

Article

Enhancing User Participation in Cultural Heritage through Serious Games: Combining Perspectives from the Experience Economy and SOR Theory

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Abstract: The dissemination and preservation of cultural heritage has attracted much attention globally, and serious games play an important role in cultural heritage dissemination and preservation; however, it is not clear which experiences of serious games are effective in increasing people's attention to cultural heritage. This study combines the experience economy and stimulus–organism–response (SOR) theory to construct a theoretical model to explore which experiences of serious games influence users' behavioral intention to care about cultural heritage. We surveyed 302 users who experienced serious games and analyzed the data and measurement model using SPSS 27 and partial least squares structural equation modeling (PLS-SEM). The results showed that the four experiences of serious games (educational, entertaining, escapist, and esthetic) had a significant effect on users' perceived value and memory and that perceived value and memory significantly influenced users' participation. In addition, this study found that the entertainment experience was not only a key factor influencing perceived value and memory, but also the most significant factor directly affecting user participation. This finding provides specific recommendations for game developers and cultural heritage organizations to enhance user engagement. Enhancing the four experience dimensions and strengthening users' perceived value and memory can effectively encourage users to pay attention to cultural heritage through serious games and contribute to the preservation and sustainable development of cultural heritage.

Keywords: cultural heritage; serious games; experience economy; SOR theory; perceived value; memory; participation

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1. Introduction

UNESCO defines cultural heritage as “the legacy of the past, a part of existing life, an irreplaceable source of life and inspiration” [1]. Cultural heritage is an asset that is passed on from one group or society to another over generations [2]. Its loss, either through degradation or disappearance, leads to the impoverishment of world heritage [3]. Enhancing the dissemination and preservation of cultural heritage has emerged as a global concern. Research indicates that serious games play a significant role in promoting and safeguarding cultural heritage [4–7]. By integrating the content of cultural heritage into serious games, it can help a wider audience understand and recognize the importance of cultural heritage. This interactive learning method is more attractive than traditional educational means and can effectively raise public awareness of cultural heritage protection [8]. However, Champion highlights that the full potential of serious games has yet to be realized. The current generation of serious games provides experiences that are insufficient in sparking public interest in cultural heritage [8–10]. Therefore, game developers and cultural heritage organizations need to understand the factors affecting user

experience and take steps to improve the gaming experience in order to attract users' attention to cultural heritage and promote its sustainable development [11]. Currently, research on serious games in the cultural heritage domain focuses on their role in promoting cultural heritage education [12–15]. However, it is still not clear enough which serious gaming experiences can effectively enhance users' attention to cultural heritage and their willingness to protect it. Therefore, it is crucial to undertake more comprehensive empirical studies in this field to address the existing research gap.

The experience economy theory, introduced by Pine and Gilmore, is widely applied in the realm of experiential studies [16]. The theory suggests that memorable experiences are more valuable than goods and services [17]. According to Pine et al., the experience economy is characterized as a method of engaging users and encouraging their active participation by crafting memorable experiences during specific events [18,19]. The experience economy theory categorizes experiences into four experience types: educational, entertaining, escapist, and esthetic [20]. The theory suggests that achieving all four realms simultaneously creates superior experiences [18,21–23], which in turn influences users' behavioral intentions [24]. Serious games are a prime example of the provision of these four experiences (educational, entertaining, escapist, and esthetic) [25–28]. Currently, no research evaluates the experiences offered by serious games related to cultural heritage through the lens of the experience economy theory [16,18]. Therefore, this study treats serious games as experiential products and utilizes the four dimensions of the experience economy theory to evaluate how the game experience influences users' behavioral intentions [29].

Furthermore, several studies have shown that perceived value is a crucial factor in determining the success or failure of an entire experience [30–32]. Chen, C. et al. argued that perceived value influences users' behavioral intentions [33,34]. Chen et al.'s findings suggest that perceived value is a mediating variable between the research experience and behavioral intentions [33]. Additionally, F. Ali et al. discovered that the four dimensions of the experience economy create strong memories for users, which in turn trigger positive behaviors [35,36]. Memory is considered as a mediating variable between user experience and behavioral intention [37]. These studies indicate that perceived value and memory are crucial mediating variables in understanding the relationship between user experience and behavioral intention.

The stimulus–organism–response (SOR) theory, proposed by Mehrabian and Russell in 1974 [38], explains how external environmental stimuli can influence an individual's internal state, subsequently leading to behavioral changes [10,39]. The theory can be used to explain how experiential stimuli from serious games can affect a user's experiential state and thus change the user's behavioral intention. Therefore, we developed an integrative framework by combining SOR theory with experiential economic theory. We define stimulus factors (S) as external environmental stimuli that influence users' behavioral intentions, summarized in the four experiences of serious games (educational, entertaining, escapist, esthetic). Organic factors (O) pertain to a user's internal emotional and experiential states, which are summarized in this study as perceived value and memory. Reaction (R), on the other hand, refers to the user's behavioral intentions, encompassing the actions that occur following changes in cognition and emotions due to internal and external stimuli. In this study, this is summarized as participation [40].

This research seeks to analyze which experiences of serious games influence users' behavioral willingness to pay attention to cultural heritage and to provide practical suggestions for the production of serious games for cultural heritage to promote their purpose of engaging users. Our goal with this study was to look into the following research questions: (1) How do the experiences of serious games influence users' behavioral intentions to pay attention to cultural heritage? (2) Which experiences have the most significant impact on users' behavioral intentions? (3) How can we distill focused opinions to inform the improvement in serious games centered on cultural heritage, building on a deeper understanding of these experiences?

In the subsequent research, we systematically reviewed the literature on serious games, cultural heritage, experience economy, and SOR theory. Based on this review, we developed a research model integrating the experience economy and SOR theory. Lastly, we discussed the significance and implications of the research findings.

2. Literature Review

2.1. Cultural Heritage and Serious Games

Cultural heritage is defined as the tangible and intangible legacy passed down from the past by a group or society [41]. Historically, cultural heritage was primarily understood in terms of tangible elements, such as artifacts, monuments, buildings, and historical sites. However, over time, the concept of cultural heritage has expanded to cover intangible heritage such as beliefs, customs, traditions, and the values and identities they carry [42,43]. In this paper, cultural heritage covers both tangible and intangible aspects.

In recent years, serious games have become a key area of interest for cultural heritage [44]. Serious games are considered to be a powerful tool for the effective maintenance and dissemination of tacit knowledge related to cultural heritage, as they are able to resonate with players through role-playing or storylines, leading to a deeper perception of historical events, different cultures, and the thoughts and behaviors of others [45]. Compared to traditional texts and images, serious games for cultural heritage provide visitors, especially the younger generation, with a more engaging experience, helping them gain a deeper insight into cultural heritage through modern digital technologies [46]. They also offer museums and cultural heritage organizations a novel approach to public communication, thus providing a crucial role in the conservation and dissemination of cultural heritage [5,47–49].

