

A Systematic Review of the Application of Immersive Technologies in Cultural Tourism Marketing

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Abstract

In recent years, the application of immersive technology in cultural tourism marketing has gradually become the focus of attention in both academia and industry. The core of cultural tourism industry lies in attracting consumers through cultural experience and scenario-based services, while immersive technology creates a deep sense of participation for consumers through multi-sensory interaction and contextual simulation. Based on the technology-user-market framework, this paper systematically reviews the application mechanism and influence path of immersive technology in cultural tourism marketing. At the technical aspect, the technology iteration cycle accelerates to drive the optimization of technical features such as interactivity and sense of presence, but its effectiveness is significantly moderated by differences in application scenarios. At the user aspect, technology stimulates users' behavioral intentions through cognitive, emotional and social dimensions, while user features and contingencies influence long-term behavioral conversion by moderating psychological outcomes. At the market aspect, immersive technology reconstructs destination brand communication, market potential exploration, and sustainable tourism practices through virtual-real integration. The study proposes that future research should focus on enhancing cross-scenario technological adaptation, dynamic user behavior tracking, and comprehensive market value assessment to facilitate high-quality, synergistic development between immersive technologies and the cultural tourism industry.

Keywords

Immersive Technology, Cultural Tourism Marketing, Cultural Experience, VR/AR/MR, Scenario-Based Services

1. Introduction

With the rapid development of digital technology, immersive technology, with its multi-sensory interaction and scenario-based narrative capabilities, has gradually become the core driving force for innovation in the cultural tourism industry, promoting the industry from one-way information delivery to the experience of co-creation of the marketing model transition (Tussyadiah et al., 2018; An et al., 2021). As an emotion-driven consumption field, the demand for immersive experience is becoming more and more prominent, for example, virtual reality (VR) significantly improves the sense of presence and participation of tourists by constructing a scene that blends reality and fiction (Huang et al., 2023), augmented reality (AR) technology facilitates word-of-mouth about destinations by enhancing narrative transmission and emotional attachment (Zhu et al., 2024a). Despite the wide application of immersive technologies in cultural tourism scenarios, their influence mechanisms and paths explored in marketing theories have not yet been fully explored. Existing research has been conducted at two levels: first, the micro level of technology implementation and user experience, such as the effect of VR spatial context on temperature comfort (Huang et al., 2023), the role of AR message type on willingness to pay in museums (He et al., 2018) and others; the second is the macro impact of technology on marketing effectiveness, such as the role of immersive technology in promoting brand equity (Natarajan et al., 2024) and tourists' intention to visit on-site at cultural heritage sites. However, there are two significant shortcomings in current research: first, practical exploration precedes theoretical construction, and although frameworks such as the technology acceptance model (TAM) and stimulus-organism-response (SOR) have been used to analyze user behaviors (Zhu et al., 2023b), they have failed to form a linkage with the market strategy, which has resulted in a lack of clarity on the synergistic mechanism of "technology-user-market". Secondly, the existing research shows obvious fragmentation characteristics and lacks systematic integration of the path of technological empowerment, which is mainly manifested in the fact that the research on different technological forms, theoretical perspectives and application scenarios are fragmented from each other, which makes it difficult for academics to establish a unified analytical framework for technological empowerment, especially the lack of a complete path of "technological characteristics - psychological mechanisms - behavioral impacts". This fragmentation makes it difficult for academics to establish a unified analytical framework for technological empowerment, especially the lack of systematic integration of the complete path of "technological characteristics - psychological mechanism - behavioral impact". Against this background, this paper aims to systematically sort out the status quo of immersive technology application in cultural tourism marketing, and construct a "technology-user-market" framework, so as to reveal the functioning mechanism and potential challenges of technological empowerment, and to provide a strategic basis for the digital upgrading of cultural tourism industry.

The theoretical significance of this paper is to construct a "technology-user-

market” framework, systematically sort out the multilevel path of immersive technology in cultural tourism marketing, and reveal the dynamic influence of variable factors on the boundary of technological efficacy, so as to make up for the deficiencies of the existing research in interdisciplinary integration and dynamic perspective. In reality, the cultural tourism industry is facing the dual challenges of homogenization competition and experience economy transformation, this study summarizes the actual cases and research results of technology application, reveals the shortcomings of the current research, and proposes the direction of the future research, with a view to providing theoretical basis for the optimization of the marketing strategy of the cultural tourism enterprises, and at the same time, promoting the cross-innovation between immersive technology and marketing disciplines.

Existing literature on the exploration of immersive technologies in the field of cultural tourism mostly focuses on a single dimension. The technology dimension focuses on the direct impact of functional attributes on experience quality (Wei et al., 2019); the user dimension focuses on the perceived value driving behavioral intention (Li & Chen, 2019; Zhu et al., 2024c); and the market dimension centers on the analysis of barriers to technology diffusion and user acceptance (Cham et al., 2024; Li et al., 2022). However, the success of a cultural tourism project requires the synergy of technology function, user psychology and market environment: technology features need to be transformed into user-perceived values (e.g., authenticity driven by a sense of presence), user behaviors need to be embedded in the market communication chain (e.g., brand loyalty driven by social sharing), and market challenges (e.g., ethical risks, generational gap) directly affect the sustainability of technology application. Based on this, this paper constructs a technology-user-market framework to systematically answer the following questions:

RQ1: What are the specific connotations and characteristics of each dimension under the technology-user-market framework?

RQ2: What are the relationships, influencing mechanisms and pathways between the technology-user-market triad?

RQ3: What are the weighting elements of the interrelationships among technology-user-market?

This study not only provides an integrated analytical framework for immersive cultural tourism marketing research, but also provides empirical evidence for the optimization of user experience and the formulation of marketing strategies for enterprises from the practical level through the systematic sorting of 115 literatures, which jointly promotes the development of academic research and industry practice.

2. Immersive Technology and Cultural Tourism Marketing

2.1. Immersive Technology

Immersive technology is a technology that creates a sense of immersion for users by blurring the boundaries between the real physical world and the virtual world (Pratisto et al., 2022). Its core feature is the integration of physical and virtual

environments through digital technological means (e.g., virtual reality, augmented reality, mixed reality, etc.), providing a multi-sensory experience that deeply integrates users into virtual or virtual-reality fusion scenarios at the cognitive, emotional, and social levels (Liu & Sutunyarak, 2024). Immersive technologies are realized in a variety of forms, and their scope has expanded from the basic forms of virtual reality (VR), augmented reality (AR), and mixed reality (MR) to emerging technologies such as meta-universes, digital twins, and blockchain.

