events, immersive AR offers a realistic experience that can increase both trust and enjoyment, ultimately fulfilling visitors' expectations through lifelike simulations (Melo et al., 2022).

H3: Immersion mediates the relationship between perceived augmented reality and tourist satisfaction

Immersion plays a crucial role in moderating the relationship between perceived AR and tourist retention, enhancing its impact on visitor loyalty. Immersive AR experiences enable tourists to feel present in a location, strengthening their emotional connection and creating memorable experiences that foster loyalty (Kaghat et al., 2020). Emotional engagement helps visitors form lasting, positive impressions, increasing the likelihood of repeat visits and recommendations (Silva et al., 2023). Through emotionally compelling immersive environments, AR can transform casual visitors into loyal advocates. Furthermore, immersion elevates visitors' perceptions of the value and uniqueness of their experiences, deepening their understanding and appreciation of a destination (Hu et al., 2021). As Li et al. (2023) suggest, immersive AR can enhance perceived value by offering unique, captivating encounters that encourage repeat visits and strengthen loyalty. Immersion also facilitates active

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participation and experience sharing, further influencing the relationship between AR and tourist loyalty. Social interaction through immersive AR applications, such as virtual tours or collaborative projects, increases enjoyment and connection, as highlighted by (Lee et al., 2020). Sharing AR experiences creates a shared narrative that fosters loyalty by linking visitors to the place and to each other. Thus, the immersive nature of AR is essential for promoting long-term engagement, enhancing both personal and social connections.

H4: Immersion mediates the relationship between perceived augmented reality and tourist loyalty

Based on the literature and ongoing discussions, we developed the conceptual framework as shown in Figure 1.

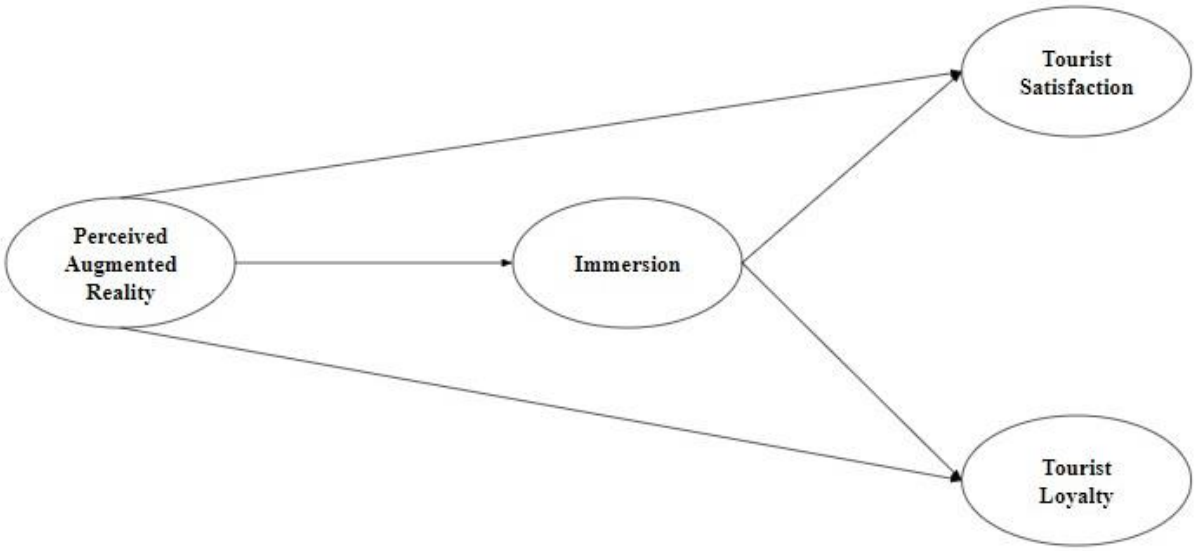

Figure 1: Conceptual Framework

Methodology

Research Design

A quantitative study using immersion looked at how visitors' perceptions of AR affect their enjoyment and loyalty. According to Levitt et al. (2018), this approach generated quantitative data for statistical analysis of variable relationships. Users of AR apps for cultural heritage tourism in China and Malaysia were polled. This method demonstrates how visitor outcomes in various cultures are impacted by AR perception. Using common scales and metrics, systematic surveys evaluated augmented reality, immersion, enjoyment, and loyalty. Regression and mediation were used to analyse the effects of the components. The intricate dynamics of augmented reality interactions and visitor outcomes were discovered through analysis.