The term “serious games” (SG) was first introduced by Abt and refers to games that are not limited to entertainment but also include educational, military, healthcare, and public policy advocacy purposes [50,51]. These games are an effective learning and behavioral change tool that combine entertainment with functionality to convey information, develop skills, or solve real-world problems [52]. This study focuses on cultural heritage serious games, i.e., games that combine cultural heritage with serious games developed to preserve, recreate, and enhance the public appreciation of cultural heritage [25]. They play a crucial role in helping people to understand cultural heritage, particularly at sites that are unsafe or difficult to access [53]. These games emphasize the reconstruction of ancient buildings, historical restoration, and museum education and the preservation of cultural heritage [48,49]. The mechanics and dynamics of these games are designed around cultural heritage participation and cover both tangible and intangible cultural heritage [54].

Although serious games have significant positive social significance in cultural heritage presentation, education, and preservation, and are gradually becoming an emerging medium, their actual development faces many challenges. Currently, many cultural heritage serious games offer cultural communication experiences that fail to trigger widespread public participation and encourage further participation in the preservation and awareness of cultural heritage [10]. Game developers with a technical background may fail to fully understand what users want from their experiences with serious games. Therefore, it is vital to understand which serious game experiences increase user participation. This will help game developers and organizations to produce more impactful and appealing serious games that promote the spread and preservation of cultural heritage [55].

2.2. Experience Economy Theory

The experience economy not only provides products and services, but also creates experiences with value through its unique characteristics. Experiential marketing focuses on providing positive and pleasurable experiences by engaging users’ senses and emotions through creative activities [56]. According to Pine et al., the experience economy is

defined as a way of engaging users and inspiring active participation by creating memorable experiences at specific events [18,19]. The experience economy model proposed by Pine and Gilmore has become a widely recognized framework for understanding the value of experiences [57]. This theoretical framework covers four domains: education, entertainment, escapism, and esthetics. These domains are linked to the level of participation (passive versus active participation) and the type of experience (absorption versus immersion). Specifically, users experience entertainment and esthetics during passive participation, while they experience education and escapism during active participation [18].

The experience economy theory has been widely recognized and validated in different scenario studies [58]. Examples include esports gaming [59], tourism [16,23,60,61], cultural meta-universes [58,62], cultural heritage festivals [63,64], artistic performances [57], and museum experiences [65], amongst other diverse domains. These studies have identified the unique roles of the four types of experiences in experience economy theory and their effects on users' behavioral intentions in different contexts. However, there are no studies that have categorized the experiences in serious gaming scenarios from an experience economy perspective. In this study, the experiences provided by serious games are classified into four types from the experience economy theory: educational experience, wherein serious games provide opportunities to learn about history and culture; entertainment experience, wherein serious games provide fun and exciting cultural experiences; escapism experience, wherein avatars and time-traveling designs provided to users in serious games allow visitors to feel physically and mentally relaxed; and esthetic experience, wherein the graphics and esthetic atmosphere in serious games provide esthetic pleasure [18,59,66].

2.3. Stimulus–Organism–Response (SOR) Model

The stimulus–organism–response (SOR) theory, developed by Mehrabian and Russell in 1974, provides insight into how external stimuli in the environment act on an individual's internal states and trigger a range of behavioral changes [60]. Within the SOR framework, stimuli (S) refer to external factors that influence users' behavioral intentions, while the organism (O) encompasses the user's internal emotional and experiential states. Responses (R) are the behaviors that result from changes in cognition and emotions due to the interaction between stimuli and the organism. These behaviors can manifest as either approach or avoidance behaviors [67]. Approach behaviors include all active actions, such as exploration, staying, and participation, whereas avoidance behaviors involve the opposite actions, such as reluctance to engage in positive actions [38].

The application of SOR theory extends from consumer psychology [68], to gamification [69], the impact of gamification on consumer behavior [70], and service marketing [71]. Gatautis et al. explored the three-dimensional aspects of gamification and assessed their similarity to the SOR model. In gamification, game elements act as stimuli that alter the psychological state of consumers through game mechanics, thereby significantly influencing users' decisions and behaviors [10,70]. In addition, past studies have utilized extended SOR models to predict user behavior by incorporating other variables such as perceived value or memory [72,73]. Chang et al., using the SOR model, found that the more realistic tourists perceive their natural environment to be, the higher their perceived value, which in turn strengthens their intention to revisit [74]. For rural tourists, the SOR model demonstrated that rural destination attributes act as stimuli to deepen tourists' memories and promote their behavioral intentions to recommend and revisit [75]. Building on the above research, the goal of this study is to explore the application of the SOR model in the context of serious games. This study uses the experience of serious games as a stimulus, perceived value and memory as user perception factors, and user participation as the behavioral intention. This approach aims to extend the applicability of the SOR model within a gamified environment.

3. Hypothesis Development

3.1. Stimulus Factors (S)

Stimuli include elements of the external environment as perceived by people. In this study, serious gaming experiences are regarded as external stimuli that can trigger psychological traits and corresponding behavioral responses. These stimuli are categorized into four domains of the experience economy, namely education, entertainment, escapism, and esthetics.

3.2. User Perception (O) Perceived Value

Perceived value has been extensively studied in the field of experience [76,77]. Zeithaml defines perceived value as a user's overall evaluation of a product based on the perceptions seen and received [78]. Furthermore, perceived value has been recognized as an effective variable for predicting user behavior [79]. According to Pine and Gilmore, well-planned experiences can create value, including perceived value [80]. Schmitt states that customers usually recognize the high value of offerings when they create valuable experiences [81]. Poncin and Mimoun emphasize the importance of incorporating perceived value into the user experience because perceived value is effective in predicting user behavior and intentions. Scholars have begun to explore the application of perceived value in experience economy theory. Many empirical studies have used all or some of the four experiences of the experience economy and found evidence of their impact on perceived value [82].

