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Preserving China's Intangible Cultural Heritage through AR/VR storytelling, social media, and AI narratives

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Intangible Cultural Heritage (ICH) has always been a major component of cultural identity and its safeguarding through digital technologies has also been developing. The current research merges the Technology Acceptance Model (TAM) witeth Media Richness Theory (MRT) to emphasize the increasing public acceptance of digital ICH experiences using Alternate Reality/Virtual Reality (AR/VR) storytelling, social media participation, and AI-produced narratives. A mixed-methods research design was applied in which the quantitative part consisted of surveying 350 digital ICH-aware participants and the qualitative part included conducting semi-structured interviews with 15 respondents. Thematic analysis was implemented on their responses to provide depth of experience. The findings indicate that the key facilitators and barriers demonstrated immersive and perceived usefulness of the technology and users' attitudes influenced mainly by authenticity. Therefore, the research provides both theoretical and policy-based solutions on how ICH can be best promoted, or even preserved, through the different digital technologies used.

Certainly, the globalization process and technical innovation have made the situation very difficult concerning the transmission, recognition, and conservation of Intangible Cultural Heritage (ICH). ICH describes the whole spectrum of social practices rituals, performing arts, craftsmanship, and oral traditions which give a particular community its cultural identity[1]. ICH, in contrast to the tangible heritage like buildings, sculptures, and artifacts is "living" and continues to be practiced and passed on in the community[2]. Urbanization and modernization have, however, led to fewer young people getting involved, thereby pushing a lot of these traditions to the brink of extinction[3]. According to reports, globalization, industrialization, and lack of proper documentation account for more than 40% of the world's ICH elements being endangered[4]. In the case of China, which has 43 UNESCO-recognized ICH elements, practices such as Peking opera, paper cutting, and embroidery are now in need of revitalization efforts at the national level[5]. The establishment of policies such as the ICH Law of the People's Republic of China (2011)[6] has not succeeded in removing all the barriers stemming from dwindling numbers of practitioners, poor youth engagement, and digital consumerism[7]. Hence, there is a growing trend to employ digital technologies, including AR, VR, AI-based storytelling, and social media, as tools to facilitate the safeguarding and advancement of ICH.

Digital communication tools designed for cultural heritage preservation have gained worldwide momentum. For developing public engagement in traditional crafts and performing arts, Japan and South Korea have adopted various tools, particularly AI storytelling and virtual museum experiences[8,9]. The National Gugak Center of South Korea has developed VR applications for experiencing traditional Korean music and performances, thereby contributing to an increased youth audience for ICH appreciation of over 60% over the past five years[10]. UNESCO and Google Arts & Culture are working together to create virtual heritage tours that will allow audiences around the world to interact with rare cultural traditions[11]. In China, major tech companies like Tencent and Alibaba have backed many digital heritage projects, such as the ongoing AI restoration of Dunhuang cave murals and Peking Opera performances enhanced with VR[12], which together gathered millions of online viewers. In this respect, the potential of digital ICH experiences in becoming a vehicle for cultural appreciation and public engagement remains underexplored.

The combination of ICH preservation and the UNSDGs not only the identity issue but also the wider scope of cultural safeguarding[13]. Both SDG 4 and SDG 11 put stress on the very fact that cultural resources need to be protected and even improved in order to foster sustainable development. China acknowledges this as a priority and, through Digital China, which

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uses advanced technology for the purpose of cultural heritage preservation and promotion, it takes the lead in this area[14]. Yet, the digital world poses a dilemma concerning the quality of experience, access, and interaction being able to take place[15]. AR/VR storytelling, underpinned by AI narratives, has attracted massive interest but on the other hand it can also lead to cognitive overload and consequently raise doubts about authenticity thus fueling the ongoing debate on the acceptability of such platforms in the future. Understanding public perceptions of digital ICH and the motivations behind technology use is therefore essential for successful program implementation. As digital interventions increasingly shape cultural sustainability, researchers have examined various media and immersive formats to enhance diffusion and protection of ICH. Shen[16] notes that text–image combinations, data visualizations, and interactive media are particularly effective storytelling formats, as different media forms shape cultural attitudes and levels of participation.

An increasing interest in digitalization's role in rural development and the cultural industry is seen in research analysing bibliometric data from 2003-2020 in ICH studies in China, emphasising digitisation as a means of economic and social regeneration beyond mere preservation. Creating a theoretical framework of the digital development of the crafts under ICH based on the state information in local databases, He and Wen[17] determined such essential enablers as management capacity, platform development, education, and community involvement. Their digital growth typology, which has been divided into three categories of primary, secondary, and fusion shows that technological advancement, promotes the sustainability of ICH crafts and their transmission. Additional tests are done on certain technology-based test platforms in the context of preserving ICH. Mehta and Kukreja[18] have shown that VR performs significantly better than traditional content environments in facilitating interaction and knowledge creation, thereby helping to sustain the tradition of bridge diving at Stari Most. Tang and Zhang[19] created interactive holographic technology with LCOS projection technology which discloses the potential to be used as high reliability immersive visualization of cultural objects. On the same note, Wen et al.[20] used UTAUT2 to examine the use of AR/VR in heritage tourism and discovered that price value and facilitating condition were essential in the use of technology. Yan[21] examined the capability of mixed reality (MR) to support the sense of narrative and cultural identification, observing that cultural authenticity and narrative coherence are necessary to help the user to immerse into the narrative. Such conclusions were replicated by Yulin[22], who demonstrated that such shows as the National Treasure or the Chinese Poetry Conference employed AR and VR to increase the cultural accessibility and, in particular, among the young people. Zhang et al.[23] proposed an educational gaming platform based on the Applied Games Engagement Model (AGEM) aimed at restoring the ancient roots of the grape trade, and the proposed solution had a beneficial influence on knowledge and perception among other users. Shen et al.[24] also emphasized the importance of database functionality, accessibility, community involvement for the sustainability of ICH digital platforms, highlighting from their study on the Zhuhai ICH Database. The recent researchers[25–27] highlight the increased role of immersive and metaverse-based technologies in various fields, such as healthcare, cultural heritage, and education. Regarding the digital therapeutics, Buragohain et al.[25] performed a systematic literature review and case study analysis of programs, such as NightWare, Freespira, EndeavorRx, and Sleepio, and proved that metaverse-based therapy is capable of mitigating such conditions as PTSD, anxiety, and ADHD, and it is supported with the help of clinical validation. Applying the same technological persistence to cultural preservation, Buragohain et al.[26]. Analyzed the VR reconstruction of Kodaiji Temple, Angkor Wat, and Shwedagon Pagoda and found out the opportunities and limitations of virtual heritage regarding the preservation of sacred architecture. Moreover, Buragohain et al.[27] have also ranked the revolutionary nature of immersive technologies in the process of education and the effect they have on the interactions, pedagogy, and the experience of the learners. Taken together, these papers demonstrate how immersive media has had an interdisciplinary potential to improve wellbeing, learning, and cultural continuity. To sum up, these studies indicate how immersive technologies including VR, AR, holography as well as mixed reality, bring forth advantages in engaging audiences with ICH. But there are still good challenges like cognitive overload, cost, authenticity, and narrative coherence.