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Population

Users of augmented reality apps that frequented Chinese and Malaysian cultural heritage sites were investigated. Using AR, Chinese tourists improved their historical and cultural experiences. Malaysian tourists used augmented reality in historical sites. This made it possible to conduct a thorough investigation into how AR affects tourist satisfaction and loyalty in both nations (Bhatti & Alshiha, 2023). They were picked because they represent a variety of historical and cultural backgrounds and offer a distinct perspective on how augmented reality technology affects visitor experiences and behaviours. The initiative looked at both universal and culturally specific factors that influence how AR may improve the visitor experience. This was accomplished by researching comparable individuals in other nations. The data was pertinent to the study because it concentrated on AR users.

Sample Size Determination and Sampling Technique

To ensure statistical significance and proper representation of Chinese and Malaysian populations, the sample size was determined through statistical power analysis. Structural equation modelling and regression analysis required 200 responses from each group, so 400 participants were recruited from each country. Stratified random sampling was used to represent the visitor demographics accurately, with a focus on minimizing bias. AR was applied at key Chinese historical sites and in culturally significant Malaysian locations, ensuring broad tourist representation. This approach enabled the findings to be reliably applicable to both countries and adaptable to other cultural contexts.

Data Collection Technique

Standardised questionnaires were used to collect data from AR app users at cultural heritage sites in Malaysia and China. A total of 400 questionnaires were distributed at each nation's AR-equipped cultural and historical sites, increasing the diversity of visitor experiences and locations. The study focused on evaluating the impact of AR on visitor impressions, satisfaction, and loyalty, with a particular emphasis on immersion, contentment, and relevance to both cultures. To enhance response rates, the survey was distributed through both online and offline channels, including travel forums, social media, tourism websites, and cultural heritage sites (Vojtko et al., 2022). This multi-channel approach ensured a wide range of responses, engaging participants effectively. In total, 200 completed questionnaires were returned from each country, yielding a 50% response rate, which exceeded the study's resource and data limits. Data were then collected, analysed, and verified, with missing or incomplete responses corrected for consistency.

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Data Analysis Technique

This study employed advanced statistical analysis using SPSS and AMOS. Bhatti and Alshiha (2023) applied SPSS for preliminary data management and descriptive statistics, including means, standard deviations, and frequency distributions, to identify trends, patterns, irregularities, and outliers in the dataset. The core analysis utilised structural equation modelling (SEM) to examine the relationships between perceived AR, immersion, satisfaction, and loyalty. SEM was employed to explain the complex interactions between immersion and AR perception in shaping visitor outcomes (Tiwari et al., 2024). AMOS was used to assess the coherence of the measurement and structural models with the data, applying model-fit analysis to evaluate direct and indirect effects, visitor enjoyment, and loyalty. The findings suggest that augmented reality experiences significantly influence cultural environments and tourist behaviour, as demonstrated by the rigorous SPSS and AMOS analyses.

Results

Table 1 presents the model fit indicators for the China-Malaysia research measurement model. The Chinese model demonstrated good fit, with a Comparative Fit Index (CFI) of 0.92, above the 0.90 threshold (Shi et al., 2022). The Tucker-Lewis Index (TLI) value of 0.90 indicated strong model agreement, while the Root Mean Square Error of Approximation (RMSEA) of 0.05, well below the 0.06 benchmark, confirmed a good fit. The Standardized Root Mean Square Residual (SRMR) value of 0.06 was within the acceptable range of less than 0.08, as per Hu and Bentler (1999). The Malaysian model also showed strong fit, with a CFI of 0.93, surpassing the recommended threshold. The TLI value of 0.91 signified good model fit (Welesilassie & Nikolov, 2022), and the RMSEA value of 0.04 met the Hu and Bentler (1999) criteria. Additionally, the SRMR value of 0.05 was below the established criterion. These fit indices indicate that the measurement model accurately represents the data in both China and Malaysia, ensuring valid and reliable construct measurement across the cultural contexts.

