Design and Evaluation of a Universal Digital Heritage Framework for Foshan Lion Dance Based on Embodied Cognition Theory

Shi Li[1]*, Akapong Inkuer[2]

[1]Doctoral Student of Philosophy Program in Visual Arts and Design, Faculty of Fine and Applied Arts, Suan Sunandha Rajabhat University, Thailand. Email: s65584948034@ssru.ac.th
[2]Advisor in Visual Arts and Design, Faculty of Fine and Applied Arts, Suan Sunandha Rajabhat University, Thailand. Email: akapong.in@ssru.ac.th

*Correspondence: Email: s65584948034@ssru.ac.th

RITA_23
June 2025
ISSN: 2340-9711
e-ISSN: 2386-7027

Received: 08-02-2025
Revised: 11-03-2025
Accepted: 02-05-2025
Published: 30-06-2025

Abstract
This research consisted of 3 research objectives. They were to 1) investigate a general framework for the digital and dynamic inheritance of Foshan Lion Dance based on embodied cognition theory, 2) compile a manual of digital design specifications for Foshan Lion Dance, and 3) promote the digital dissemination and living inheritance of lion dance culture by building a systematic, interactive digital experience. This research applied a combination of qualitative and quantitative research methods with the aim of systematically promoting the cultural pedigree and digital living expression mechanisms of the Foshan Lion Dance. These two approaches were complementary, forming a continuous research loop from cultural investigation to user-centered validation. The rationale for selecting research methods was structured around the following three stages: cultural foundation exploration, application in digital design, and user perception validation. The final results indicated that the AIGC modules effectively recreated authentic Foshan Lion Dance environments, demonstrating that maintaining a user distance between 2.5 and 4 meters significantly enhanced motion capture accuracy. Additionally, innovative approaches such as incorporating visual depth and integrating Foshan Lion Dance elements enhance immersion and realism, thereby elevating the quality of the interactive experience. These techniques more accurately capture the dynamic movements and spatial interactions inherent to Foshan Lion Dance, emphasizing the relevance of spatial and visual factors in optimizing virtual performance simulations.

Keywords: Foshan Lion Dance, embodied cognition, virtual interactive modules, traditional choreography

 DOI: https://doi.org/10.24192/2386-7027.2025.v11i23.11

INTRODUCTION

The Foshan Lion Dance is one of China's most iconic forms of intangible cultural heritage (ICH), representing centuries-old traditions rooted in martial arts, ritual, and communal performance. As urbanization and cultural globalization continue to reshape communities, the preservation of such living cultural practices faces increasing challenges. Traditional methods of documentation often fall short in conveying the dynamic, embodied nature of the Lion Dance—particularly its reliance on performers' kinaesthetic knowledge, spatial choreography, and interaction with live audiences. To address these limitations, digital heritage frameworks have gained attention as a means to preserve and revitalize ICH through immersive and interactive technologies [1].

Recent advances in virtual reality (VR) and artificial intelligence-generated content (AIGC) enable the creation of highly realistic, interactive environments where traditional performances can be experienced beyond geographical and temporal limits. However, many existing digital heritage projects prioritize visual representation over embodied interaction, limiting their ability to convey the tacit knowledge and physical skills integral to such cultural practices. This results in the theory of embodied cognition, which is deeply rooted in bodily perception and action and offers a powerful lens for designing more meaningful digital heritage experiences [2].

Embedding embodied cognition into digital heritage design shifts the focus from static representation to situated, performative engagement, causing his perspective to align closely with the interactive and performative nature of the Lion Dance, which traditionally integrates martial arts, music, choreography, and ritual symbolism into a fluid performance. Nonetheless, there remains a lack of systematic frameworks that operationalize embodied cognition theory within the design and evaluation of digital ICH platforms, particularly for complex, action-oriented heritage such as the Foshan Lion Dance. A universal digital heritage framework for the Foshan Lion Dance must address both the technical challenges of virtual representation and the theoretical principles of embodied cognition in its design. Immersive technologies have proven effective in revitalizing intangible cultural heritage, as demonstrated in the digital preservation of Nanyin performance and Cantonese Opera [3].