Virtual Reality (VR) completely isolates the physical environment through head-mounted devices and somatosensory feedback systems, constructing a closed digital space for users to immerse themselves in a virtual scene at the visual, auditory, and even tactile levels (Griffin et al., 2023). Augmented Reality (AR), on the other hand, superimposes digital information onto a real scene through devices such as smartphones, tablets, head-mounted displays, and smart eyes to realize dynamic interaction (Tsang et al., 2023). And Mixed Reality (MR) further integrates the features of both to support real-time anchoring and interaction between virtual objects and real environments. In recent years, metaverse, as a comprehensive carrier of immersive technologies, has been used to construct a virtual social space that is both interrelated and distinct from the real world by integrating a variety of technologies (Suanpang et al., 2022). For example, in the tourism industry, metaverse can be used to create a virtual tourism experience in which tourists visit museums and tourist attractions, etc., which reduces the cost of tourism and at the same time changes the consumption behavior of tourists and the way of tourism experience.

From the perspective of user experience, the core value of immersive technology lies in its multi-sensory stimulation (e.g., visual, auditory, tactile) and interactive design (e.g., gesture control, environmental feedback), which prompts users to generate in-depth participation in cognitive, emotional and social dimensions (Liu & Sutunyarak, 2024). For example, VR stimulates users' emotional resonance through panoramic scene restoration, AR enhances users' cognition of cultural symbols through information superimposition, and MR facilitates collaboration and social communication among users through the integration of reality and reality. Such technical characteristics are highly compatible with the needs of cultural tourism marketing, and the attractiveness of cultural tourism scenes relies on the visualization of cultural connotations and the active participation of users, which can only be realized with the help of immersive technologies.

2.2. Cultural Tourism Marketing

Cultural tourism marketing is a marketing method that takes cultural concept as the core, stimulates consumers' deep participation and cultural consumption activities through scenario-based experience design and emotional value transmission, and realizes synergistic transformation of cultural protection and commercial value. Based on the theory of experience economy, the core of cultural tourism

marketing lies in upgrading cultural consumption from single-function service to multi-dimensional experience supply, and shifting from purely providing products or services to creating a unique experience for tourists, which will leave them with deep memories and good feelings (Lee et al., 2020).

Under the background of the digitalization wave and the deep integration of intelligent technology, the scenario of cultural tourism marketing is experiencing a leap from physical space to virtual and real symbiotic space. The connotation of cultural tourism marketing is also being further deepened, showing a paradigm shift from static display to dynamic interaction, and from one-way communication to co-creation and participation. For example, museums, through technology-enabled narrative reconstruction, transform cultural symbols into perceptible and dialogic experience carriers, and tourists are no longer just bystanders, but form emotional resonance with history and art through immersive scenarios (Nechita & Rezeanu, 2019); at the same time, the value chain of cultural and tourism marketing has also been extended to the online and offline coverage of the whole area through the virtual-real fusion of the consumption scenario, which both enhances the breadth of cultural communication and strengthens the sustainability of commercial transformation (Vishwakarma et al., 2020).

2.3. The Application of Immersive Technologies in Cultural Tourism Marketing

The application of immersive technology in cultural tourism marketing focuses on reconstructing cultural resources through the integration of virtual reality and transforming static cultural resources into dynamic participatory experiences. In the field of cultural heritage revitalization, virtual reality (VR) technology is used to break through physical limitations, such as the “Digital Dunhuang” project launched by the Dunhuang Research Institute, where tourists can wear VR equipment to enter the unopened caves of the Mogao Grottoes, observe the details of the mural paintings at close range and participate in the virtual restoration process, thus integrating cultural relics protection and educational experience in depth. In the live tour scene, augmented reality (AR) technology through real-time image recognition and dynamic superposition, giving static landscape interactivity, such as Longmen Grottoes scenic area development of the AR guide system, tourists scanning the statue of Buddha can trigger the holographic projection of historical figures, to the first-person perspective, “dialog!” of the ancients, upgrading the one-way narration to an immersive narrative (Deng et al., 2024). In the field of cultural IP derivation, blockchain technology is used for the secure storage and verification of meta-universe data to ensure the authenticity of cultural IPs and the trustworthiness of user interactions in virtual environments. For example, user behavior data is recorded in virtual communities to support personalized recommendation and precision marketing, while enhancing user trust in virtual experiences (Corne et al., 2023).

The application framework of immersive technology in cultural tourism mar-

keting is constructed with the synergistic logic of “technology empowerment - user perception - market transformation” as the core, forming a dynamic closed-loop system. At the technical level, the presentation and interaction of cultural resources are reconstructed through the synergy of virtual reality (VR), augmented reality (AR), digital twin and blockchain technologies. The user level relies on technology-enabled scenario design to activate multi-dimensional experiences in cognitive, emotional and social dimensions. At the market level, value transformation is accomplished through the three-phase path of “social communication - brand building - market potential”. In addition, the release of technological efficiency needs to be adapted to cultural differences and scenario needs, for example, high power distance cultures rely more on the social communication attributes of AR (Jung et al., 2018).

3. Literature Review Methods

3.1. Database Search

This study utilized the Web of Science Core Collection as the main data source to search for literature related to immersive technology and the cultural tourism industry through the subject field, and the keywords are shown in **Table 1**. The time span is set from January 2014 to February 2025 to cover key phases in the development of technology and industry practices. The final screening obtained 115 valid documents involving 2733 citations, providing a solid base for the subsequent analysis.

Table 1. Literature search conditions.

Essentials	Details
Data sources	Web of Science Core Collection
Search subjects	Retrieve keywords (intra-group relationship “or”, inter-group relationship “and”) using topic as the field identifier. “Immersive technology” or “Virtual technology” or and “Cultural tourism industry” or “Culture” or “Metaverse” or “VR” or “AR” or “MR” “Cultural tourism” or “Museum” or “library” or “gallery” or “archive”
Time span	January 2014-February 2025
Selection criteria	(1) At the subject level, the search was confined to studies on the application of immersive technologies in cultural tourism, excluding researches on technological development unrelated to tourism contexts. (2) In terms of methodological quality, priority was given to peer-reviewed empirical studies, while excluding literature with unclear research design, insufficient data support, or poorly reasoned conclusions.
Search results	115 valid documents, 2733 citations

3.2. Establish Screening Criteria

Inclusion criteria. The literature screening criteria were established following the principles of systematicity, rigor, and contextual relevance to ensure that the literature included is highly relevant to the topic and methodological reliability. The

inclusion criteria were developed across three dimensions: thematic relevance, methodological quality, and timeliness. First, studies must focus on the application of immersive technologies (e.g., virtual reality, augmented reality, mixed reality, and metaverse) in cultural tourism contexts, with content covering at least one core dimension: technical feature analysis, user experience measurement, or market impact assessment. Second, methodologically, priority was given to peer-reviewed empirical studies featuring clear research design, reliable data support, and logically sound conclusions. Finally, the temporal scope was limited to January 2014 to February 2025, with full-text availability required for in-depth analysis, ensuring coverage of immersive technology's full developmental cycle from initial exploration to mature application.