Table 1: Measurement Model Fit Indices

Country	Fit Index	Overall Model Score	Acceptable Threshold Value
China	Comparative Fit Index (CFI)	0.92	≥ 0.90
	Tucker-Lewis Index (TLI)	0.90	≥ 0.90
	Root Mean Square Error of Approximation (RMSEA)	0.05	≤ 0.06
	Standardized Root Mean Square Residual (SRMR)	0.06	≤ 0.08

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Table 1: Measurement Model Fit Indices (cont…)

Country	Fit Index	Overall Model Score	Acceptable Threshold Value
Malaysia	Comparative Fit Index (CFI)	0.93	≥ 0.90
	Tucker-Lewis Index (TLI)	0.91	≥ 0.90
	Root Mean Square Error of Approximation (RMSEA)	0.04	≤ 0.06
	Standardized Root Mean Square Residual (SRMR)	0.05	≤ 0.08

Table 2 presents the reliability and convergent validity of study variables in China and Malaysia. In China, all constructs demonstrated strong internal consistency, with Cronbach's alpha values exceeding 0.70 for each category: Perceived Augmented Reality (0.85), Immersion (0.87), Tourist Satisfaction (0.88), and Tourist Loyalty (0.84). Composite Reliability (CR) values also indicated satisfactory construct reliability, with Perceived Augmented Reality (0.87), Immersion (0.88), Tourist Satisfaction (0.89), and Tourist Loyalty (0.85). The Average Variance Extracted (AVE) values, all above 0.50, confirmed convergent validity, with Perceived Augmented Reality (0.55), Immersion (0.58), Tourist Satisfaction (0.60), and Tourist Loyalty (0.52) explaining most indicator variation (Fornell & Larcker, 1981).

Table 2: Reliability and Convergent Validity

	Variable	Cronbach's α	Composite Reliability (CR)	AVE
China	Perceived Augmented Reality	0.85	0.87	0.55
	Immersion	0.87	0.88	0.58
	Tourist Satisfaction	0.88	0.89	0.60
	Tourist Loyalty	0.84	0.85	0.52
Malaysia	Perceived Augmented Reality	0.86	0.88	0.56
	Immersion	0.88	0.89	0.59
	Tourist Satisfaction	0.89	0.90	0.62
	Tourist Loyalty	0.85	0.86	0.54

In Malaysia, reliability and convergent validity were similarly strong. Cronbach's alpha values for Perceived Augmented Reality (0.86), Immersion (0.88), Tourist Satisfaction (0.89), and Tourist Loyalty (0.85) exceeded the threshold for internal consistency. Malaysia showed higher CR values than China, with Perceived Augmented Reality (0.88), Immersion (0.89), Tourist Satisfaction (0.90), and Tourist Loyalty (0.86). The AVE values also surpassed 0.50: Perceived Augmented Reality (0.56), Immersion (0.59), Tourist Satisfaction (0.62), and Tourist Loyalty (0.54). These

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results confirm high convergent validity in both countries. Thus, the constructs are consistently and appropriately measured, demonstrating the reliability of the assessment approach.

Table 3 presents the discriminant validity of the research variables in China and Malaysia. Discriminant validity is assessed by comparing the square root of the AVE with construct correlations. In China, the square root of AVE values for each construct showed adequate discriminant validity. PAR's square root of AVE (0.74) was greater than those of Immersion (0.55), Tourist Satisfaction (0.53), and Tourist Loyalty (0.49). Immersion's square root of AVE (0.76) surpassed those of Tourist Satisfaction (0.57) and Tourist Loyalty (0.50). Tourist Satisfaction had an AVE of 0.77, stronger than Tourist Loyalty. These findings confirm good discriminant validity in the Chinese sample. In Malaysia, similar assessments showed that the square root of PAR's AVE (0.75) exceeded its correlations with Immersion (0.57), Tourist Satisfaction (0.55), and Tourist Loyalty (0.51), demonstrating distinctness. Immersion's AVE (0.77) was higher than those of Tourist Satisfaction (0.58) and Tourist Loyalty (0.53). Tourist Satisfaction had an AVE of 0.78, stronger than Tourist Loyalty's 0.56. These results confirm the distinctiveness of constructs, supporting the validity of the Malaysian context.