Research in this area is imperative because of the broaden gap between technological advancements and user acceptance of digital heritage experiences[28]. Although many research works focused on the digitization process of museums and cultural tourism, very little has been done on how AR/VR and social media with narratives by using AI alter an individual's attitude toward ICH preservation-from previous health care and well-being to less acceptance of preservation initiatives. However, most of the research has scribbled the tangible cultural heritage as digital model artefacts, whereas aspects of performing arts, oral tradition, craftsmanship, etc., has been described in a significant way as underrepresented in digital heritage studies. At the same time, although China spends large amounts of money on projects relating to its digital heritage, it has not yet determined the effect of such investments on the understanding and involvement of the public in culture.

The foremost objectives of this study are:

- To investigate the factors affecting willingness to adopt digital ICH experience in China along the lines of PU, PEOU, Perceived Immersion, Perceived Authenticity, and Social Media Engagement.
- To examine the mediating role of acceptance of technology in influencing the relationships of digital storytelling tools (AR/VR, AI narratives, and social media) with their adoption of digital ICH experiences.
- To analyze how digital communication tools enrich cultural awareness and interaction with ICH by younger generations especially.
- To provide useful applications of digital ICH conserving and recommendations to both individuals making the policies and the technical equipment developers.

Preservation of ICH in the digital generation has become critical issue globally, and in China, traditional art forms, performing arts and storytelling were some of the challenges which approached and overcame with advancement and technological changes. Specifically, the use of digital communication tools is one of the innovations that will maintain ICH and promote it using such methods as AR, VR, AI-assisted storytelling, and social media. Nevertheless, this whole phenomenon of digital interjection is only expert to the extent that it is accepted by users and is perceived as an authentic experience. Hence, to understand the willingness for digital ICH experience adoption by the general public, the present study integrates the TAM[29] with MRT[30] to examine selected factors influencing digital ICH adoption.

The Technology Acceptance Model (TAM) has been widely applied to examine how users adopt new technologies, emphasizing two core constructs Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) that shape individuals' behavioral intentions. PU and PEOU have been understood in the context of ICH as the ways in which digital systems make it easier to preserve and present cultural practices. On the other hand, Media Richness Theory (MRT) is more inclined to look at the communicative effectiveness of various media and the very importance of interactivity, engagement, and immersion[31]. When MRT is applied to ICH, it justifies that AR/VR-based storytelling is able to create such emotionally engaging environments that the users' connection to heritage is actually strengthened. PU has consistently been shown to significantly predict technology-adoption behaviors[32], as users are more likely to embrace digital ICH when it enhances cultural knowledge, provides meaningful experiences, and increases accessibility. Studies on digital museum environments show that users adopt virtual exhibitions when they perceive them as beneficial for learning[33]. Similarly, in ICH contexts, stronger perceptions of usefulness in digital storytelling lead to higher engagement and increased recommendations of digital ICH experiences.

H1: PU positively influences the readiness to embrace digital ICH - The degree to which the user finds complexities in interaction with digital

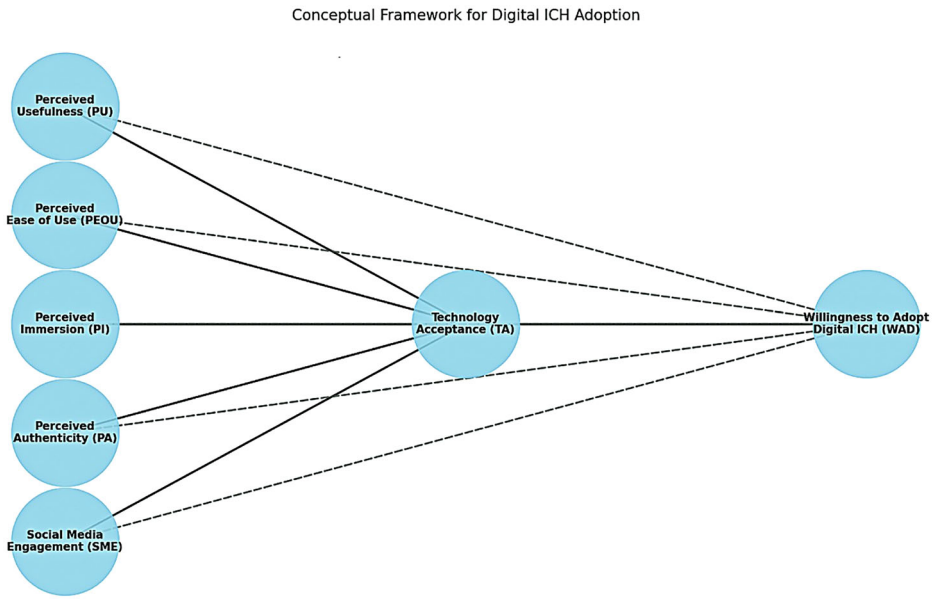

Fig. 1 | Conceptual framework diagram. This Fig. 1 illustrates how five key factors Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Perceived Immersion (PI), Perceived Authenticity (PA), and Social Media Engagement (SME) influence Technology Acceptance (TA). In turn, TA affects users' Willingness to Adopt Digital ICH (WAD). The model highlights both direct and indirect relationships between perceptions, acceptance, and adoption intention within the context of digital intangible cultural heritage.

heritage systems or makes it easy is important for determining the adoption patterns[34]. Therefore, when such interaction cost is very high in terms of effort needed in navigating the AR applications or VR storytelling for digital ICH technologies, such channels may become self-disqualifying. Therefore, user-friendly and easy-to-use applications putting little demand on their technical know-how are more likely to lead to digital adoption.

