

Enhancing Player Game Interaction Frameworks for Intangible Cultural Heritage Games: A Systematic Literature Review

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ABSTRACT

This systematic review compiles the research findings within 10 years (2015 to 2026) on the player–game interaction frameworks for intangible cultural heritage games, highlighting the common problems that have been investigated in the field of Player Game Interaction (PGI) for Intangible Cultural Heritage (ICH) games. The review focuses on classifying current interaction methods and design frameworks. It evaluates embodied and gestural approaches and compares the use of immersive technologies, such as virtual reality, augmented reality, mixed reality, and artificial intelligence. The review also identifies evidence-based strategies for cultural adaptation and compares user experience outcomes for different implementations. In accordance with PRISMA 2020 guidelines, 50 studies were selected and peer-reviewed before analysis by thematic coding, chronological comparison, and critical synthesis. The results indicate that when directly connected to the embodied movement and meaning of the underlying cultural practice, embodying always leads to better knowledge retention and emotional connection by users. While immersive technologies can have a positive effect in making heritage more accessible and increasing a sense of presence, this is dependent on the culturally sensitive design of the technologies, which cannot be superficial in nature. Maintaining authenticity and the reflection of lived experiences and values of members of the living community is essential and can be achieved by participatory co-design with heritage practitioners and community members. Schemes that are good at embedding meaningful cultural content with fun and enjoyment produce better long-term engagement and learning. This review aims to synthesise existing knowledge, reveal the problems that are still to be solved in the field, and offer guidelines on how to create inclusive, culturally congruent intangible cultural heritage games, which can be used as effective tools for preservation, education, and intergenerational transmission.

Keywords: Intangible Cultural Heritage Games; Player Game Interaction Frameworks; Embodied Interaction; Cultural Authenticity; Immersive Technologies

INTRODUCTION

As digital tools gain increasing global acceptance as key instruments for preserving and passing on cultural knowledge, research on how to improve interaction frameworks between players and games for intangible cultural heritage games is an important field of study (Zhang & Hui, 2025; Mohapatra et al., 2025). In recent years, the field has significantly advanced, transitioning from simple digital archives to interactive experiences through virtual, augmented, and mixed realities, as well as AI technologies, offering a way to present intangible practices such as traditional performances, craftsmanship, rituals, oral traditions, and community games to a wider audience (Xiao et al., 2025; Nikolakopoulou & Koutsabasis, 2025). The former demonstrates that the public has increasingly recognised the potential of ICH games to transform cultural education and foster emotional bonds with cultural heritage, while several studies have shown positive outcomes in user engagement and cultural appreciation from well-designed ICH games (Zhao et al., 2025; Chai-Arayalert et al., 2025). This work is practical and timely, as it is widely reported that there is a decline in participation in traditional culture all over the world, and there is a need for innovative, inclusive approaches to digital preservation that can reach the widest possible range of demographic groups (Nie et al., 2024; Lai et al., 2025).

Despite significant advancements in technology and design, the field faces a core challenge: the low level of integration of culturally glued interaction models that can effectively combine entertainment appeal, educational value, and authentic emotional resonance (Sun & Hashim, 2025; Qin-chuan, 2025). Despite the abundance of existing research on intangible cultural heritage game projects, many of them focus on novelty technology and static cultural content and do not fully consider the user experience of interacting with the game elements or do they consider how to produce long-term interest in the cultural heritage topic. (Zhang et al., 2025; Wang & Men, 2025). There is also a continuing discussion on the relative advantages of different types of interaction modalities, such as gesture-based systems, tangible user interfaces (TUI), and AI-based adaptive experiences, and whether the focus should be on embodied cognition approaches or personalised algorithmic design (PAL) (Ma et al., 2023; Antonio & Henry, 2025; Arendt et al., 2023). These gaps are exacerbated by the absence of systematic frameworks that classify approaches to interaction and guide the design of interaction to address the specific contextual needs across various domains of intangible cultural heritage, which reduces the potential for the scalability of successful models and dilutes cultural authenticity in less meticulously planned interactions (Xiao et al., 2025; Fadzli et al., 2025).