Table 3: Discriminant Validity (China)

Country	Construct	PAR	I	TS	TL
China	Perceived Augmented Reality	0.74			
	Immersion	0.55	0.76		
	Tourist Satisfaction	0.53	0.57	0.77	
	Tourist Loyalty	0.49	0.50	0.55	0.72
	Construct	**PAR**	**I**	**TS**	**TL**
Malaysia	Perceived Augmented Reality	0.75			
	Immersion	0.57	0.77		
	Tourist Satisfaction	0.55	0.58	0.78	
	Tourist Loyalty	0.51	0.53	0.56	0.73

Table 4 presents the structural model fit indices for the China and Malaysia studies, demonstrating the model's suitability in both contexts. In China, the CFI was 0.91, indicating a good model fit. However, the Adjusted Goodness-of-Fit Index (AGFI) was slightly below 0.89, suggesting potential for improvement. The RMSEA was 0.06, within the acceptable range (<0.06), and the Chi-Square/df ratio (CMIN/df) was 2.35, well below the threshold of 3.00, indicating a robust model fit. The TLI was 0.89, slightly below the 0.90 standard, but the IFI was 0.92, exceeding the 0.90 criterion. While the model shows strong connections, there is room for improvement in the Chinese context. For Malaysia, the model fit indices were also favourable. The CFI was 0.92, and the IFI was 0.93, both above the 0.90 threshold, suggesting a good model fit. The AGFI value was 0.90, indicating satisfactory fit quality. The RMSEA was 0.05,

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within the acceptable range, and the Chi-Square/df ratio (CMIN/df) was 2.20, below the 3.00 criterion. The TLI of 0.90 indicated a good match, confirming the model's suitability and reliability in the Malaysian context.

Table 4: Structural Model Fit Indices

	Fit Index	Overall Model Score	Acceptable Threshold Value
China	Comparative Fit Index (CFI)	0.91	≥ 0.90
	Adjusted Goodness-of-Fit Index (AGFI)	0.89	≥ 0.90
	Root Mean Square Error of Approximation (RMSEA)	0.06	≤ 0.06
	Chi-Square/df (CMIN/df)	2.35	≤ 3.00
	Tucker-Lewis Index (TLI)	0.89	≥ 0.90
	Incremental Fit Index (IFI)	0.92	≥ 0.90
Malaysia	Comparative Fit Index (CFI)	0.92	≥ 0.90
	Adjusted Goodness-of-Fit Index (AGFI)	0.90	≥ 0.90
	Root Mean Square Error of Approximation (RMSEA)	0.05	≤ 0.06
	Chi-Square/df (CMIN/df)	2.20	≤ 3.00
	Tucker-Lewis Index (TLI)	0.90	≥ 0.90
	Incremental Fit Index (IFI)	0.93	≥ 0.90

Table 5, Figure 2, and Figure 3 summarise the results of direct effect hypothesis testing for China and Malaysia. The obtained data presents path coefficients (β) and p-values for each hypothesis. Hypothesis H1, which posited that Perceived Augmented Reality (PAR) improves Tourist Satisfaction, was supported in China with a path coefficient of 0.45 and a p-value of less than 0.01. This indicates a significant positive relationship between higher PAR and increased satisfaction ($\beta = 0.45$, $p < 0.01$). Similarly, Hypothesis H2, suggesting that Perceived Augmented Reality enhances Tourist Loyalty, was supported in China with a path coefficient of 0.40 and a p-value of less than 0.01, indicating a positive effect of PAR on loyalty. In Malaysia, Hypothesis H1 was also supported, with a path coefficient of 0.48 and a p-value of 0.01, confirming that Perceived Augmented Reality significantly increases Tourist Satisfaction ($\beta = 0.48$, $p < 0.01$). Hypothesis H2 was similarly supported with a path coefficient of 0.42 and a p-value of less than 0.01, showing that PAR positively impacts Tourist Loyalty in Malaysia ($\beta = 0.42$, $p < 0.01$). These consistent findings in both China and Malaysia highlight that Perceived Augmented Reality has a significant and positive impact on both tourist satisfaction and loyalty.

