The Working of Research on Experience Dimension of MR Products in Chinese Cultural Tourism

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Abstract

The aim of this study is : (1) to assess the actual impact of Yangzhou Ancient Canal's MR experiential products on Chinese cultural tourism; (2) to systematically investigate the key factors that influence visitors' experience dimensions when using MR cultural tourism products. During the research process, we carefully selected 203 tourists and 6 industry experts as research participants, and collected data through questionnaire surveys and expert interviews as two research methods. An online questionnaire platform system was utilized for data collection. In the data analysis stage, we employed structural equation modeling to validate the proposed hypothesis model on factors influencing visitors' experience with MR products in cultural tourism. Additionally, online SPSS software was used for analyzing the results of questionnaire surveys.

Through this study, we have accomplished the following outcomes: (1) validated the positive impact of immersion, emotion, learning, and interaction on the experience of MR cultural tourism products; (2) derived design strategies for cultural tourism products based on empirical data; (3) developed an evaluation model for assessing the experience of MR cultural tourism products; (4) provided recommendations for future design decisions to facilitate the further advancement and application of MR technology in the field of cultural tourism.

Keywords: Cultural tourism; Mixed Reality(MR); Product experience; Yangzhou Ancient Canal MR experience system

Introduction

This study aims to explore an evaluation model for assessing experiential aspects of cultural tourism products by focusing on indicators and evaluation factors as well as their levels of influence and importance rankings. "Tourism product experiences" represent typical examples of experiential economy where identifying core factors plays a crucial role in driving destination economic value (Pine & Gilmore, 1998 : 97-105). Users place great importance on tourist experiences in cultural tourism. Research findings suggest that key aspects include sensory aesthetic experiences at the perceptual level; emotional experiences at the interactional level; reflective (learning) experiences at the cognitive level; etc.

Mixed reality (MR) technologies aim to enhance or expand experiential sensations themselves. These technologies' cores are directly related to tourist experiences： On one hand, digital products of this nature expand the dimensions of display and experience, enhancing the flexibility of cultural presentation by transforming virtual spaces into more enduring places with resonance. On the other hand, designs incorporating VR, AR, and MR bring about immersion and strong guidance, creating more creative and participatory forms of tourism that help integrate visitors into a more active and lasting experiential form. Therefore, as relevant

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digital products reach a certain scale and complete industry chain, there is an inevitable emphasis on product experience requirements. It is not only necessary to establish an experiential model that aligns with product characteristics but also to evaluate and provide feedback on this model in practice in order to enrich research data in related fields.In the past, UX design and research did not play a significant role due to developers struggling with limitations imposed by this technology. The substantial hardware requirements, limited processing power, low resolution, and poor frame rates were major obstacles hindering user-friendly experiences. However, as hardware-software challenges continue to be overcome along with constant upgrades in user-friendly design platforms software; currently for evaluating tourism product experiences there are early classic evaluation models like Technology Acceptance Model (TAM) (Davis, 1989 : 319-340) , which primarily assess "perceived usefulness," "perceived ease-of-use," and "user acceptance." However,this model has limitations when it comes to explaining the richness of users' immersive virtual reality experiences since it consists of simple variables developed over 30 years ago. Similarly,the other early classic experience models such as TPB or TRA also have similar limitations when evaluating virtual reality,augmented reality,and mixed reality products.On one hand, digital products of this nature expand the dimensions of display and experience, thereby enhancing the flexibility of cultural presentation and transforming virtual spaces into enduringly resonant places. On the other hand, researchers need to focus on studying audience experiences with VR and similar products, considering both sensory and psychological aspects. Further research should be conducted to propose guidelines (experience models) that cater to visitors' encounters with VR, AR, and MR products in cultural tourism. To gain a practical understanding of this topic, this study will commence by examining the design of "Yangzhou Ancient Canal Mixed Reality Experience System" in China and explore methods for enhancing digital product experiences in cultural tourism through mixed reality technology. By employing digitization techniques, mixed reality technology can expand perceptual boundaries while overcoming limitations imposed by time and space; thus creating immersive experiences that hold significant value in cultural tourism projects.

Research Objective

Evaluate the practical application effectiveness of Yangzhou ancient canal MR experience products in Chinese cultural tourism; systematically explore the key factors influencing tourists' experiential dimension when using MR cultural tourism products, with the aim of constructing a comprehensive and scientific evaluation model, and providing theoretical support and practical guidance for optimizing and developing MR experience products.

Literature Review

1. Overview of the Development Status of MR Products in Cultural Tourism

Cultural tourism encompasses the observation, perception, and immersive experience of diverse locations and heterogeneous cultures, driven by individuals' desire to explore different places or engage with varied cultural contexts. Zhang (2001) Typically involving visitors from outside the host community, cultural tourism is motivated by a keen interest in history, art, science, lifestyle, communities, regions, groups or institutions. It has been widely recognized as a significant contributor to both economic and social development in Europe and

worldwide. As technology advances and tourism markets evolve with improved infrastructure and services, there has been a shift towards more profound forms of travel experiences beyond traditional group or independent tours – known as in-depth tourism. (Lv , Li & Xia, 2020) In-depth tourism caters to travelers' growing demand for deeper cultural understanding at tourist destinations; mixed reality (MR), for instance, has demonstrated positive effects on enhancing tourists' experiential dimensions such as expanding perceptual horizons, deepening cognitive engagement and enriching aesthetic encounters. The digital product industry chain within the realm of cultural tourism has also matured over time with promising prospects.