The conceptual framework of this review draws on recent theoretical advances in the field (Zhang & Hui, 2025; Antonio & Henry, 2025; Nikolakopoulou & Koutsabasis, 2025), and three interrelated pillars are used as the basis for analysis. Embodied interaction involves the alignment of physical and sensory interaction with the actual embodied actions and experiences of cultural practice, and cultural contextualisation involves the seamless integration of the narrative, symbolism, and social meaning into the game play. The concept of “adaptive gamification” involves leveraging user input and computational techniques to customise the game for each user, enhancing accessibility and sustainability of motivation while maintaining cultural integrity (Grammatikopoulou et al., 2019; Sun & Hashim, 2025). Based on these precedents, this review consolidates existing research and practice, finds common design strategies, and assesses technological solutions that can be used to develop intangible cultural heritage games that are immersive and culturally significant.

METHODOLOGY

In line with PRISMA 2020 guidelines, we ensured transparency and replicability in study selection and reporting (Page et al., 2021). The original research question was broken down into targeted search statements that explored both technical and cultural aspects of the question, including embodied interaction modalities, immersive technology integration, participatory design, cultural authenticity, and inclusive access. The searches were carried out using key academic search engines, resulting in 279 records from the last five years. Backward and forward citation analysis were used to generate a list of 43 other publications to consider, thus ensuring that no relevant foundational or emerging work was missed (Xiao et al., 2025).

To ensure that all papers were relevant to the scope of the review, pre-defined inclusion/exclusion criteria were used to screen all candidate papers. Studies were selected based on the following criteria: studies dedicated specifically to intangible cultural heritage, not tangible sites or artefacts; studies based on player–game interaction design or framework development; and studies that have been published in peer-reviewed journals, conference proceedings, or edited volumes. Works were excluded if they did not include any analysis of interaction design aspects, if they were only about cultural heritage policy and/or management and not about game-related aspects, or if they were not published in peer-reviewed journals or were industry reports or blog posts. After deduplication, records were screened by title and abstract, and the full text of the resulting records was assessed, and relevance scores were assigned based on alignment with the objectives of the review. This process led to a final collection of 50 studies to be fully analysed, which were coded for key characteristics such as interaction modality, technological integration, cultural context, design framework, and reported user outcomes and analysed through thematic coding, chronological comparison, and cross-study analysis of areas of agreement and divergence (Braithwaite et al., 2025).

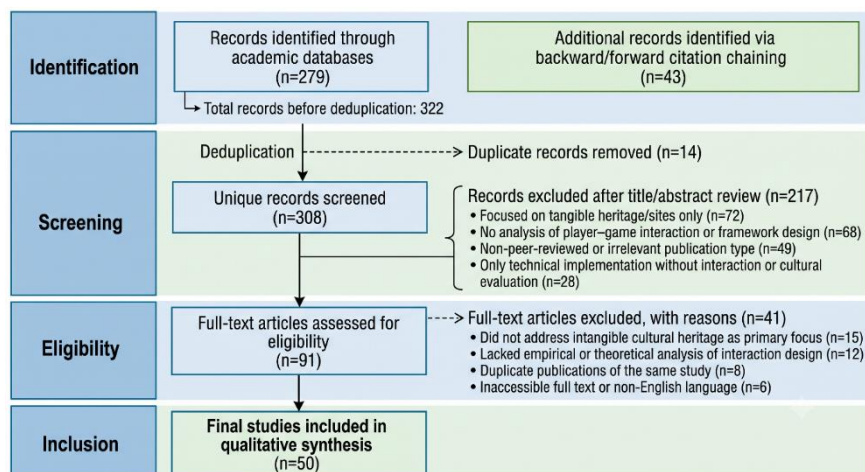


Figure 1. PRISMA 2020 Flow Diagram of Literature Selection Process

Figure 1 adheres strictly to the PRISMA 2020 reporting requirements by documenting every stage of study selection with exact counts and clear reasons for exclusion at both the screening and eligibility stages, ensuring full transparency and replicability of the review process.

