

EMBODIED COGNITION AND DIGITALIZATION OF INTANGIBLE CULTURAL HERITAGE IN THE INTELLIGENT MEDIA ERA

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Abstract

This study explores the integration of embodied cognition into the digitalization of intangible cultural heritage (ICH), enhancing user engagement and experience within the intelligent media era. Utilizing advanced technologies such as augmented reality (AR), virtual reality (VR), and artificial intelligence (AI), the research aims to transform traditional ICH preservation into dynamic, living transmissions that maintain cultural essence while expanding accessibility. Methodologically, the study combines qualitative and quantitative approaches, including the Analytic Hierarchy Process (AHP) for assessing impacts and grounded theory for deeper narrative understanding. **Results indicate that** embodied cognition significantly enriches user interactions by enabling active participation and deeper emotional connections to cultural heritage, supported by a structured digitalization framework that categorizes processes into visual symbolism, sensory engagement, and reflective identity. This approach not only fosters a comprehensive understanding and appreciation of ICH but also promotes its sustainable transmission in the digital age.

Keywords: Intangible Cultural Heritage; Digitalization Design; Embodied Cognitive; Intelligent Media Age

Introduction

The era of intelligent media has ushered in a transformative phase for the protection and transmission of intangible cultural heritage (ICH), moving from mere record-keeping to a dynamic, living transmission through digitalization. The adoption of technologies such as augmented reality (AR), virtual reality (VR), and artificial intelligence (AI) has not only reshaped production methods, lifestyles, and ways of thinking but has also created novel pathways for the safeguarding and inheritance of cultural heritage (Wang, 2022). ICH, as an essential carrier of national historical memory and unique cultural identity, has garnered unprecedented global attention for its protection and preservation. With advancements in policy and technology, the transmission of ICH is transitioning towards a new phase of "living" and "digital" preservation, presenting unprecedented opportunities for the transmission and innovation of cultural heritage while posing significant challenges in maintaining the cultural essence amidst technological integration (Wu, 2023).

However, while technologies like AR and VR offer exciting opportunities to present cultural heritage in more immersive and accessible formats, they also bring forth challenges in ensuring the authenticity and integrity of digitally rendered traditions. The simplification of complex cultural practices to fit digital platforms may result in the loss of essential symbolic meanings or misrepresentations of cultural narratives. Additionally, the rapid pace of technological advancement necessitates sustainable strategies to ensure that digitized cultural assets remain accessible and relevant over time. Recent studies suggest integrating blockchain technology to manage cultural heritage archives securely, transparently, and sustainably (Qin, 2022).

Globally, ICH has been recognized as a key element of human cultural diversity. More than 600 Chinese ICH elements, including Peking Opera, embroidery, and the Dragon Boat Festival, have been inscribed by UNESCO, highlighting their cultural, economic, and social significance. Economically, industries related to ICH, like Miao embroidery in Guizhou, have adapted to modern markets and driven significant local economic growth, showcasing the potential of cultural assets in economic transformation (Li & Zhang, 2019).

In this digital age, the emerging digital ecosystem acts as a transformative force in the preservation and dissemination of ICH. The integration of AI, big data, and interactive design has expanded the potential for creating immersive and meaningful cultural experiences. Emphasizing sustainability and user-centric approaches, the digital ecosystem enriches the application of ICH digitalization, addressing significant challenges by proposing multidimensional approaches that balance innovation with cultural preservation. This study, drawing on interdisciplinary research, seeks to advance methods for digitalizing ICH in an era where traditional practices must be preserved authentically while leveraging modern technologies to meet contemporary expectations.

Research Objectives

1. Investigate the digitalization of intangible cultural heritage (ICH).
2. Explore the embodied cognition theory in ICH digitalization design.
3. Analyze ICH digitalization design under the embodied cognition theory.

Literature Reviews

Theories of Digital design method: The landscape of digital design for intangible cultural heritage (ICH) has been reshaped by a shift towards user-centered and participatory design approaches, which prioritize the understanding of user needs and the incorporation of community input. This evolution ensures that digital representations authentically reflect their cultural contexts and resonate deeply with users. Engaging users and communities in the design process not only enhances the authenticity of the digital content but also promotes a deeper connection and appreciation among those interacting with these digital embodiments of cultural heritage (Katz, 2016).