2. Review of experience model research

Xie (2011) argues that the concept of tourism experience pertains to the transient alterations in individuals' psychological levels and structures when they encounter unfamiliar environments, influenced by their surroundings. Similar to physical travel, virtual tourism also aims to fully immerse individuals in novel environments, resulting in a perceptual transformation. The fundamental essence of this experiential sensation remains unchanged ((Huang, Backman & Moore,2013: 490-501). Despite the generally positive anticipation within the industry regarding the integration of mixed reality with cultural tourism, there still exist numerous aspects pertaining to its mechanisms and underlying motivations that necessitate further verification. On one hand, comprehensive data on how MR applications impact visitor experiences overall is lacking. Another crucial question revolves around whether these technologies will enhance or diminish visitor experiences due to additional digital layers between visitors and cultural artifacts; research data on this aspect is also insufficient. Han, Weber,Bastiaansen, Mitas & Lub (2019: 113-128) argue that attention, engagement, and immersion are distinct factors primarily derived from the combination of virtual reality and gaming products (Ermi & Mayra, 2005). Cognitive and absorptive factors have also been repeatedly mentioned, including time dissociation, focused attention, increased enjoyment, personal control, and curiosity. Furthermore, emotional arousal is considered a significant influencing factor(Skavronskaya, Scott, Moyle, Le, Hadinejad, Zhang & Shakeela, 2017: 221-237.; Moyle, B. D., Moyle, C. L., Bec & Scott,,2019: 1393-1399.). In the tourism industry context, previous researchers have proposed meaningful experience models such as the Technology Acceptance Model (TAM), Hedonic-Motivation System Adoption Model (HMSAM), and Education Communication Theory model. However, due to continuous product upgrades and expanding breadth and depth in tourism experiences, these classic models require further optimization or extension to accommodate new forms and patterns. To enhance traditional tourism product experience models' scope and assist researchers in incorporating dimensions encompassing recent research findings effectively. Table provides a concise description of relevant product experience models used in prior studies.

Table 1 Existing research on the dimensions of MR tourism experiences

Studies	Antecedents	Findings	Time
Davis	Perceived usefulness, perceived ease of use and user acceptance	The Technology Acceptance Model (TAM) has been widely applied in the evaluation of product experiences.	1986
Kim,J.H.,Ritchie,J.,& Mccormick,B.	hedonism, refreshment, local culture, meaningfulness, knowledge, involvement, and novelty	The cross-cultural validity of the memorable tourism experience scale (MTES)	2012
Wenjuan Y.Qi w.Chuandong H.	Convenience, novelty, richness, simulation and experience	Reveal the essence of virtual tourism experience through the construction of an evaluation model based on the analytic hierarchy process.	2012
M. Claudia tom Dieck and Timothy Jung	information quality, system quality, costs of use, recommendations, personal innovativeness and risk as well as facilitating conditions.	An AR acceptance model in the context of urban heritage tourism	2015
Martins, J	Sight, hearing, smell, touch and taste	A multisensory virtual experience model for thematic tourism	2017
Kim, M. J. , & Hall, C. M.	hedonism, refreshment, local culture, meaningfulness, knowledge, involvement, and novelty.	Research the application of HMSAM in flow theory (CA) and hedonic motivation	2019
Lee, W. , & Kim, Y. H.	Two dimensions of value related to consumer variables	Expanded the dimension of immersive experience in the TAM theory model.	2021
Kusdibyo, L. , Brien, A., Sutrisno, R,& Suhartanto, D.	enjoyment and learning, escape, involvement, application, and peace of mind	Expanding the theoretical model of experience economy	2021
Xiaojun Fan, Xinyu Jiang, Nianqi Deng	identified as the core feature of AR/VR in the tourism field	A meta-analysis of augmented/virtual reality applications and their impact on tourism experience	2022

3. Case study on experience-driven design of MR products in Chinese cultural tourism

As a key component of the tourism economy, cultural tourism places significant emphasis on enhancing tourist experiences and exhibits a strong interest in innovative experiential products. Researchers conducted field research and analysis on Chinese cultural tourism products to investigate the design of MR cultural tourism products.