For example, in Song et al.'s research, it was discovered that all four experiences—escapist, entertaining, esthetic, and educational—had an impact on tourists' perceived value [23]. In a study by Prebensen et al., it was also noted that educational, esthetic, escapist, and entertaining experiences were positively related to perceived value [34]. In mobile environments, Xu, Oh, and Teo's study supported that entertainment experiences have a positive influence on perceived value [83]. Agapity and Mugobi's study showed that escapist experiences positively impacted tourists' perceived value, which further contributed to tourism [84]. Xu et al. emphasized the importance of esthetic experiences on perceived value, stating that designers should focus on the interface design of an application to enhance its visual appeal [85]. According to the results of prior research, we developed four hypotheses (H) regarding the relationship between the four experiences and perceived value in serious games:

H1: *Educational experiences have a positive impact on users' perceived value.*

H2: *Entertainment experiences have a positive impact on users' perceived value.*

H3: *Escapist experiences have a positive impact on users' perceived value.*

H4: *Esthetic experiences have a positive impact on users' perceived value.*

3.3. User Perception (O) Memory

Memory is the ability to retain and consciously recall past events or experiences [86]. Numerous studies have examined the factors that influence user memory [35,37,66,87]. Manthiou et al. showed that memory is the residual part of an event after a sensory experience has taken place and is an integral part of any experiential framework [35]. Many studies have recognized the significance of experiencing events and resulting memories [88]. Research has shown that positive experiences that are particularly active and enhance immersion lead to vivid memories, which further trigger positive emotions [87]. This was confirmed by Manthiou et al., who noted that positive experiences enhance memory [35].

Loureiro et al. found that memory is an important mediator between experience economy and behavioral intentions in rural tourism [60]. Ali, F., Hussain, K., et al. found

that all four types (educational, entertaining, escapist, and esthetic) of vacation experiences positively affected tourists' memories [36]. Ivan K.W. Lai et al. found that in the area of cuisine experiences, all four domains of the experience economy affect visitors' memories [89]. J. Mykletun, R. et al. found that education, esthetics, and entertainment had a significant effect on memory in extreme sports [88]. Quadri-Felitti, D. L. et al. found that esthetics were highly correlated with memory for tourists [90]. E. Kastenholz and M.J. Carneiro et al. also demonstrated that escapism and the esthetic dimensions have a positive effect on tourists' memories [87]. Therefore, based on the results of previous studies, four hypotheses (H) related to the relationship between the four experiences of serious games and memory are proposed as the following:

H5: *Educational experiences have a positive impact on users' memory.*

H6: *Entertainment experiences have a positive impact on users' memory.*

H7: *Escapist experiences have a positive impact on users' memory.*

H8: *Esthetic experiences have a positive impact on users' memory.*

3.4. User Behavioral Intention (R)Participation

Watson and Waterton believe that merely understanding cultural heritage is not enough; people also need to care about it and be willing to take action to protect it [91]. In their study, Martinez et al. defined participation as a concept that includes behavioral, affective, and cognitive dimensions that influence users' motivation and emotional awareness to participate and carry out actions [92]. In a study by Camuñas-García et al., cultural heritage participation was defined as an individual's evaluation and response to cultural heritage, encompassing cognitive, emotional, and behavioral dimensions [54]. Therefore, the definition of participation in this study covers three facets: cognitive, emotional, and behavioral. In order to engage more with cultural heritage, users may show changes in the following dimensions: (a) cognitive dimension, wherein users will have a deeper understanding of cultural heritage and acquire more knowledge related to cultural heritage through various platforms and means; (b) emotional dimension, wherein users will pay more attention to cultural heritage and develop the emotions to disseminate and protect it; and (c) behavioral dimension, wherein users will make behavioral changes, such as spreading the idea of cultural heritage preservation or visiting actual sites of cultural heritage in person.

In their study, Sharma et al. stated that consumer-perceived value has a positive impact on participation [93]. Chen et al. discovered that perceived value mediates the connection between experience quality and behavioral use intentions [33]. Many tourism studies have shown that the perceived value of a tourism experience greatly influences a tourist's behavioral intention to revisit or participate in a similar experience in the future [94].

In addition, Tom Dieck et al. showed that three types of experiences—education, entertainment, and escapism—influence memory, and memory ultimately influences tourists' willingness to participate [24]. Ali, F. et al. noted that tourists' memories can significantly influence their behavioral intentions [37]. Therefore, based on the results of previous research, we developed two hypotheses (H) to explore the connections among user-perceived value, memory, and participation in cultural heritage:

H9: *Users' perceived value has a positive impact on their participation with cultural heritage.*

H10: *Users' memory has a positive impact on their participation with cultural heritage.*

3.5. Conceptual Model

In this study, a new modeling framework was constructed based on the SOR model and the experience economy model (Figure 1). The aim was to determine which external experiential stimuli of serious games influenced users' internal experiential states, including their perceived value and memory, leading to changes in users' behavioral intentions.

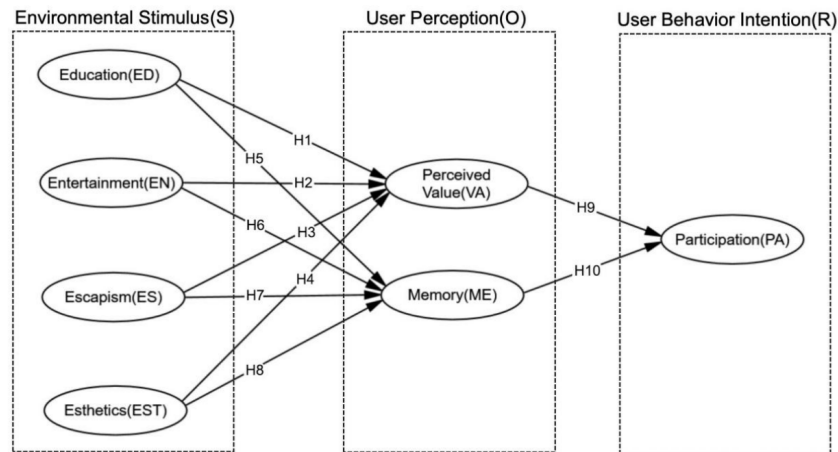


Figure 1. Proposed conceptual model.

4. Methods

4.1. Case Selection and Experimental Platform

The case selected for this paper was the Dunhuang “Digital Library Cave” (<https://dlc.e-dunhuang.com/>, accessed on 29 July 2024) serious game (Figure 2). The “Digital Library Cave” was jointly developed by Dunhuang Research Institute and Tencent Games and was launched on 19 April 2023. Using AI technology, a digital twin, game engine, and cloud game, the game uses Chinese-style modern brush painting art scenes to vividly recreate the historical scenes of a cave of Tibetan Buddhist scriptures from a hundred years ago, providing users with an immersive experience with 4K-level picture quality. The game won the “2023 Star of Excellence Award for Global World Heritage Education Innovation Cases” from UNESCO [95]. Choosing the right experimental platform was challenging, so we carefully considered the following six aspects:

1. **Inclusiveness**—The platform is available in domestic and international versions (providing multi-language versions in English, French, etc.), which is suitable for global users to experience.
2. **Advanced gaming technology**—Adopting cutting-edge AI technology, high-precision digital twins, game engine physical rendering, and global dynamic lighting and other cloud gaming technologies, the platform brings users a new cultural experience that is highly restorative, immersive, and low-threshold.
3. **Educational experience**—Through entertaining content and a narrative based on a rigorous historical background, users can enhance their understanding of Dunhuang’s cultural heritage and awareness of cultural inheritance.
4. **Entertainment**—Interactive games are designed to provide users with a fun and exciting cultural experience.
5. **Escapist experience**—The avatar and time-traveling design allow users to feel physically and mentally relaxed, providing an escapist experience.
6. **Esthetic experience**—4K film and television quality and exquisite oriental esthetic and historical scenes provide users with a high level of visual enjoyment.