Furthermore, the integration of immersive technologies such as augmented reality (AR) and virtual reality (VR) has transformed how users interact with ICH, making these cultural narratives more engaging and accessible. These technologies allow users to experience cultural heritage in

innovative and relatable ways, thereby enhancing the appeal of ICH to contemporary audiences (Li & Wang, 2018).

Additionally, the application of embodied cognition theories in digital design underscores the significance of physical interaction in understanding and appreciating cultural heritage. Physical interactions with digital representations, such as through touch or movement, lead to a more profound understanding of the cultural practices being showcased. This approach ensures that digital designs not only engage users cognitively but also encourage active participation and sensory involvement, aligning modern technological innovations with the enduring values of traditional cultures (Qin, 2020).

Theories of Intangible Cultural Heritage (ICH): Virtual Heritage Theory has significantly shaped the preservation and presentation of Intangible Cultural Heritage (ICH) by leveraging advanced digital technologies like virtual reality (VR) and augmented reality (AR). This theory, which evolved during the late 1990s, initially focused on material heritage but has since expanded to encompass intangible elements such as traditional performances and rituals. As digital tools have advanced, they have allowed for immersive and interactive experiences that make heritage accessible globally, thereby ensuring its preservation and continued relevance. The theory highlights how digital archives, 3D models, and immersive environments play essential roles in making intangible cultural heritage accessible and engaging for a worldwide audience (Wang, 2020).

Cultural Transmission Theory focuses on the passing of cultural knowledge, practices, and values from one generation to the next, emphasizing that intangible cultural heritage (ICH) is a 'living' heritage that requires continuous engagement and adaptation. This theory stresses the importance of oral traditions, demonstrations, and communal learning as key transmission modes that sustain cultural continuity within communities. It frames ICH as an adaptable entity, constantly renewed through communal engagement, allowing it to withstand social changes and the passage of time, thus maintaining its relevance and vitality in contemporary society (Smith, 2006).

Intelligent media age: In the Intelligent Media Age, theories such as Media Ecology and Technological Determinism provide foundational insights into how digital and intelligent media are transforming the preservation, dissemination, and interaction with Intangible Cultural Heritage (ICH). Media ecology, originally introduced by McLuhan, suggests that media are not merely tools but environments that shape human perception and interaction, thereby affecting how cultural heritage is perceived and engaged with. This theory highlights the role of digital technologies, such as VR and AR, in shifting cultural practices from traditional methods to more dynamic, interactive formats, thereby altering how communities experience and sustain their heritage (Rafaeli, 1988).

Furthermore, Technological Determinism posits that technological advancement is the primary drivers of social and cultural changes, influencing how ICH is preserved and practiced. This theory suggests that technologies like AI and virtual reality are not just tools but active agents reshaping cultural experiences, enabling ICH to transcend traditional physical boundaries and reach global audiences. These technological changes encourage a shift from passive reception to active participation, enhancing the public's engagement with and understanding of cultural heritage in profound ways (Ming, 2010).

Criteria of digitalization design, intangible cultural heritage, and intelligent media age: User engagement is crucial, as it drives how audiences interact with ICH content. Effective digital designs incorporate interactive elements such as virtual reality (VR), augmented reality (AR), and gamification to create immersive and engaging experiences. These technologies facilitate active exploration and learning, making the content more relatable and accessible (Zhang, 2020).

Cultural authenticity is imperative in preserving the collective memory and identity of communities. It requires fidelity to cultural origins, involving consultations with cultural practitioners and careful representation of traditional practices to prevent misinterpretations or dilution of cultural essence (UNESCO, 2010). Technological feasibility ensures the practical application of innovative technologies like AR and VR, taking into account technical and economic constraints to maintain the sustainability and relevance of digital platforms over time (Li & Zhang, 2019).

5. Studies of Distitalization design method related ICH

The digitization of Intangible Cultural Heritage (ICH) has evolved through three distinct phases, each characterized by its approach to leveraging technology for cultural preservation and engagement. Initially, from 2005 to 2012, the focus was on digital archiving, using media like text, images, and videos to document ICH in static forms, ensuring emergency protection of vulnerable cultural practices (Ci, 2007). This period laid the foundational work for preserving detailed records of cultural heritage, emphasizing the importance of safeguarding against loss.