3.1 Design based on immersive experience

The Forbidden City in China stands as one of the most renowned cultural landmarks, attracting a consistently high number of visitors. However, traditional methods of touring often impose limitations that hinder tourists from fully immersing themselves in the rich culture it embodies. On December 18th, 2015, the Palace Museum officially initiated the "Yanxin Palace Research and Conservation Project," aiming to undertake a five-year endeavor for its restoration and preservation. To compensate for this period and enhance visitor experiences, the Palace Museum has introduced the innovative "V-Gugong Virtual Reality Experience Project." For instance, within Qianlong Garden lies an architectural marvel known as "Juanqinzhai," celebrated for its exquisite beauty and historical artifacts. Unfortunately, due to its limited size and inadequate lighting conditions inside Juanqinzhai itself, overcrowding becomes inevitable when multiple individuals enter simultaneously. Consequently, such circumstances significantly impact visitors' overall experience. Therefore, through the "Juanqinzhai" section of V-Gugong project, this confined physical space is digitally expanded infinitely within a virtual context to enable visitors to freely explore and observe intricate details of these historical artifacts. Henceforth, Mixed Reality (MR) technologies hold immense value in cultural tourism projects by expanding perceptual boundaries through digitalization techniques while transcending limitations imposed by time and space to create truly immersive experiences.

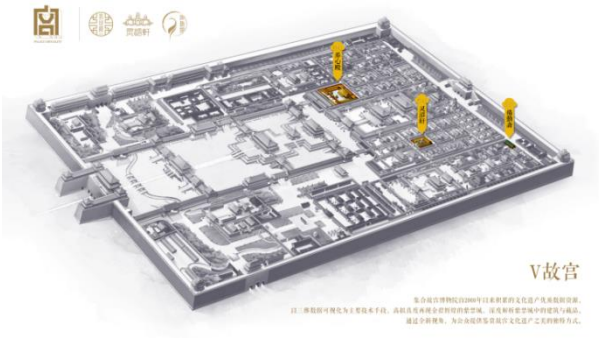

Figure 1 The interface of the V Forbidden City
Source: V Forbidden City

Figure 2 Viewing the details of cultural relics mobile phones
Source: V Forbidden City

3.2 Design based on emotional experience

Experiers of cultural tourism place greater emphasis on immersive experiences and seek emotional engagement from their travels. As early as 1996, Otto and Ritchie proposed that the experiential attributes of tourist destinations can effectively evoke emotional responses. Sharma and Nayak (2019 : 504-518.) confirmed in their research that tourists' emotional experiences can influence their behavioral intentions. Ratnasari, Gunawan, Mawardi, & Kirana, (2021 : 864-881) argue that tourists' emotional encounters at cultural attractions significantly impact their satisfaction levels and serve as a decisive factor for their future travel intentions. The MR Experience product, launched by Sanqing Mountain, a renowned 5A tourist scenic spot in China, offers "One thousand years, Sanqing beautiful AR wonderful tour." This innovative experience begins with the Oriental goddess and Giant Python emerging from the mountain peaks – two of the most enigmatic summits within Sanqing Mountains. These peaks are steeped in captivating myths and legends that effortlessly resonate with visitors' emotions. Equipped with AR glasses, visitors embark on a journey through time and space via a tunnel where they encounter Yao Ji, the Oriental goddess herself. This immersive experience transcends reality as guests bear witness to the mythical stories surrounding both peaks – experiencing firsthand the protagonist's emotional transformations while immersing themselves in rich cultural scenes designed to intensify their emotive encounters. By stimulating tourists' emotional experiences through this unique offering, we aim to leave them with indelible impressions while better promoting our scenic spots' cultural heritage.

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Figure 3 Tourists experience sanqingshan Cultural tourism project
Source: China Daily.com.cn

3.3 Design based on learning experience

In the research on tourism motivation of cultural tourists, quite a number of consumers have learning motivation. Tourists with learning purposes can visit tourist attractions with cultural connotations, experience and learn relevant historical and cultural knowledge, enjoy the enjoyment and inspiration brought by heterogeneous cultures, encourage innovative thinking, and even influence the development of attitudes and values. Therefore, learning (education) experience is also an important part of cultural tourism. For example, virtual annotations are added to augmented reality mobile applications to expand tourists' understanding of real-world objects in scenic spots, enhance users' surrounding environment and reality perception, and provide users with new knowledge acquisition. Meta-cosmic cultural tourism can superimpose 2D and 3D images, ICONS, texts or videos into the virtual view of tourists through technical means, encourage tourists to constantly explore hidden stories and discover new knowledge, and learn knowledge points in an intuitive and immediate way, which is particularly obvious in knowledge-based cultural tourism projects such as cultural museums and art galleries. The MR Experience System of Sanxingdui Museum and MR Experience System of China Imperial Examination Museum shown in the figure are relatively mature virtual experience cultural travel products with the main purpose of knowledge dissemination. Various forms of ICTs can be used to enhance the learning experience in these key areas of cultural heritage tourism; In this process, tourists accumulate cultural knowledge through the information education obtained in the virtual experience, and then they can choose to combine the observation of real objects and scenes in the field tour to achieve the purpose of deepening understanding and enriching cognitive structure. Therefore, in the design of related products, the establishment of learning experience is of great significance.

