



OPEN Interpreting visitor experiences with digital cultural heritage exhibitions in Yimeng China through thematic analysis

Yue Li¹✉, Tiantian Li¹, Yue Bai¹, Nor Atiah Ismail², Jinjin Chen¹, Taoyu Wei¹ & Hashem Salarzadeh Jenatabadi³

Yimeng cultural heritage landscapes are a crucible of regional identity, historical memory, and dynamic nodes in the context of heritage, tourism, and digital innovation. In the context of sustainable cultural tourism in the digital age, in general, this paper aims to explore the operation mechanism of visitor experience and meaning making of digital exhibitions in the cultural heritage landscape of Yimeng. Building on the Knowledge, Attitude, and Perception (KAP) framework, this work investigates how digital components—such as virtual reconstruction, multimedia storytelling, and interactive exhibits—influence the cognitive understanding (knowledge), evaluative responses (attitudes), and lived experiences (perceptions) of cultural stories by tourists. A qualitative method was employed, and 22 semi-structured interviews were conducted with visitors at the major display sites in Yimeng. Thematic analysis, conducted with the support of the MAXQDA software, generated five primary themes: Authenticity, Preservation, and Cultural Integrity, Emotional Resonance and Psychological Impact, Cultural Recognition and Valuation Enhancement, Community and Environmental Sustainability, and Future Directions and Enhancements. The themes present the everyday encounters and interpretive narratives that tourists create within these digital interactions, and in doing so, suggest how these technologies can facilitate cultural meaning-making, participatory learning, and emotional attachment to heritage. The findings are practically valuable for heritage practitioners, digital content developers, and policymakers who aim to develop inclusive and engaging digital heritage environments for cultural sustainability and meaningful visitor connection, as well as improved KAP outcomes.

Keywords Cultural heritage landscape, Tourist perceptions, Behavioral influences, Technological interaction, Digital exhibitions

Abbreviation

KAP Knowledge, attitude, and perception

A cultural heritage landscape is a geographical region that has been molded by the collaborative efforts of both nature and humans, showcasing the interplay between a community and its surroundings throughout history. These landscapes might vary from well-tended gardens and parks to vast regions shaped by agricultural, industrial, or urban activity. Cultural heritage landscapes, which are highly regarded for their importance, typically encompass historical landmarks, traditional customs, and natural characteristics that symbolize the values, beliefs, and aesthetic sensitivities of a particular culture^{1,2}. Through the examination of these landscapes, individuals can acquire a deeper understanding of the socio-economic progress, environmental past, and cultural distinctiveness of a particular area. The notion promotes the conservation of these areas as a valuable element of human heritage, emphasizing the significance of the mutually beneficial connection between individuals and their natural environment³.

Knowledge, attitude, and perception (KAP) are interrelated factors that influence an individual's comprehension and engagement with the surrounding world⁴. Knowledge encompasses the accumulation

¹School of Art and Design, Shandong Women's University, Ji'nan 250300, China. ²Department of Landscape Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia, Serdang 43400, Malaysia. ³Monash University Malaysia, Jalan Lagoon Selatan, Bandar Sunway, Subang Jaya 47500, Selangor, Malaysia. ✉email: 29066@sdwu.edu.cn

of information and abilities obtained from personal experience or formal education, serving as the basis for comprehending concepts and factual information. Attitude refers to an individual's preexisting mental position towards specific concepts, individuals, or circumstances, which might be favorable, unfavorable, or impartial, and is shaped by a person's understanding and encounters. Perception, however, refers to the cognitive process by which individuals interpret sensory input, thereby constructing their own subjective comprehension of their surroundings.

Literature review

Cultural heritage landscapes

The idea of cultural heritage landscapes includes an extensive range of environments across which the interaction of people and the environment has, over time, generated distinct types of space. UNESCO⁵ further states that cultural landscapes are the “combined work of nature and man” and demonstrate human society's progress in materialized forms based on historical, social, and environmental processes. These landscapes are typically classified as one of three types: designed, evolved and associative cultural landscapes, with designed landscapes being consciously designed and deliberately constructed (e.g., gardens, parks, and estates), evolved landscapes that have developed over time through human-nature interaction and are further subdivided into relict and continuing landscapes; and associative cultural landscapes which are recognized primarily for its cultural, religious, or artistic values which exist in an intangible form as well as a physical form^{5,6}. These typologies support understanding the range of heritage landscapes and their function as guardians of cultural memory, social values, and local identity. Cultural landscapes as repositories of diverse traditional knowledge are of great interest for not only scientific purposes but also as living landscapes which offer territorial identity capacity, sustenance of community values, religious beliefs and support a wide range of economic activities such as cultural tourism⁷. At a global level, the importance of these landscapes in maintaining cultural diversity and contributing to the development of sustainable forms of tourism corresponds to UNESCO's sustainable development goals.

The importance of cultural heritage landscapes has received much attention from academics and practitioners in China, due to the state's long history, rich ethnic cultures, and deep-seated philosophical and aesthetic values that have molded its lived environments for thousands of years⁸. A large and diverse array of heritage landscapes around China—ranging from ancient agricultural systems, sacred mountains, and classical gardens to traditional villages—all reflecting how people have historically lived in harmony with and influenced the natural world around them. Recent national endeavors have further heightened this significance to integrate heritage preservation with larger socio-economic goals, especially promoting tourism and rural revitalization to reduce poverty and preserve cultural continuity. As heritage becomes embedded in the Chinese state's regional planning and national narratives, the heritage landscape is increasingly configured as an instrument of economic renaissance, cultural diplomacy and soft power⁹. However, this blending is also the source of new dialectics between commodification of and conservation for, authenticity and adaptation, local values and state ideology. These tensions also demonstrate the necessity for a more complex reading of the theoretical and practical conceptualizations of cultural landscapes concerning identity formation, placemaking and participative governance. Thus, investigating cultural heritage landscapes in China is important for national heritage management and connects with global debates regarding long-term sustainability, cultural continuity and ethical stewardship of common humanity heritage.

KAP of tourists toward cultural heritage landscapes

Tourists' experiences and behaviors at cultural heritage landscapes are profoundly shaped by their KAP, which together form an essential framework for understanding how individuals engage with heritage environments. Tourist knowledge is the level of historical knowledge and cultural literacy or familiarity with the site's symbolic structure or socio-political meaning. This understanding can be obtained via formal education, travel literature, digital media or on-site interpretation (guides, exhibitions and signage)⁴. When tourists possess a high level of historical and contextual awareness, they are more likely to interpret the cultural landscape with greater sensitivity and engage more meaningfully with its narratives¹⁰. In addition, tourists' attitudes are seen to influence the preservation of heritage, authenticity, and engagement in culture. Conservation-minded visitors generally have respect for national traditions and an interest in sustainable tourism behavior¹¹. Attitude is relevant to the ethical disposition towards heritage, appreciation of site authenticity, critical reflection over history and the determination to contribute to cultural continuity¹².

On the other hand, tourist experiences cover the first-order sensory and affective responses to the heritage landscape shaped by material culture, visual presentation and interpretive framing. Such perceptions are often intensely subjective and are influenced by previous travel experiences, personal expectations, and cultural background¹³. Furthermore, digital mediation (e.g., augmented reality, virtual tours, interactive storytelling) can profoundly reshape tourists' perceptions by deepening immersion and emotional resonance, thus enabling more intense psychological connection with the site^{14,15}. Together, knowledge, attitudes, and perceptions represent an interlocking system that shapes how tourists view and value cultural heritage landscapes, and how they behave, remember, and advocate for heritage conservation.