The development of the cultural industry and artistic affairs today is significant. Cultural resources have been recognized as valuable assets of human civilization, reflecting the identity, concept, and creativity of the nation and its people. Cultural resources also serve as a source of inspiration for creating fine arts and applied arts in the modern era. Therefore, the conservation and development of this knowledge and heritage have received deep international attention because lion dancing is an important element of Cantonese culture. The Foshan Lion Dance not only reflects the profound wisdom and skills of the local community, but it is also hidden with spiritual values that have been inherited uninterruptedly and are extremely significant in the contemporary context. Despite ongoing conservation and restoration efforts, the Foshan Lion Dance continues to thrive. However, the transmission and practice of lion dance today still follow a traditional framework that is both outdated and complex. As a result, there are problems with the efficiency of the exhibition and public access. Structural issues, including the presence of older successors, pose a significant challenge. These structural issues include the gap between generations and the shortage of young workers [4].

The dance involves performers mimicking a lion's movements, incorporating acrobatics, and aiming to bring good luck and ward off evil spirits. The first record of the performance of an early form of the lion dance dates to the early Han Dynasty (Third Century B.C.). To better promote and convey the cultural essence of Foshan Lion Dance in the digital media era, digital technology has continued to play an increasing role in people's daily lives., especially through the application of various forms such as digital information resource management systems, digital exhibitions in museums, [5].

This study had three research objectives. They were to 1) investigate a general framework for the digital and dynamic inheritance of Foshan Lion Dance based on embodied cognition theory, 2) compile a manual of digital design specifications for Foshan Lion Dance, and 3) promote the digital dissemination and living inheritance of Lion Dance culture by building a systematic, interactive digital experience. Moreover, the research objectives match three research questions. They were 1) What does a general framework for the digital and dynamic inheritance of Foshan Lion Dance based on embodied cognition theory mean? 2) How will a manual of digital design specifications for Foshan Lion Dance be compiled? and 3) How will the digital dissemination and living inheritance of Lion Dance culture be promoted?Moreover, this study had a conceptual/theoretical framework, as shown below.

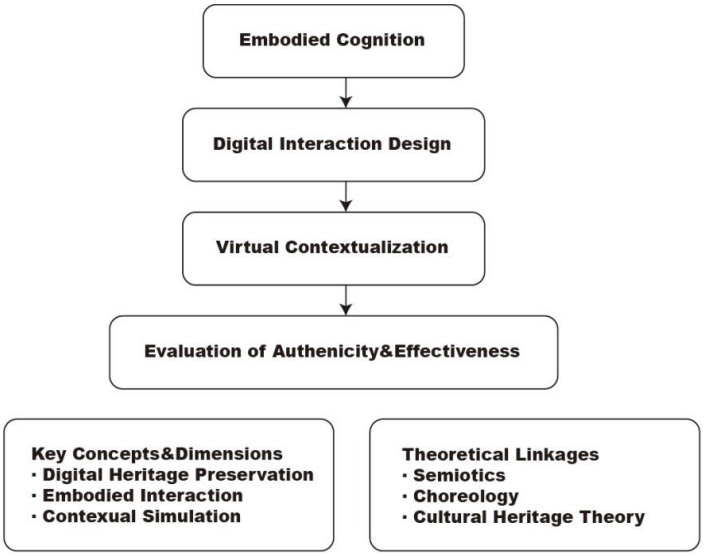

Figure 1: Expressed the embodied cognition, the digital interaction design, and evaluation of authenticity & effectiveness

This study addressed this gap by proposing and critically evaluating a universal digital heritage framework for the Foshan Lion Dance, grounded in embodied cognition principles. This was achieved by utilizing immersive technologies and participatory design approaches. This framework aims to create diverse virtual environments where people can interact, experience, and learn authentic lion dance performances regardless of their physical surroundings. In doing so, the research contributed to broader discourses on the preservation, transmission, and revitalization of intangible cultural heritage in the digital age [6,7]. Beyond photorealistic reconstructions, virtual heritage emphasizes meaningful, situated engagement with place, event, and narrative through interaction design [8]. Positioning Lion Dance within this lineage motivates our shift from "look-at" displays to participatory, performative modules.

LITERATURE REVIEW

Early virtual-heritage research already noted that the value of digital reconstructions lies not only in accuracy but also in accessible, public-facing experiences [9], a mandate that aligns with our dissemination goals.