RESULTS

Descriptive Overview of Included Studies

The selected studies span various research methods, including experimental user studies, theoretical frameworks, technical prototype testing, and participatory design projects, and are geographically spread out, mainly in Asian and European countries, but also in the Middle East, Africa, and the Americas (Zhang & Hui, 2025; Zahari et al., 2024). The scope of studies ranges from traditional performing arts, craftsmanship, ritual activities, and oral stories to traditional community games, covering not only the wide range of intangible cultural heritage but also the increasing flexibility of interactive design approaches (Zhu et al., 2024; Tandon & Nag, 2025). The modalities that are analysed in the corpus span from embodied interaction based on gestures to tangible physical-digital interfaces, multimodal sensory feedback systems, adaptive AI-supported gameplay, and narrative-driven interactions, and the technology used varies from mobile and web-based applications to simple AR overlay and full VR setups to mixed reality (MR) installations and AI-driven personalisation tools (Antonio & Henry, 2025; Vilar et al., 2024). While the metrics and methods for measuring engagement, learning, or cultural connection vary widely throughout the corpus, most studies report positive user outcomes due to thoughtful interaction design, with several recent studies using physiological measures such as skin conductance or eye tracking in conjunction with self-reports to provide more solid evidence of user experience (Zhao et al., 2025; Tin et al., 2025).

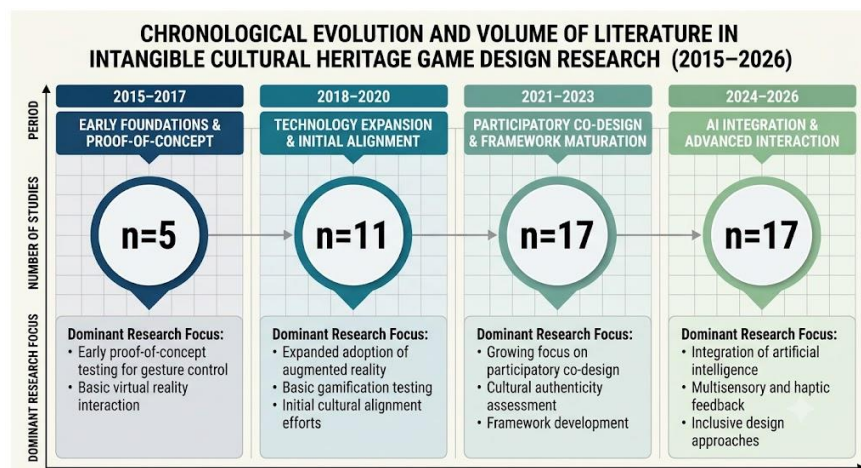


Figure 2. Distribution of Included Studies by Publication Year (2015–2026)

Figure 2 visualises the chronological evolution of the field over the review period, showing steady growth in research volume and clear shifts in priority from technical feasibility testing toward culturally grounded, user-centred framework development, which aligns with the broader synthesis of findings presented later in the review.

Table 1. Key Characteristics of Included Studies (n=50)

Category	Subcategory	Count	Percentage
Geographic Focus	Asia (including China, Malaysia, South Asia, Southeast Asia)	29	58%
	Europe and Middle East	14	28%
	Africa, Americas, and Pacific Islands	7	14%
Primary Research Methodology	Empirical user evaluation or experimental study	27	54%
	Theoretical framework development or critical analysis	12	24%
	Participatory co-design or community-based project	7	14%
	Systematic comparison or literature synthesis	4	8%
Intangible Cultural Heritage Domain Studied	Performing arts, craftsmanship, and traditional skills	22	44%
	Traditional games, rituals, and festival practices	15	30%
	Oral heritage, storytelling, and language traditions	8	16%
	Mixed or other intangible cultural expressions	5	10%

Table 1 provides a structured overview of the research landscape, revealing geographic concentration in Asian contexts, a strong emphasis on empirical testing, and broad coverage of different intangible heritage domains, while also highlighting the underrepresentation of regions outside Asia and Europe, which is addressed in the limitations section.