Exclusion criteria. The exclusion criteria target deviations, methodological flaws, and non-academic content. First, studies on non-cultural-tourism applications (e.g., immersive technology in healthcare or education) or purely technical developments (e.g., hardware engineering or algorithm optimization, without involving cultural tourism application) were excluded. Second, commentaries, editorials, technical specifications without data support, as well as analyses with insufficient sample sizes or uncontrolled confounders, were removed. Non-academic materials (e.g., book chapters, conference abstracts, patents, policy reports) and literature with inaccessible full texts or data quality issues were also excluded.

3.3. Search and Screening Process

The literature screening in this study strictly adhered to the principles of systematicity, transparency, and reproducibility to ensure the scientific validity and reliability of the conclusions. The screening process consisted of the following three stages:

Initial screening. A preliminary database search yielded 2273 records. After deduplication in EndNote, 872 articles remained. And excluded obviously irrelevant studies based on title and abstract screening, leaving 198 articles for full-text assessment.

Full-text screening. The 198 articles were thoroughly reviewed, and further selection was conducted based on the inclusion and exclusion criteria, 115 high-quality articles were finally retained. The primary reasons for exclusion were: studies deviating from cultural tourism marketing (32 articles), unclear methodology (28 articles), and insufficient data quality (23 articles).

Data extraction and classification. After analyzing the final 115 articles, core information extracted, including technology type (e.g., VR/AR/MR), application context (e.g., cultural heritage, virtual tourism), user behavior variables (e.g., cognitive, affective, social dimensions), and market impact (e.g., social dissemination, brand building). These were categorized and synthesized within a "Technology-User-Market" framework to facilitate subsequent cross-dimensional correlation analysis.

Through above methodology, this study ensures comprehensive literature cov-

erage and a logically structured analytical framework, providing a reliable foundation for uncovering the multi-level impact pathways of immersive technology in cultural tourism marketing.

4. Analysis of Cultural Tourism Marketing in a Technology-User-Market Framework

The digital transformation of the cultural tourism industry has given rise to the widespread application of immersive technologies, but existing studies mostly focus on a single dimension, either emphasizing the direct impact of technical features on experience, exploring the drive of user psychology on behavior, or analyzing barriers to technology acceptance in marketing. This fragmented perspective makes it difficult to explain the dynamic synergy among technology, users and market. To this end, this paper proposes a technology-user-market framework (see **Figure 1**), which starts with technology types and core features, drives behavioral transformation through multi-dimensional user experience, and ultimately creates social communication effects and sustainable brand value at the market level. The framework aims to reveal the chain role and dynamic balance among the three, forming a closed-loop driven ecology of cultural tourism value innovation.

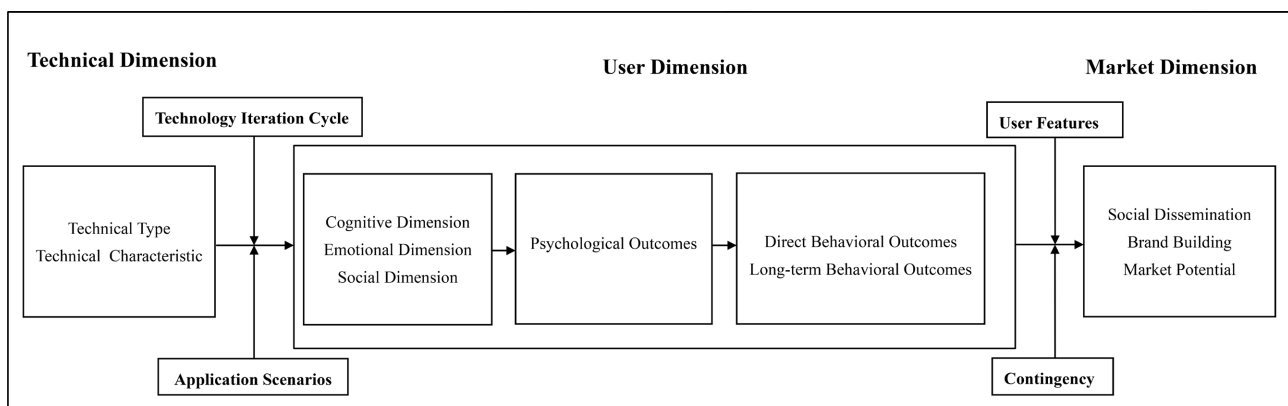


Figure 1. Conceptual framework.

4.1. Technical Dimension

The rapid iteration of technologies such as Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and Metaverse, is reshaping the interaction mode between tourists and tourism scenes, but their impact is not one-dimensional. In order to systematically analyze the path of technology's effect on tourism, research needs to start from a multidimensional perspective. Based on the existing literature, the direction of the impact of technology can be categorized into four categories: positive impact, negative impact, double-edged sword impact and uncertainty.

For example, VR significantly enhances tourists' sense of presence and emotional arousal through high immersion characteristics, and its positive effects are

reflected in the enhancement of satisfaction, revisit and recommendation intention in theme parks and cultural heritage sites (Wei et al., 2019). However, the technology may also be counterproductive due to insufficient scenario adaptation or differences in user characteristics: when tourists' expected enjoyment of a destination is low, highly immersive VR may inhibit actual visit behavior through the perceived similarity between virtual and real experiences (Li & Chen, 2019). Meanwhile, existing research indicates that while highly immersive VR technology can enhance users' sense of presence and engagement, it may also trigger health issues such as motion sickness and eye strain. These effects can diminish visitors' physical and mental experiences, potentially reducing their acceptance of virtual tourism environments and willingness to continue using them (Yoon & Nam, 2024). Such "double-edged sword" phenomena suggest that the effectiveness of the technology is highly dependent on the dynamic matching of user psychology and scene characteristics.