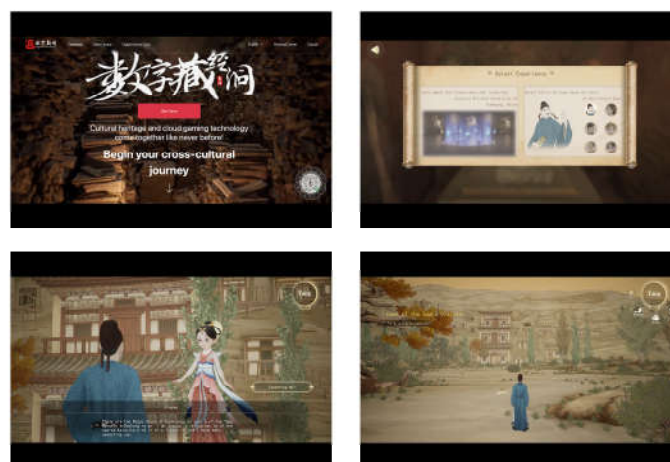


Figure 2. User experience and usage scenarios of the “Digital Library Cave” serious game.

4.2. Questionnaire Design

First of all, considering that some users may not have known much about the “Digital Library Cave” serious game, we introduced them to some background information about the “Digital Library Cave” game. Users could log in to experience the “Digital Library Cave” through the “Yunyou Dunhuang” app (AppID:wx619fcbb18be7ab70,) or the “Digital Dunhuang” website (<https://www.e-dunhuang.com/>, accessed on 29 July 2024). After logging in, users could enter the high-definition reproduction of the cave to see the details of the cave’s murals, colorful sculptures, and inscriptions up close [96]. After the experience, a follow-up questionnaire was conducted.

The second part of the questionnaire investigated the demographic characteristics of the respondents, including gender, age, education level, familiarity with the game, and frequency of traveling to cultural heritage sites.

The third part of the questionnaire consisted of 28 questions addressing seven variables: education, entertainment, escapism, esthetics, perceived value, memory, and participation. To ensure that the indicators were suitable for this study, all variables were measured using multiple scales adapted from the previous literature. The scales for education and entertainment were modified from the work of Lee et al. [16,65,97]. The scales for escapism and esthetics were adapted from Han et al. [30,65,97]. The perceived value scale was adapted from Darvishmotevali et al. [23,97]. The memory scale was adapted from Ding et al. [24,98]. And the participation scale was modified from the study by tom Dieck et al. [24,99]. All items were measured on a 7-point Likert scale ranging from “strongly disagree (1)” to “strongly agree (7)”.

Since most of the scales used in this study were in their original English versions, three professional English translators were invited to conduct several rounds of translation and proofreading before the questionnaires were sent out to minimize errors in translation. Before completing the questionnaire, all respondents signed an informed consent form to protect their rights to privacy. The list of questionnaire entries and references is shown in Table 1.

Table 1. Questionnaire scales and references.

Variable	Items/Issues	Ref.
Education (ED) (4 items)	ED1 I have learned about the “Library Cave”.	[16,65,97]
	ED2 It has sparked my curiosity to learn more about Dunhuang.	
	ED3 It provided me with a great learning experience.	

	ED4 This gaming experience has given me a deeper understanding of the history of the “Library Cave”.	
Entertainment (EN) (4 items)	EN1 I think this game is very fun. EN2 I think this game is entertaining. EN3 I think this gaming experience was enjoyable. EN4 I think this game fascinates me.	[16,65,97]
Escapism (ES) (4 items)	ES1 I felt like I played different roles. ES2 It took me away from the worries and stresses of real life. ES3 It made me imagine myself as someone else, as if I were in another world. ES4 I felt like I was living in a different time and place.	[30,65,97]
Esthetics (EST) (4 items)	AE1 The visual design of this game is very visually appealing. AE2 The music and narration of this game provide an auditory delight. AE3 I felt a sense of harmony in the overall atmosphere. AE4 I experienced both sensory and emotional engagement.	[30,65,97]
Perceived value (VA) (6 items)	VA1 This game itself is very valuable. VA2 Compared to the time I spent, experiencing the “Digital Library Cave” game was worthwhile. VA3 Compared to the effort I put in, experiencing the “Digital Library Cave” game was worthwhile. VA4 The experience of this game is fantastic. VA5 I like the “Digital Library Cave” game. VA6 I believe this game has a higher perceived value compared to other purely entertaining games.	[23,97]
Memory (ME) (3 items)	ME1 I have fond memories of this gaming experience. ME2 I will not forget this gaming experience. ME3 I will remember many positive aspects of this gaming experience.	[24,98]
Participation (PA) (3 items)	PA1 This gaming experience has prompted me to further explore the history and cultural knowledge related to the “Digital Library Cave” and Dunhuang. PA2 This gaming experience has created an emotional connection for me with the “Digital Library Cave”, making me want to learn more about it and stay updated with related information. PA3 This gaming experience has made me want to visit the real “Digital Library Cave” in Dunhuang.	[24,99]

4.3. Data Collection and Analysis

For the data collection in this paper, Questionnaire Star (<https://www.wjx.cn/>, accessed on 29 July 2024), a professional online survey platform in China, was used to create questionnaire links and QR codes online, invite users to fill out the questionnaire via WeChat (Version 8.0.50), QQ (Version 9.0.90.614), and other social media platforms, and collect the data via social media using snowball sampling techniques [100]. Participants who completed the questionnaire online were entered into a prize draw. The prizes included (1) 6.6 CNY WeChat red packets; (2) 8.8 CNY WeChat red packets; and (3) a thank you for joining. To minimize the limitations of the snowball sampling technique, we chose to distribute the questionnaire links through WeChat and QQ groups at the initial stage, rather than relying only on individual recommendations. Each respondent was asked to recommend people from different backgrounds to avoid a concentration of the sample on specific groups. All responses were filled out online immediately after participants

completed the “Digital Library Cave” serious game experience. Participation was voluntary and there was no conflict of interest throughout the process. A total of 317 questionnaires were collected for this study. After careful scrutiny by two researchers, 15 questionnaires were determined to be invalid. The final number of valid questionnaires was 302. The descriptive analysis of demographic information is shown in Table 2.

Table 2. Participant demographic information (n = 302).