Tourists' KAP of cultural heritage landscapes have a substantial impact on their travel experiences and behaviors. Acquiring information about a cultural heritage landscape, including its historical background, importance, and the customs it represents, improves tourists' comprehension and admiration of the location, frequently intensifying their involvement with the area^{10,12}. Individuals' dispositions towards cultural preservation and the significance they attribute to heritage might influence their level of respect while engaging with the environment, hence influencing their choices about adherence to guidelines, involvement in local traditions, and endorsement of conservation initiatives¹¹. Jangra, Kaushik¹³ believed that perception is a vital factor in influencing the tourists' overall experience, as it determines their interpretation and appreciation of the

cultural and aesthetic aspects of the area. Perceptions are frequently influenced by preexisting knowledge and attitudes, but they can also be molded by direct experiences and interactions at the destination¹⁶. Collectively, these components establish the caliber of the tourists' experience and their influence on the cultural sites they investigate.

This study

Aim of the study

This study aims to explore how visitors experience and interpret digital cultural heritage exhibitions in Yimeng, China. Specifically, it examines how exhibition design, storytelling elements, and interactive digital features shape tourists' emotional, cognitive, and sensory engagement with cultural narratives embedded in the landscape.

Objectives of the study

The primary objective of this study is to investigate how tourists make meaning of their experiences with digitally mediated exhibitions in the cultural heritage landscape of Yimeng, China. Rather than measuring changes in knowledge, attitudes, or behaviors, the study explores how these dimensions emerge as part of visitors' subjective and interpretive engagement with digital heritage content. Because Yimeng contains a deep revolutionary meaning and rich cultural memory, this study emphasizes how digital technology can help visitors gain insight into, resonate with, and appreciate the culture through virtual reconstruction, multimedia text, interactive display, etc. It also considers these digital experiences' roles in shaping heritage tourism authenticity, value and sustainability. Applying a qualitative thematic analysis of semi-structured interviews, the paper looks at repeated patterns and meanings in the tourists' narratives to enlighten how digital exhibition design can enhance heritage interpretation and enrich engagement with historically laden landscapes.

Novelty of the study

This paper provides some innovative insights into heritage tourism and digital interpretation, focusing on the cultural heritage landscape in Yimeng, China. First, it is one of the first few empirical studies that adopt a KAP framework, where the impact of digital technologies on interactions among tourists and revolutionary and cultural landscape, in a Chinese context, was investigated. Previous research has discussed digital innovation in heritage, with only a limited number of studies qualitatively exploring how digital exhibitions affect tourists' cognitive, affective, and behavioral experience in politically and historically significant attractions such as Yimeng. Second, it utilizes a thematic analysis of first-hand visitor narratives to offer insights into how digital displays impact emotional engagement, historical understanding, and attribution of cultural value. Third, the study adds to discussions over heritage authenticity and sustainability by showing how digitally mediated heritage can preserve this balance, shaping an immersive interpretation without compromising respectful preservation of ideological and historical integrity. Finally, the results provide targeted policy insights for heritage managers and tourism planners in China and beyond, illustrating how digital technologies could be used strategically to nurture meaningful engagement, strengthen cultural identity, and promote sustainable tourism in culturally sensitive landscapes such as Yimeng.

Materials and methods

Study area

Yimeng is in the middle of Shandong Province, China. Its cultural heritage landscape is a moving reminder of China's revolutionary past and the early struggles of the Chinese Communist Party. Yimeng's landscape (See Fig. 1) is now marked by many historical places, such as guerrilla hideouts, monuments to martyrs, and old command posts, that tell stories of bravery, strength, and sacrifice. Local customs in art, music, and folklore have grown out of the revolutionary history of the Yimeng area and add to the city's rich culture.

The cultural resources of the Yimeng region are more than just historical sites; they are a live heritage that still affects and inspires Chinese society today¹⁷. Yimeng, which is in Shandong province, was a center of revolutionary action, especially during the anti-Japanese War and the Chinese Civil War. Because of this, it is a very important place to learn about revolutionary history. The local culture is deeply rooted in the beliefs of the communist guerrillas. This is shown through oral histories, folk songs, and group activities that remind people of the hard times and strong beliefs of the past¹⁷. Scholars and tourists alike come to the region's museums, memorial halls, and preserved guerrilla camps to learn about and think about the huge effects of these historical events¹⁸. This culture landscape makes people feel very connected to the past. It makes sure that the legacy of the region's ancestors lives on in the Chinese people, teaching them values like loyalty, sacrifice, and working together.

Study design

In accordance with the information presented in Table 1, an interview structure was developed after thorough literature research and preliminary pilot interviews were conducted. Yue Li, the first author of this research, carried out fifteen in-depth interviews. These interviews were either performed in person or through WeChat, and all of the participant interactions were documented on tape to ensure accuracy. Through the utilization of a semi-structured approach, Yue Li made certain that every participant was questioned with the same set of questions, so ensuring that the interviews were consistent with one another. This strategy made it possible to have a conversation that was both structured and flexible, which enabled participants to provide comments that were more in-depth while also ensuring that all of the important subjects were discussed in the same manner. Permission to perform this research was acknowledged by the research ethics committee of Shandong Women's University, Ji'nan, China.

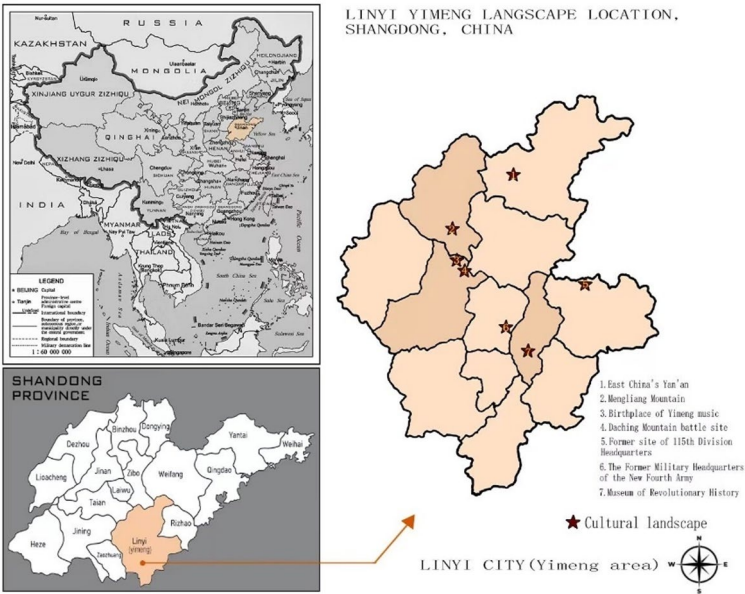


Fig. 1. Yimeng Landscape Location.

1. In what important ways have you learned about the red culture landscape that you did not know before?
2. Please describe the feelings you have while you're at the cultural scene.
3. Did you feel like you had a connection to the past or stories behind Yimeng's cultural heritage landscapes?
4. How did your visit make you feel on a mental level? Did it make you feel amazed, proud, or sympathetic?
5. Has your visit changed the way you will behave or act in the future, for example by making you want to learn more about other cultures or help protect them?
6. How well do you think the cultural heritage landscape shows the past and culture of the area?
7. Please talk about how your view of the local community has changed since you've been to the cultural settings.

Table 1. The interview structure.

Interview section process

From December 5th to December 20th, 2023, a study team talked to tourists at the Yimeng Revolutionary Memorial Hall, the East China Revolutionary Martyrs' Mausoleum, and the Mengliang Mountain Battle Memorial Hall. Because these places are so important historically and culturally, they have got a lot of different kinds of tourists. Their ideas were very useful for an academic project that looked at how memorials affect culture. Thirty tourists agreed to help with the study project after being told about its goals and methods. They would be interviewed online over a period. These people, who wanted to help with studying cultural heritage, gave their WeChat contact information so that the next discussions could go more smoothly. Unfortunately, some people in this group could not make it to the online interviews that were set to happen from January 3, 2024, to the end of February 29, 2024, for twenty-two participants.