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Table 5: Hypothesis Testing - Direct Effects

	Hypothesis	Path	β	P-Value
China	H1	Perceived Augmented Reality → Tourist Satisfaction	0.45	<0.01
	H2	Perceived Augmented Reality → Tourist Loyalty	0.40	<0.01
Malaysia	H1	Perceived Augmented Reality → Tourist Satisfaction	0.48	<0.01
	H2	Perceived Augmented Reality → Tourist Loyalty	0.42	<0.01

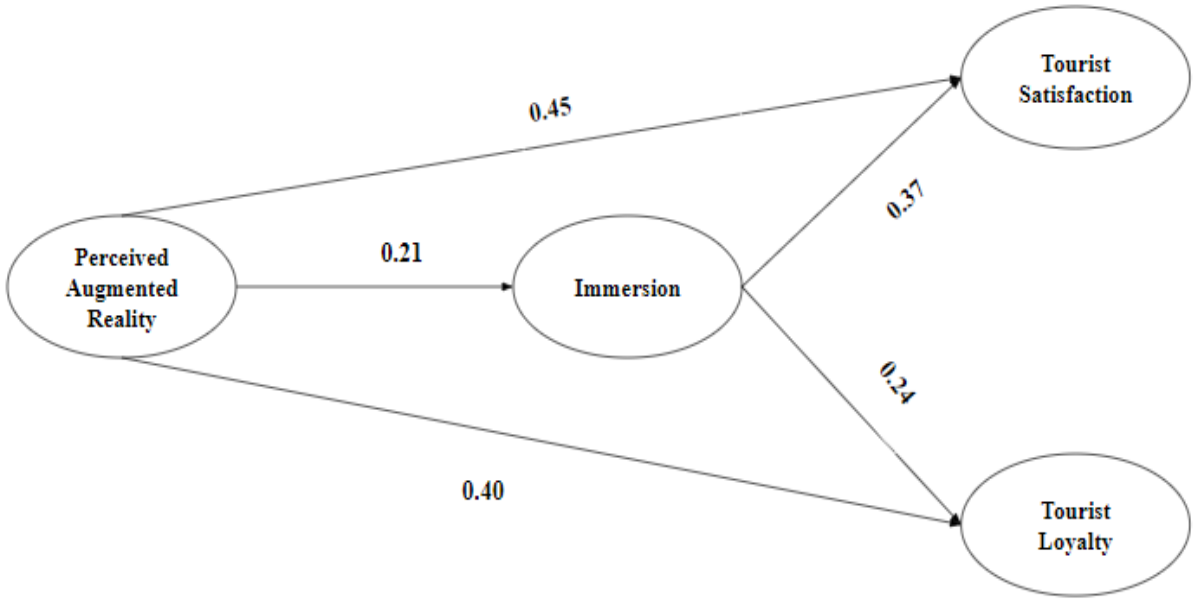

Figure 2: Structural Model of China

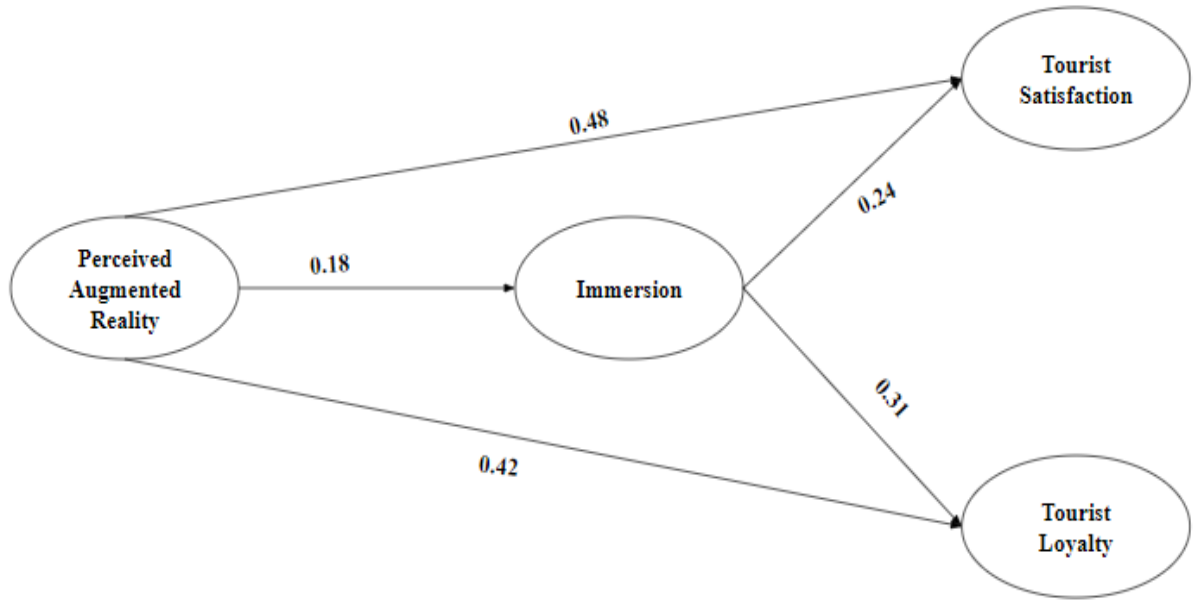

Figure 3: Structural Model of Malaysia

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Table 6 presents the indirect influence hypothesis testing results for Malaysia and China, focusing on Immersion as a mediator. Hypothesis H3, examining the indirect effect of PAR on Tourist Satisfaction via Immersion, was supported in both countries, with China showing a path coefficient of 0.30 ($p < 0.01$) and Malaysia a stronger effect of 0.32 ($p < 0.01$). This indicates that Immersion significantly mediates the relationship between PAR and Tourist Satisfaction in both contexts. Hypothesis H4, which explores Immersion's mediation between PAR and Tourist Loyalty, was also supported, with China reporting a path coefficient of 0.25 ($p < 0.01$) and Malaysia 0.28 ($p < 0.01$). These findings confirm that Immersion plays a key role in enhancing both satisfaction and loyalty through immersive experiences in diverse cultural settings.

Table 6: Hypothesis Testing - Indirect Effects

	Hypothesis	Path	β	P-Value
China	H3	Perceived Augmented Reality → Immersion → Tourist Satisfaction	0.30	<0.01
	H4	Perceived Augmented Reality → Immersion → Tourist Loyalty	0.25	<0.01
Malaysia	H3	Perceived Augmented Reality → Immersion → Tourist Satisfaction	0.32	<0.01
	H4	Perceived Augmented Reality → Immersion → Tourist Loyalty	0.28	<0.01

Discussion

This study examines how PAR enhances visitor satisfaction and loyalty in the cultural heritage tourism sectors of China and Malaysia. AR technology has the potential to revolutionise the tourism industry by offering immersive, interactive, and personalised information experiences. This multimodal study investigates both the direct and indirect effects of AR on visitor perceptions and behaviours, with a focus on how immersion influences AR's impact on satisfaction and loyalty. The findings confirm previous