Measure	Category	Frequency	Percent
Gender	Male	152	50.30%
	Female	150	49.70%
Age	<18	15	5%
	18–25	90	29.80%
	26–35	87	28.80%
	36–45	58	19.20%
	46–55	31	10.30%
	56–60	21	7%
Education	Junior high school and below	24	7.90%
	High school/secondary school	53	17.50%
	University college	82	27.20%
	University undergraduate	106	35.10%
	Postgraduate and above	37	12.30%
	Completely unfamiliar: never played	27	8.90%
Familiarity with online games	Slightly unfamiliar: rarely played	39	12.90%
	Medium: some experience	91	30.10%
	Familiarity: often played	115	38.10%
	Very familiar: play regularly	30	9.90%
	Never: never been	21	7%
How often tours of cultural heritage sites are undertaken	Rarely: once every few years	25	8.30%
	Occasionally: once a year	65	21.50%
	Frequently: several times a year	101	33.40%
	Very frequent: several times in six months	90	29.80%

5. Results

In this study, data were analyzed and models were measured using SPSS 27 and Smart PLS 4. PLS-SEM (Partial Least Squares Structural Equation Modeling), as a variance-based method, excels in dealing with complex models and is increasingly used in social science research [101]. It is more suitable for exploratory research and is able to model effectively under small sample conditions, making it well suited to deal with actually collected data [102]. Therefore, PLS-SEM was an ideal analytical tool for this study.

5.1. Model Fit

To ensure the reliability and validity of the findings, the measurement model was assessed for goodness of fit in this study. In the structural modeling of PLS-SEM, goodness of fit is used to measure the residuals and bias of covariates to assess the degree of fit of the constructed model. We used the standardized residual root mean square (SRMR) and the standardized fit index (NFI) to assess the goodness of fit of the structural model. The fit of the model was considered good when the SRMR value was ≤ 0.08 and the NFI value was ≥ 0.90 [103]. The model in this study had an NFI value of 0.90 and an SRMR value of 0.04, both of which met the standard thresholds (Table 3). This indicates a relatively good fit of the model.

Table 3. The results of the construct assessment.

Fit Index	Computed Value	Threshold	Reference
SRMR	0.049	≤ 0.08	Henseler et al. [104]
NFI	0.909	≥ 0.90	Gupta and Singharia [103]

5.2. Common Methodological Bias

Common method bias (CMB) is a potential problem that can be present in all questionnaire items, while the variance inflation factor (VIF) is commonly used as an indicator of multicollinearity in assessing formative characteristics. Higher VIF values indicate higher covariance, and VIF values should be close to 3.0 or lower [105]. The results of this study showed that the VIF values for all items ranged from 1.152 to 1.438, and these values were well below the threshold of 3.0, indicating the absence of multicollinearity problems (Table 4).

Table 4. Covariance diagnostics.

Path	VIF
ED → ME	1.152
ED → VA	1.152
EN → ME	1.374
EN → VA	1.374
ES → ME	1.371
ES → VA	1.371
EST → ME	1.438
EST → VA	1.438
ME → PA	1.233
VA → PA	1.233

5.3. Reliability and Validity Analysis

To assess the reliability and validity of the questionnaire, a factor analysis was conducted in PLS-SEM and Cronbach's alpha, composite reliability (CR), and AVE were calculated. Cronbach's alpha is used to measure the internal consistency or reliability among the items in a questionnaire, test, or survey. Typically, a Cronbach's α value greater than 0.7 indicates that a scale has good internal consistency [106]. Factor loading indicates the correlation coefficient between an observed variable and a latent factor, reflecting the proportion of the factor's contribution to the variance in the explanatory variable. Factor loadings greater than 0.7 are usually regarded as high correlations, indicating a strong correlation between the observed variable and the underlying factor [107].

The Cronbach's α values and composite reliabilities (rho_a and rho_c) for this measure were both greater than 0.7, indicating that the questionnaire entries had good reliability [108]. In addition, the factor loadings and CRs of the measured variables for each dimension exceeded 0.7, and the AVEs were all greater than 0.5; thus, the scale had sufficient convergent validity [109]. Therefore, all the constructs in the model showed sufficient reliability and convergent validity to support the validity of the research questionnaire (Table 5).

Table 5. Reliability and validity analysis.

	Variable	Factor Loading	AVE	CR (rho_a)	CR(rho_c)	α
Education (ED) (4 items)	ED1	0.932	0.854	0.945	0.959	0.943
	ED2	0.932				
	ED3	0.933				
	ED4	0.9				

Entertainment (EN) (4 items)	EN1	0.952				
	EN2	0.909				
	EN3	0.913	0.852	0.944	0.958	0.942
	EN4	0.916				
Escapism (ES) (4 items)	ES1	0.95				
	ES2	0.906				
	ES3	0.899	0.835	0.937	0.953	0.934
	ES4	0.899				
Esthetics (EST) (4 items)	EST1	0.946				
	EST2	0.905				
	EST3	0.906	0.835	0.935	0.953	0.934
	EST4	0.898				
Perceived value (VA) (6 items)	VA1	0.96				
	VA2	0.924				
	VA3	0.905				
	VA4	0.916	0.864	0.970	0.974	0.968
	VA5	0.936				
	VA6	0.936				
Memory (ME) (3 items)	ME1	0.911				
	ME2	0.904	0.831	0.899	0.937	0.898
	ME3	0.92				
Participation (PA) (3 items)	PA1	0.958				
	PA2	0.935	0.902	0.946	0.965	0.946
	PA3	0.956				

Note: α = Cronbach's alpha.

As shown in the analysis results in Table 6, the standardized correlation coefficients between the dimensions were all lower than the square root of the AVE for their respective dimensions, indicating good discriminant validity [108].

Table 6. Discriminant validity (Fornell–Larcker criterion).

	ED	EN	ES	EST	ME	PA	VA
ED	0.924						
EN	0.313	0.923					
ES	0.285	0.377	0.914				
EST	0.226	0.451	0.463	0.914			
ME	0.465	0.465	0.423	0.45	0.912		
PA	0.246	0.39	0.377	0.451	0.432	0.95	
VA	0.304	0.486	0.41	0.454	0.434	0.457	0.93

Note: The number on the diagonal is the square root of the average variance (AVE).

Second, all the heterogeneous trait–monomorphic trait correlation ratios (HTMT) in Table 7 were below 0.85. The cross loadings of the indicators in Table 8 were higher than those of their corresponding variable indicators. Therefore, combining the analyses of these three indicators, we concluded that the model in this study had good discriminant validity [108].

Table 7. Discriminant validity (HTMT values).