Figure 4 Tourists wear MR glasses to watch Sanxingdui
Source: Author (2023)

Figure 5 Children wearing MR glasses in the Imperial Examination Museum
Source: Author (2023)

3.4 Design based on interactive experience

Interactive experience is an important factor affecting tourists' travel experience. The reason may be that the various interactive features of the destination help visitors to become more involved in the tourism activities, allowing them to learn about all events and activities, build social Spaces in the digital environment, and share their memorable and unique travel experiences with others. These technology-based travel experiences can increase satisfaction with travel and enhance the willingness to visit a destination again. The most common form of interactive experience design in MR Cultural tourism experience products is to use the superposition of augmented reality and the real world to interact. The recent cultural tourism augmented reality products allow multiple users to observe and collaborate with the same superposition objects as the group, so that the experiencer can not only see other experiencers, but also see other experiencers. You can also see their actions and effects in the virtual elements. This approach allows for group interaction around tangible points of cultural interest at different scales, such as historical sites, buildings, and statues and paintings (Jacob & Nobrega, 2021 : 27-47). The "Imperial Examination Museum MR Experience System" in Nanjing, China, adopts this interactive experience mode. Visitors can easily have interactive experience through a mobile intelligent terminal and MR Glasses, select the information points they are interested in to consult, identify or scan the cultural relic QR code activated game (Xia Cuijuan, Tie Zhong, Huang Wei. 2023), these games are simple, fun and easy to operate, and are especially popular with children. By completing all the missions and games, visitors can complete the tour without even knowing it.

Figure 6 The MR experience of intelligent terminal devices
Source: Author (2023)

Figure 7 The MR experience point
Source: Author (2023)

Research Conceptual framework

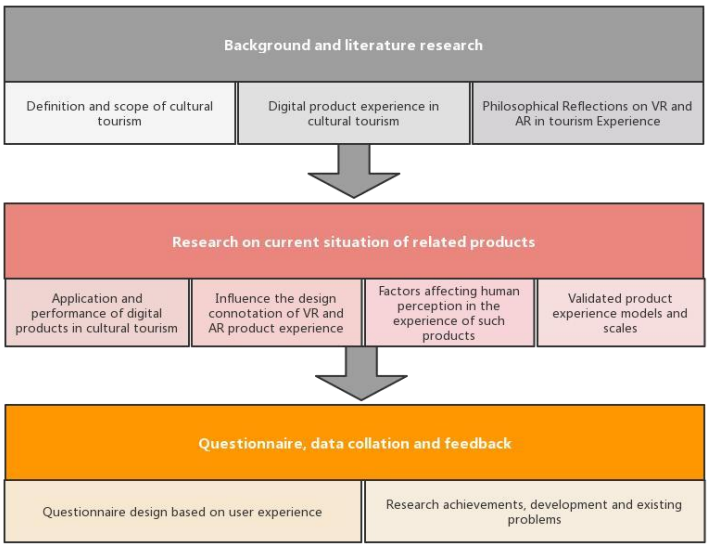

Figure 8 conceptual framework of research
Source: Author (2023)

Research Scope

In this study, the researchers have identified the following scopes:

1. Overall Scope

The research targets encompass users of MR experiences in cultural tourism, designers involved in related product development, as well as design experts within relevant fields. To obtain an appropriate estimation for the entire population.

2. Sample Scope

Sample scope consisting of an evaluation survey on MR products associated with Yangzhou's ancient canal will be employed. The targeted investigation data goals include“ immersive experience, learning experience, emotional experience, and interactive experience”. Extensive surveys will be conducted using methods such as on-site investigations and questionnaires among diverse groups. Based on survey results pertaining to immersive experience, emotional experience, and learning experience; relevant factors influencing tourist experiences and behavioral intentions towards MR usage will be determined along with their respective degrees of influence. Furthermore, a corresponding product experiential model will be established.

Research Methodology

This research adopts a mixed research method of qualitative and quantitative approaches, which consists of two main parts. Firstly, six industry experts were invited to provide comprehensive evaluations on the research findings and design. Secondly, 203 tourism experiencers were invited to experience the designed products and complete a survey questionnaire. All participants provided informed consent, and their identities were kept confidential.

1. Data collection and experimental design

Step1: Conducting a comprehensive literature review on the development of cultural tourism products in the digital era, as well as an exploration of cultural tourism resources along the Canal in Yang Zhou， China.

Step2: Undertaking field investigations and expert interviews to delve into the historical background, various types, and current status of relevant products; additionally, extracting specific experiential dimensions from selected products.

Step3: The product design is implemented and the design evaluation is conducted, based on the four key dimensions of immersion, emotion, learning, and interaction.

Step 4: Implementing product design based on four key dimensions - immersive experience, emotional engagement, educational value, and interactive elements.

Step 5: Conducted a questionnaire survey on MR product experience, and collected and sorted out the questionnaire results.