Data Preparation based on thematic analysis

The study project used MAXQDA software (version 2012) to effectively handle and arrange the data that was gathered, which made it easier to conduct a thorough analysis of the interview transcripts. The transcripts were analyzed using thematic analysis. At first, all interviews were recorded on audio and then carefully typed into Chinese by members of the study team, making sure that the spoken content was preserved. The study team regularly listened to the recordings to make sure that the transcripts were correct. This kept the data's integrity. Next, two researchers, first and second authors of this paper, worked separately to make sure the quality and accuracy of the translations of the transcripts into English. Then, the researchers found parts of the transcripts that directly answered the study questions. They called these "meaning units." These units were coded in a planned way, and the codes that were made were then looked at to find trends. The team looked at the differences and similarities between the codes, which let them be put into sub-themes and larger themes. This gave the study and interpretation of the data more depth.

Coding and thematic development process

We used the six-phase method of thematic analysis described by Braun and Clarke¹⁹: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) writing up the report. Once the interviews were written out and checked for accuracy, the

research team coded the data using MAXQDA. Two researchers coded each transcript line by line to capture the segments of text, which are referred to as “meaning units”, reflecting the content about the research questions towards tourists’ knowledge, attitudes, and perceptions.

These meaning units were assigned descriptive codes, which were then iteratively compared and grouped into categories based on conceptual similarity and relevance to the study objectives. These categories formed the basis for the sub-themes, which reflect distinct yet interconnected patterns across the data. The final themes were constructed by clustering related sub-themes under broader conceptual umbrellas, capturing the underlying dimensions of tourists’ cognitive, emotional, and behavioral engagement with the cultural heritage landscape.

The theme criteria were occurrence across interviews, a depth of understanding into tourist experiences, and a correspondence with the KAP (Knowledge–Attitude–Perception) framework. For instance, the category “Authenticity and Preservation of Cultural Integrity” arises because they are reminded that the films must depict but also be faithful, historically relevant, and face the extremities of what to conserve. Likewise, the theme “Emotional Resonance and Psychological Impact” encompasses emotional reactions, sense of identity, and cultural connection conveyed in the narratives. The outcome of these discussions yielded the final five themes and their associated sub-themes (Table 3), and these were further refined through team discussion to ensure integrity, validity, and theoretical fit.

Results

Demographic descriptive statistics

The interview participants in our study represent a varied range of individuals, each contributing their distinct perspective. Out of the 22 participants, a small majority consisted of females, making up 12 of the totals, while 10 were males. The age distribution exhibited a bias towards the middle-aged category, with 14 participants falling within the 40–49 age range, 5 tourists below the age of 40, and a smaller group of 3 participants who were over the age of 50. The majority of the interviewees, amounting to 16, were married, while only 6 were single. Regarding their educational background, most participants possessed a bachelor’s degree (12 individuals), while 6 had a diploma and 5 earned a master’s degree or a higher level. There was a range of experience in their various industries, with 11 individuals having worked for 21–30 years. This suggests that they have a seasoned viewpoint in their input. Among the participants, 5 had 11–20 years of experience, 3 had less than 10 years, and 3 had over 30 years of experience. The diverse demographic of participants suggests a broad spectrum of perspectives and life experiences, which is expected to enhance the depth of understanding gained from the study. Beyond the basic demographics, two visitor profile variables were explored to contextualize participants’ experience with cultural heritage and digital media. First, the frequency of visiting cultural heritage sites was surveyed. Responses indicated a broad spectrum of engagement: 4 said they went to such sites infrequently (1–2 times in their lifetime), eight said they visited them periodically (once every few years), and 10 said they visited them regularly (at least once a year). This distribution also implies a representative sample of casual and regular heritage site visitors; thus a richer analysis is likely to capture different levels of familiarity with cultural content and places. Second, participants were questioned regarding previous contact with digital exhibitions. Fourteen participants had previously experienced digital heritage displays (e.g., virtual tours, multimedia presentations), while eight had not. This variable is particularly significant when considering the reasoning of tourists’ perception, emotional involvement, and cognition level towards digitally mediated cultural landscapes. Table 2 displays the results of demographic descriptive statistics.

Thematic analysis

Five themes and the associated sub-themes emerged from the analysis: (1) Authenticity Preservation and Cultural Integrity; (2) Emotional Resonance and Psychological Impact; (3) Cultural Recognition and Valuation Enhancement; (4) Community and Environmental Sustainability; (5) Future Directions and Enhancements (Table 3).

Theme 1: Authenticity Preservation and Cultural Integrity. Authenticity preservation and cultural integrity pertain to the endeavors undertaken to uphold and protect the genuine essence and historical precision of cultural heritage sites and traditions. This issue highlights the significance of preserving the authentic attributes and features of cultural assets, encompassing architectural styles, traditional crafts, rituals, and festivals, in the face of the detrimental impacts of commercialization, modernity, and globalization. Preserving cultural integrity entails maintaining the customary techniques, substances, and significances that establish a culture’s distinct character, enabling future generations to encounter and comprehend their history in its most genuine manifestation. These endeavors are vital for cultivating a profound reverence for cultural diversity and historical continuity, advancing sustainable tourism that honors local values and traditions, and simultaneously enhancing cultural education and global appreciation. Three categories have been identified for this theme (a) Perceptions of Authentic Representation; (b) Impact on Cultural Veracity; (c) Conservation and Preservation Challenges.

Perceptions of Authentic Representation. The category “Perceptions of Authentic Representation” explores how individuals or groups perceive and understand the genuineness of cultural expressions, artifacts, or tales as they are depicted in different contexts. This entails assessing whether these depictions faithfully capture the actual cultural origins in terms of specificities, essence, and authenticity. The way in which cultural information is perceived as genuine can greatly affect its reception and worth, influencing several aspects such as tourism, media, and educational resources. The need for genuine portrayal is especially crucial in a worldwide society when cultural aspects can be readily taken or misconstrued. Authenticating cultural portrayals not only demonstrates respect for the original community but also enhances the broader audience’s comprehension and involvement with other cultures, promoting a more inclusive and accurate global cultural exchange.

Characteristics	Number
Gender	
Female	12
Male	10
Age	
less than 40 years old	5
between 40–49 years old	14
more than 50 years old	3
Marital status	
Married	16
Single	6
Educational level	
Diploma	6
Bachelor	12
Master and above	5
Year of work experience	
less than 10 years	3
between 11–20 years	5
between 21–30 years	11
more than 30 years	3
Frequency of visiting cultural heritage sites	
Rarely (1–2 times in lifetime)	4
Occasionally (once every few years)	8
Frequently (at least once a year)	10
Prior exposure to digital exhibitions	
Yes	14
No	8

Table 2. Demographic descriptive statistics.

Theme	Category (Sub-Theme)
Authenticity Preservation and Cultural Integrity	Perceptions of Authentic Representation
	Impact on Cultural Veracity
	Conservation and Preservation Challenges
Emotional Resonance and Psychological Impact	Emotive Connectivity
	Cultural Sentiment and Identity
Cultural Recognition and Valuation Enhancement	Insightful Cultural Depictions
	Accuracy and Respectfulness of Cultural Representations
	Facilitation of Cultural Discourse
Community and Environmental Sustainability	Local Economic Impacts
	Social Implications
Future Directions and Enhancements	
	Visitor Feedback and Improvement Opportunities
	Anticipation of Technological Advancements

Table 3. Themes and categories (sub-themes) developed from thematic analysis.

“It became clear to me how hard it is to keep the true essence of culturally important places when I looked at a digital show of the Cultural heritage landscape. This display showed how places that were affected by communist and Yimeng history have changed over time by focusing on those areas. I realized how important it is to protect these places in a way that truly shows their historical and cultural backgrounds after seeing this.” [Female; less than 40 years old; Yimeng Revolutionary Memorial Hall].

“This experience made me even more sure that protecting these kinds of landscapes needs a careful balance of historical knowledge and sensitive interpretation so that they don’t become overly simple tourist draws.” [Male; between 40 and 49 years old; East China Revolutionary Martyrs’ Mausoleum].