	ED	EN	ES	EST	ME	PA	VA
ED							
EN	0.331						

ES	0.302	0.4				
EST	0.24	0.48	0.497			
ME	0.505	0.505	0.461	0.49		
PA	0.261	0.412	0.4	0.481	0.468	
VA	0.318	0.507	0.43	0.476	0.463	0.477

Table 8. Discriminant validity (cross loadings.).

	ED	EN	ES	EST	ME	PA	VA
ED1	0.932	0.331	0.289	0.229	0.412	0.23	0.293
ED2	0.932	0.28	0.264	0.21	0.447	0.237	0.296
ED3	0.933	0.323	0.29	0.233	0.443	0.243	0.279
ED4	0.9	0.222	0.209	0.163	0.417	0.198	0.255
EN1	0.298	0.952	0.349	0.46	0.453	0.377	0.478
EN2	0.287	0.909	0.363	0.416	0.422	0.386	0.457
EN3	0.24	0.913	0.339	0.399	0.407	0.319	0.402
EN4	0.328	0.916	0.34	0.386	0.431	0.353	0.454
ES1	0.294	0.388	0.95	0.444	0.418	0.383	0.4
ES2	0.283	0.313	0.906	0.424	0.379	0.348	0.378
ES3	0.227	0.367	0.899	0.385	0.39	0.333	0.366
ES4	0.234	0.304	0.899	0.441	0.354	0.309	0.352
EST1	0.23	0.435	0.436	0.946	0.415	0.435	0.407
EST2	0.174	0.424	0.446	0.905	0.389	0.436	0.399
EST3	0.232	0.381	0.386	0.906	0.415	0.393	0.41
EST4	0.19	0.408	0.426	0.898	0.423	0.388	0.444
ME1	0.41	0.43	0.399	0.405	0.911	0.372	0.36
ME2	0.432	0.432	0.374	0.41	0.904	0.366	0.38
ME3	0.431	0.41	0.383	0.414	0.92	0.441	0.446
PA1	0.22	0.39	0.392	0.421	0.425	0.958	0.438
PA2	0.262	0.339	0.341	0.42	0.399	0.935	0.422
PA3	0.221	0.381	0.34	0.445	0.407	0.956	0.443
VA1	0.311	0.484	0.383	0.45	0.426	0.44	0.96
VA2	0.266	0.442	0.36	0.396	0.403	0.418	0.924
VA3	0.283	0.437	0.37	0.386	0.365	0.379	0.905
VA4	0.258	0.48	0.427	0.454	0.426	0.443	0.916
VA5	0.308	0.404	0.363	0.398	0.373	0.409	0.936
VA6	0.271	0.46	0.38	0.442	0.423	0.456	0.936

5.4. Hypothesis Testing

Path coefficients and p -values were calculated for this study based on a sample of 302 participants. According to Table 9 and Figure 3, all hypotheses were supported (** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$) [110].

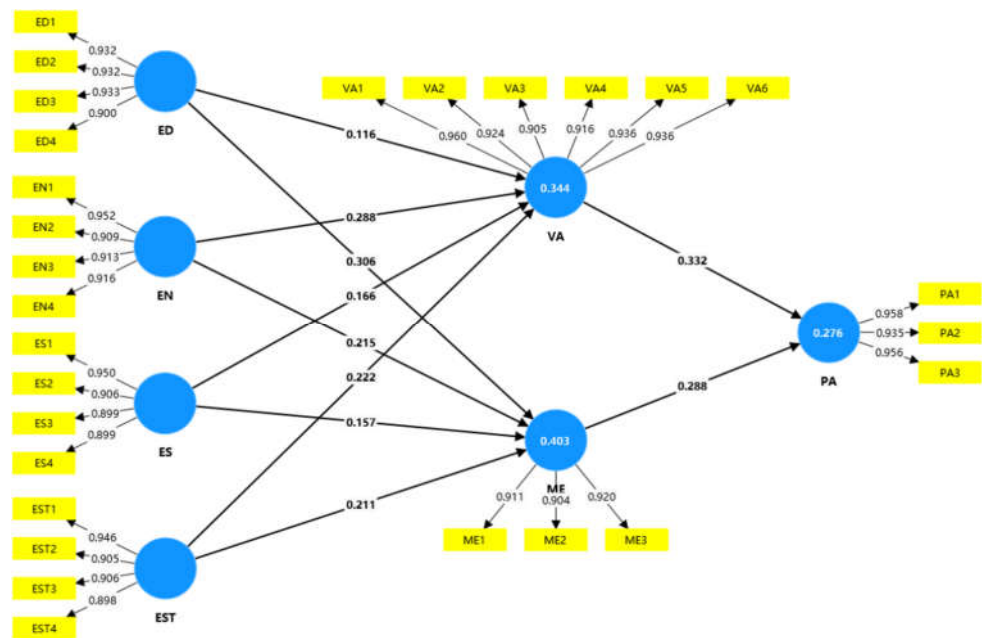


Figure 3. Results of the PLS structural model.

In the “Digital Library Cave” serious game, educational experience ($\beta = 0.116$, $p < 0.05$), entertaining experience ($\beta = 0.288$, $p < 0.001$), escapist experience ($\beta = 0.166$, $p < 0.01$), and esthetic experience ($\beta = 0.222$, $p < 0.001$) had a positive effect on the perceived value. This supports hypotheses H1, H2, H3, and H4, where the entertainment experience of the game had a particularly significant effect on the perceived value.

In addition, educational experience ($\beta = 0.306$, $p < 0.001$), entertaining experience ($\beta = 0.215$, $p < 0.001$), escapist experience ($\beta = 0.157$, $p < 0.05$), and esthetic experience ($\beta = 0.211$, $p < 0.001$) all positively influenced memory. This supports hypotheses H5, H6, H7, and H8, where the educational experience of the game had a particularly significant effect on memory.

Finally, both perceived value ($\beta = 0.332$, $p < 0.001$) and memory ($\beta = 0.288$, $p < 0.001$) had a significant effect on participation, which supported hypotheses H9 and H10; therefore, the model was validated (Figure 3).

Table 9. Hypothesis testing summary.