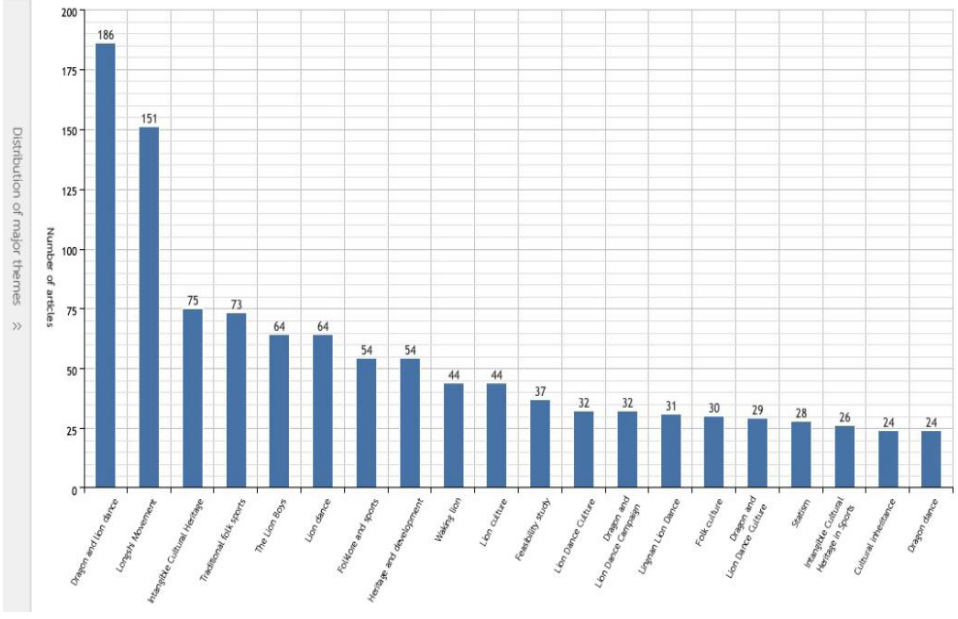

Figure 2: Analysis of literature related to the study of the theme of lion dance [5]

A total of 1647 Chinese academic papers (September 2024) in the category of folklore, sports and dance, including 328 papers in core journals, have been searched on China Knowledge with the title of "lion dance" or "waking lion". The topics of research are widely distributed, mainly including the origin, historical evolution, cultural characteristics, functions and values, inheritance and development of lion dance culture, as well as regional lion dance culture.

The origin of Lion Dance culture traces back to the cross-cultural exchange history of lions introduced to China from the Western Regions. As a non-native species, lions were gradually brought into China via the Silk Road from the Eastern Han to Tang dynasties, with the earliest records appearing in Han-era classical texts. The Book of Later Han explicitly documents: "In the first year of Zhanghe (The year 87 AD), the Yuezhi state presented lions"; "In the thirteenth year of Yongyuan (The year 101 AD), King Manqu of Parthia again offered lions and Tiaozhi giant birds, then called 'Parthian phoenixes'"; and "In the second year of Yangjia (The year 133 AD), the Shule state presented lions and humped cattle". Additionally, Ming dynasty pharmacologist Li Shizhen noted in Compendium of Materia Medica: "Lions originate from Western Regions". Ban Gu's Book of Han recorded: "During the reigns of Wen and Jing... exotic creatures like elephants, lions, fierce hounds, and giant birds were kept in outer courts". Subsequently, lions became recurring tribute items in Chinese history, gradually evolving into symbols of power [10].

Scholars hold divergent views on the emergence of the lion dance. It derived from the fusion of Western lion-taming arts and Chinese traditional "masked performances," originating in the Three Kingdoms period and gaining popularity during the Northern and Southern dynasties. Other researchers argued that the lion dance first proliferated in military contexts before spreading to civilian society. By the Six Dynasties period, Lion Dance had become integral to imperial banquets as part of the "Animal Procession Dance." Historical texts like Taiping Yue, Tongdian, and Old Book of Tang document its exclusive use in Tang court ceremonies to manifest imperial authority. As the lion dance disseminated from palaces to folk communities, it diversified into regional variants. The Northern-Southern stylistic bifurcation began during the Song-Liao-Jin period. Guangdong Provincial Annals: Sports records: "Northern Lion Dance maintains Tang-era aristocratic solemnity, while Southern Lion Dance features horned heads emphasizing vigorous expressiveness and awakening drum rhythms—hence named 'Awakening Lion' (Xingshi)". Scholarly consensus confirmed that the Southern Lion Dance emerged later from Northern prototypes. The Guangdong Annals stated that "Guangdong Lion Dance evolved from Northern 'Yellow Lions,' spreading to Lingnan regions after the Five Dynasties period."