2. Data Analysis

In terms of data analysis, descriptive statistics were employed, including frequency, percentage, mean, standard deviation, skewness and kurtosis. The expected outcome of the study's model is to yield a satisfactory goodness-of-fit index (Tabachnick & Fidell, 2013 : 497-516). However, in cases where the model is deemed inappropriate, adjustments can be made based on modification indices (Knekta, Runyon & Eddy, 2019). To achieve the main

objectives, results are reported in both descriptive and tabular forms. All details will be described in the following section.

Hypothesis

In this section, we present our proposed hypotheses based on our research framework. Drawing upon extensive literature research, it is hypothesized that immersion experience, emotional experience, learning experience, and interaction experience serve as crucial variables influencing mixed reality (MR) encounters within the realm of tourism. These hypotheses specifically examine the favorable association between MR-based tourist experiences with these aforementioned key factors:

Hypothesis 1 (H1): There exists a positive correlation between the level of experiential engagement and the degree of immersion experienced in cultural tourism products.

Hypothesis 2 (H2): A positive relationship is observed between the level of experiential engagement and the extent of emotional experience derived from cultural tourism products.

Hypothesis 3 (H3): The level of experiential engagement positively influences perceived learning experiences associated with cultural tourism products.

Hypothesis 4（H4）: A positive correlation is found between the level of experiential engagement and the degree of interactive experiences offered by cultural tourism products.

Research Result

1.Design evaluation

The MR product " Mixed Reality for Ancient Canal Culture Tourism in Yangzhou, China" aims to validate the preliminary research findings. This product primarily takes the form of mixed reality digital products, with a specific focus on the oldest segment of the Yangzhou section of the Grand Canal. It encompasses a mixed reality experience system that showcases both the natural beauty along the canal and its rich historical cultural content, serving as a digital guide for immersing oneself in canal culture tourism spots and exploring their historical significance. The primary objective of this product is to promote and facilitate cultural history in southern regions along the canal, stimulate development within related cultural tourism industries, and provide a digitized development strategy for sustainable utilization of cultural tourism resources.

Before conducting the formal product experience, researchers invited industry experts to conduct preliminary evaluations of the design outcomes. This involved a comprehensive assessment by three specialists in mixed reality product design and three experts in cultural tourism research. The experts provided positive evaluations for the product, with a maximum rating of 5 points, and an average score exceeding 4.00 points.The survey results presented in Table 1 demonstrate that the quality and experience of the design are highly regarded by industry experts.

Table 2 Design results and expert evaluation

NO .	Design	Mean	SD	Satisfaction
1	Product interface	4.33	0.56	High
2	content experience	5	1	Highest
3	interactive style	4.23	0.64	High
4	freedom of use	4.6	0.47	High
5	cultural communication	4.13	0.5	High
6	extended experience	4.6	0.71	High

2.Demographic information

According to the demographic analysis of survey data, researchers have examined the characteristics of the tourist group. The primary profile of the target tourists is as follows: there is a slightly higher proportion of female participants compared to males; overall, the age distribution tends to be younger among the target population, with a relatively smaller percentage of individuals aged over 45 years old; in terms of educational attainment, excluding preschool children, most respondents have completed college or undergraduate degrees; regarding occupation distribution, students and employees from government agencies and enterprises are predominant. With respect to motivations for tourism and product experiences, due to comprehensive data collection methods employed in this survey questionnaire, no significant deviations were observed in gender distribution, age distribution, and occupation distribution among respondents. These factors do not impact the findings obtained from this survey.

Table 3 Distribution of sample demographic variables (N=203)

Demographic variable	Category	quantity	Frequency
Sex	Male	85	42%
	Female	118	58%
Age	18 and below	30	15%
	19-29	98	48%
	30-45	60	30%
	Over 45years old	15	7%
Educational background	preschool	6	3%
	primary school student	24	12%
	Junior high school or high school	8	4%
	Colleges and vocational schools	133	66%
	Bachelor degree and above	32	15%
Profession	preschool children	6	3%
	student	69	34%
	education practitioner	24	12%

Agencies/Enterprises and Institutions	76	37%
Retirees	8	4%
other	20	10%

3.Data Analysis

The mean values, standard deviations, and explanations of the relevant variables are presented in Table 4. As depicted in Table 1, this study reveals that four proposed variables - "immersion, emotion, learning, and interaction" —— significantly impact the tourist experience in cultural tourism mixed reality products. Among these experiential factors influencing outcomes, immersion experience exhibits the highest coefficient of influence on tourist experience, followed by learning experience. The remaining values also demonstrate a positive relationship between these variables and the enhancement of tourist experiences.