“I thought about how these places shouldn’t just be shown as tourist spots but should be shown in a way that keeps their real stories and meanings alive. I learned that to really protect a culture’s history, we need

to know and respect both how these important places look and what they mean to people on a deeper level.” [Male; more than 50 years old; Yimeng Revolutionary Memorial Hall].

Impact on Cultural Veracity. The category “Impact on Cultural Veracity” refers to the influence of issues such as globalization, commercialization, or misrepresentation on cultural truths and authenticity. This notion examines the integrity and precision of cultural expressions as they are conserved, interpreted, or modified across time. This addresses the difficulties of preserving the genuine character and significance of cultural items, traditions, or landscapes in the face of external forces that could diminish their authenticity. Comprehending this influence is essential to guarantee the accurate transmission of cultural heritage to future generations, so preventing the erosion of historical facts and preserving a diversified and culturally rich tapestry that accurately reflects its beginnings. Therefore, the preservation and safeguarding of cultural heritage from the oversimplification caused by widespread access and commercial interests must take into account its impact on cultural authenticity.

“This exhibit showed how these landscapes are affected by history and politics, which is why it is important to show them correctly to keep their cultural authenticity. I learned that keeping the physical parts of these places isn’t enough; we also need to keep the original ideas and meanings behind them to really honor their cultural integrity.” [Female; between 40 and 49 years old; East China Revolutionary Martyrs’ Mausoleum].

“I learned a lot about how hard it is to keep the authenticity of cultural sites that were shaped by socialist and communist ideas after seeing a digital show on the Cultural heritage landscape.” [Female; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

“As a tourist, I know how important it is to support activities that honor and bring attention to the real stories and history of the places I visit, so that as they change over time, their core truths aren’t lost. This point of view encourages us to learn more about culturally important landscapes and treat them with more respect.” [Male; more than 50 years old; Mengliang Mountain Battle Memorial Hall].

Conservation and Preservation Challenges. The category “Conservation and Preservation Challenges” refers to the diverse challenges and barriers encountered in the effort to uphold the authenticity and ongoing existence of cultural, historical, and natural resources. These issues can stem from environmental reasons, such as the impact of climate change and natural deterioration, as well as from human activity, including urbanization, tourism, and the illegal trading of cultural items. In addition, insufficient financing and resources, political instability, and a lack of public awareness or involvement can hinder the effectiveness of conservation initiatives. To tackle these difficulties, a comprehensive strategy is needed that encompasses policy formulation, community involvement, technical advancements, and global collaboration. The objective is to develop enduring plans that safeguard these priceless resources while managing present demands and future concerns, guaranteeing the preservation and availability of cultural and natural heritage for future generations.

“This made me even more determined to visit places that put an emphasis on genuine conservation efforts. It also made me more aware of the delicate balance that needs to be struck between growing tourism and protecting historical authenticity.” [Female; between 40 and 49 years old; Yimeng Revolutionary Memorial Hall].

“I now know that to truly preserve culture, continuing work and well-thought-out plans are needed to lessen the effects of changes in the outside world and keep these special landscapes safe for future generations.” [Female; less than 40 years old; East China Revolutionary Martyrs’ Mausoleum].

Theme 1 was particularly evident among female respondents (4 of the five responses), reflecting greater awareness among women of the veracity and protection of cultural landscapes. Visitors aged 40 or older were most attentive to this theme, suggesting that middle-aged or older visitors could have a closer historical or emotional connection with the heritage of these sites. The geospatial distribution of these answers to Yimeng Revolutionary Memorial Hall, East China Revolutionary Martyrs’ Mausoleum, and Mengliang Mountain Battle Memorial Hall indicates that all heritage sites are equally concerned with the historical integrity.

Theme 2: Emotional Resonance and Psychological Impact. The theme “Emotional Resonance and Psychological Impact” pertains to the deep influence that specific experiences, surroundings, or stimuli can exert on an individual’s emotional well-being and cognitive state. This idea is frequently examined within the realms of arts, nature, and interpersonal relationships, where particular environments or encounters can elicit intense emotional reactions, resulting in enduring psychological impacts. For example, music, art, and natural landscapes have the ability to evoke emotions such as joy, tranquility, or nostalgia, and may also help to reduce symptoms of stress, anxiety, and sadness. Likewise, settings such as jobs or houses have an impact on one’s mood and mental state of being. Gaining insight into the impact of our environment and our relationships on our emotions and psychology is essential for creating environments that provide support and enrichment, improving personal well-being, and promoting emotional connections.

Emotive Connectivity. The category “Emotive Connectivity” examines how specific stimuli, such as art, nature, media, or human relationships, can create profound emotional bonds between humans and the events or objects they encounter. This relationship is crucial in influencing how individuals perceive, engage with, and recall experiences. For instance, a musical composition can profoundly resonate, eliciting a distinct emotional state or memory, thereby establishing a powerful emotional connection with that composition. Similarly, within a cultural framework, the act of engaging with traditional customs or objects can elicit a feeling of one’s cultural legacy and connection. Emotive connectedness highlights the significance of emotional involvement as a crucial aspect of human experience, impacting various aspects such as personal enjoyment in leisure activities and

engagement and effectiveness in work settings. Gaining insight into and utilizing this emotional connection can significantly improve the efficiency of communication, educational encounters, and endeavors to preserve culture.

“This emotional engagement altered my perception of these places, converting them from basic historical facts to vivid, dramatic realities that influence how I perceive and connect with history on a psychological level.” [Male; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

“This encounter demonstrated the critical role that emotive connectedness plays in comprehending and empathizing with diverse cultural and historical settings.” [Female; more than 50 years old; East China Revolutionary Martyrs’ Mausoleum].

“After witnessing a computerized representation of the Cultural heritage landscape, I had a strong emotional connection to the places and history depicted. The vivid stories and visuals of communities created by socialism and communist ideas moved me, inspiring awe and a better understanding of the struggles and goals that shaped these countries.” [Male; less than 40 years old; East China Revolutionary Martyrs’ Mausoleum].

“It wasn’t only about viewing the past; it was also about experiencing the spirit and feelings of those who lived throughout those times.” [Female; between 40 and 49 years old; Yimeng Revolutionary Memorial Hall].

Cultural Sentiment and Identity. The category “Cultural Sentiment and Identity” refers to the emotional and psychological connections that individuals and groups have with their cultural heritage, which in turn influences their sense of identity. This relationship is established by the mutual presence of traditions, languages, rituals, and historical narratives that collectively contribute to the distinctive cultural profile of a community. Cultural sentiment encompasses the emotions of pride, belonging, and continuity that emerge from these shared features, frequently strengthening group unity and individual self-perception. Identity, however, is influenced by these emotions and is manifested in how individuals and groups view themselves and are regarded by others. This category highlights the significance of cultural preservation in promoting the emotional well-being of individuals and preserving the authenticity of a group’s identity, particularly in the context of globalization and cultural homogenization.

“It was fascinating to witness how these historical tales continue to shape the identity and cultural beliefs of those groups now, providing a more nuanced understanding of the long-term psychological impact these movements have had.” [Female; between 40 and 49 years old; Yimeng Revolutionary Memorial Hall].

“The stories and symbols portrayed inspired a strong sense of identity and belonging among those who supported these campaigns.” [Male; less than 40 years old; East China Revolutionary Martyrs’ Mausoleum].

“I felt a strong sense of affinity for the cultural sentiments and identities shaped by previous socialist movements.” [Female; more than 50 years old; Yimeng Revolutionary Memorial Hall].

“This display not only showcased the architectural and creative legacies of these ideas, but it also effectively conveyed the emotional and social effects they had on communities.” [Female; less than 40 years old; Mengliang Mountain Battle Memorial Hall].