AR technology, however, focuses more on enhancing tourists' interactions with physical scenes, such as in museums, where dynamic verbal cues combined with a high sense of virtual presence significantly enhance tourists' willingness to pay (He et al., 2018). However, the effectiveness of its application is limited by differences in the cost of equipment and users' technological acceptance, and especially in the humanized digital experience in the context of virtual tourism, ethical and compliance issues are increasingly coming to the fore. Immersive devices often involve real-time collection and analysis of eye-tracking, facial expressions, and location data. Without effective oversight and safeguards, this may lead to risks of data privacy breaches and misuse for tourists (Huang & Liu, 2021). Empirical research further indicates that in gamified smart tourism, user concerns about privacy risks related to information collection significantly inhibit willingness to use AR virtual tours (Yoo et al., 2017). This suggests that future AR applications advancing technological implementation must balance transparent governance with minimized data collection to mitigate privacy resistance and enhance user adoption willingness. At the same time, metaverse, as an emerging technological paradigm, provides an innovative path for sustainable tourism and cultural heritage preservation through virtualized bodies, digital twins and cross-platform interactions, but its technological maturity and user acceptance still face challenges: on the one hand, its immersive experience relies on high-precision devices and network infrastructure, and its technological accessibility is insufficient in developing countries or remote areas; on the other hand, users' trust in the virtual social mechanisms have not been perfected, for example, among the elderly, technology anxiety and operational complexity may weaken their willingness to participate (Hao et al., 2025).

In order to present the complexity of technology impact more clearly, this paper synthesizes the core findings of 115 papers and constructs a categorization table of the direction of technology impact (see **Table 2**). This categorization suggests that the successful landing of technology needs to take into account technology

maturity, scene suitability, and user psychological characteristics.

Table 2. Classification of technology impact directions.

Direction of Technology Impact	Technical Type	Application Scenarios	Main Findings
Positive impact (89 articles)	VR, AR, MR, Metaverse	Museums, Cultural Heritage Destinations, Virtual Tours	Technology significantly improves visitor experience, satisfaction, intent to visit, brand value and more.
Negative impact (6 articles)	VR, AR, Avatar	Cultural heritage destinations, virtual tours	Technology may raise health concerns, ethical issues, reduce actual willingness to visit, or have negative effects such as device mismatch.
Double-edged sword impact (10 articles)	VR, AR	Museums, cultural heritage destinations, virtual tours	Technical effects depend on user expectations, cultural context or scenario design, with multiple factors leading to simultaneous positive and negative effects.
Uncertainty (10 articles)	VR, Metaverse, Blockchain	Tourist destinations, virtual tours	The results of the study need to be validated over time, or the relationship of the variables is complex and the direction of the impact of the technology is not clear.

Next, the connotations of types of technologies and characteristics of technologies and their implications will be further elaborated.

4.1.1. Types of Technology

The differentiated application of immersive technology in cultural tourism marketing stems from the multiplicity of its technological forms and interaction logic. Virtual reality, augmented reality, mixed reality and meta-universe, as the core types, have become the antecedent variables driving tourists' behavioral transformations through unique perception reconstruction mechanisms and scene adaptation paths, respectively. The rapid development of immersive technology has given rise to diversified technological forms, while these technologies create differentiated immersive experiences for tourists through different interaction methods and presentation forms, becoming an important driving force for cultural tourism marketing innovation.

Virtual reality (VR) constructs a completely virtual digital environment through head-mounted devices (HMD) or holographic projection, allowing users to break away from physical space constraints and realize a highly immersive sensory experience. In the cultural tourism scenario, VR technology is widely used in areas such as destination virtual preview, cultural heritage restoration and theme park entertainment. For example, by comparing the effects of traditional media and VR in cruise tourism marketing, some scholars have found that VR can more significantly enhance tourists' behavioral intentions (e.g., willingness to visit and recommend) due to its high sense of presence and emotional arousal (Yung et al., 2021). In addition, VR has also been used to stimulate demand for slow tourism, e.g., by triggering nostalgia, VR significantly increased tourists' willingness to explore historical and cultural destinations such as Jinan (Lin et al., 2020). However,

there are also potential risks associated with VR technology, e.g., over-immersion may lead to tourists' alternative satisfaction to real travel (Deng et al., 2019).

Augmented reality (AR) superimposes virtual information onto the real scene through mobile devices or smart glasses, realizing an interactive experience that integrates reality and virtual reality. AR technology has been prominent in museum guided tours, heritage site interpretation and outdoor tourism. Some studies have found that AR's dynamic language cues and high virtual presence design can significantly enhance tourists' willingness to pay, and its effect is realized through the mediating role of mental imagery (He et al., 2018). In cultural heritage scenarios, AR's entertaining and empathic pathways have been shown to be key to engaging younger audiences, such as the Muresanu Family Museum in Romania, where visitors' understanding of the social context of the exhibits was strengthened through an AR multisensory experience (Nechita & Rezeanu, 2019). Notably, ethical compliance issues (e.g., data privacy) of AR also need to be emphasized in applications (Huang & Liu, 2021).

Mixed reality (MR) combines VR and AR technologies to allow users to simultaneously interact with virtual and real objects in real time, and is suitable for immersive narratives in complex scenarios. It has been found that in Italian cultural heritage museums, functional elements of MR devices (e.g., haptic feedback and spatial mapping) can enhance the perceived heritage value of traditional exhibitions and drive post-experience behaviors (e.g., word-of-mouth) among visitors (Trunfio et al., 2022).

Metaverse, as a multidimensional virtual space integrating VR, AR, blockchain and other technologies to support collaborative multi-user interaction and asset digitization, is reshaping the boundaries of cultural and tourism marketing. Research suggests that the Metaverse can enhance tourists' emotional connection to green destination brands through features such as anthropomorphism, self-representation, and intimacy. However, the long-term sustainability and cultural adaptability of the metaverse are still urgent issues to be addressed (Dayoub et al., 2024).

To summarize, various immersive technologies have empowered cultural tourism marketing through differentiated paths: VR builds alternative experiences, AR strengthens realistic interactions, MR integrates virtual and real narratives, and meta-universe creates a multi-dimensional social space. The choice of technology needs to be combined with the characteristics of the target scene and user needs to achieve a balance between experience optimization and commercial value.

4.1.2. Characteristics of Technology

The core features of immersive technology are embodied in six dimensions: interactivity, vividness, functionality, effectiveness, authenticity and media, which together constitute the infrastructure at the technical level, and through the synergistic effect of the technology type and the scene, they directly affect the user experience and behavioral results in cultural tourism marketing.