Table 2. Thematic Distribution of Core Research Focus

Core Research Theme	Number of Studies	Percentage of Total
Immersive technology integration (VR/AR/MR/AI)	18	36%
Embodied and gesture-based interaction design	15	30%
Cultural contextualization and participatory co-design	13	26%
Multimodal, adaptive, and inclusive design approaches	9	18%

Note: Some studies address multiple themes, so percentages sum to more than 100%

Table 2 quantifies the relative attention each core theme has received in existing research, demonstrating that technology integration and embodied interaction dominate current work, whereas inclusive and multi-sensory design remain emerging areas that require further investigation.

Critical Synthesis of Key Findings

A strong theme in the body of work is the evidence of the value of embodied and gestural interaction for facilitating cultural learning and emotional involvement, as evidenced by 15 studies that specifically address embodied and gestural interaction. These approaches enable players to perform physical actions that correspond to the actions and practices of the cultural heritage they represent, thereby enabling the experience rather than just reading traditional skills or rituals. Multimodal controlled comparisons have demonstrated that gesture sets directly connected to the represented cultural practice can increase knowledge retention and feelings of cultural presence compared to a generic controller input (Zhang & Hui, 2025; Pang et al., 2022). However, the findings are generally positive, with some implementations requiring additional hardware, such as motion trackers or virtual reality headsets, which reduces widespread accessibility, and few studies assessing gesture designs across different cultural and/or demographic groups, which risks misinterpretation and/or exclusion (Arendt et al., 2023). However, information on sustained use or physical fatigue when using repeated gestures is still scarce, and there is a lack of knowledge about how these systems are expected to perform over longer durations (Wu et al., 2025).

Eighteen studies explore various immersive technologies, such as virtual reality, augmented reality, mixed reality, and artificial intelligence, and all agree that these technologies greatly extend the possibilities for authentic heritage representation. Virtual reality environments can be used to simulate cultural practices that are difficult to access in everyday life, augmented reality overlays can help place intangible heritage within a real-life setting, and mixed reality installations can provide a hybrid experience between the physical and digital, mimicking the living nature of many intangible cultural heritage practices (Nikolakopoulou & Koutsabasis, 2025; Fadzli et al., 2025). AI technologies are now being applied to assist with adaptive learning pathways, dialogue with cultural stories and heritage using natural language technology, and procedural generation of culturally consistent content (Mohapatra et al., 2025; Zhu et al., 2025). There is some divergence in the literature on what technological fidelity and scalability are optimal: some studies focus on high-fidelity immersive spatial environments for museum or educational contexts, but others emphasise the use of simpler mobile or web environments to be accessible to a wider audience, without requiring specialised equipment (Zahari et al., 2024; Ke et al., 2025). Some have raised concerns about technological innovation taking precedence over the exploration of heritage meaning or social context, especially when the content is superficial or superficial cultural content is prioritised over the technology (Sun & Hashim, 2025).

In examining strategies for cultural contextualisation, thirteen studies highlighted the importance of designing interactions that reflect the values, symbols, and social meanings inherent in the cultural heritage being portrayed. This approach is favoured over the mere application of standard game mechanics within a cultural framework (Tandon & Nag, 2025). A recurring theme is that to ensure authenticity, games need to be co-designed with a range of people involved in the heritage practice, including heritage practitioners, community elders, and cultural experts, to prevent misrepresentation and ensure that games represent the lived experiences and diverse views of the communities that manage the heritage (Feng et al., 2025; Nikolakopoulou & Koutsabasis, 2025). There are also several studies that emphasise the importance of using a narration approach in the design of interactions, in which interaction is directly related to the narration traditions instead of the challenge structures, to increase the emotional attachment, but there are challenges between cultural depth and broadness, as the designs that are very specific to the cultural community may not be accepted by others, or the designs that are too general may lose some unique cultural elements (Xu et al., 2025; Qin-chuan, 2025). Too many projects also fail to engage communities in the evaluation process or for long-term adaptation, thus decreasing the opportunities for ongoing cultural ownership of the outcome (Noakowski, 2025).