Theme 2 showed a one-to-one ratio of male/female, indicating that visitors had an emotional connection in the same degree, irrespective of gender, for this theme. Altogether, the age strata represented diverse age groups from under 40 to over 50 years, indicating that the emotional and identity-related dimensions of the sites appeal to people across all age groups. To our surprise, the East China Revolutionary Martyrs’ Mausoleum and Yimeng Revolutionary Memorial Hall were often displayed in this theme. Interestingly, the East China Revolutionary Martyrs’ Mausoleum and Yimeng Revolutionary Memorial Hall appeared frequently in this theme, suggesting these sites evoke stronger emotional and psychological engagement due to their narrative content or display methods.

Theme 3: Cultural Recognition and Valuation Enhancement. The theme “Cultural Recognition and Valuation Enhancement” focuses on recognizing and enhancing the worth and importance of different cultural manifestations and actively working to increase their recognition and respect in society. This process entails the identification, documentation, and promotion of cultural items, traditions, and behaviors that may otherwise be disregarded or underestimated. By elevating their status and increasing their visibility, these cultural features achieve wider acknowledgment, so aiding in their preservation while also fostering local pride and potentially attracting tourism and investment. These endeavors can result in economic advantages for communities by presenting their cultural abundance on a broader platform. The fundamental concept is to guarantee the celebration and preservation of many cultural identities, thus enhancing the global cultural mosaic and fostering a more comprehensive comprehension of human heritage.

Insightful Cultural Depictions. The category “Insightful Cultural Depictions” encompasses the precise and contemplative portrayal of civilizations in diverse mediums, including literature, film, art, and exhibitions. The purpose of these renderings is to offer a more profound comprehension of a culture’s intricacies, principles, and customs, surpassing shallow or stereotyped representations. Insightful cultural depictions enhance the understanding and enjoyment of diverse cultures by emphasizing authenticity and depth. This, in turn, fosters empathy and a heightened awareness of the world’s diversity among viewers or readers. These images play a vital role in dismantling cultural barriers and fostering mutual respect among diverse populations. Additionally, they

have a crucial function in safeguarding cultural heritage by recording and conveying the intricacies of cultural identities in a manner that is easily understood and captivating for a wide range of people.

“This experience demonstrated the significance of presenting cultural histories in a way that not only informs but also honors the richness of the culture being represented.” [Male; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

“I noticed how effective accurate cultural depictions are in increasing recognition and valuation of a culture’s history and philosophy.” [Male; less than 40 years old; East China Revolutionary Martyrs’ Mausoleum].

“It improved my understanding and appreciation, letting me realize the importance of conserving such cultural narratives in all of their authenticity and complexity.” [Female; less than 40 years old; Yimeng Revolutionary Memorial Hall].

Accuracy and Respectfulness of Cultural Representations. The category “Accuracy and Respectfulness of Cultural Representations” emphasizes the significance of authentically and respectfully depicting cultures in many forms of media, art, and education. This requires a meticulous equilibrium of extensive research, awareness of cultural subtleties, and a conscious effort to avoid generalizations and distortions. Promoting precision and reverence in cultural depictions not only cultivates enhanced comprehension and admiration among diverse cultural communities but also aids in countering cultural appropriation and prejudice. The statement underscores the obligation of creators, educators, and communicators to express cultural aspects with integrity and respect, hence fostering inclusivity and mutual respect in a heterogeneous society. Adopting this method is crucial for establishing confidence and communication between different cultures, hence enhancing the whole human experience.

“After watching the digital display of the Cultural heritage landscape, I had a renewed appreciation for cultural representations that are accurate and sensitive, particularly in terms of cultural acknowledgment and valuation.” [Female; less than 40 years old; Yimeng Revolutionary Memorial Hall].

“It eschewed celebrating or criticizing, instead presenting a balanced viewpoint that acknowledged the intricacies of the civilizations depicted. This method made me more aware of the importance of nuanced and accurate depictions in all forms of cultural representation.” [Male; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

“It demonstrated how such accuracy in depiction may educate and elicit a deeper respect for other cultural backgrounds, increasing their worth in the eyes of viewers like me and fostering a more meaningful connection and understanding.” [Female; less than 40 years old; East China Revolutionary Martyrs’ Mausoleum].

Facilitation of Cultural Discourse. The category “Facilitation of Cultural Discourse” includes programs and venues that promote dialogue and exchange on cultural values, practices, and issues. This discussion is essential for promoting comprehension and admiration across many societies, enabling the exchange of viewpoints and experiences that enhance collective wisdom and empathy. Enabling such discussions can be achieved through several methods, including public forums, educational initiatives, cultural celebrations, or digital platforms that foster connections among individuals from diverse backgrounds. These conversations facilitate the dismantling of cultural boundaries, question preconceived notions, and foster inclusiveness. Through active participation in cultural debate, societies can effectively confront and traverse cultural disparities, resulting in more unified communities and a deeper comprehension of the intricate tapestry of global cultures.

“I was intrigued by the enormous potential for promoting cultural debate as a means of increasing cultural recognition and value. The exhibit not only highlighted the historical and cultural relevance of countries affected by socialist and communist ideas, but it also spurred discussions among spectators on the broader implications of these ideologies for global culture and society.” [Male; less than 40 years old; Yimeng Revolutionary Memorial Hall].

“I believe that expanding such exhibits to incorporate interactive forums or discussion panels will considerably deepen this discourse by allowing people from many backgrounds to exchange thoughts, dispute interpretations, and comprehend the complexities of these cultural heritage landscapes.” [Female; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

This theme emerged with an equal balance of female and male content. It was more common among those under 40 and their 40s, suggesting that younger and middle-aged attendees are particularly involved in identifying and assessing the cultural value of the sites. All three sites were represented, yet Yimeng Revolutionary Memorial Hall was more popular, reflecting its richer or more symbolic exhibitions. However, it also has some that prompt cultural reflection and discussion.

Theme 4: Community and Environmental Sustainability. The theme “Community and Environmental Sustainability” highlights the interdependence between local communities and their natural surroundings, with a focus on implementing strategies that foster both ecological well-being and social welfare concurrently. These activities encompass sustainable agriculture, responsible waste management, adoption of renewable energy, and conservation efforts. They are intended to safeguard and improve the local environment, while simultaneously promoting the economic and social well-being of the community. By promoting a harmonious coexistence between development and environmental conservation, communities may establish robust systems that not only endure environmental difficulties but also prosper economically and socially. This strategy fosters community

engagement and empowerment, guaranteeing that sustainability initiatives are comprehensive and customized to local requirements. Consequently, it cultivates a lasting dedication to both environmental and community welfare.

Local Economic Impacts. The term “Local Economic Impacts” refers to the consequences that different activities, policies, and developments have on the economic well-being of a community. The impacts can vary from the provision of employment opportunities and generation of cash to the encouragement of local enterprises and the wider economic framework. Tourism, industrial growth, and large-scale agricultural operations have a considerable impact on the local economy. Furthermore, measures such as tax incentives or subsidies can either strengthen or encumber local financial systems. Gaining a comprehensive understanding of these effects is essential for policymakers and community leaders who want to improve economic stability and growth, while also ensuring that the advantages are fairly divided among citizens. Efficient administration of local economic effects aids in developing self-sustaining communities that can endure and adjust to evolving economic circumstances in the long run.

“The show demonstrated how regions with socialist and communist traditions are leveraging their unique cultural assets to foster economic growth while ensuring environmental sustainability.” [Male; less than 40 years old; Yimeng Revolutionary Memorial Hall].

“This approach has resulted in the development of eco-friendly tourism that respects and preserves historical places and natural landscapes, generating long-term income for local people. It demonstrated to me the potential for cultural heritage assets to contribute economically to a community while maintaining their environmental and historical integrity.” [Female; more than 50 years old; East China Revolutionary Martyrs’ Mausoleum].