Interactivity and vividness. Interactivity, which refers to the two-way dynamic

responsiveness between the user and the virtual/real environment, is a key feature that distinguishes immersive technologies from traditional media. For example, AR technology empowers users with real-time manipulation of virtual objects through environmental embedding and simulated physical control (e.g., gesture recognition), thus enhancing restorative experience and immersion (Huang, 2021). In meta-universes, social interaction features (e.g., avatar co-exploration) significantly increase engagement and satisfaction by enhancing the user's connection with the virtual environment (Zhu et al., 2023b). Vividness, on the other hand, emphasizes the extent to which the technology reproduces sensory stimuli. VR simulates real scenes through high-resolution images and stereo sound effects, which are far more effective in emotional arousal than static pictures or videos (Yung et al., 2021). Research has shown that dynamic verbal cues with multisensory overlays (e.g., haptic feedback in AR) can activate users' mental imagery and strengthen cognitive memory (He et al., 2018).

Functionality and effectiveness. Functionality is reflected in the ability of technology to adapt to user needs, including scene customization, information integration and multimodal interaction. For example, MR devices enable visitors to "touch" virtual artifacts through spatial mapping and haptic feedback, enhancing the perceived value of cultural heritage (Trunfio et al., 2022). Effectiveness focuses on the actual driving effect of technology on target behaviors, e.g., VR's sense of presence significantly enhances tourists' impulsive travel desires by shortening the psychological distance (Kang, 2020). Based on the Technology Acceptance Model (TAM), perceived usefulness and ease of use have been shown to be the core variables influencing users' willingness to sustain use (Huang, 2023).

Authenticity and communicability. Authenticity is the core ethical criterion for the application of technology in cultural tourism scenarios, and the objective and existential authenticity of AR can enhance tourists' recognition of heritage values through dynamic visualization of historical scenes (Zhu et al., 2024a). The communicability nature emphasizes the efficacy of technology in disseminating information, for example, the media richness of VR (including multi-sensory channels and real-time feedback) is significantly better than traditional media, which can enhance cognitive and emotional images at the same time (Ghorbanzadeh et al., 2024).

4.2. User Dimension

In the cultural tourism industry, the application of immersive technology has profoundly changed the user's behavior pattern and decision-making path. The formation and change of user behavior is subject to the synergistic effect of cognitive, emotional and social dimensions (see Figure 2). Specifically, in the cognitive dimension, the user's functional assessment of the technology, information quality, value judgment and barriers to adoption directly affect their acceptance of the technology and value perception; in the emotional dimension, through sensory stimulation, emotional perception and negative emotional feedback, the technol-

ogy experience triggers the user's emotional response, which in turn affects their psychological attitude; and in the social dimension, individual interaction and group communication through social identity and herd effect. In the social dimension, individual interaction and group communication strengthen the social driving force of user behavior through social recognition and herd effect. These dimensions are eventually transformed into direct behaviors through psychological outcomes and further developed into long-term behaviors.

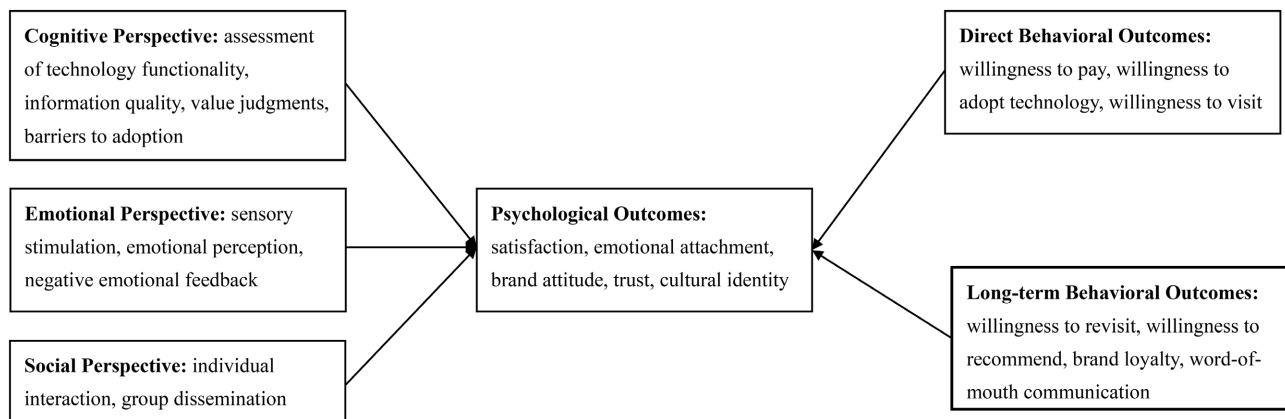


Figure 2. Analysis of factors influencing cultural tourism user behavior driven by immersive technology.

4.2.1. Synergy between Cognitive, Emotional and Social Perspectives

First, the cognitive perspective is the process of users' rational judgment of technology functional attributes, information value and usage cost, covering four types of variables: technology function assessment, information quality, value judgment and technology adoption barriers. First, perceived usefulness and ease of use determine the technology adoption threshold (Huang et al., 2023); second, information quality and sensory interactions positively affect tourists' immersive experience (An et al., 2021); subsequently, perceived value influences tourists' willingness to adopt immersive technologies (Vishwakarma et al., 2020); and finally, technology anxiety and psychological barriers may produce resistance to technology adoption behavior. (Cham et al., 2024).

Second, the emotional perspective focuses on users' emotional responses and psychological projections triggered by technology. At the sensory stimulation level, visual immersion and auditory feedback directly trigger hedonic experiences, e.g., cruise VR marketing simulates the pleasure of real travel through highly immersive design (Yung et al., 2021). At the level of emotional perception, technological content elicits users' emotional resonance through scene reproduction and narrative transmission. For example, cultural heritage application scenarios effectively stimulate users' nostalgia through historical scene recreation, and this emotional connection has been shown to be a key mediating variable driving slow travel intentions (Lin et al., 2020). However, negative affective feedback may undermine the beneficial impact of the technology. Overly realistic VR experiences may lead to an attenuation of interest in reality and reduce field visit

intentions (Deng et al., 2019). Such double-edged effects suggest the need to balance the association between depth of immersion and reality in technology design.

Third, the social perspective reconfigures the social attributes of the tourism experience through immersive technologies and promotes the transformation of individual behavior to group communication. For example, virtual social cues enhance user engagement through quasi-social interaction mechanisms, and the sense of co-presence and spatial presence brought about by immersive technologies significantly increase group collaboration willingness (Zhu et al., 2024c). In addition, users are more likely to share their experiences via social media after an immersive experience. Studies have shown that social interactions, while potentially weakening individual immersion, indirectly enhance user loyalty through group belonging (Hudson et al., 2019).