research and deepen our understanding of AR's role in tourism, particularly its effect on enhancing visitor experiences. By highlighting the importance of AR in shaping tourist satisfaction, the study suggests that destination marketers and managers can leverage AR to boost engagement and foster loyalty. Specifically, Hypothesis H1 is supported, with AR being shown to significantly impact Tourist Satisfaction. The study affirms that AR's interactive and immersive content enriches the visitor experience. Research by Do et al. (2020) indicates that AR apps with interactive elements and additional content enhance visitor happiness, while Innocente et al. (2023) note that AR transforms tourism into an experience economy, where memorable and educational experiences are a key driver of satisfaction.

Furthermore, AR enables tourists to interact with cultural heritage sites, overlaying digital information onto the physical world to enhance understanding. The study also

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supports the view that AR creates unique and engaging experiences that foster greater enjoyment, as noted by Silva et al. (2023), with AR apps offering tailored content based on individual preferences, making travel both educational and enjoyable. AR enhances the tourism experience, which is expected to boost visitor satisfaction, as suggested by Hypothesis H2, which posits that AR perception increases visitor loyalty. This highlights AR's role in fostering lasting relationships between tourists and destinations. AR can create memorable experiences that strengthen emotional bonds with a location, encouraging repeat visits. Abd Halim et al. (2024) note that AR's immersive nature can draw tourists back, while Park et al. (2019) argue that such experiences enhance emotional attachments to the destination. By making visits more engaging, AR can increase the likelihood of return visits and recommendations. Nawres et al. (2024) found that emotional connections and trip satisfaction are key drivers of tourist loyalty, and AR can foster both. Moreover, Sharma et al. (2023) assert that unique and immersive AR interactions can boost enjoyment and loyalty by offering fresh experiences to a wide range of consumers. This underscores the value of investing in AR to retain customers by delivering exceptional experiences.