Figure 3: The shape of the Southern lion [11]

Researchers have analyzed the lion dance through multidisciplinary lenses, including cultural studies and religious anthropology. Among diverse origin myths, the "Nian Beast Vegetable Plucking" legend is seminal. The Nian—a lion-like mythical creature—devoured vegetables to dispel plagues. People crafted Nian effigies and ritual dances, later renaming the auspicious beast "Rui Shi (Auspicious Lion)" and its vegetable-eating ritual "Cai Qing (Plucking

Greens)." Another Foshan legend describes colored lions expelling crop-destroying monsters during Ming dynasty winters, cementing lions' status as evil-warding mascots. Culturally, lion dance is interpreted as originating from primal religion, with its persistence intricately linked to Chinese religious, regional, and folk traditions. Some studies framed it as satisfying four human needs: religious faith, spiritual sustenance, survival, and cultural identity. Despite formal diversity, lion-dragon culture—an agrarian civilization product—maintained consistent symbolic value rooted in totemic worship. Substantial descriptive and explanatory research exists on Lion Dance's historical development. After centuries of dissemination, it syncretized with local traditions. By the Ming-Qing periods, distinct Northern (emphasizing lifelike agility) and Southern (prioritizing martial-dance fusion and symbolic verve) styles crystallized [5]. Studies on Suixi lion heads document how material craft, horn geometry, and paint schemes encode stylistic identity within Southern schools [12], which informed our parametric modeling of head features. In Foshan specifically, analyses of "conveying spirit through form" map iconic head-shape symbols to expressive functions, offering a vocabulary we can translate into avatar rigging constraints [13].

Figure 4: Lion Head Craftsmanship Processes [5]

The details of the lion's head of the Foshan Waking Lion were reproduced through 3D modeling technology, especially in the details of the lion's head ornamentation and facial structure, which achieved a high degree of restoration, enabling the traditional skill of the Waking Lion to be preserved in its entirety through the digital platform. This kind of research not only helps to solve the problem of "only inherited, difficult to preserve" in traditional Lion Dance skills, but also promotes the digital presentation of cultural heritage and further enhances the public's sense of participation and interactivity in culture [14].

Figure 5: Lion Dance created by AIGC [14]

Embodied (or grounded) cognition posits that cognitive processes are intrinsically linked to bodily action and perceptual coupling with the environment rather than being confined to amodal symbol manipulation in the brain [15]. This theory reverses the traditional "cognitivist" conception of the brain as a single processor of information and suggests that cognition can exist independently of the body because the Embodied cognition theory extends the

cognitive process beyond the brain, arguing that the body plays an important role in cognitive activities, a view that has gradually gained widespread acceptance in the fields of psychology, neuroscience, philosophy, linguistics, and artificial intelligence [16].

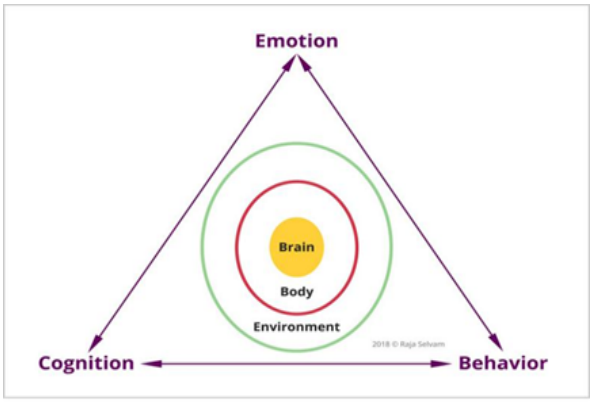

Figure 6: Embodied Cognition Theory [16]

In this way, traditional culture enters into the daily life of the public with the help of the digital platform, which enhances the dissemination effect and participation of culture. Pioneering installations such as Place-Hampi demonstrate how co-evolutionary interfaces can situate visitors inside heritage narratives rather than in front of them, a principle we adapt to performative ICH [17].

Figure 7: Digital interaction of Lion Dance [18]

RESEARCH METHODOLOGY

Research Design

This study employed a design-based research (DBR) methodology to develop, implement, and evaluate a universal digital heritage framework for the Foshan Lion Dance. Design-based research is suitable for bridging theoretical frameworks and practical applications through iterative design, implementation, and reflection. The research integrates principles of embodied cognition to ensure that the digital environment preserves the kinesthetic, performative, and spatial aspects of Lion Dance practice.

Framework Development

The framework was designed in three phases:

Needs Analysis

A comprehensive needs assessment was conducted through semi-structured interviews and participatory workshops with Foshan Lion Dance masters, performers, cultural experts, and community stakeholders [1]. This ensured that the framework's content and interaction design reflected authentic cultural and performative elements [19].