4.2.2. Psychological Outcomes

Immersive technology significantly shapes users' psychological attitudes and emotional connections to a cultural tourism destination through the synergistic effects of multidimensional experiences. Satisfaction is a core representation of users' psychological outcomes, and studies have found that VR's high sense of presence positively influences users' overall satisfaction with virtual tours by enhancing emotional arousal and hedonic experience (Yung et al., 2021), whereas AR's dynamic verbal cues and high-virtual-presence design further strengthens users' satisfaction with the museum experience by enhancing the vividness of mental imagery (He et al., 2018). Emotional attachment, on the other hand, is formed through technology-enabled anthropomorphization and self-representation mechanisms, e.g., virtual avatars in the meta-universe deepen users' emotional attachment to the green brand by enhancing their intimacy with the destination (Huang & Liu, 2021). In addition, trust is crucial in the application of technology; AR enhances users' trust in cultural symbols through information transparency and dynamic authenticity, while technological anxiety counteracts the hedonistic aspects of the AR experience, which in turn reduces their satisfaction (Sancho-Esper et al., 2023). Cultural identity is a unique psychological outcome in cultural tourism scenarios, and cultural heritage VR inspires users to deeply identify with the cultural values of the destination through nostalgic narratives and historical scene restoration (Lin et al., 2020). However, the double-edged sword effect of technology may lead to psychological conflicts, e.g., overly realistic VR experiences may weaken users' interest in real destinations (Deng et al., 2019), suggesting the need to balance the emotional connection between the virtual and the real (Li & Chen, 2019). In conclusion, psychological outcomes are mainly characterized by attitude change and emotional reinforcement, a process that not only relies on a single dimension of efficacy, but also requires a dynamic balance of technological features, emotional stimulation, and social interaction.

4.2.3. Behavioral Outcomes

User behavioral outcomes show a dynamic correlation between short-term re-

sponse and long-term conversion. Direct behavioral outcomes include willingness to adopt technology, willingness to pay and intention to visit. Studies have shown that VR's sense of presence significantly enhances visitors' impulsive travel desires by shortening the psychological distance (Kang, 2020), while AR's interactive design directly drives willingness to pay by enhancing the value of the experience (Huang, 2021). For example, the dynamic verbal cues of AR tours in museums led to a significant increase in visitors' willingness to pay a premium (He et al., 2018). Long-term behavioral outcomes are reflected in brand loyalty and word-of-mouth communication. Immersive technologies strengthen user stickiness through emotional resonance and social interaction, e.g., virtual collaboration in the meta-universe significantly enhances users' willingness to revisit a destination through a sense of co-presence (Zhu et al., 2024b), whereas social sharing behaviors after a VR experience indirectly enhance brand loyalty through a sense of group belonging (Hudson et al., 2019). It is important to note that short-term behavioral outcomes, such as willingness to pay and visitation intent, gradually accumulate through sustained experiences and interactions, ultimately transforming into long-term outcomes like brand loyalty and word-of-mouth promotion. Furthermore, behavioral outcomes are moderated by user characteristics, with younger users more likely to generate visit intentions due to technological novelty, while older users' technological anxiety may inhibit behavioral conversion (Cham et al., 2024). In addition, unexpected events (e.g., epidemics) reconfigure the behavioral logic through risk perception, and users' willingness to adopt virtual tours is significantly higher and may translate into postepidemic field visit behavior (Li et al., 2022).

4.3. Market Dimension

Technological innovation in the tourism sector is gradually changing the competitive landscape of the tourism market, and its impact is mainly reflected in three aspects: social communication, brand building and market potential. Social communication accelerates the diffusion of destination information through user-generated content and interactive mechanisms; branding enhances emotional connection and value recognition through immersive experiences; and market potential is empowered by technology to expand user coverage, optimize supply and demand matching, and drive industry innovation. Existing research shows that the application of technology has not only changed the traditional tourism marketing model, but also given rise to new market behaviors and business models (Yung et al., 2021). The following is a specific elaboration of the three aspects mentioned above.

4.3.1. Social Dissemination

The core of social communication lies in how technology stimulates users' active sharing behavior and expands the reach of information. Studies have shown that the vividness and interactivity of virtual reality significantly enhance users' media

richness perception, which in turn promotes information search and sharing behaviors (Lee et al., 2021). For example, virtual social cues in VR tours inspire users to generate more vivid mental imagery through enhanced interactivity and quasi-social interactions, which ultimately enhances sharing intentions (Zhu et al., 2024c). In addition, augmented reality gamification design prompts users to share game achievements and destination experiences on social media through location binding and knowledge transfer mechanisms, forming fissionary communication (Lacka, 2020). It is worth noting that the effect of social communication is affected by cultural differences and user characteristics, for example, users in collectivist cultures are more dependent on social influences (Jung et al., 2018); furthermore, younger users are more inclined to share technological experiences in travel on social platforms, while older groups may be less willing to share due to technological anxiety (Cham et al., 2024). Whereas avatars in meta-universes with cross-cultural socialization scenarios may alleviate this limitation (Jin, 2024).

4.3.2. Brand Building

Branding focuses on how to provide differentiated experiences through the use of technology to strengthen destination image and user loyalty. Research has shown that immersive technologies can enhance brand experience through highly immersive experiences that create a sense of “being there”, thereby increasing the emotional value of the brand (Bogicevic et al., 2019). For example, museum AR tours significantly enhance tourists’ willingness to pay and brand identity through dynamic language prompts and high virtual presence design (He et al., 2018). In addition, humanized digital experiences in the meta-universe deepen users’ emotional attachment to green destination brands by satisfying their self-representation needs (Huang & Liu, 2021). Studies have also found that branding requires a differentiation strategy, and for low-awareness destinations (e.g., Jinan), VR can reconstruct the cognitive image through nostalgic narratives, prompting tourists to experience the destination more deeply and enhancing their destination image (Lin et al., 2020). However, the application of technology may produce a “double-edged sword” effect, such as overly realistic VR experiences may weaken the motivation to travel in reality (Deng et al., 2019), and the complementarity between virtual and reality needs to be balanced through content design.