“After investigating the digital display of the Cultural heritage landscape, I became more aware of how historical and cultural tourism may have a large local economic impact, particularly in terms of community and environmental sustainability.” [Female; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

Social Implications. The category “Social Implications” refers to the wider consequences that events, policies, actions, or trends can have on the social organization and functioning of a community or society. This encompasses the influence on societal standards, principles, connections, and actions within the community. For instance, the implementation of novel technology or regulation can profoundly modify the manner in which humans engage, communicate, and operate on a day-to-day basis. Likewise, changes in the economy or public health emergencies might result in alterations in social unity, a rise in social inequalities, or modifications in cultural customs. Comprehending these social ramifications is essential for politicians, corporations, and community leaders to foresee possible results and difficulties, therefore allowing them to enact strategies that enhance social welfare and reduce adverse impacts on the community’s social structure.

“This observation has increased my understanding and recognition of the long-lasting societal consequences of past policies and how they have influenced present strategies for achieving sustainability.” [Female; more than 50 years old; Mengliang Mountain Battle Memorial Hall].

“This experience emphasized the importance of comprehending these historical backgrounds in order to actively participate in and make meaningful contributions to ongoing community initiatives aimed at conserving both cultural and environmental heritage.” [Male; less than 40 years old; Yimeng Revolutionary Memorial Hall].

This theme appealed to respondents of all ages, and strong results were gathered from the respondents aged 50 and above, particularly for the sub-theme of Social Implications. Participants. The results indicate that women are slightly more active, which aligns with the general observation that women may be more closely aligned with the cultural and social dimensions of heritage tourism. Most of the hits were for the Mengliang Mountain Battle Memorial Hall, suggesting that this location may be associated with the connection between cultural heritage and community identity, or environmental sense of place.

Theme 5: Future Directions and Enhancements. The subject “Future Directions and Enhancements” for the Cultural heritage landscapes in Yimeng of China focuses on devising creative approaches to conserve and advance the region’s abundant cultural legacy, while also adopting sustainable development methods. This involves utilizing technological breakthroughs and improving tourism infrastructure to enhance the experiences of visitors while simultaneously reducing the negative effects on the environment. In addition, future plans may involve promoting partnerships among local communities, government agencies, and cultural institutions to guarantee efficient administration and conservation of the cultural environment. Adopting sustainable agricultural techniques, endorsing eco-friendly tourism efforts, and allocating resources to education and cultural exchange programs can enhance the long-term sustainability and vibrancy of the Cultural heritage landscapes in Yimeng. By taking proactive measures to tackle difficulties and make the most of possibilities, stakeholders can protect this distinctive cultural heritage for future generations while promoting economic growth and the well-being of the community.

Visitor Feedback and Improvement Opportunities. The category “Visitor Feedback and Improvement Opportunities” centers on the crucial function of gathering and scrutinizing feedback from tourists to better services, attractions, and overall visitor experiences. Through actively seeking and incorporating feedback, organizations, such as museums, parks, tourist sites, or any service-oriented entity, can pinpoint their strengths and weaknesses. This technique facilitates ongoing enhancement by identifying deficiencies in visitor satisfaction and adjusting offers to align with evolving tastes and expectations. Visitor comments can result in the creation of

novel exhibitions, upgraded signage, increased accessible features, or more captivating tour experiences. Utilizing this feedback not only assists in improving the operational aspects but also in generating more captivating and significant experiences for future guests, ultimately leading to enhanced satisfaction and repeated visits.

“Although I learned a lot from the display’s interactive features, I thought it would have been even more impactful if it had included additional anecdotes from locals to make the audience feel more connected to the area’s past.” [Male; more than 50 years old; East China Revolutionary Martyrs’ Mausoleum].

“For example, as a tourist, I think it would be great if there was more immersive and interactive technology that could let us virtually explore inaccessible places or use augmented reality to make historical events more vivid.” [Female; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

Anticipation of Technological Advancements. The term “Anticipation of Technological Advancements” pertains to the proactive prediction and readiness for future technologies that have the potential to greatly influence industries, society, and everyday life. This process of anticipation entails the identification of prospective innovations that may arise in the future, comprehending their consequences, and devising strategies to successfully incorporate new technologies. Keeping abreast of developments in artificial intelligence, biotechnology, renewable energy, and digital communication tools enables firms, governments, and individuals to quickly adjust and preserve a competitive advantage. By anticipating technology changes, organizations can leverage emerging capabilities to enhance operational efficiency, address intricate challenges, stimulate economic development, and elevate the overall standard of living. Adopting this progressive mindset is essential for success in a world that is becoming more and more technology-driven, with rapid changes and high expectations for innovation.

“I witnessed directly how anticipated technological improvements might greatly improve the presentation and comprehension of historical and cultural content.” [Female; less than 40 years old; Yimeng Revolutionary Memorial Hall].

“The usage of digital media was successful, but I feel that future additions may include augmented reality (AR) or virtual reality (VR) technologies to provide more immersive experiences. Such technologies could enable tourists to travel back in time and observe the landscape as it existed throughout various historical periods, as well as interact with digital recreations of historical individuals.” [Male; more than 50 years old; East China Revolutionary Martyrs’ Mausoleum].

“Anticipating and incorporating emerging technologies has the potential to alter visitor interaction, making historical learning more dynamic and participatory. This would not only boost interest and visitor numbers, but it would also improve the educational impact of such exhibitions, ensuring that they remain current and captivating in a quickly changing technological context.” [Female; between 40 and 49 years old; Mengliang Mountain Battle Memorial Hall].

Both older and younger visitors contributed to this theme, with particular emphasis from those aged under 40 and over 50 years, demonstrating intergenerational interest in how digital innovation can enhance heritage encounters. There was a slight overrepresentation of women in this theme, particularly in the anticipation of Technological Advancements, indicating that women may be more interested in interactivity or additional educational content. The Yimeng Revolutionary Memorial Hall and East China Revolutionary Martyrs’ Mausoleum were the most frequently visited, which may be a result of the existing digital devices at these two locations and recommendations for improvement in the future.

Discussion

The primary goal of this study is to investigate the perceptions, understanding, and attitudes of tourists towards the digitally showcased cultural environment of Yimeng, China. This study is unique because it is the first to analyze the red culture landscape of Yimeng by considering tourists’ knowledge, attitudes, and impressions. In addition, it utilizes theme analysis to explore human behavior in relation to cultural heritage landscapes, offering a distinctive method for comprehending the impact of digital displays on visitor engagement and interpretation of cultural property. The study introduces multiple novel approaches that enhance both theoretical understanding and practical use.

First, this research examines the impact of digital displays, which are a crucial element of computer-human interaction, on human understanding, attitudes, and perceptions about cultural heritage landscapes. This study seeks to further investigate the impacts of digital displays on human cognition and behavior, specifically within the context of cultural heritage landscape interpretation in Yimeng, China. It builds upon prior research in this field that has already studied the impact of digital technology on many elements of human cognition and behavior in cultural heritage landscape studies. Preparing research has shown that interactive and immersive digital experiences can improve learning outcomes by promoting greater engagement and retention of knowledge. In addition, this study intends to build a strong theoretical framework for its methodological approach and analytical interpretation by placing its research within the wider body of literature on digital technology and human cognition. This article seeks to enhance our comprehension of the intricate relationship between technology and culture by examining how digital displays impact human knowledge, attitudes, and perceptions of cultural heritage landscapes in Chinese concept.