Table 4 The Result of Convergent Validity (confirmatory factor analysis) (n=203)

Dimension	**Factor**	**Coef.**	**Std. Error**	**α**	**p**	**Std. Estimate**
Immersive Experience	IE1	1	-	0.929	-	0.913
	IE2	1.115	0.046	0.929	0	0.949
	IE3	1.002	0.078	0.932	0	0.711
	IE4	1.009	0.052	0.929	0	0.875
	IE5	1.009	0.063	0.93	0	0.806
Emotional Experience	EE1	1	-	0.934	-	0.54
	EE2	0.99	0.37	0.963	0.008	0.197
	EE3	1.807	0.209	0.929	0	0.927
	EE4	1.96	0.224	0.928	0	0.963
	EE5	2.115	0.267	0.93	0	0.776
Learning Experience	LE1	1	-	0.929	-	0.942
	LE2	0.986	0.046	0.93	0	0.883
	LE3	1.018	0.042	0.929	0	0.916
	LE4	1.014	0.041	0.929	0	0.923
Interactive Experience	LTE1	1	-	0.929	-	0.868
	LTE2	1.046	0.057	0.928	0	0.896
	LTE3	1.138	0.052	0.927	0	0.964
	LTE4	1.128	0.052	0.928	0	0.96

Table 5 Model AVE and CR indicator results

Factor	Calculating the Average Variance Extraction (AVE) value	Combination confidence CR value
H1	0.731	0.931
H2	0.544	0.835
H3	0.839	0.954
H4	0.852	0.958

The immersive experience variables IE1-5 correspond to hypothesis 1（H1）, the emotional experience variables EE1-5 correspond to hypothesis 2（H2), the learning experience variables LE1-4 correspond to hypothesis 3(H3), and the interactive experience variables LTE1-4 correspond to hypothesis 4(H4).

According to the test results in Table 4 and Table 5, each variable has a standardized factor loading range of 0.54 to 0.964, all exceeding 0.4; AVE values range from 0.544 to 0.852, all exceeding 0.5; CR values range from0 .835-0.958, all exceeding 0.7.All indicators meet the testing standards, indicating that the measurement scales used in this study have good structural validity and discriminant validity.Sample data reliability tests were conducted using SPSS26, with α coefficients for immersive experience, emotional experience, learning experience and interactive experience variables being greater than 0.7,indicating good reliability and validity of these scales ensuring the subsequent research meets the requirements of this study.

The results of hypothesis testing and their effects on variables are presented in Figure 8. H1: A positive correlation exists between the level of mixed reality product experience and immersion experience in cultural tourism. H2: A positive correlation exists between the level of mixed reality product experience and emotional experience in cultural tourism. H3: A positive correlation exists between the level of mixed reality product experience and learning experience in cultural tourism. H4: A positive correlation exists between the level of mixed reality product experience and interactive experience in cultural tourism. Furthermore, the results indicate a positive relationship between interactive experiences and both learning experiences and emotional experiences, suggesting that favorable interactive experiences (usability) can influence the establishment of learning experiences and emotional experiences. It should also be noted that the depth of emotional experiences may impact immersion experiences (utility), but this study does not determine whether it has a positive or negative effect, which warrants further investigation in future research.

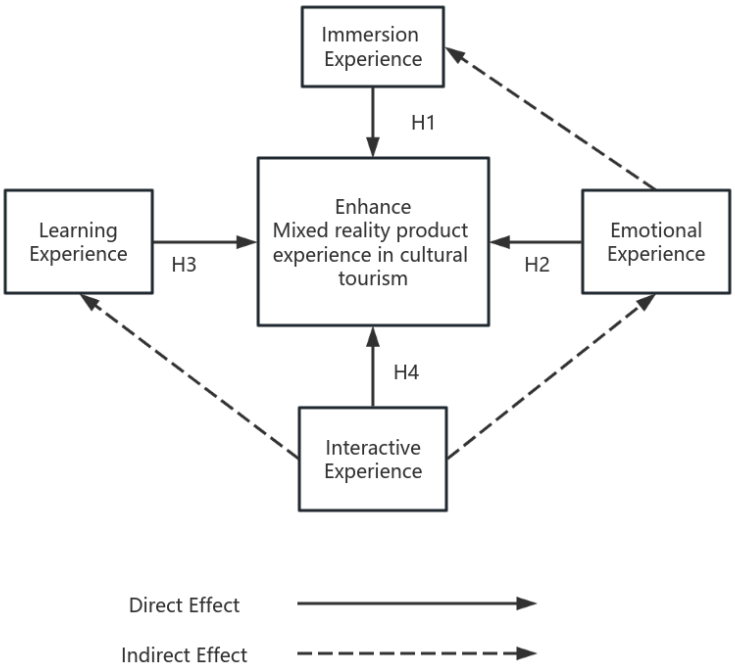

Figure 8 Modeling the dimensions of cultural tourism MR product experience
Source: Author (2024)

4. The design strategies are formulated based on empirical data

Through the analysis of research data, we have gained a comprehensive understanding of the experiential elements in MR cultural tourism products and derived design strategies for such products. These strategies not only offer theoretical guidance to designers but also provide practical suggestions for product development.

Firstly, to enhance immersion, designers should leverage the inherent features of MR technology by crafting cultural contexts, employing captivating visual effects and audio-visual techniques, as well as implementing natural interaction methods. These measures create an illusion of being present in a genuine cultural setting for visitors. Simultaneously, incorporating multi-sensory stimulation like lifelike sound effects and tactile feedback further heightens the sense of immersion, enabling visitors to fully engage themselves in the virtual world experience.