Conceptual Design

Insights from the needs analysis were translated into a conceptual design that integrated immersive technologies, such as virtual reality (VR) and AIGC-based virtual environments. The design featured multiple virtual settings to simulate varied performance contexts. Embodied interaction principles guided interface design, focusing on user body movement, spatial navigation, and haptic feedback to replicate the physicality of the Lion Dance [2]. We therefore adopt an embodied interaction perspective in which meaning arises through action in the world and through the coupling of perception and manipulation [20], informing choices about locomotion, viewpoint control, and haptic responses. In paractivity theory Theory frames the learning task as goal-directed activity mediated by tools and community rules, which we operationalize via task scripts, scaffolded feedback, and role-appropriate interfaces [21]. Recent syntheses in HCI further argue that embodied mechanisms—presence, agency, and sensorimotor contingencies—are design-controllable levers for learning and engagement in interactive systems [22], which our modules explicitly target.

Prototype Development

A functional prototype was developed using Unity3D and VR hardware. The prototype incorporated motion tracking and interactive modules to allow users to observe, learn, and replicate basic Lion Dance movements [11].

Evaluation

The framework was evaluated through mixed methods, combining usability testing, embodied experience assessment, and expert validation.

Participants

Participants included three groups:

- Lion Dance performers (n = 10)
- Cultural heritage scholars (n = 5)
- General users with no prior Lion Dance experience (n = 20)

Data Collection

Usability Testing: Observational data and system logs will record how participants interact with the virtual modules.

Embodied Experience Measures: Pre- and post-experience questionnaires adapted from Waller, and Lehn[23] assessed bodily engagement and perceived learning.

Expert Review: Semi-structured interviews with Lion Dance masters and cultural scholars evaluated cultural authenticity and pedagogical value [24].

Data Analysis

Quantitative data (task completion times, error rates, questionnaire scores) analyzed using descriptive statistics. Qualitative data (interview transcripts, user feedback) applied the thematic analysis to identify design strengths, limitations, and cultural considerations.

Ethical Considerations

The study followed ethical guidelines for research involving cultural communities, ensuring informed consent, cultural sensitivity, and intellectual property rights. All participants had the right to withdraw at any stage.

Limitations

The prototype's scope focused on fundamental Lion Dance sequences and might not fully represent all stylistic variations. Future iterations may expand to incorporate AI-driven choreography adaptation or multi-user collaborative learning.

RESULTS

This study employed a mixed-methods approach, utilizing both qualitative and quantitative research methods to collect comprehensive and in-depth data. Qualitative research focuses on expert interviews and in-depth analysis, while quantitative research employs surveys and experiments to measure participant responses and assess the impact

of digital technology on Foshan Lion Dance. This study combined quantitative and qualitative research tools to comprehensively collect and analyze the influencing factors of the digital and dynamic inheritance of Foshan Lion Dance. The research tools included semi-structured interviews, structured questionnaires, and observation records, which were respectively used to collect in-depth insights from experts, measure user satisfaction and response, and analyze the behavior of participants in simulated scenarios.

Qualitative

Qualitative methods, building upon the literature review, thoroughly investigate cognitive states related to digital design for living inheritance within the framework of embodied cognition. Semi-structured interviews were conducted with lion dance experts, AI technology experts, and the general public, primarily concentrated in Foshan City, Guangdong Province, China. These interviews aim to multidimensionally reveal cognitive differences, preference tendencies, inheritance challenges, and embodied cognition needs across groups, which is helpful for in-depth analysis. Interview sessions were audio/video-recorded to ensure comprehensive content analysis. Data collection included face-to-face interactions and online meetings to accommodate participants' schedules. Direct observation of user interaction behaviors—including movements, gestures, and facial to capture immediate emotional feedback and acceptance levels. Detailed field notes documented observational contexts. Online questionnaires and feedback forms collected direct user responses regarding the value perception of digital design in Lion Dance inheritance, including comments, suggestions, and critiques to enrich qualitative data. Based on qualitative insights and research objectives, two hypotheses are proposed for testing:

H1: Physical Factors (PF) have a positive impact on Situational Factors (SF).
H2: Physical Factors (PF) have a positive impact on Heritage Value (HV).