Subsequent years, particularly from 2013 to 2016, saw diversified experimentation with interactive and multimedia tools, introducing technologies that allowed for dynamic cultural engagements, such as AR and VR. These technologies were utilized not just for documentation but to create immersive experiences that foster deeper audience participation. The role of AR in museums and the establishment of digital archives, exemplify efforts to make ICH more engaging and accessible, blending traditional content with modern digital interactivity (Pan, 2011).

Studies of Digitalization design method related ICH: Gao Yan (2014) proposed the use of Digital Modeling as a Preservation Tool for ICH, focusing on creating 3D models of heritage objects and environments. Gao's approach involves scanning and digitally reconstructing physical artifacts to ensure their preservation in case of damage or loss. This method offers an accurate and permanent digital record of cultural heritage objects, which can be accessed remotely and replicated if needed.

The academic discourse on such projects underscores several key considerations for intelligent media in digital design methods. These include the need to balance innovation with cultural authenticity, ensure accessibility across diverse audiences, and develop scalable platforms for long-term cultural preservation. The broader field has also addressed the challenges of technological integration, particularly regarding sustainability and the preservation of cultural integrity in digitally mediated contexts (Feng, 2019).

Research Methodology

1. Population and Sample: The study focuses on a diverse group comprising cultural heritage professionals, museum visitors, design experts, and academic scholars associated with the Guangdong Intangible Cultural Heritage Museum and the Hong Kong Museum of Art. A purposive sample of 34 participants is selected based on their direct involvement and expertise in cultural heritage, aiming to capture a wide range of insights on the digitalization of intangible cultural heritage (ICH). **2. Research Tools:** The methodology incorporates both quantitative and qualitative research tools. The Analytic Hierarchy Process (AHP) is employed to quantitatively evaluate the impact of embodied cognition and cultural symbols on enhancing cultural perception. Concurrently, grounded theory is utilized for qualitative analysis, applied to data collected from interviews, focus groups, and observations to gain a deeper understanding of user experiences and interactions with ICH in digital environments. **3. Data Collection:** Data collection is carried out through a combination of AHP assessments, structured interviews, and focus groups. The AHP provides structured, measurable insights into factors influencing user engagement with digital ICH content. Simultaneously, interviews and focus groups are conducted to gather detailed qualitative data on how participants interact with and perceive ICH when mediated through advanced digital technologies such as augmented reality (AR) and virtual reality (VR). **4. Data Analysis:** The analysis of collected data is bifurcated into quantitative and qualitative strands. Quantitative data from the AHP assessments are statistically analyzed to ascertain the effectiveness and impact of specific design elements on user engagement and cultural perception. For qualitative data, thematic analysis is employed to systematically identify and interpret patterns and themes, focusing on participants' perceptions, emotional connections, and interactive experiences with digital ICH content.

Results

The findings synthesize quantitative and qualitative analyses of ICH digitalization, demonstrating how embodied cognition theory improves user experience and comprehension in digital formats. Integrates these insights with existing literature, identifying trends, challenges, and best practices to inform future design strategies in the field of ICH digitalization.

Mapping the Digitization Stages of Intangible Cultural Heritage

This analysis synthesizes the evolution of intangible cultural heritage (ICH) digitalization from 2005 to 2024, utilizing bibliometric and content analysis across significant databases like Web of Science and CNKI. Initial research phases focused on digital storage and archival construction, evolving towards the incorporation of emerging technologies like virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) to enhance interactivity and user engagement.

The data sourced from "intangible cultural heritage" and "digitalization" related keywords reveals a consistent growth in research outputs, reflecting broader disciplinary engagement from computer science to cultural heritage studies. Computer science has heavily influenced the application of AI and deep learning for processing ICH data, while cultural heritage and museum studies have concentrated on the use of digital technologies for the preservation and dissemination of heritage. Art studies dominate domestic research, significantly involving the display, protection, and innovative application of ICH.