Hypothesis H3 further supports the idea that immersive experiences bridge the gap between visitor enjoyment and AR perception, enhancing satisfaction. Immersion, by encouraging deeper interaction with both the environment and AR technology, enhances the overall experience. Loureiro et al. (2020) propose that the experience economy thrives on offering unique, immersive experiences that elevate customer satisfaction, and the mediation effect suggests that immersion amplifies the positive impact of AR-enhanced experiences. Melo et al. (2022) found that immersive visitor experiences increase satisfaction by providing unique and intriguing interactions. AR may immerse passengers in happy, engaging experiences. AR enhances visitor engagement with cultural heritage sites, increasing satisfaction by fostering a strong sense of presence and participation. Hypothesis H4 suggests that immersive experiences boost visitor loyalty by creating emotional connections with destinations. Hu et al. (2021) and Li et al. (2023) highlight that immersion strengthens loyalty by deepening the visitor's relationship with the site. AR can create tailored, captivating experiences that attract diverse users, increasing their likelihood of returning. Melo et al. (2022) and Lee et al. (2020) emphasize that unique, immersive interactions foster loyalty, underscoring the need for AR companies to design compelling, engaging experiences to maximize its impact on visitor satisfaction and loyalty.

Conclusion

This study demonstrates that PAR enhances tourist satisfaction and loyalty in the cultural heritage tourism sectors of China and Malaysia. Immersive AR experiences boost visitor engagement, fostering both satisfaction and loyalty. The findings align with previous research showing that AR enables dynamic, captivating interactions that improve visitor experiences. The study highlights how AR's impact on tourism

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varies across cultures, suggesting its potential to enhance international tourism offerings. It recommends that tourism managers and marketers invest in AR technology and immersive experiences to drive satisfaction and loyalty. Additionally, the study enhances the theoretical understanding of AR's role in tourism behaviour and suggests exploring other mediators and moderators to further investigate digital technology's potential in tourism. Ultimately, the research underscores AR's transformative potential in cultural heritage tourism, offering more immersive, meaningful ways for visitors to engage with destinations.

Implications

Practical Implications

This study provides key insights for tourism managers and marketers, especially in cultural heritage. PAR significantly enhances visitor satisfaction and loyalty, suggesting that AR technology can greatly improve tourist experiences. Tourism operators can integrate AR apps for interactive, immersive heritage site experiences to meet the demand for unique cultural engagement. Customizable AR content tailored to visitor interests boosts loyalty and satisfaction. The paper recommends using AR advertising to stand out, particularly targeting tech-savvy visitors. AR can differentiate a venue's value proposition, attracting more customers and boosting revenue. Additionally, AR improves word-of-mouth and online reviews, increasing appeal. To maximize impact, tourism providers should invest in user-friendly interfaces, clear instructions, and regular app updates to keep experiences engaging and foster customer loyalty.

Theoretical Implications

This study enhances tourism technology knowledge by revealing how AR impacts tourist satisfaction and loyalty through psychological and sensory factors. Immersion is key to AR's effectiveness, aligning with the experience economy's focus on memorable, engaging encounters. The cross-country comparison between China and Malaysia shows AR's global applicability in tourism, validating its benefits worldwide. This research offers valuable insights for integrating culture and technology in tourism studies and highlights the need for further exploration of mediators and moderators in AR's effects. Future research could expand these findings by examining factors like technology adoption and cultural influences to deepen our understanding of how digital advancements shape tourism experiences.

Limitations and Future Direction

Despite certain limitations, this study offers valuable insights into augmented reality's impact on tourist satisfaction and loyalty. The reliance on questionnaire data may have introduced memory bias or social desirability bias, as respondents might have

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provided positive feedback. Future research could address this by combining quantitative surveys with qualitative methods like interviews and focus groups to gain a deeper understanding of visitor experiences. The study's cross-sectional design limits its ability to establish causal relationships, suggesting the need for longitudinal research to track how AR affects visitor loyalty and satisfaction over time. Additionally, the study's focus on China and Malaysia, while useful for comparative analysis, limits its applicability to other regions. Future studies should include a broader range of countries to explore cultural and contextual differences in AR's impact. The study also centred on the technology acceptance model, primarily examining perceived utility and ease of use, but did not fully explore other psychological and contextual factors, such as the quality, relevance, and novelty of AR content or visitors' previous AR experiences. Future research should incorporate these factors to better understand AR adoption and visitor behaviour. Finally, exploring both the positive and negative effects of AR, including potential dissatisfaction or overuse, could offer a more comprehensive understanding of its role in tourism.

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