4.3.3. Market Potential

The market potential is reflected in the technology’s ability to drive user scale, consumption scenarios and industry growth. In terms of user reach, immersive technologies can break through geographic and physical constraints to attract potential tourists to participate in virtual tours and convert them into on-site visit intentions (Sancho-Esper et al., 2023). For example, a VR experience in a retirement community significantly improves older users’ willingness to recommend it by reducing technological anxiety (Sancho-Esper et al., 2023). Regarding the expansion of consumption scenarios, the rise of the meta-universe concept has opened up new scenarios for the tourism market, such as virtual destinations at-

tracting users to participate in the experience through digital twins, which in turn translates into actual intention to visit (Deng et al., 2024). Meanwhile, the acceptance of non-contact travel technologies by users has significantly increased after the epidemic, and VR is perceived as a complementary tool to field trips (Kim et al., 2021). In addition, sustainability orientation has become an emerging trend, and VR fits the low-carbon market demand by reducing the carbon footprint of field trips and promoting awareness of regenerative tourism (Liu & Hao, 2024). However, the release of market potential is limited by the cost of technology and the lack of standardization, for example, cheap VR devices may increase penetration but may sacrifice the quality of experience (Vishwakarma et al., 2020), which requires policy and industry collaboration to develop technical specifications.

4.4. Moderating Variables

In the study of technology application in the field of cultural tourism, it is summarized that moderating variables such as technology iteration cycles, application scenarios, user characteristics and contingencies significantly affect the acceptance and effectiveness of immersive technologies. These variables not only shape users' perception and behavior towards immersive technologies, but also determine the applicability and sustainability of technologies in different contexts. Existing studies show that technology iteration cycle determines the maturity of technology functions and user acceptance threshold, differences in application scenarios shape the applicability boundaries of technology functions, user characteristics perceive the heterogeneity of technology through demographic features and personality traits, and emergencies reconfigure the demand for technology and the direction of market competition through external shocks.

4.4.1. Technology Iteration Cycle

The technology iteration cycle continues to influence users' perception and behavioral intention towards the cultural tourism industry through functional innovation and experience optimization. Early technological devices have a lack of presence due to rigid interaction, which limits their application in cultural tourism scenes. With the improvement of technical functions and experience optimization, technological breakthroughs have further expanded the application scenarios. For example, the introduction of haptic feedback technology makes the touch experience of cultural relics in virtual museums more realistic, and users can perceive the texture details of cultural relics through the haptic interface, which prolongs the exploration time and enhances the user's experience (Cecacci et al., 2021). At the same time, technology iteration drives business model innovation, with initial meta-universe tourism relying on simple 3D modeling, while the current combination of blockchain's NFT digital collections and cross-platform virtual economy systems derives a sustainable cultural tourism consumption ecology (Corne et al., 2023). However, the rapid iteration of technology

may lead to user cognitive load and technological anxiety, and some users hold barriers of skepticism and resistance to the use of VR technology for tourism, which may directly affect users' willingness to adopt the technology (Cham et al., 2024).

4.4.2. Application Scenarios

The differences in application scenarios require that technology design and functionality should be highly adapted to specific contexts, and existing research focuses on three major areas: cultural heritage scenarios, live tourism scenarios, and cultural IP derivation scenarios. In cultural heritage scenarios, AR technology enhances the cognitive authenticity and emotional resonance of tourists by superimposing historical information and dynamic narratives, for example, the AR navigation of Taishan Mountain enhances tourists' satisfaction by constructing authenticity (Zhu et al., 2023b). Live-action tourism scenarios emphasize technology's enhancement of physical space and experience optimization. For example, cruise tourism utilizes VR previews to enhance tourists' perception of itinerary certainty and reduce decision-making risks (Martínez-Molés et al., 2022); while theme parks stimulate tourists' sense of control through VR roller coaster programs, significantly increasing the willingness to revisit (Wei et al., 2019). Cultural IP derivation scenes rely on technologies such as meta-universe and blockchain to promote digital innovation and user co-creation of cultural symbols. For example, the developed scalable meta-universe platform is more flexible than other platforms, and users' satisfaction with the meta-universe system is higher, contributing to the sustainable development of tourism (Suanpang et al., 2022).

4.4.3. User Features

User features reflect the heterogeneity of technological influences in terms of both demographic characteristics and personality traits. In terms of demographic characteristics, younger users are highly receptive to meta-universe socialization and virtual tours, and their behaviors are driven by entertainment and technological novelty; whereas older users are technologically anxious about virtual tours and this anxiety reduces the perceived ease of use of VR devices (Sancho-Esper et al., 2023). Cultural background also plays a key role, with users from collectivist cultures relying more on social recommendations than on independent exploration (Jung et al., 2018). Among personality traits, users with high technological readiness quickly adapt to complex features and enjoy personalized experiences on virtual tours, which in turn enhance brand attachment (Huang & Liu, 2021). In addition, users with strong nostalgic tendencies respond more positively to roaming designs for cultural heritage VR, driving emotional resonance and destination loyalty (Lin et al., 2020).

4.4.4. Contingency

As an important contextual variable, emergencies can regulate the path and effect

of technological innovation in the cultural tourism industry. Among them, COVID-19, as the most representative global emergency in recent years, forced the LCS industry to accelerate technological integration and model innovation. During the epidemic, immersive technology became a core alternative to on-site tourism, and tourists preferred virtual tourism due to risk perception (Li et al., 2022). Meanwhile, the epidemic catalyzed the demand for non-contact services, and augmented reality (AR) mirroring technology increased users' willingness to make virtual purchases through AR body reproduction and AR selfie sharing activities (Huang et al., 2023). In terms of long-term impacts, outbreaks reinforce the role of technology in supporting sustainable tourism, mitigating the environmental impacts of on-the-ground tourism behaviors, and promoting responsible tourism (Adnan et al., 2024). Beyond public health crises, other contextual factors may also reshape the trajectory of technology adoption. For instance, major economic transformations could alter tourists' spending patterns, while geopolitical conflicts might propel virtual tourism into a vital alternative for cross-border cultural exchange. Thus, the ongoing impact of outbreaks suggests that technology needs to be resiliently adapted to cope with future uncertainty.

5. Conclusion and Discussion

With the rapid development of digital technology, immersive technology has gradually become the core driving force for the innovation and marketing transformation of the cultural tourism industry through multi-sensory interaction, fusion of reality and scenario-based narrative. However, the mining of its marketing value still faces the double challenges of theory and practice. Based on the technology-user-market framework, this study systematically investigates the application mechanism and influence path of immersive technology in cultural tourism marketing, and reveals the dynamic role and potential boundary conditions of technology-enabled cultural tourism marketing by combining with the systematic analysis of 115 documents. The study not only provides an integrated theoretical framework for the academic field, but also provides empirical evidence for the optimization of marketing strategies and industry practices of cultural tourism enterprises.