High-frequency keywords from the past five years such as "artificial intelligence," "digital preservation," and "3D printing" highlight the technological pivot in ICH research. Current hotspots include AI-enhanced text and image processing and the use of VR and AR for more immersive educational experiences in the field of ICH. The integration of these technologies into ICH digitalization points to a significant shift towards more interactive, user-centered heritage experiences that leverage digital advancements to foster deeper connections to cultural narratives.

This shift underscores a growing recognition of embodied cognition theory in enhancing the digital interaction experience, ensuring that digital transformations of ICH not only preserve but enrich the user's cultural engagement. The synthesis of these findings with existing literature aims to create a cohesive narrative that bridges empirical evidence with theoretical insights, offering a forward-looking perspective on best practices and future directions in ICH digitalization.

Measurement and Analysis of the Intangible Cultural Heritage Case: “Mounting Paintings”

This section examined the case study of 'Mounting Paintings,' a traditional art form representing intangible cultural heritage (ICH). The research utilized grounded theory and hierarchical analysis to explore participants' experiences and perceptions.

1) Open Coding: In the open coding phase of this study, data from interviews with museum visitors interacting with digitalized intangible cultural heritage (ICH) were systematically analyzed to generate conceptual labels. This analysis pinpointed visitors' perceptions of digital elements and the design features that facilitated their understanding and engagement. Using NVivo software, key themes such as motivations, barriers, and preferences that influence digital ICH experiences were identified.

This phase structured the data into fundamental conceptual nodes that aided in further examination of embodied cognition in ICH digitalization, pinpointing design elements that boost visitor engagement. To maintain theoretical relevance, labels were scrutinized and refined; superfluous or unrelated labels were discarded, and overlapping labels consolidated to sharpen the focus on the study's objectives. This resulted in a streamlined set of categories that clearly reflect visitors' interactions with digital ICH, highlighting how various design elements enrich their cultural engagement.

2) Axial Coding: In the axial coding phase, three principal dimensions emerged from the design elements that influenced visitors' experiences with intangible cultural heritage (ICH): visual symbolism, sensory and interactive

engagement, and identity and reflective connection. These dimensions encompassed key aspects like the cultural symbols embedded in digital design, tactile and auditory elements, and opportunities for personal reflection, offering a lens through which the diverse impacts of digital tools and embodied interactions on visitors' emotional and cognitive responses were examined.

Building on the isolated initial concepts identified during open coding, axial coding served to establish systematic connections among these concepts, providing a clearer understanding of their interrelationships. This phase refined the open codes into structured categories, highlighting core themes and key concepts that elucidate how various digital design elements influence visitors' perceptions and engagement with ICH. Ultimately, axial coding synthesized the data into cohesive categories, significantly enhancing the understanding of how different design elements contribute to visitor engagement with cultural heritage.

3) Selective Coding: In this section, the process of selective coding integrated the primary categories identified in axial coding—specifically, the digital design elements influencing intangible cultural heritage (ICH) visitors' perceptions—into a comprehensive theoretical framework that revealed key factors and their interactions. The selective coding phase developed a theoretical framework clarifying the relationships between the core category, ICH visitors' perceptions, and other relevant categories.

This table presents a structured summary of the relationships among the main categories, illustrating core meanings and relevant examples. This relational structure demonstrates how various digital design elements collectively shape visitors' engagement and experiences with intangible cultural heritage.

4) Measurement Consistency and Validity: To ensure the reliability and validity of the questionnaire used in this study, SPSS 21.0 software was employed to calculate the Cronbach's alpha coefficient for 20 measurement items related to experiencers' perceptions of digital design methods for intangible cultural heritage and its five latent variables. The overall alpha value achieved was 0.924, indicating excellent internal consistency and reliability. Furthermore, factor analysis confirmed construct validity, with all measurement

items displaying factor loadings above 0.7, thus satisfying the requirements for discriminant validity.

These findings underscore the high measurement quality of the questionnaire, which guarantees the reliability of data analysis and the scientific validity of the research conclusions. The results also support that the questionnaire is effectively capturing the nuances of embodied interactions and cultural identity in the context of ICH digitalization. This comprehensive testing ensures that the questionnaire can reliably gauge participants' emotional and cognitive responses to digital heritage elements.