Hypothesis	β	SD	t-Value	p	Result
H1: ED $\rightarrow$ VA	0.116	0.055	2.119	0.034	Supported
H2: EN $\rightarrow$ VA	0.288	0.066	4.389	0.000	Supported
H3: ES $\rightarrow$ VA	0.166	0.056	2.95	0.003	Supported
H4: EST $\rightarrow$ VA	0.222	0.057	3.912	0.000	Supported
H5: ED $\rightarrow$ ME	0.306	0.05	6.142	0.000	Supported
H6: EN $\rightarrow$ ME	0.215	0.061	3.533	0.000	Supported
H7: ES $\rightarrow$ ME	0.157	0.062	2.53	0.011	Supported
H8: EST $\rightarrow$ ME	0.211	0.06	3.54	0.000	Supported
H9: VA $\rightarrow$ PA	0.332	0.064	5.191	0.000	Supported
H10: ME $\rightarrow$ PA	0.288	0.065	4.402	0.000	Supported

5.5. Mediation Analysis

According to the existing literature, when the 95% confidence interval obtained through bootstrapping does not include zero, the mediating effect is considered significant [111]. In this study, the 95% confidence intervals for the relationships between

education (ED), entertainment (EN), escapism (ES), esthetics (EST), and participation (PA) all excluded zero, indicating that the mediating effects of perceived value (VA) and memory (ME) were significant in these pathways (Table 10). To more clearly illustrate the strength of these mediating effects, we used the Variance Accounted For (VAF) measure in PLS-SEM. This measure evaluates the size of the mediating effect by calculating the ratio of the indirect effect to the total effect, defined as $VAF = ab/c$ [112]. When $20\% < VAF < 80\%$, this indicates a partial mediation effect, while when $VAF > 80\%$, this indicates a full mediation effect. Based on the presented results, we found that the four experiences of education (ED), entertainment (EN), escapism (ES), and esthetics (EST) not only directly affected participation (PA), but also played a partially mediating role through perceived value (VA) and memory (ME).

Education played a partial mediating role through perceived value and memory, explaining 31% and 69% of the variance, respectively; entertainment played a partial mediating role through perceived value and memory, explaining 61% and 39% of the variance, respectively; escapism played a partial mediating role through perceived value and memory, explaining 55% and 45% of the variance, respectively; and esthetics played a partial mediating role, explaining 55% and 45% of the variance, respectively.

Table 10. Direct and indirect effects.

	Path	β	SE	t-Value	p	2.50%	97.50%	Supported	VAF
ED: Direct effect	ED → PA	0.127	0.03	4.244	0.000	0.068	0.185	Yes	
ED: Indirect effect	ED → VA → PA	0.039	0.019	2.045	0.041	0.004	0.078	Yes	0.31
	ED → ME → PA	0.088	0.024	3.698	0.000	0.045	0.138	Yes	0.69
EN: Direct effect	EN → PA	0.157	0.033	4.753	0.000	0.093	0.224	Yes	
EN: Indirect effect	EN → VA → PA	0.096	0.029	3.256	0.001	0.043	0.158	Yes	0.61
	EN → ME → PA	0.062	0.024	2.526	0.012	0.021	0.117	Yes	0.39
ES: Direct effect	ES → PA	0.1	0.032	3.179	0.001	0.045	0.167	Yes	
ES: Indirect effect	ES → VA → PA	0.055	0.023	2.398	0.017	0.016	0.105	Yes	0.55
	ES → ME → PA	0.045	0.022	2.075	0.038	0.01	0.095	Yes	0.45
EST: Direct effect	EST → PA	0.134	0.034	3.998	0.000	0.075	0.204	Yes	
EST: Indirect effect	EST → VA → PA	0.074	0.026	2.819	0.005	0.029	0.132	Yes	0.55
	EST → ME → PA	0.061	0.025	2.443	0.015	0.019	0.115	Yes	0.45

6. Discussion

Based on the experience economy and SOR theory, this study explored how external experiential stimuli from serious games affected users' experiential states and thus their behavioral intentions. We categorized external experiential stimuli from serious games into four experience types: educational, entertaining, escapist, and esthetic experiences. Users' experiential states were included as the perceived value and memory, and users' behaviors were summarized as participation. This conceptualization provided us with an analytical framework and also laid the foundation for explaining how these experiential features enhanced users' behavioral intentions by influencing their experiential states. The results of this study support our initial hypothesis that the four experiences of serious gaming—educational, entertaining, escapist, and esthetic—significantly affect users' perceived value and memory, thereby significantly increasing their participation. A number of key findings were obtained from the results analyzed in this empirical study.

6.1. Discussion of Research Results

Firstly, the research results validated hypotheses H1, H2, H3, and H4, indicating that educational experiences, entertaining experiences, escapist experiences, and esthetic experiences, as external stimuli, all positively impacted users' perceived value in the "Digital Library Cave" serious game. Among these, the entertainment experience of the serious game had the most significant effects on users' perceived value. This finding aligns with the research findings of Petrick and Tonne [113]. Previous research has also emphasized the importance of fun in serious games, noting that these games are designed to use "fun" to facilitate the effective learning of "serious" knowledge. These games must be entertaining; otherwise, they will fail to provide the participation and motivation needed to encourage learning [10,42]. Secondly, esthetic experiences also have a significant impact on users' perceived value. Prior research has demonstrated that esthetics are necessary for the perception of learning in serious games and serve as a design component that improves the perceived enjoyment of games [114]. Educational experiences also positively affect perceived value, consistent with the findings of Song et al. [23]. Although escapist experiences positively impact perceived value, their influence is not the most significant. This differs from the findings of a prior study by Lee et al., which identified escapism as the most important experience [16]. This discrepancy may be due to the current serious games containing more passive, fixed content delivery, lacking immersion. In the future, incorporating advanced technologies such as VR and AR and adding self-exploration elements can make the game environment more realistic and vivid, enhancing immersion and interactivity.

Secondly, hypotheses H5, H6, H7, and H8 were validated, indicating that educational experiences, entertainment experiences, escapist experiences, and esthetic experiences as environmental stimuli all positively impacted users' memory in the "Digital Library Cave" serious game. Among these, educational experiences had the most significant impact on users' memory, in line with the results of Tom Dieck et al. [24]. As a key feature of serious games, educational experiences enhance the memory of cultural heritage by imparting knowledge and thought processes related to it, enabling participants to acquire new skills and knowledge. Christopoulos et al. also pointed out that serious games are more complex to produce than conventional video games because they have to be both engaging and educational. For instance, cultural heritage serious games must render environments and architectural heritage in a visually appealing way comparable to modern video games while ensuring the content is historically accurate [115]. Additionally, the entertainment experiences of serious games significantly impact users' memory, aligning with Mykletun et al.'s findings that entertainment experiences are significant predictors of memory [88]. Other studies have demonstrated that esthetic stimuli have a significant impact on memory. E. Kastenholz et al. pointed out that esthetic experiences positively influence memory promotion [35,87]. In contrast, escapist experiences had a weaker impact in this study, consistent with Tom Dieck et al.'s findings that escapist experiences have the least influence on memory [24].