Furthermore, with regards to interactivity, designers should prioritize enhancing the opportunities and modalities for visitors to engage with the virtual environment. By incorporating intricate interactive elements and tasks, visitors are encouraged to actively participate in it. It is important to emphasize the technical indicators of perceived usefulness and perceived ease of use during interaction, in order to mitigate potential digital disparities arising from excessively complex interactive design.

In addition, it is imperative to consider the emotional response of users throughout the experiential process. Designers should possess a profound comprehension of the cultural background and emotional requirements of target tourists, aiming to evoke emotional

resonance and cognitive engagement by crafting scenes and narratives rich in cultural emotive elements. Simultaneously, employing appropriate techniques for emotional expression such as gentle tones and evocative music can foster a warm, delightful or awe-inspiring emotional ambiance, thereby enabling tourists to undergo a profound emotional experience during their journey.

Finally, enhancing the learning outcomes constitutes a crucial aspect of the design strategy. Designers can incorporate pertinent cultural knowledge and historical narratives into their products, thereby guiding tourists to acquire knowledge during the exploration process through engaging and stimulating pedagogical approaches. Simultaneously, incorporating challenging learning tasks or game sessions can foster tourists' interest and motivation in learning, ultimately augmenting their cultural proficiency and cognitive abilities within an entertaining context.

In the process of actual product development, designers can employ these strategies in conjunction with specific cultural tourism resources and technical means to create MR cultural tourism products that are more captivating, intriguing, and educational. This will contribute to enhancing tourist satisfaction and engagement while fostering the digital transformation and advancement of the cultural tourism industry.

Discussion

This study aims to investigate the dimensions of mixed reality product experience in cultural tourism. We utilized questionnaire surveys and expert interviews, and conducted thorough data analysis using structural equation modeling and SPSS software.

Firstly,our findings indicate that immersion, emotion, learning, and interaction are significant factors that positively impact the experience of MR cultural tourism products. These results align with previous research on virtual reality and augmented reality, demonstrating that mixed reality technology can create a highly immersive environment while stimulating emotional responses, promoting learning opportunities, and encouraging interaction among users. Together these elements constitute the core components of MR cultural tourism product experiences which provide strong theoretical support for designing more engaging digital products. Based on empirical data we have summarized design strategies for cultural tourism products; designers should focus on improving immersion and interaction while also considering users' emotional responses and learning effects throughout the experience process. These design strategies not only enhance product attractiveness but also promote deep user participation in cultural tourism.

Furthermore, we have developed the MR cultural tourism product experience evaluation model, which offers a quantitative foundation for future design decisions. This comprehensive model takes into account four key factors: immersion, emotion, learning, and interaction, enabling a thorough assessment of the experiential impact of MR cultural tourism products.In constructing the experience evaluation model proposed in this study, we have learned from classic models like TAM（Davis, F. D. 1989: 319-340）, HMSAM（Lowry, P. B., Gaskin, J., Twyman, N., Hammer, B., & Roberts, T. 2012: 617-671.）, and MTES（Kim, J. H., & Ritchie, J. B. 2014: 323-335）. Building upon these frameworks, we have innovatively refined and expanded them. Compared to earlier models, our focus is on the specific details of

product experience. This not only aligns with current technology and tourism trends but also delves deeper into the personalized needs of cultural tourism experiencers. We particularly emphasize key factors such as cultural context construction, emotional resonance stimulation, and learning satisfaction to provide comprehensive guidance for designing and optimizing cultural tourism products. Through this model, we can accurately evaluate the quality of cultural tourism experiences and drive continuous innovation in the industry.

Nevertheless, it is important to acknowledge certain limitations in this study. Primarily, the sample selection predominantly focuses on Chinese tourists and industry experts; thus there may be regional and cultural biases present. Future research should expand the sample range to investigate experiences with MR cultural tourism products across diverse regions and cultural backgrounds. Additionally, this study primarily concentrates on exploring the application effects of MR technology without delving into its development or enhancement aspects. As technology continues to advance rapidly, future research should further explore innovative applications and developmental trends of MR technology within the realm of cultural tourism.

Conclusion

This study focuses on the application of mixed reality technology in enhancing cultural tourism experiences and presents a series of significant findings. Firstly, we confirm that creating an immersive environment can greatly enhance tourists' emotional engagement, learning opportunities, and interactive experiences during cultural tourism visits. Additionally, we propose an evaluation model to comprehensively assess the experiential impact of mixed reality cultural tourism products, providing a quantitative basis for design decisions. While this study has yielded valuable results, further expansion of the sample range is necessary to comprehensively evaluate the application effects of mixed reality technology across diverse regions and cultural backgrounds. In summary, this study provides robust support for integrating mixed reality technology into the field of cultural tourism and offers important directions for future research and practical implementation. We anticipate that mixed reality technology will play an increasingly pivotal role in enriching cultural tourism experiences.