In nine studies, multimodal interaction systems are examined. These systems facilitate engagement with the environment by providing visual, auditory, and increasingly haptic feedback, aligning with the multi-sensory nature of most intangible cultural practices. The use of flexible electronic skin technology, tangible interfaces, and spatial audio has been proven to have a significant positive effect on perceived authenticity and immersion in play, and multimodal design can also enhance accessibility. Early research has been conducted on how a customisable audio-tactile interface could make traditional games accessible to those with visual or hearing impairments (Ke et al., 2025; Ibrahim & Murphy, 2025). Full inclusive design processes are still scarce, and accessibility features are sometimes considered at the last moment, very late in the design process, or there is

not enough research on adapting multimodal systems to users who have sensory processing differences or are not digitally literate (Yang et al., 2018)

In the last decade, research has gone beyond assessing individual interaction technologies to creating integrated frameworks that link design decisions to cultural impact, and from an emphasis on entertainment value to a combination of preservation, education, and engagement (Wang & Men, 2025). Initial research (2015–2020) mainly focused on comparing simple modes of multimodal and gesture control), whereas recent work (2021 and beyond) has focused on the design of interaction to represent cultural epistemologies and provide community-led transmission (Xiao et al., 2025). Commonalities include that interaction with content aligned with cultural practice positively influences learning outcomes, immersive technologies enhance presence, and cultural authenticity is crucial for meaningful multimodal differences in the amount of entertainment and education content that should be included, accessibility versus high fidelity of content, and the extent to which artificial intelligence systems should be given authority over cultural representation (Braithwaite et al., 2025; Antonio & Henry, 2025).

Table 3. Critical Synthesis of Core Interaction Design Dimensions

Design Dimension	Key Strengths Identified Across Studies	Consistent Limitations and Challenges Reported	Number of Supporting Studies
Embodied and gesture-based interaction	Improves knowledge retention, cultural presence, and emotional resonance; aligns directly with cultural practice (Zhang & Hui, 2025; Pang et al., 2022)	Relies on specialized hardware; limited cross-cultural validation; insufficient long-term fatigue data (Arendttorp et al., 2023; Wu et al., 2025)	15
Immersive technology integration (VR/AR/MR/AI)	Enables authentic simulation of rare practices; supports personalization and broad access (Nie et al., 2024; Zhu et al., 2025)	Risk of prioritizing novelty over cultural depth; accessibility barriers; ethical considerations understudied (Sun & Hashim, 2025)	18
Cultural contextualization and participatory design	Prevents misrepresentation; builds community ownership; reflects pluralistic cultural meaning (Feng et al., 2025; Noakowski, 2025)	Time and resource intensive; tension between specificity and broad appeal (Qin-chuan, 2025)	13
Multimodal and inclusive design	Replicates sensory dimensions of heritage; supports diverse user needs (Ke et al., 2025; Lei & Tan, 2025)	Few standardized frameworks; accessibility often added late in development (Ibrahim & Murphy, 2025)	9

Table 3 consolidates the cross-study findings to compare the trade-offs across the four most researched design dimensions, providing clear multimodal evidence to the reported strengths and weaknesses to form an evidence base for practical recommendations.

DISCUSSION

Theoretical Implications

The results of this review have several important contributions to current theory. The emerging consistent evidence for the positive effects of embodied interaction in learning cultures supports embodied cognition theory in the heritage communication field and shows that embodied inter multimodal only provides novelty but also facilitates more in-depth cognitive and emotional understanding of cultural practice (Zhao et al., 2025; Zhang &

Hui, 2025). The classification of interaction modes in heritage games also contributes to the progress of human–computer interaction theory by defining four dimensions of interaction modes (participatory, cognitive, perceptual, and social) that are validated and can be applied in cultural contexts (Xiao et al., 2025). The findings in this synthesis also underscore the importance of explicitly incorporating critical perspectives of heritage studies into game design theory, beyond the prevailing emphasis on measuring users' engagement with a game (Champion, 2014; Sun & Hashim, 2025), and the findings related to adaptive personalisation contribute to broadening theoretical understanding of how scalable digital systems can facilitate cultural diversity beyond a false dichotomy of standardisation vs personalisation (Antonio & Henry, 2025).