Framework Development: Designing Effective ICH Digitalization Based on Embodied Cognition

In the experiment, we tracked the interactive behavior of visitors, conducted in-depth interviews, and captured their emotional and cognitive responses. As shown in the figure 2, the individual user experience is visually presented in stages. Users' emotional changes, pain points, and opportunity points across different stages, which are divided into three main phases: the initial phase of text and image presentation, the second phase of embodied action, and the third phase of symbolic representation. This phased analysis of user experience reveals the pathways through which different design elements impact user interaction and cognition in digital contexts.

In the first phase (text and image presentation), users primarily understood ICH content through visual and textual input. This experience provided a foundational layer with a focus on symbolic presentation; however, it offered limited cognitive engagement, making it difficult to trigger deeper emotional connections. The chart shows that user emotions and cognitive engagement remained relatively steady at this stage, without effectively inspiring high levels of participation or emotional resonance. This finding suggests that while symbolic elements can convey basic information, they are insufficient for creating an immersive cultural experience on their own.

The second phase, involving embodied action, significantly improved user experience. By incorporating gesture-based interactions and action

feedback, users transitioned from passive observers to active participants, deeply engaging with the culture physically. This shift not only increased emotional involvement but also enhanced understanding of cultural symbols through physical interaction, markedly boosting user engagement levels.

In the third phase, symbolic representation, the user experience was further enriched by presenting cultural symbols in more tangible and complex ways. This phase allowed users to internalize and reflect on their experiences, culminating in heightened emotional and cognitive engagement. It effectively used layer symbolic elements to broaden users' cultural understanding and strengthen their cultural identity.

Overall, the progression through these phases demonstrated that while symbolic elements provide a basic framework for cultural content delivery, embodied interactions significantly enhance the depth of the user experience. The integration of both elements facilitated a more profound connection with ICH, allowing users to achieve a fuller emotional and cognitive engagement with the heritage content. This structured approach to digital design in ICH not only deepened user interactions but also clarified the critical dimensions—such as sensory engagement and cultural identity—that influence user experiences in digital environments.

This framework systematically identifies and integrates key factors and interaction mechanisms that shape user experiences with digital ICH content. The analysis revealed several critical dimensions impacting visitor engagement, including digital design elements, the depth of sensory interaction, cultural identity resonance, cognitive processing pathways, and the influence of external environmental factors. These insights informed the creation of a structured approach to ICH digitalization, organizing essential design considerations into three core levels: visual symbolism, sensory and behavioral engagement, and identity and reflection.

This framework integrates essential factors and mechanisms to enhance user engagement with digital ICH, organizing it into three core levels: visual symbolism, sensory and behavioral engagement, and identity and reflection. Visual symbolism uses culturally significant symbols to connect users to heritage, while sensory engagement deepens interaction through elements like

gesture control and sound immersion. The final level, identity and reflection, encourages personal connection and cultural reflection, creating a rich, immersive experience that respects the authenticity of cultural heritage. This structured approach aligns design with embodied cognition to effectively digitalize ICH (Figure 3).

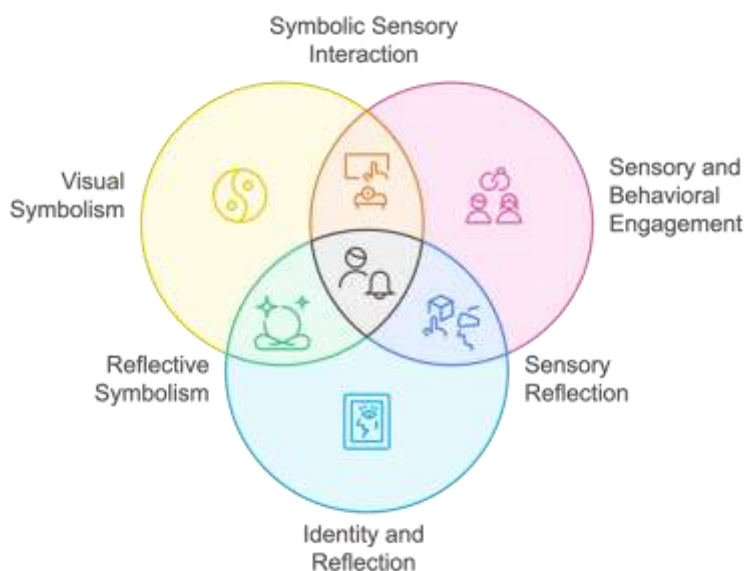


Figure 3: Several critical dimensions impacting visitor engagement
(Source: Constructed by researcher).