Finally, this study validated hypotheses H9 and H10, indicating that users' perceived value and memory had a meaningful impact on user participation, which is consistent with prior studies [34,60,93]. Among them, the effect of perceived value was higher than memory, which is in line with the results of J.F. Petrick et al. [94]. In addition, the four types of external experiential stimuli, namely educational, entertaining, escapist, and esthetic, not only affect participation by influencing users' perceived value and memory, but also can directly influence users' behavioral intention. This suggests that external experiential stimuli have multiple mechanisms of action in enhancing user participation. By optimizing these four experiential dimensions of cultural heritage serious games, users' perceived value and memory can be increased, thus improving their participation. This study's findings showcased the capacity of serious games to augment user engagement with cultural heritage. By utilizing serious games for cultural heritage, users are able to immerse themselves in all facets of cultural heritage, fostering a greater interest and

appreciation for it. Consequently, this motivates users to actively contribute to its preservation [54].

It is worth noting that the entertainment experience is not only a critical element that influences perceived value and memory, it is also the most important factor that directly affects user participation. Therefore, when designing a serious game for cultural heritage, the first step should be to satisfy users' needs for an entertainment experience. Rewards such as game coins, unlocked levels, and site tickets can be provided to increase users' perceived value and memory, thus increasing their willingness to participate. Secondly, the educational experience can be combined with the entertainment experience to teach and entertain, increase users' perceived value, and create a positive experience that strengthens their memories and leaves them with fond memories. Developers should also focus on the esthetic experience, incorporating unique local art styles to enhance visual appeal and brand impression. Digital twin technology can be used to ensure that the buildings, landscapes, and props in a game are historically accurate and maintain a high level of visual realism. For example, the complexity and importance of cultural heritage protection work can be visualized by simulating ancient building restoration or archaeological excavation. This experience can stimulate users' interest and sense of responsibility in cultural heritage protection and promote their support of and participation in cultural heritage protection actions in real life [116]. Finally, the escapist experience is enhanced by the creation of immersive environments. Using advanced digital technologies like VR, AR, and 3D modeling to build virtual worlds and digitally reproduce cultural heritage, it is possible to display and experience cultural heritage in a virtual environment. This not only helps in the dissemination and promotion of cultural heritage, but also preserves the digital record of cultural heritage as a means of preservation in case it is physically damaged or disappears [43,117]. Using emotional narratives and real historical events, the concept of sustainable development can be conveyed through game plot and design, allowing player choices to influence story development and enhancing immersion and interactivity. For example, games can simulate situations in which cultural heritage suffers from environmental changes, urbanization processes, or human destruction, thus leading players to think about how to achieve the sustainable conservation of cultural heritage in modern society. The development of such awareness can contribute to the formation of a broader societal consensus to promote policies and actions for sustainable development [118]. Through these means, serious games for cultural heritage can provide entertainment while realizing the purpose of education and cultural heritage preservation.

6.2. Significance

Firstly, this study combined stimulus–organism–response (SOR) theory and experience economy theory at the theoretical level to construct a new research framework. Second, this study classified serious game experiences into four categories, education, entertainment, escapism, and esthetics, which was the first time that the experience economy theory was applied to the field of serious games and fills the gap of experience economy theory in this field. Finally, using the Dunhuang “Digital Library Cave” serious game as a case study, this study provides a reference for other cultural heritage organizations in designing serious games, demonstrating the possibility of using serious games as a marketing and communication tool. Serious games are not only an important medium for communicating cultural heritage, but can also be utilized as a pre-promotional tool for cultural heritage tourism. By introducing new perspectives and analytical frameworks, this study advances research on enhancing users' willingness to pay attention to and behave towards cultural heritage and broadens the scope of research related to cultural heritage communication and education. Serious games on cultural heritage can be a useful instrument to increase people's knowledge in actively contributing to the protection of cultural heritage, stimulating more attention to and appreciation of cultural heritage, so as to improve the sustainable development of cultural heritage [119]. Simultaneously,

games with cultural heritage themes can stimulate connected travel and help to support conservation economically [8].

On a practical level, this study proposes the following specific guidance: game developers should focus on enhancing four experience dimensions in their future designs. Firstly, there is a need to enhance the entertainment experience of serious games to satisfy the basic entertainment needs of users and to promote a more direct and effective perception and memory of these experiences. Combine the entertainment experience with an educational experience to teach and entertain. Second, designers should pay attention to the game's esthetic experience. Addressing user preferences for game design and esthetic quality is critical, as these factors significantly influence their perceptions. Integrating the game's visual interface with the style of the cultural heritage and ensuring its uniqueness can enhance the overall user experience and memory points. Finally, designers should use advanced science and technology to enhance the user's escapism experience and introduce and promote cultural heritage in an engaging way. This strategy can help cultural heritage organizations to attract younger users and deepen their emotional connection with cultural heritage, increasing user participation and awareness of the need to protect cultural heritage.

In addition, cultural heritage institutions and game designers should work closely together to enhance the perceived value and memory of users. Designers need to understand the user's experiential expectations and combine them with the information and motivation provided by the cultural heritage institution to ensure that the game is engaging. In addition, successful game design requires interdisciplinary collaboration, including historians, educators, screenwriters, software developers, and art and sound designers.

7. Conclusions

This research was organized around three core research questions. Firstly, by combining SOR theory and experience economy theory, a new model was constructed and measured and tested. The findings showed that all four external experiential stimuli (education, entertainment, escapism, and esthetics) of serious games significantly affected users' experiential states, including their perceived value and memory, which significantly affected users' behavioral willingness to pay attention to cultural heritage. Second, the finding that the entertainment experience was the most influential element on perceived value suggests that users' basic entertainment needs must be met before they can be led to further participation. Educational experience was the most significant factor affecting memory, indicating that a quality educational experience could leave a deep impression on users and deepen their learning memory of cultural heritage knowledge. Finally, these findings provide targeted recommendations for serious game designers in the future. By reinforcing these four experiences and strengthening the perceived value and memory of users in these experiences, users can be effectively encouraged to pay attention to cultural heritage through serious games and increase their participation, thus stimulating more people's interest and sense of responsibility in the conservation of cultural heritage and helping to comprehend the sustainable development of cultural heritage.

Limitations and Future Research Directions

The existing limitations of this research are as follows. Firstly, the research participants were from similar cultural backgrounds, which limited the generalizability of the results to some extent. Future research could expand the data sources to cover participants from different cultural backgrounds in order to explore differences and similarities with the results of the present study. Second, the data gathering in this research involved only one serious game, and future studies should expand the scope to include serious games from different countries or different cultural organizations to test the findings of this research. In addition, this research classified the experience of serious games into four categories, and future research could further subdivide these experiences, involving

conducting interviews through qualitative research methods, refining the factors that affect users' game experience, and then verifying them through quantitative research methods. Finally, future research should also delve into other communication methods that enhance attention to cultural heritage, e.g., exploring the promotional effects of the Netflix economy and modern Internet platforms (e.g., Jitterbug, Instagram, etc.), as well as replicating real-life cultural heritage in metaverse environments to create virtual tourism experiences.

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