Second, conserving the genuineness and cultural coherence of Cultural heritage landscapes, which are locations greatly influenced by socialism or communist beliefs, poses distinct difficulties and prospects that have gained recognition in tourist impressions. Tourists as visitors to these locations frequently desire an authentic encounter that provides understanding of the historical and ideological foundations of the regions. They have a tendency to prioritize places that preserve the original structures, propaganda materials, and communal

amenities that convey the socio-political history of the locality. The presence of authenticity not only enhances their trip experience but also facilitates their comprehension of the tremendous effects of these ideas on local communities and landscapes. This is consistent with prior research that highlights the significance of preserving cultural authenticity in order to establish a thorough and precise historical account. Academics contend that the conservation of these landscapes in their unaltered condition, encompassing monuments, murals, and even urban designs, plays a crucial role in comprehending previous governments and their socio-economic strategies²⁰. Moreover, previous studies supported the educational significance of these places, indicating that they can function as potent instruments for historical education and cultural introspection, empowering visitors to actively analyze the past^{21,22}. Nevertheless, the difficulty frequently arises in finding a proper equilibrium between the need of conserving historical monuments and the imperative of promoting economic growth, given that these locations also draw tourists, whose presence can occasionally result in excessive commercialization, thereby compromising the genuine experience.

Third, the study adds the influence of digital displays on tourists' understanding, opinions, and views of the cultural heritage landscape, specifically exploring emotional resonance and psychological implications. Digital displays used at cultural heritage sites have the distinct capacity to enhance tourist experiences by creating immersive and interactive learning environments that generate powerful emotional responses and increase psychological connection with the place. Prior research has confirmed that incorporating multimedia components, such as virtual reality and augmented reality, can greatly enhance emotional attachments to cultural narratives by enabling tourists to immerse themselves in historical events and cultural settings in a more captivating and individualized way²³. Li, Xie¹⁴ has shown that when tourists engage with these digital displays, their emotional engagement intensifies, resulting in a heightened enjoyment and comprehension of the offered cultural heritage. The emotional engagement is essential since it not only improves the immediate experience but also affects the long-term memory retention and the overall perception of the cultural site¹⁵. Moreover, the available literature has examined the psychological effects of these technologies, which encompass heightened empathy and an altered viewpoint towards cultural heritage landscape^{24,25}. This frequently results in a more sophisticated understanding and admiration for cultural heritage landscape.

Fourth, this study investigates the influence of digital displays on tourists' ability to recognize and appreciate the cultural heritage landscape. It is based on previous research that studies the impact of digital technologies on cultural heritage landscapes in general^{12,26}. Research has demonstrated that digital displays, including interactive kiosks, augmented reality apps, and virtual reality tours, can enhance tourists' comprehension and admiration of cultural heritage landscape. These technologies have the ability to vividly portray the history, importance, and intricacies of cultural heritage landscapes, hence promoting more involvement and awareness among visitors. Prior research has established that immersive encounters not only boost the acquisition of knowledge but also elevate the appreciation of cultural heritage²⁷. This is because tourists develop a more thorough awareness of its importance and are more inclined to support conservation initiatives. Research conducted in many cultural contexts has demonstrated that when individuals engage with digital displays that provide contextual information and describe the historical significance of a location, their understanding and admiration for both the physical and abstract elements of the culture are enhanced²⁸. This can result in increased cultural appreciation, as tourists recognize and appreciate the distinctiveness and significance of the landscape. It can also lead to an increase in the perceived value of maintaining certain landscapes.

Conclusion

This study provides meaningful insights into how visitors engage with and make sense of digital cultural exhibitions in the context of Yimeng's heritage landscape. Rather than attempting to measure changes in knowledge, attitudes, or behavior, the research focuses on subjective experiences, emotional responses, and interpretive reflections elicited by digital heritage encounters. Adopting a thematic analysis rooted in the KAP (Knowledge–Attitude–Perception) framework, this research suggests that digital technologies can contribute to transforming the museum-visit experience by enhancing understanding and cognitive engagement with history, eliciting emotional resonance, and fostering cultural identification. These results have important practical implications for cultural heritage managers, exhibition designers, policymakers, and technology developers. The results highlight the need for practitioners to create digital exhibitions that provide static information and actively stimulate interactive, emotionally engaging experiences. This can ultimately maintain visitor satisfaction, encourage returning visits, and enhance an emotional attachment to cultural conservation. The evidence presented here also serves as a case for policymakers and heritage institutions: investing in digital infrastructures is a strategy that contributes to making culture more democratic, while simultaneously overcoming generational and linguistic divides, and reinforcing the social and educational role of heritage sites. This study also provides specific suggestions for technology developers, focusing on developing inclusive, intuitive, and content-rich digital tools to appeal to users across a broad spectrum of digital literacy levels. Furthermore, our study's affective and behavioral responses suggest that digital storytelling with immersive visualization tools can catalyze raising the public's understanding and long-term support for cultural sustainability. The research provides valuable insights into digital heritage and visitor psychology in academic contexts, offering an actionable and timely roadmap for integrating digital innovation into cultural tourism planning. This ensures heritage landscapes remain relevant, engaging, and protected in an increasingly digital world.

Practical implications

The study's findings on the effects of digital displays on improving tourists' comprehension and admiration of cultural heritage landscapes have important practical implications. These insights are particularly relevant for cultural heritage managers, legislators, and technology developers. First and foremost, the results emphasize the significance of using digital technology into cultural tourism plans in order to enhance visitor experiences and

expand their comprehension of the cultural importance of landscapes. This can result in elevated satisfaction ratings and heightened user engagement, thus fostering recurring visits and favorable word-of-mouth, thereby boosting the site's reputation and visitor count. The study emphasizes the importance of creating well-designed digital exhibitions for heritage managers and curators. These exhibits should be accessible to a wide range of people, including those of varied ages, language abilities, and levels of technological proficiency. Furthermore, the findings indicate that digital displays should not alone provide information and education but also elicit emotional involvement from visitors. This will enhance their attachment to cultural heritage landscape and inspire them to actively contribute to conservation and preservation initiatives. This approach can be very impactful in securing financial resources and promoting legislative changes, since tourists who are actively involved and well-informed might potentially become strong supporters of preserving cultural heritage landscape. Furthermore, this research offers valuable insights to technology developers regarding the most impactful sorts of material and interactive elements in cultural settings. These findings can inform the creation of future digital tools that are both informative and captivating. Ultimately, this study provides policymakers with empirical evidence to justify the allocation of resources towards incorporating cutting-edge technologies in cultural institutions. It argues for the significance of digital upgrades in fostering cultural tourism and education. In summary, these practical consequences indicate that well executed digital displays can greatly improve the tourist experience while also advancing the protection and education of cultural heritage landscape in Yimeng, China.

Limitations

Lack of tourist origin specification Although we included a wide range of demographic details, the difference between domestic and overseas tourists was not highlighted in our analysis. The lack of this information may constrain the applicability of the results, particularly considering the growing trend towards a globalized form of cultural tourism, and the fact that cultural variations may exist in the comprehension of digital content.

Sample size and thematic saturation Although the study captured rich qualitative insights from 22 participants, a limited sample size may limit the generalizability of the findings to wider populations. The depth of understanding is high, but broader demographic inclusion could enhance the robustness of the findings.

Digital literacy divide Differences in terms of technological literacy, especially among the elderly, can impact the participants' engagement with digital exhibitions. For example, older and low-average digital literacy participants might use interactive features less frequently, leading to a possible participation bias in the results.

Digital literacy disparities Variations in technological proficiency—particularly across age groups—may affect participants' ability to engage with digital exhibitions. For instance, older participants or those with lower digital literacy might underutilize interactive features, introducing a potential participation bias in the findings.

Cultural specificities These findings are based on the socio-cultural environment of a Chinese heritage landscape and do not necessarily apply or transfer to other international and cross-cultural settings, as they are influenced by alternative interpretations, symbolic meanings, and expectations.

Technological obsolescence Since digital heritage tools are quickly evolving, some of the technological infrastructure analyzed may be obsolete. As new technologies (such as AI-generated narration, AR/VR, and spatial computing) continue to surface, the long-term significance of these findings might be limited.

Recommendations for future research

Include tourist origin In future research, it is crucial to differentiate between domestic and international tourists when profiling participants. This would allow for cross-cultural contrasts and increase the generalisability of results across other visitor groups or cultural settings.