By systematically combing 115 papers and constructing a technology-user-market framework, this study extracts the core conclusions from the three dimensions of technology-enabling paths, user behavior transformation mechanism and market value creation logic, in order to answer the three research questions raised in the previous section.

First, the three levels of technology, user and market have differentiated connotations and characteristics in the framework of immersive cultural tourism marketing. It is found that the technological dimension is characterized by interactivity, vividness, functionality, effectiveness, authenticity, and media, covering VR, AR, MR, and meta-universe, etc. VR reconfigures the sense of presence of the cultural experience through a closed virtual scene, AR enhances the interactivity

of reality with the superimposition of real and virtual reality, MR integrates real and virtual narratives to promote collaborative explorations, and meta-universe constructs multi-dimensional cultural spaces through cross-platform socialization and digital assets (Griffin et al., 2023; Zhu et al., 2023a). The connotation of the user level focuses on the multi-dimensional experience of cognitive, emotional and social dimensions: the cognitive dimension involves the evaluation of technological functions and value judgment, the emotional dimension triggers emotional resonance through sensory stimulation and narrative transmission, and the social dimension strengthens the sense of belonging to a group through virtual collaboration and sharing behaviors. The market dimension is reflected in the three-phase path of social communication, brand building and market potential, with the technology expanding the reach of information through media richness, deepening the brand's emotional connection through highly immersive experiences, and promoting the sustainable consumption market by breaking through geographic constraints through virtual tours and meta-universe scenarios.

Second, technology, users and market realize value co-creation through dynamic closed-loop mechanism. Technology triggers multi-dimensional user experience through functional features: cognitive usability lowers the adoption threshold, emotional resonance enhances cultural identity, and social interaction drives group communication (He et al., 2018; Lin et al., 2020). User behavior translates into immediate and long-term behavior through psychological outcomes, which in turn drives value transformation at the market level (Yung et al., 2021; Hudson et al., 2019). Market feedback in turn influences technology iteration and user strategies, such as social communication data optimizing AR scene design, and brand-building needs driving meta-universe cultural IP innovation (Deng et al., 2024; Corne et al., 2023). This closed-loop mechanism of "technology empowerment-user perception-market transformation-technology optimization" reflects the complex relationship of multi-directional interaction and dynamic balance among the three.

Third, the weighting factors of the relationship between technology, users and market mainly include technology iteration cycle, application scenario differences, user characteristics and unexpected events. The technology iteration cycle determines the maturity of functions and the threshold of user acceptance, for example, haptic feedback technology improves the touch experience of cultural relics (Ceccacci et al., 2021), but rapid iteration may trigger the technology anxiety of the elderly group (Sancho-Esper et al., 2023); the differences in application scenarios require that the technology be adapted to the specific scenario, for example, AR enhances cognitive realism in cultural heritage scenarios (Zhu et al., 2023a). While VR in theme parks needs to balance the depth of immersion and substitution effect (Wei et al., 2019); user characteristics regulate behavioral paths, with younger groups preferring virtual socialization, and collectivist users relying on social recommendations (Jung et al., 2018); Unforeseen events (e.g., epidemics)

reconfigure the demand for technology, and non-contact services accelerate the popularity of virtual tours (Huang & Liu, 2021), while driving the evolution of technology in a sustainable direction. These elements dynamically regulate the boundaries of technological efficacy and determine the adaptability and sustainability of immersive cultural tourism marketing.

6. Research Limitations and Future Directions

Although this study provides an integrated analytical framework for immersive cultural tourism marketing, there are still three limitations: first, the existing literature focuses on the short-term effects of technology implementation and user experience, and there is a lack of empirical research on cross-scenario adaptability and the long-term impact of technology; second, there are geographic and age biases in the selection of samples, and most of the studies focus on the developed countries or the younger age groups, and there is a lack of deeper discussion of cultural diversity and older users; finally, the discussion of the ethics of technology (e.g., data privacy, virtual social trust) and commercialization balance is still in its infancy. Finally, the discussion on the balance between technological ethics (e.g., data privacy, virtual social trust) and commercialization is still at an early stage, and a systematic evaluation framework is urgently needed.

Combining the existing research limitations and industry needs, future research should closely focus on the core elements of immersive technology in cultural tourism marketing (product, price, channel, promotion), and deeply explore the complex interactive relationship between technology features, user behavior and market effects, which can be carried out in the following directions:

First, research on technology adaptability and marketing value transformation. The differentiated features of immersive technology need to be deeply combined with cultural tourism scenes to enhance the perceived value of products and the effectiveness of pricing strategies. For example, AR dynamic narrative in cultural heritage marketing may strengthen tourists' brand attachment by enhancing emotional authenticity, while VR panoramic roaming stimulates impulsive consumption behavior through remote presence in the promotion of natural scenic spots. In the future, it is necessary to pay attention to the synergistic effect between technical features (e.g., information quality, interaction mode) and cultural attributes of the scene, verify the threshold relationship between technical complexity and price sensitivity, and reveal how highly immersive technologies can support premium pricing through perceptual uniqueness.

Second, the study of precision marketing path driven by user heterogeneity. There are significant differences in the acceptance and behavioral paths of different groups towards immersive technologies, and stratification strategies need to be constructed based on age, cultural background and technical readiness. Elderly users' technological anxiety mostly stems from cognitive load, which requires simplifying the interaction design to lower the operation threshold; Generation Z pays more attention to virtual socialization, which requires enhancing the willing-

ness to participate through the design of sense of belonging to the community. In cross-cultural scenarios, collectivist users enhance social identity through virtual collaboration, while individualist users prefer autonomous exploration to trigger behavioral intentions.

Third, the study of market ethical risks and long-term management of brand equity. Issues such as privacy leakage and virtual social trust crisis derived from immersive technologies may erode brand equity, and risk mitigation strategies and sustainable development paths need to be explored. For example, differentiated privacy strategies can regulate the rebuilding of user trust through perceived control; high-frequency virtual tours may weaken the cultural identity of on-the-ground destinations through cognitive dissonance, and longitudinal tracking is needed to identify the tipping point of behavioral transformation. Future research may also incorporate existing ethical frameworks from digital marketing or artificial intelligence as theoretical references for immersive technology risk governance, thereby expanding the depth and systematic nature of research on this topic.

The above directions not only echo the double-edged sword effect of technology, the heterogeneity of user behavior, and the ethical challenges of the market revealed in the previous section, but also aim to fill the interdisciplinary theoretical gaps, provide scientific anchors for the fine-tuning of immersive cultural tourism marketing, and lead the cultural tourism industry towards a new paradigm of high-quality development in which the virtual and the real coexist.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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