H2: PEOU has beneficial effects on the Willingness to Adopt Digital ICH - Publishing to digital platforms is one of the most critical determinants of user engagement[35]. Immersion talks about the degree of psychological presence experienced by users in a digital environment while perceiving cultural heritage as if they were part of it. According to MRT, immersion technologies collectively decrease the ambiguity of the presented information and enhance the storytelling experience[36]. Studies in the field of virtual heritage[37] suggest that highly immersive experiences, such as a virtual tour of a 3D-rendered traditional Chinese opera stage, have strengthened emotional bonds with cultural artifacts. Therefore, an experience in digital ICH that is richer and more immersive is likely to see acceptance and appreciation from users.

H3: Perceived Immersion positively influences the Willingness to Adopt Digital ICH - One key question surrounding the concept of digital ICH is whether or not these virtual experiences has replicated the authenticity of a set of traditional cultural expressions. Authenticity is seen as the degree to which a digital representation is considered to be faithful to the original cultural heritage[38]. Users may remain skeptical about AI-generated narratives or augmented reality-enhanced artifacts, should they feel that the digital recreations are devoid of any semblance of craftsmanship and cultural depth, which are the very essence of the human touch in art. Hence, if users see digital ICH as authentic and credible, they are likely to adopt it.

H4: Perceived Authenticity positively influences the Willingness to Adopt Digital ICH- Social media platforms thus become critical mediators in the attitudes of users regarding the digital cultural heritage aspect[39]. Users have developed a sense of community and cultural appreciation through participation in sharing digital exhibitions, discussion forums, or watching live-streamed heritage performances on ICH content through social media. That have include apps such as WeChat, Weibo, and Douyin (TikTok China), which are highly credited for digital storytelling in increasing audience interaction with traditional arts and crafts. The interaction makes digital ICH more visible and accessible; it, therefore, makes users more willing to explore and adopt these experiences.

H5: Social Media Engagement positively influences the Willingness to Adopt Digital ICH-All of these indicate that, even while there is a motivating factor for adopting electronic ICH, Technology Acceptance (TA) could moderate the actual result as a linking variable to transfer the perceptions of the users and result in their final decision to adopt or not to adopt. According to the TAM, TA depends on the usefulness, ease of use, and immersion of the digital ICH tools to derive a positive attitude and hence higher acceptance by the user[29]. If users perceive AR/VR-based storytelling as believable and engaging, they are more likely to accept it as a valid means for preserving culture. Hence, TA serves as an interventional step via which independent variables influence final adoption behavior (H6).

This study advances theoretical innovation by proposing a unified TAM–MRT model tailored to the underexplored domain of digital ICH, a context that differs substantially from typical technology-adoption settings. While TAM and MRT have been widely applied in e-commerce, e-learning, and entertainment, their use in cultural sustainability and immersive heritage environments remains limited. This study extends the integrated TAM–MRT framework (Fig. 1) by incorporating cultural authenticity, heritage immersion, and emotional connectedness constructs rarely treated as central in prior adoption research. The current framework, unlike the previous models primarily motivated by utility or pleasure, considers the perception of cultural value and the validation of authenticity as the main factors of acceptance. By incorporating the communication richness of MRT with TAM, the model reinterprets the PU not just in the terms of functional effectiveness but also in the terms of cultural emotional enrichment. On the methodological side, the studies introduce Perceived Authenticity and Perceived Immersion as quantifiable predictors within a unified empirical model, thus allowing the quantitative evaluation of subjective heritage experiences. On the theoretical side, it connects experiential communication theory with heritage-authenticity discourse, thereby incorporating a traditionally qualitative field into a validated adoption model. The inclusion of social media interaction bolsters the explanatory power by tackling participatory digital heritage practices. The framework, in general, reinterprets the TA as a cultural co-creation process influenced by digital affordances, authenticity perceptions, and immersive engagement.

Methods

This study implements a quantitative approach bolstered by methodological refinements to increase the rigor, representativeness, and contextual validity. A stratified purposive sampling technique was used to achieve equal representation of participants from various demographic and regional backgrounds, consisting of individuals from large cities (Beijing, Shanghai, Guangzhou) and heritage-oriented provinces (Sichuan, Yunnan, Fujian). This method gets the mixed experiences of digital ICH platforms in both the

high-tech regions and the culturally conservative regions, thus, increasing the generalization. The number of young adults (18–45 years old), cultural practitioners, heritage educators, and digital-media users with previous exposure to AR/VR or AI-based cultural experiences was 350 valid responses. Recruitment was facilitated by heritage organizations, cultural-event forums, and online communities that focus on traditional arts and digital culture. This multi-channel technique lowers selection bias and guarantees that individuals who are actively involved in digital heritage consumption are included in the study.

The survey tool was also reformulated to have domain specific measurement items that captured the dynamics of digitization of cultural heritage, but not directly copy TAM/MRT constructs. As an example, PU was measured in relation to the perceived cultural learning, and heritage preservation value, PEOU focused on the ease with which people interacted with culturally-themed AR/VR apps; and Perceived Authenticity (PA) was measured by how authentic people believed that digital representations of craftsmanship and narratives were. In the same manner, the cultural resonance, emotional engagement, and authenticity of AI narratives in the heritage contexts were reflected in the constructs of Perceived Immersion (PI), Social Media Engagement (SME), and AI-driven Storytelling (AIS). Each construct was to be addressed on a 5-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree), and pre-tested via a pilot study of 40 participants on clarity, internal consistency, and cultural relevance basis before full deployment.