Practical Implications

The review provides clear directions on how to design games about ICH, beginning with the idea that the project should start from the principle of making the game as close to the actual cultural activity as possible and that community members must be involved in designing and evaluating the game (Fadzli et al., 2025; Nikolakopoulou & Koutsabasis, 2025). When choosing technologies, teams should prioritise accessibility and cultural fit over high-fidelity novelty and keep in mind that a combination of simpler and more advanced technologies can be used to connect with diverse audiences. Cultural institutions can use these insights to create more engaging museum exhibits and educational programs (Vilar et al., 2024; Ibrahim & Murphy, 2025). Policymakers should focus on funding projects that show good community engagement in co-design and inclusive design, and developers should consider integrating good cultural objectives and entertainment value and not allow the game to overpower the heritage being represented (Chai-Arayalert et al., 2025; Zahari et al., 2024).

Limitations of Current Research

This review highlights the following key limitations of the literature. Few studies have a longitudinal design to assess knowledge retention or long-term cultural impact, and most studies have short evaluation periods and small sample sizes (Wu et al., 2025; Lo, 2025). Geographically, research is also limited, with sparse representation of intangible cultural heritage from Africa, the Pacific Islands, and indigenous communities worldwide, which limits the generalisability of existing findings across cultural contexts, and methodological inconsistencies make it challenging to compare findings across studies (Arendttorp et al., 2023; Patil & Raut, 2025). There is no standardised set of metrics for measuring cultural authenticity or emotional resonance. Finally, most studies have been conducted on a single user experience, while many intangible cultural practices are social or multiplayer in nature (Lo, 2025).

Table 4. Identified Research Gaps and Future Research Directions

Priority Level	Identified Gap	Recommended Future Research	Rationale
High	No unified intangible cultural heritage-specific interaction classification framework	Develop and validate a standard framework integrating cultural dimensions as core criteria	Generic human–computer interaction frameworks do not account for the unique cultural characteristics of intangible heritage (Xiao et al., 2025).
High	Limited longitudinal evidence of long-term impact	Conduct follow-up studies of six months or longer to assess sustained knowledge retention and cultural identity formation	Most evaluations measure only short-term engagement immediately after use (Wu et al., 2025).
High	Underexplored multi-sensory and haptic interaction design	Evaluate tactile, olfactory, and other sensory feedback for ritual and craft heritage experiences	Sensory dimensions are central to many intangible cultural practices but remain understudied in digital game design (Ke et al., 2025).

Medium	Accessibility often treated as an afterthought	Integrate Universal Design for Learning principles from the earliest prototyping stages	Inclusive design expands access and ensures cultural relevance across diverse user groups (Ibrahim & Murphy, 2025).
Medium	Limited social and multi-player interaction models	Design and test community-focused multiplayer experiences that reflect communal heritage practice	Most intangible cultural heritage is practiced collectively, but most existing games are designed for single users (Lo, 2025).

Table 4 organises identified gaps by priority, linking each gap to concrete research actions and justifications grounded in the review findings, ensuring that future directions are specific, evidence-based, and actionable.

CONCLUSION

The frameworks for creating player–game interaction for intangible cultural heritage games must be designed carefully with a balance of embodied, culturally connected design, adaptive technologies, and proper participatory community involvement. In the wide range of studies reviewed, the more closely an interaction system reflects the real movement, meaning, and social nature of cultural practice, the more authentic, engaging, and educative the experience will be, compared to a generic or technology-driven design (Zhang & Hui, 2025; Zhao et al., 2025). While immersive and adaptive technologies may be powerful tools for improving access and personalised experiences, their significance is their ability to seamlessly integrate them into culturally meaningful frameworks, not as an end in itself (Nikolakopoulou & Koutsabasis, 2025; Sun & Hashim, 2025). Despite recent advances, there are still some gaps to address in the field, such as standardised methods of evaluation, accessibility, and inclusion of communities throughout the development process (Champion, 2014; Arendttorp et al., 2023). Seizing the potential of intangible cultural heritage games as inclusive, effective mechanisms for the preservation of living cultural traditions, understanding between cultures, and the intergenerational transmission of knowledge for future generations will require addressing these gaps.

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