Recommendations

1. Theoretical Recommendation

The dimensions of cultural tourism MR product experience should encompass immersive, emotional, learning, and interactive experiences. These dimensions exert a significant influence on the overall product experience, thus necessitating consideration in enhancing these aspects during product design. Future research can explore the interplay between these experiential dimensions across diverse cultural backgrounds to better cater to the needs of various user groups.

2. Policy Recommendations

The government departments should formulate supportive policies to facilitate the high-quality development of cultural tourism MR products, thereby fostering the growth of the tourism industry and enhancing visitor experiences. Additionally, they ought to provide backing for relevant industry organizations in organizing training and exchange activities, with the aim of augmenting practitioners' comprehension and proficiency in designing immersive experiences for cultural tourism through MR products.

3. Practical Recommendations

When designing mixed reality products for cultural tourism, it is crucial to thoroughly consider immersive, emotional, learning, and interactive experiences in order to enhance the appeal and competitiveness of these products. By conducting user research and implementing feedback mechanisms, continuous improvement of the product experience can be achieved to meet user needs and enhance customer satisfaction. Strengthening collaboration with cultural institutions and tourist attractions while leveraging their resources and information can provide valuable support and guidance for the development of mixed reality products in cultural tourism.

4.Suggestions for future research

(1) Expand the scope of research and enhance cross-cultural comparisons: Through cross-cultural comparisons, a more comprehensive understanding of the experiential differences of MR cultural tourism products in diverse cultural contexts can be achieved.

(2) Deepen technological exploration and focus on innovation and application: Future research should closely monitor the latest trends in MR technology development and explore innovative applications within the field of cultural tourism.

(3) Strengthen empirical research to improve the universality and practicality of evaluation models: Continuous improvement and optimization of evaluation models through extensive empirical research is necessary to enhance their universal applicability. Additionally, considering other relevant factors such as user behavior and market environment could provide a more comprehensive assessment of the overall experiential impact of MR cultural tourism products.

These Recommendation aim to facilitate a better understanding and application of research findings on the experiences associated with cultural tourism mixed reality products, ultimately enhancing product quality and user experience.

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References

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*. 13 (3), 319-340.

Han, D. I. D., Weber, J., Bastiaansen, M., Mitas, O., & Lub, X. (2019). *Virtual and augmented reality technologies to enhance the visitor experience in cultural tourism. In J*. Weber & O. Mitas (Eds.), Augmented reality and virtual reality: The power of AR and VR for business (113-128). Springer.

Huang, Y. C., Backman, S. J., Backman, K. F., & Moore, D. (2013). Exploring user acceptance of 3D virtual worlds in travel and tourism marketing. *Tourism Management*. 36, 490-501.

Jacob, J., & Nóbrega, R. (2021). *Collaborative augmented reality for cultural heritage, tourist sites, and museums: Sharing visitors' experiences and interactions. In M. C. Neves & F. J. G. Silva (Eds.),* Augmented Reality in Tourism, Museums and Heritage: A New Technology to Inform and Entertain (27-47).

Knekta, E., Runyon, C., & Eddy, S. (2019). One size doesn't fit all: Using factor analysis to gather validity evidence when using surveys in your research. *CBE—Life Sciences Education.* 18 (1), ar1.

Lv, X., Li, H., & Xia, L. (2020). Effects of haptic cues on consumers' online hotel booking decisions: The mediating role of mental imagery. *Tourism Management*. 77, 104025.

Moyle, B. D., Moyle, C. L., Bec, A., & Scott, N. (2019). The next frontier in tourism emotion research. *Current Issues in Tourism*. 22 (12), 1393-1399.

Pine, B. J., & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard Business Review.* 76 (4), 97-105.

Ratnasari, R. T., Gunawan, S., Mawardi, I., & Kirana, K. C. (2021). Emotional experience on behavioral intention for halal tourism. *Journal of Islamic Marketing*. 12 (4), 864-881.

Sharma, P., & Nayak, J. K. (2019). Understanding memorable tourism experiences as the determinants of tourists' behaviour. *International Journal of Tourism Research*. 21 (4), 504-518.

Skavronskaya, L., Scott, N., Moyle, B., Le, D., Hadinejad, A., Zhang, R., & Shakeela, A. (2017). Cognitive psychology and tourism research: State of the art. *Tourism Review*. 72 (2), 221-237.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2013). *Using multivariate statistics*. Boston, MA: pearson.

Xie, Y. (2015). *Basic tourism science.* The Commercial Press.

Zhang, G. (2001). *Chinese cultural tourism: Theory, strategy and practice*. Nankai University Press.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly.* 13 (3), 319-340.

Kim, J. H., & Ritchie, J. B. (2014). Cross-cultural validation of a memorable tourism experience scale (MTES). *Journal of Travel Research*. 53 (3), 323-335.

Lowry, P. B., Gaskin, J., Twyman, N., Hammer, B., & Roberts, T. (2012). Taking 'fun and games' seriously: Proposing the hedonic-motivation system adoption model (HMSAM). *Journal of the association for information systems*. 14 (11), 617-671.