The research incorporates the complementary design components in order to strengthen it. Though quantitative in nature, it involves the use of triangulation with a follow up of the 15 participants who represent diverse demographic backgrounds and, in this manner, provide the numerical data with context and explain pattern of technology adoption in a culturally sensitive manner. Descriptive statistics were run for quantitative analysis, correlation, multiple regression analysis, and mediation. These were done using SPSS and AMOS software packages. The central regression model examines the direct effects of the digital engagement variables on WADI and is formulated as follows:

$$WADI = \beta_0 + \beta_1 PI + \beta_2 SME + \beta_3 AIS + \beta_4 PU + \beta_5 PEOU + \beta_6 PA + \epsilon \quad (1)$$

where β coefficients determine the effect of each independent variable on WADI. For investigating the mediating role of TA in facilitating WADI, both the mediational approach of Baron and Kenny[30] and Bootstrapping in AMOS were used. The mediation models are structured as:

TA as an outcome variable:

$$TA = \alpha_0 + \alpha_1 PI + \alpha_2 SME + \alpha_3 AIS + \alpha_4 PU + \alpha_5 PEOU + \alpha_6 PA + \epsilon \quad (2)$$

TA as a mediator in WADI adoption:

$$WADI = \gamma_0 + \gamma_1 PI + \gamma_2 SME + \gamma_3 AIS + \gamma_4 PU + \gamma_5 PEOU + \gamma_6 PA + \gamma_7 TA + \epsilon \quad (3)$$

Quantitative internal consistent and discriminant reliability assessments have been carried through with the concepts. Internal reliability was verified by Cronbach's Alpha (>0.85), while AVE (>0.50) and Fornell-Larcker criterion established construct validity. Due attention was paid to ethical issues. The qualitative interviews were conducted through internet, based on such platforms as Zoom or WeChat and lasted about 45–60 minutes but were audio-recorded and word-to-word transcribed. Thematic analysis consists of six phases used to analyze the data: (1) familiarizing oneself with the data, (2) initial codes, (3) locating themes, (4) revising themes, (5) defining and naming themes, and (6) writing report. The coding and the structure of the textual data were conducted in a systematic way with the assistance of NVivo 12 software that simplified the ways of identifying the repetitive patterns and links between the various constructs such as authenticity perception, emotional immersion, usability issues and community involvement. The respondents were informed and the responses were anonymized to save their privacy. Moreover, the study was performed in the terms of an institutional ethical code of ethics of human-subject research.

Results

Demographic profile

This wide-ranging and comprehensive analysis, which considered various factors, provides a straightforward representation of the impact that the technological changes have had on the whole process of ICH keeping and its promotion. The demographic profile of the 350 respondents is shown in Table 1, which reveals an evenly distributed gender distribution, with males (51.4%) and females (48.6%) taking part almost in the same numbers. The sample is mainly composed of young people, since the largest age groups are 18–25 years (34.3%) and 26–35 years (40.0%), which points to a strong involvement of the younger adults in digital ICH. The age group of 36 to 45 year olds constitutes 17.1%, while only 8.6% are over 46, indicating that there is less participation of the elderly in the digital heritage. Regarding the education, more than half of the participants have a bachelor degree (51.4%), followed by master degrees (34.3%) which implies that the sample is quite educated. The smallest group represented is high school graduates (14.3%). Interestingly, 60% of the participants claimed to have previously used digital ICH platforms, which indicates a strong familiarity with AR/VR or AI cultural experiences. This participant distribution is supportive of the study's goal of gathering informed user viewpoints on digital heritage involvement.

Descriptive statistics

The analysis of the descriptive statistics, which are presented in Table 2, led to the conclusion that the mean values of the constructs, being high, were favorable and thus produced a positive attitude towards the digital preservation methods. The mean ratings given in the description went from 4.10 SME to 4.30 PI, which means that the users are aware that the digital tools have played their part in enriching cultural experiences. The highest mean scores were of 4.30 for PI and 4.27 for WADI respectively, which have turned out the role of AR/VR technologies in making the cultural heritage

Table 1 | Demographic Profile of Respondents (*N* = 350)

Variable	Category	Percentage (%)
Gender	Male	51.4%
	Female	48.6%
Age group	18–25 years	34.3%
	26–35 years	40.0%
	36–45 years	17.1%
	46+ years	8.6%
Education level	High School	14.3%
	Undergraduate	51.4%
	Postgraduate	34.3%
Prior experience with digital ICH	Yes	60.0%
	No	40.0%

Table 2 | Descriptive Statistics and Reliability Analysis

Variable	Mean	SD	Cronbach's Alpha
Perceived Usefulness (PU)	4.21	0.72	0.89
Perceived Ease of Use (PEOU)	4.15	0.75	0.87
Perceived Immersion (PI)	4.30	0.68	0.88
Perceived Authenticity (PA)	4.18	0.71	0.86
Social Media Engagement (SME)	4.10	0.74	0.85
Technology Acceptance (TA)	4.25	0.70	0.90
Willingness to Adopt Digital ICH (WADI)	4.27	0.69	0.91

more pulling to the audience. These results support previous research that indicates that immersive storytelling strengthens the emotional and cognitive connection with the cultural narratives, thus making AR/VR an indispensable tool in digitally orchestrating heritage preservation. Moreover, Cronbach's Alpha values were weighted above 0.85 confirming the high internal consistency of constructs, thereby assuring the reliability of the data. Hence, a further affirmation of the validity of the present study's conclusions on the effects brought about by the various digital communication tools has been supported.

Model fit indices and multicollinearity

The model fit indices (Table 3) show that the data is very good to the hypothesized model. The Chi-square/df ratio (2.41) has been used to determine that there is a comfortable fit of the model with a deviating covariance structure between the observed and predicted covariance structure as the Chi-square/df ratio is below the recommended 3.00. This fact is further supported by the Goodness-of-Fit Index (GPI = 0.93) and Adjusted GPI (AGPI = 0.89), which indicate that the model accounts a large percentage of the variance in the observed values. The Comparative Fit Index (CFI = 0.95) and Tucker-Lewis Index (TLI = 0.94) are also very high indicators of incremental fit, and they are above the recommended cut-off of 0.90, which confirms the capability of the model being superior to a baseline independence model. In the meantime, RMSEA (0.056) and SRMR (0.045) are significantly less than the maximum acceptable value of 0.08, which means that there is a small amount of residual error and a high correspondence between theoretical and real data structures.

The multicollinearity tests (Table 4) support the internal consistency of the model and the dissimilarity of the model constructs. All the VIFs are within the safe range of 1-5 with the maximum one of 2.34 in the TA variable, meaning that no predictor variable has excessive influence over other variables. The fact that each construct has a sufficiently unique value, i.e., between 0.43 and 0.52, further proves that perceived usefulness (PU), perceived ease of use (PEOU), perceived immersion (PI), perceived authenticity (PA), Social Media Engagement (SME), and TA have sufficiently good uniqueness with no excessive overlap with other variables. This lack of multicollinearity guarantees that the estimated regression coefficients are stable and explainable, so it is credible to the relations that have been found in the structural equation modelling (SEM).