Discussions

This research delves into the digitalization of intangible cultural heritage (ICH) within the context of intelligent media, highlighting the critical role of embodied cognition in enhancing user engagement and experience. The transition of ICH digitalization from mere record-keeping to dynamic, living transmissions underscores a significant shift towards incorporating sensory, cognitive, and emotional dimensions within digital platforms. The study emphasizes that embodied cognition not only fosters deeper cultural interactions but also transforms passive viewers into active participants by leveraging gesture-based interactions and haptic feedback. Furthermore, the structured framework developed through this study categorizes the digitalization process into three primary design levels: visual symbolism, sensory and behavioral engagement, and identity and reflection. This tiered approach facilitates a

deeper, more meaningful interaction with cultural heritage, ensuring that users not only receive information but also experience and internalize cultural narratives, thereby enhancing their understanding and appreciation of ICH.

New Knowledges

This study introduces new knowledge into the field of intangible cultural heritage (ICH) digitalization by emphasizing the role of embodied cognition in enhancing user experiences within digital media environments. By integrating sensory and interactive elements—such as augmented reality (AR), virtual reality (VR), and gesture-based interactions—into the presentation of ICH, this research establishes a comprehensive framework that bridges traditional cultural narratives with advanced digital technologies. The findings demonstrate that a deeper sensory engagement significantly enriches users' emotional and cognitive connections to cultural heritage, transforming their role from passive viewers to active participants. Furthermore, the study advances the understanding of how digital platforms can be designed to not only preserve but actively promote the living transmission of cultural heritage. It highlights the potential of intelligent media to foster a dynamic interaction between users and ICH, thereby enhancing cultural transmission in the digital age. This approach ensures that digitalization respects the authenticity and integrity of cultural narratives while making them accessible to a global audience. The insights provided here contribute to both theoretical advancements and practical applications in the preservation and innovative presentation of ICH, offering valuable strategies for cultural stakeholders to navigate the complexities of digital heritage preservation.

Conclusions

This study elucidates the transformative impacts of intelligent media on the digitalization of intangible cultural heritage (ICH), marking a progression from static record-keeping to dynamic, living transmissions. By incorporating embodied cognition, the digitalization process significantly enhances user engagement, transitioning from simple sensory stimulation to profound emotional and cognitive involvement. The research findings underscore the importance of interactive and embodied experiences in deepening users' connections to cultural heritage, effectively converting them from passive

recipients to active participants. A structured digitalization framework developed through this research categorizes the process into visual symbolism, sensory and behavioral engagement, and identity and reflection. This approach not only ensures that users are intellectually engaged but also emotionally connected, promoting a comprehensive understanding of ICH. This framework serves as a robust model for future digital ICH projects, ensuring that they preserve cultural authenticity while embracing technological advancements.

Recommendations

1. Theoretical Recommendations

Expand Embodied Cognition Research: Future studies should further explore embodied cognition's role across various ICH forms, customizing digitalization strategies to maintain cultural authenticity and enhance user interaction.

Integrate Advanced Technologies: Investigate how emerging technologies like AI, AR, and VR can be optimized to enhance the sensory and interactive components of ICH, providing users with more immersive and meaningful experiences.

2. Policy Recommendations

Support Cultural Preservation through Technology: Encourage policies that foster the integration of technology in cultural heritage preservation, ensuring that digitalization efforts are supported at governmental and institutional levels.

Promote Sustainable Practices: Advocate for sustainable digitalization practices that consider long-term accessibility and relevance of digitalized cultural assets.

3. Future Research Recommendations

Conduct comparative studies across different cultures to understand universal and unique aspects of digitalizing ICH, which can help tailor digitalization practices more effectively.

Implement longitudinal studies to assess the long-term impacts of digitalized ICH experiences on cultural preservation and user engagement.

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