Broaden the demographics of the participants A broadened array of survey participants, covering aspects such as age, geographical setting, digital literacy, and cultural background, would ensure a more inclusive and comparative understanding of how different segments perceive and interact with digital heritage.

Include larger and more varied samples A larger and more diverse sample will also enable us to achieve greater thematic saturation and compare whether certain themes are stronger within specific population segments (e.g., first-time vs. repeat, local vs. non-local).

Use mixed methods The use of quantitative measures (e.g., Likert-scale survey items about emotional impact or knowledge gains) can be employed to triangulate and support the qualitative findings, providing a more refined and complex analysis.

Longitudinal studies Tracking participants over time would enable researchers to assess the long-term impact of digital heritage displays on memory, perception, and cultural engagement beyond the immediate visit.

Integrate biometric and behavioral signals Techniques such as eye tracking, galvanic skin response (GSR), or facial emotion recognition can provide objective insights into users' attentional and emotional responses to digital features.

Pilot-test adaptive digital frameworks Testing should consider how cutting-edge technology, such as AI for storytelling, spatial computing, and personalization of digital content, can inform heritage interpretation to enable even richer experiences.

Economic and institutional outcomes of effort: Effective evaluation requires research on both institutional and economic consequences of effort, including but not limited to cost-effectiveness, scaling potential, and return on investment, for content-producing institutions.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Received: 3 March 2025; Accepted: 17 November 2025

Published online: 10 December 2025

References

1. Zhao, Y. et al. *The application of landscape character classification for Spatial zoning management in mountainous protected areas—A case study of Laoshan National park, China*. *Heliyon*, **9**(3), 1 (2023).
2. Li, X. et al. Evolution of cultural landscape heritage layers and value assessment in urban countryside historic districts: the case of Jiufeng Sheshan, Shanghai, China. *Herit. Sci.* **12** (1), 96 (2024).
3. Lu, Y. & Ahmad, Y. Heritage protection perspective of sustainable development of traditional villages in Guangxi, China. *Sustainability* **15** (4), 3387 (2023).
4. Zhang, X., Khachatryan, H. & Knuth, M. Relating knowledge and perception of sustainable landscape practices to the adoption intention of environmentally friendly landscapes. *Sustainability* **13** (24), 14070 (2021).
5. UNESCO. *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO, 2008).
6. Rössler, M. World heritage cultural landscapes: A UNESCO flagship programme 1992–2006. *Landsc. Res.* **31** (4), 333–353 (2006).
7. Pijet-Migoñ, E. & Migoñ, P. Geoheritage and cultural heritage—a review of recurrent and interlinked themes. *Geosciences* **12** (2), 98 (2022).
8. Li, J. et al. Spatiotemporal evolution characteristics and causative analysis of toponymic cultural landscapes in traditional villages in Northern Guangdong, China. *Sustainability* **17** (1), 271 (2025).
9. Song, H., Chen, J. & Li, P. Decoding the cultural heritage tourism landscape and visitor crowding behavior from the multidimensional embodied perspective: insights from Chinese classical gardens. *Tour. Manag.* **110**, 105180 (2025).
10. Chen, B., Nakama, Y. & Zhang, Y. Traditional village forest landscapes: tourists' attitudes and preferences for conservation. *Tour. Manag.* **59**, 652–662 (2017).
11. Sæþórsdóttir, A. D. & Ólafsdóttir, R. Not in my back yard or not on my playground: residents and tourists' attitudes towards wind turbines in Icelandic landscapes. *Energy. Sustain. Dev.* **54**, 127–138 (2020).
12. Cai, Z. et al. Joint development of cultural heritage protection and tourism: the case of Mount Lushan cultural landscape heritage site. *Herit. Sci.* **9** (1), 86 (2021).
13. Jangra, R., Kaushik, S. & Saini, S. S. An analysis of tourists' perceptions toward tourism development: study of cold desert destination, India. *Geogr. Sustain.* **2** (1), 48–58 (2021).
14. Li, Y. et al. Understanding different cultural ecosystem services: an exploration of rural landscape preferences based on geographic and social media data. *J. Environ. Manage.* **317**, 115487 (2022).
15. Zhou, J. et al. Cultural landscape perception of the Chinese traditional settlement: based on tourists' online comments. *Plos One*. **18** (4), e0283335 (2023).
16. Shen, K. & Yang, J. Residents' support for tourism amidst the COVID-19 era: an application of social amplification of risk framework and knowledge, attitudes, and practices theory. *Int. J. Environ. Res. Public Health*. **19** (6), 3736 (2022).
17. Hui, W. et al. *Inheritance of red culture and perception of tourism development in Yimeng under the background of cultural and tourism integration*. *J. Landsc. Res.*, **15**(6), 51 (2023).
18. Fan, L. Tourism resources and their characteristics in Shandong Province. *Resour. Data J.* **1**, 31–37 (2022).
19. Braun, V. & Clarke, V. Using thematic analysis in psychology. *Qualitative Res. Psychol.* **3** (2), 77–101 (2006).
20. Wu, S., Wu, N. & Zhong, B. What ecosystem services flowing from Linpan system—A cultural landscape in Chengdu Plain, Southwest China. *Sustainability* **12** (10), 4122 (2020).
21. Ivanović, S. et al. Cultural landscape management in context: local communities' perceptions under Jadar mineral extraction project in Serbia. *Extractive Industries Soc.* **16**, 101361 (2023).
22. Manca, S., Raffaghelli, J. E. & Sangrà, A. *A learning ecology-based approach for enhancing digital holocaust memory in European cultural heritage education*. *Heliyon*, **9**(9), 1 (2023).
23. Cheng, Y. et al. Effects of cultural landscape service features in National forest parks on visitors' sentiments: A nationwide social media-based analysis in China. *Ecosyst. Serv.* **67**, 101614 (2024).
24. Yang, C. & Liu, T. Social media data in urban design and landscape research: A comprehensive literature review. *Land* **11** (10), 1796 (2022).
25. Zhao, W. & Han, W. Examination of urban landscape aesthetics through mapping using geotagged social media data from Flickr. *Curr. Urban Stud.* **9** (01), 66 (2021).
26. Yang, C. & Han, F. A digital information system for cultural landscapes: the case of slender West lake scenic area in Yangzhou, China. *Built Herit.* **4** (1), 3 (2020).
27. Mantzou, P., Bitsikas, X. & Floros, A. Enriching cultural heritage through the integration of Art and digital technologies. *Social Sci.* **12** (11), 594 (2023).
28. Dongyi, K. Interpretation of the cultural landscape of the industrial heritage in the Ruhr area of Germany: hybrid industrial cultural landscape. *Landsc. Archit.* **27** (7), 18–29 (2020).

Author contributions

HSJ and NAI; methodology, software, validation, formal analysis, investigation, resources, and writing—original draft preparation: YL, TL, YB; data curation: JC and TW; writing—review and editing: YL, TL, YB; visualization: JC and TW; supervision, project administration, and funding acquisition: YL. All authors have read and agreed to the published version of the manuscript. All the authors have read and approved the final manuscript.

Funding

This research was funded by: Social Science Planning Research Project of Shandong Province, China [Research title: Research on Digital Presentation of Red Yimeng Cultural Landscape Art (22DWYJ20)]

Declarations

Ethics approval and consent to participate

The survey was conducted with the Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia approval. The research techniques were conducted in compliance with the applicable standards and regulations. Study participants were verbally informed of the goal, objectives, and their rights to participate, deny participation, or withdraw from the research activities. Respondents have been informed that the provided information is private and confidential, intended solely for academic reasons. Informed consent was obtained from all the participants.

Competing interests

The authors declare no competing interests.

Additional information

Correspondence and requests for materials should be addressed to Y.L.

Reprints and permissions information is available at www.nature.com/reprints.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

© The Author(s) 2025