Discriminant validity

Studies based on the Fornell-Larcker Criterion (Table 5) within the discriminant validities reaffirm that the constructs thus measured are both separate and related as the square root of AVE for each variable turns out to be greater than the correlation with other variables. Validation of this kind statistically is critical so that concepts such as PU, PEOU, social media engagement (SME), perceived authenticity (PA), and willingness to adopt digital ICH (WADI) has been free of each other, thus, allowing their independent contributions to digital engagement for researching purposes. The high correlations found among PU and WADI (0.70), TA and WADI (0.75), and PI and WADI (0.72) signify the perceived value of the technology, immersion experiences, and also the general level of acceptance of digital tools will strongly influence users' willingness to embrace digital ICH preservation. The close relationship established between PA and WADI (0.69) reflects further the growing concern for authenticity in digital heritage projects. Such technologies are perhaps palatable to users only where they make them feel that the digital representation is true to the original cultural substance; this underscores the required carefulness in curating content that is AI-driven and enhanced by VR.

Hypothesis testing: regression analysis

The regression analysis (Table 6) disclosed that all the suggested hypotheses got support (p values < 0.001). Therefore, the independent variables had positive relationships with the willingness to adopt digital ICH. With

Table 3 | Model fit indices for the proposed structural model

Fit Index	Obtained value
χ^2/df (Chi-square/df)	2.41
GFI (Goodness-of-Fit Index)	0.93
AGFI (Adjusted GFI)	0.89
CFI (Comparative Fit Index)	0.95
TLI (Tucker-Lewis Index)	0.94
RMSEA (Root Mean Square Error of Approximation)	0.056
SRMR (Standardized Root Mean Square Residual)	0.045

Table 4 | Multicollinearity diagnostics

Variable	VIF	Tolerance	Interpretation
Perceived Usefulness (PU)	2.11	0.47	No multicollinearity
Perceived Ease of Use (PEOU)	2.03	0.49	No multicollinearity
Perceived Immersion (PI)	2.26	0.44	No multicollinearity
Perceived Authenticity (PA)	2.18	0.46	No multicollinearity
Social Media Engagement (SME)	1.92	0.52	No multicollinearity
Technology Acceptance (TA)	2.34	0.43	No multicollinearity

Table 6 | Regression analysis for hypothesis testing

Hypothesis	Relationship	β	*t*-value	*p*-value	Supported?
H1	PU → WADI	0.32	4.87	<0.001	Yes
H2	PEOU → WADI	0.28	4.25	<0.001	Yes
H3	PI → WADI	0.35	5.21	<0.001	Yes
H4	PA → WADI	0.30	4.73	<0.001	Yes
H5	SME → WADI	0.26	4.10	<0.001	Yes

(All independent variables significantly impact Willingness to Adopt Digital ICH).

Table 5 | Discriminant validity (Fornell-Larcker Criterion)

Construct	PU	PEOU	PI	PA	SME	TA	WADI
PU	0.89						
PEOU	0.61	0.87					
PI	0.58	0.55	0.88				
PA	0.63	0.59	0.62	0.86			
SME	0.55	0.57	0.60	0.56	0.85		
TA	0.66	0.64	0.68	0.65	0.61	0.90	
WADI	0.70	0.67	0.72	0.69	0.63	0.75	0.91

(Diagonal values represent the square root of AVE; Off-diagonal values are correlations).

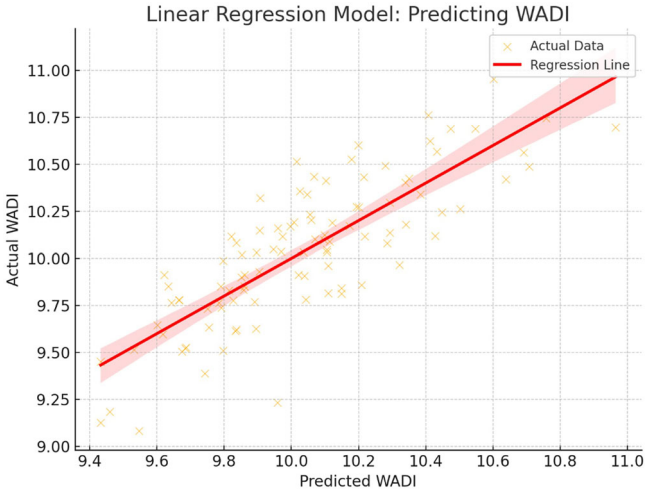

Fig. 2 | Linear regression model in predicting the WADI. The linear regression model shown in Fig. 2 clarifies how the WADI treated with predicted and actual values relating to the mainframe input variables. Yellow crosses denote all observed data points, whereas the red line shows the best-fit regression line along with a 95% confidence interval (the shaded area). The steep positive slope indicates a strong linear dependence, implying that the model can very well predict real WADI values just based on the TA dimensions such as PU, PEOU, PI, PA, and SME. The close grouping of the data points around the regression line is interpreted as a good fit of the model, which means that the chosen predictors can together account for a large part of the variance in users' willingness to adopt digital ICH platforms. The validation of this model conforms to the proposed relationships in the conceptual framework, thus confirming its predictive power and internal consistency.

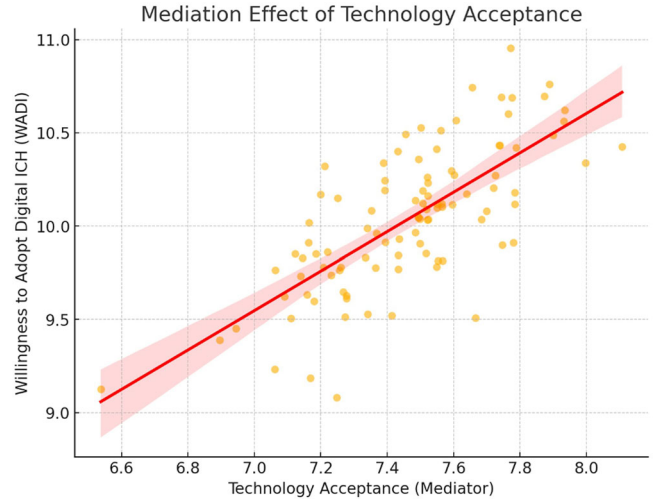

Fig. 3 | Linear regression model for mediation effect. Figure 3 illustrates the mediating effect of TA in the process affecting WADI. The scatter plot along with a fitted regression line reveals a strong positive linear correlation between TA and WADI thereby indicating that acceptance of technology to a high degree leads to a significant increase in users' willingness to interact with digital heritage platforms. The proximity of the data points to the regression line and the width of the 95% confidence interval both signify the strength and reliability of this mediating effect. This association means that the positive views of usefulness, ease of use, immersion, authenticity, and social media engagement are, in a way, imparting indirect influence on adoption behavior via their impact on TA.

Table 7 | Mediation analysis (TA as Mediator)

Pathway	Direct effect (β)	Indirect effect (β)	Total effect (β)	Mediation type
PU → TA → WADI	0.19	0.13	0.32	Partial
PEOU → TA → WADI	0.16	0.12	0.28	Partial
PI → TA → WADI	0.21	0.14	0.35	Partial
PA → TA → WADI	0.18	0.12	0.30	Partial
SME → TA → WADI	0.14	0.12	0.26	Partial

standardized coefficients perceived immersion ($\beta = 0.35$, $p < 0.001$) emerged as influencing WADI (Fig. 2) the most, followed by perceived usefulness ($\beta = 0.32$, $p < 0.001$), perceived authenticity ($\beta = 0.30$, $p < 0.001$), perceived ease of use ($\beta = 0.28$, $p < 0.001$), and social media engagement ($\beta = 0.26$, $p < 0.001$). These results highlight the fact that ICH must be regarded as something that is both immersive and valuable for engagement. Indeed, it determines the measurements obtained from TAM, where perceived utility and perceived user-friendliness are considered the most decisive factors for the user's acceptance. Moreover, the importance of perceived authenticity stresses the need for cultural integrity to be maintained in digital storytelling practices, especially when AI narratives that might alter historical accuracy are used. Furthermore, social media interaction being a pivotal factor ($\beta = 0.26$, $p < 0.001$) suggests that channels like WeChat, TikTok, and Weibo have been very influential in the enlightenment and safeguarding of ICH.

Mediation analysis: role of TA

The mediation analysis presented in Table 7 investigates the influence of TA (Fig. 3) on these relationships and thus enhances our comprehension of the factors driving digital ICH adoption. Results show TA acts to partially mediate the relations between PU, PEOU, PI, PA, SME, and WADI with indirect effects ranging from 0.12 to 0.14 (Fig. 4). This indicates that while every independent variable mediates WADI directly, in fact, the strength of that direct effect is enhanced by TA. In other words, perceived immersion has a total impact of 0.35 on WADI, having a direct impact of 0.21 and an indirect impact of 0.14 through TA. In other words, immersive storytelling boosts engagement behaviour directly; however, users' acceptance of new digital technology makes engagement even greater.

Thematic analysis

The qualitative study produced four broad themes that further elaborate on the experiences, perceptions, and evaluations of the Chinese users about the digital Intangible Cultural Heritage (ICH) using AR/VR storytelling, AI narration, and social media interactions. These topics, (1) Immersive Cultural Connection, (2) Authenticity Negotiation, (3) Social Media as Cultural Mediator and (4) Emotional Resonance and Cultural Continuity bring interpretive richness to the quantitative data by placing the user attitude and motivations in the realities of experience of digital heritage consumption.

Theme 1: Intense cultural bond

The respondents always mentioned AR/VR storytelling as a revolutionary tool, which enables them to enter the culture rather than become an observer of it. Most of the respondents reiterated the fact that immersion helped to close the generational and geographical distance, and it helped them gain access to traditions that have been otherwise unavailable. To one of the interviewees, when putting on the VR headset and strolling across an ancient opera stage or temple, it seemed as though I am a part of the past and that my forefathers are leading me. Not to observe culture, but to have it. One more participant explained it with the addition of AR, which makes the experience more personal. "*I have an opportunity to move artifacts, hear the sounds of the drums, and also feel the rhythm of the story. It assists me in learning culture by doing rather than reading.*" These stories show that immersive technologies transform cultural delivery into interactive ones, which is in line with the claim of MRT that the richer the media, the more emotional it becomes and the better understood. Immersion therefore becomes a learning experience and an experience that promotes participation and perception of authenticity in a digital heritage context.

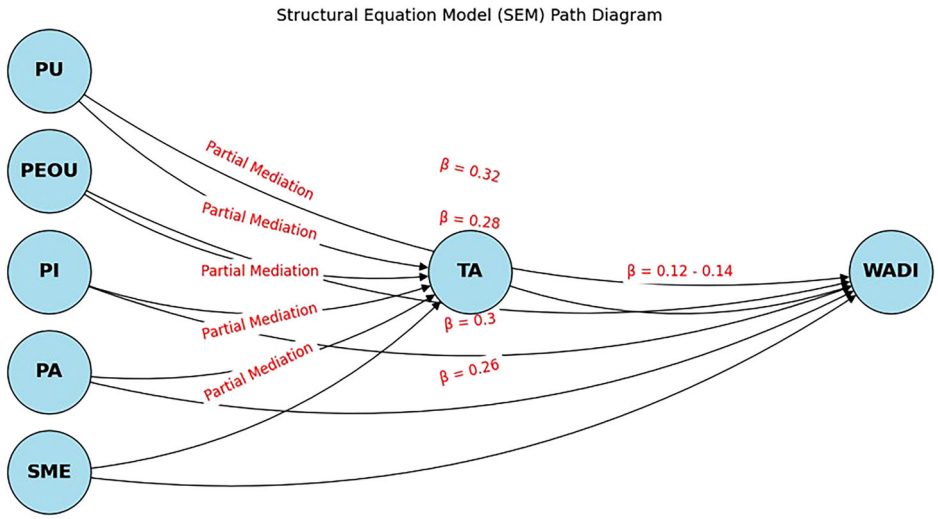

Fig. 4 | Pathway diagram with standardized regression coefficients. The elimination of TA from the scene will result to repositioning the main factors' relationships PU, PEOU, PI, PA, and SME to the dependent variable WADI just like in the original scenario. The role of trust is mainly depicted in Fig. 4 to have a large impact on WADI, which is then supported by the regression coefficients that are in the TA range from β = 0.26 to 0.32. It can be concluded from these values that the perceived functional and experiential benefits are building trust to a large extent. TA, therefore, positively mediates WADI (β = 0.12–0.14) and the support for partial mediation in all paths is confirmed. This implies the direct effect from PU, PEOU, PI, PA, and SME to WADI but at the same time, the significant portion of their influence is through trust.

Theme 2: Authenticity negotiation

The issue of authenticity was a replicating conflict in the responses of the participants. Although people were pleased with the idea of digital recreation being made available and preserved, they also expressed their concern about the fact that cultural depth has been lost. One of the respondents said, AI storytelling is imaginative, which at times is too good to machine like. Traditions of reality are not perfect, and narrate their own stories. Another one commented that "*when there is a lack of tiny movements in the digital version of a dance or a ritual, it loses its human quality. To me, authenticity is a matter of spirit, but not precision*." These considerations show that authenticity in the digital ICH is not only concerned with the integrity to physical aspects but also with the expression of emotional and spiritual aspects. The results indicate that consumers are involved in an active negotiating authenticity process taking between the admiration of technological advancement and the need to touch and feel the human element and emotional sincerity. Therefore, perceived authenticity is a facilitator and inhibitor of digital ICH adoption.

Theme 3: Social media as cultural intermediary

The social media sites were considered as influential zones of sharing culture and involvement amongst communities. The participants narrated how apps such as WeChat, Douyin, and Bilibili helped not only to share content but also create a sense of collective identity. One of the cultural bloggers wrote, "*Short videos of traditional crafts posted in Douyin attract many young followers. They pose questions, express their experiences, and occasionally even go to museums after that*." One of the other participants also commented, "*WeChat groups on local festivals make me feel that I belong to my hometown despite my working in Shanghai. It preserves the tradition in a new way.*" The above-mentioned examples illustrate the role of social media as a cultural mediator in the communication of people, and the process of converting passive observers to active contributors to culture was one of the most significant changes in social media people relationships. The sites become virtual public squares for heritage, where narratives are exchanged, and thus, interpreted, disagreed upon, and sustained. This supports the MRT hypothesis that when message clarity and media richness engagement are together, it results in cultural continuity in a participatory digital ecology.

Theme 4: Emotional resonance and cultural continuity

Besides valuing technology, the participants also pointed out the emotional connection as the key measurement of digital heritage success. A very great number of people thought that immersion and AI-created narratives returned the audience feelings of pride, nostalgia, and belonging. One of the participants put it this way: "*After seeing the VR story of my province folk dance, I could not help crying. It made me recall my grandmother who was teaching me the same steps when I was little*." The other interviewer said, "*The digital experience is not the same as reality but it does evoke real-life memories. That's why I am still using new AR heritage apps*." The emotions felt by the participants point to digital ICH experiences being affective contact points between the users and their cultural roots. The use of these technologies was also seen by the participants as a way to connect generations. A VR app was said to be the source through which one parent came to know about shadow puppetry. His child is now showing it off in school. This collaborative effort across generations showcases the fact that emotional resonance results in cultural engagement that lasts for a long time, and at the same time, it also supports the goals of digital ICH projects in keeping the cultures alive.

Triangulation findings

The qualitative results of this study that are linked with the quantitative ones will provide a comprehensive and multifaceted view of the part played by digital technologies in the safeguarding and treatment of ICH in China. The study revealed through quantitative analysis that perceived immersion (b = 0.35), PU (b = 0.32), and perceived authenticity (b = 0.30) are the strongest predictors of the willingness to accept digital ICH, while social media engagement (b = 0.26) and perceived ease of use (b = 0.28) still significantly influence the adoption. These quantitative tendencies are evidently echoed in the thematic analysis. As an example, the Immersive Cultural Connection theme adds to the statistical data by indicating that AR/VR storytelling works by making cultural learning participatory, which is why the path coefficient of perceived immersion is so high. Equally, the Authenticity Negotiation theme puts into context the quantitative relationship existing between the authenticity and adoption by demonstrating that the emotional and spiritual fidelity are as important to the user as visual realism is. The theme of the Social Media as Cultural Mediator helps to support the observation that use of social media such as WeChat and Douyin contributes to the willingness to accept digital ICH due to the nature of interaction and community-based interaction that these platforms promote, which correlates with the positive relationship between SME and WADI. Last but not the least, the theme of Emotional Resonance and Cultural Continuity describes the reason why PU is not limited to functionality, but to emotional enhancement, strengthening the acceptance of technology by providing an effective response. These qualitative stories confirm the mediating force of TA in quantitative mediation analysis, in which adoption decisions made by users are not merely cognitive but strongly affective and social.

Discussion

The increasing significance of immersive tech, social media platforms, and AI-powered storytelling in digital communication and ICH preservation becomes more evident in the current research. This research gets its support from previous studies which revealed that the applications of technology in the digital realm can boost cultural participation significantly, at the same time binding people emotionally to their heritage, and supporting the sustainability of ICH practices in a fast-paced technological world. The present research has added to the body of knowledge by analyzing the role of AR/VR, social media, and AI-first storytelling in granting access to cultural memory that was once limited. Thus, allowing a larger audience to experience, reinterpret, and digitally engage with heritage. The prominence of PI as the principal factor affecting digital ICH engagement is in line with Mehta and Kukreja's analysis[18] that brought out the power of VR as the mainstay for preserving the cultural narrative through immersive storytelling. Their exploration of the Stari Most bridge-diving tradition found VR to be a medium that could significantly boost user engagement and knowledge retention when compared to traditional media. Likewise, in an AR/VR-based museum tour, Wen et al.[23] reported that performance expectancy and price value were the strongest predictors of the users' technology-adoption intentions. All in all, the evidence pointed out the necessity of constructing immersive digital experiences that create strong emotional and cognitive ties to cultural heritage.

The present study found a strong relationship between WADI and TA which is consistent with the UTAUT2 model as described by Wen et al.[23], where habit, personal innovativeness, and involvement were the key factors that determined the users' intention to adopt digital heritage applications. The mediator estimate conducted in the present study provided further credence to the view that perceived immersion, usefulness, authenticity, and ease of use are direct influences on user inclination to participate in digital ICH, with the effect strengthened when users have a broad acceptance of the adoption of emerging technologies. Similarly, Yan[21] stresses the importance of deliberate caring for audience interaction within digital heritage projects. One of the main conclusions of the study is that the adoption of digital ICH very much depends on the PA, which is in line with Yulin's[22] results. Their analysis of the role of digital technology in cultural TV shows highlighted that the authenticity of digital representation was of utmost relevance in shaping the audience's perception of cultural identity. Users would be more likely to participate in or agree to any content, if the historical or cultural aspects were well represented in the digital storytelling formats. Also, Hu et al.[23] speculated that if the authenticity was guaranteed, the cultural heritage educational platforms would lead to students having a better understanding and appreciation of the themes of traditional practices. These results raise a very crucial issue which is to be considered in digital heritage projects; AI-based storytelling and AR/VR experiences offer a wide range of narrating techniques, but the cultural dimension must be observed to win the users' credibility and trust.

One of the main factors that have influenced the acceptance of digital UNESCO intermediaries, whether intentionally or unintentionally, is social media interaction. This paper's results only confirm the assertions made by Shen[16] that digital means are very potent in the process of cultural spreading. It was also noted by Shen[16] that digitally produced interactivity and visual storytelling are the main factors that give different digital formats the power to excite engagement with ICH. Weibo, WeChat, and TikTok, among other places, are giving a firm hand to the process of easy and fast sharing of cultural stories in such a way that they are even connecting the young generation and at the same time keeping people active and offering them the opportunity to create together. The role of social media in the promotion of digital ICH is once again emphasized by the findings of Shen et al.[24], who in their study on the Zhuhai Intangible Cultural Heritage Database found that community involvement and ease of access were the major factors determining user satisfaction. The overall picture painted by these findings is that social media interaction has to be a part of the digital preservation efforts in order to guarantee that everywhere the cultural experience is interactive and participatory.

Further, the thematic analysis carried out in the present research revealed the rise of digital ICH preservation, along with the identification of the issues going between the two extremes of tradition and authenticity as one of the major troubles in the literature. He and Wen[17] deeply investigated this issue and suggested a theoretical framework for the digital development of intangible heritage crafts, which included factors like digital governance, application of cutting-edge technology, and management skills as the support systems for that. Their framework accepted the fact that digital algorithms could possibly put authenticity at risk, but they also recognized the simultaneous creation of economic and social value for ICH due to the algorithms. Likewise, Tang and Zhang[19] showed that the use of interactive holographic technology can achieve very closely reproduction of cultural artifacts with high-quality visual representation; however, it needs a lot of precise tuning to be able to do so without losing the original cultural forms. All these revelations combined have alerted the need for a well-thought technology integration in the area of digital heritage preservation to create a winning situation for the three-horned battle of authenticity, innovation, and accessibility.

Another significant theme in this research was public perception and acceptance of digital ICH, which was in line with the discoveries of Wen et al.[20] and Shen et al.[24]. Though these investigations enlighten the advantages of the digital heritage initiatives, they also point out the ongoing problems, including usability difficulties, limited access, and the public's unfounded suspicion of the digital representations, which are the factors that have been obstructing the widespread taking up of digital ICH the most. Although Yulin[22] reported that architectural digitization in cultural television programming attracted the younger audience more when it was done interactively and in visually appealing ways, the current research shows a more careful and hesitant public reaction. This contradiction emphasizes the need for digital heritage projects to be guided by user-centered principles that are very strong to develop user-friendly interfaces, compelling content and smooth digital storytelling. The thematic analysis additionally implies that digital heritage in mainland China will be an ever-changing and innovative area that requires constant creativity and inter-sector collaboration. The study indicates that the combination of AR/VR narratives, AI-generated content and social media interactions will not only be the markers of the future but also be the main force behind the transformation of the ways in which the intangible cultural heritage is preserved, communicated and experienced. In support of this view, Zhang et al.[23] prove that digital educational platforms not only nurture but also facilitate sustainable cultural behavior. The study is built on such evidence and, thus, points out the potential of combining immersive storytelling with participatory engagement to strengthen user involvement and acceptance of digital ICH. However, the road to achieving long-term sustainability will be littered with the hurdles of technological cost and different levels of.

The study brought the remarkable importance of contemporary digital communication means like storytelling through artificial and virtual reality, social media, and artificial intelligence narratives in the protection and dissemination of intangible cultural heritage in China. By merging the data from both quantitative and qualitative analysis, the researchers have gained more insightful knowledge about the cultural benefits of using digital tools and the possible factors that have influenced the perceptions of users and led to the acceptance of digital heritage experiences. It was found that higher immersion is closely related to greater user engagement while perceived immersion is actually a key factor determining the intention to participate in digital ICH experiences. Additionally, the study pointed out that the social media environment is conducive to the cultural transmission required and the perceived authenticity acts as a measure of user trust within the digital representations. Most significantly, the present study also supported the mediating function of TA in that it even promotes adults to take up digital heritage when they perceive it as user-friendly and culturally rich.

The study presents a new model for understanding the acceptance of ICH by the stakeholders based on technology, psychology, and cultural factors, and it also explores its practical implications for digital ICH. It identifies the factors of user adoption namely; immersion,

authenticity, social interaction, and technology acceptance. On the downside, the model's potential is limited by the fact that it is based on a particular cultural scenario of China, making it less representative of other cultures. Other than that, the long-term effects of digital heritage projects are still to be investigated. The digital communication tools, however, have proven to be an important resource in the preservation of cultural heritage for the future generations, notwithstanding the limitations of the study.

Data availability

Data will be available on request.

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Author contributions

Conceptualization, J.L. and C.C.; methodology, C.C.; software, C.C.; validation, C.C., H.Z., J.Z., and D.G.; formal analysis, C.C.; investigation, C.C.; resources, J.L. and C.C.; data curation, C.C.; writing—original draft preparation, C.C.; writing—review and editing, C.C., H.Z., and J.Z.; visualization, C.C.; supervision, H.Z.; project administration, C.C.

Competing interests

The authors declare no competing interests.

Additional information

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