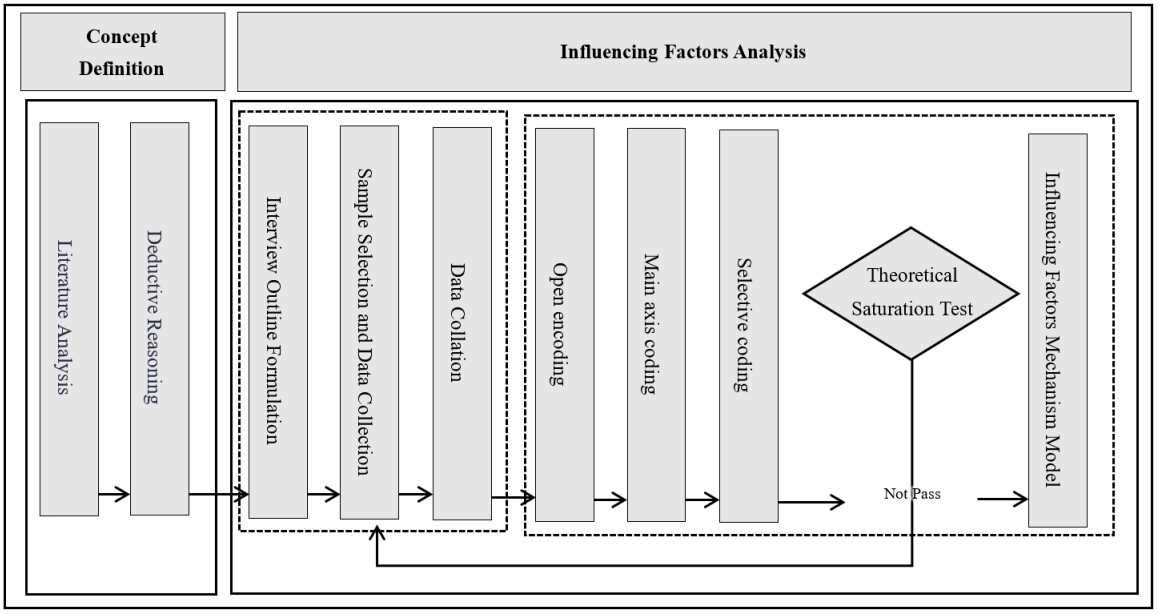

Figure 8: Research steps for analysing the influencing factors of digital living inheritance of Foshan Lion Dance

Drawing on the interview corpus, we articulate four mechanisms that link virtual–real interaction to the living transmission of Foshan Lion Dance.

a. Sensory processing in virtual–real interaction

Traditional performances are multisensory; the digital modules intensify this by coupling vision, audition, haptics, and balance to drive sensorimotor engagement. As one participant noted, "the digital lion head feels real; my body moved involuntarily." Such coupling shifts audiences from passive viewing to embodied presence, reinforcing perception–action loops that underpin embodied cognition.

b. Multiple dimensions of digital embodied experience

Participants described a composite experiential profile, with immersion as the salient dimension—often marked by time compression ("I thought it was one or two minutes; it had been over ten"). This sustained sense of being there indicates that well-orchestrated cues facilitate absorption and consolidate meaning-making. A participant summarized: "I lost track of time because it felt like I was inside the performance."

c. Deepening embodied cognition through virtual–real coupling

Relative to traditional viewing, the digital experience reconfigures perception, spatiality, and interactivity in mutually reinforcing ways. Spatialized depth and navigable viewpoints foster arrival-like presence; immediate, bi-directional interaction enables co-creation among designers, managers, and experiencers. Text overlays and spatialized audio, such as drums, cymbals, and gongs, offer timely scaffolds that transform perceptual engagement into conceptual understanding, thereby enhancing embodied cognition. As one participant described, "with the AR overlay I could read the movement notes while hearing the layered drum–cymbal–gong sound, and it suddenly made cultural details click."

d. Post-experience, value accumulation

After leaving the digital setting, participants reported affective settling and appraisal of "play value." The embodied episode catalyzed place attachment, memorable experiences, and belief formation, which stabilized into post-visit intentions (e.g., recommending to others). These trajectories collectively sediment the living-heritage value of Foshan Lion Dance. In the words of one participant: "It was so memorable that I told my friends they should experience the Foshan Lion Dance in this digital way."

Quantitative

Based on the quantitative research, a research model was constructed specifying independent/dependent variables and research hypotheses. Structured questionnaire surveys designed for public samples systematically gathered quantitative data to examine embodied cognition levels, digital acceptance, and living value perception. Questionnaires incorporated Likert scales and multiple-choice items to precisely capture key data points. Online/offline data collection enabled statistical analysis to test hypotheses and explore causal relationships between variables.

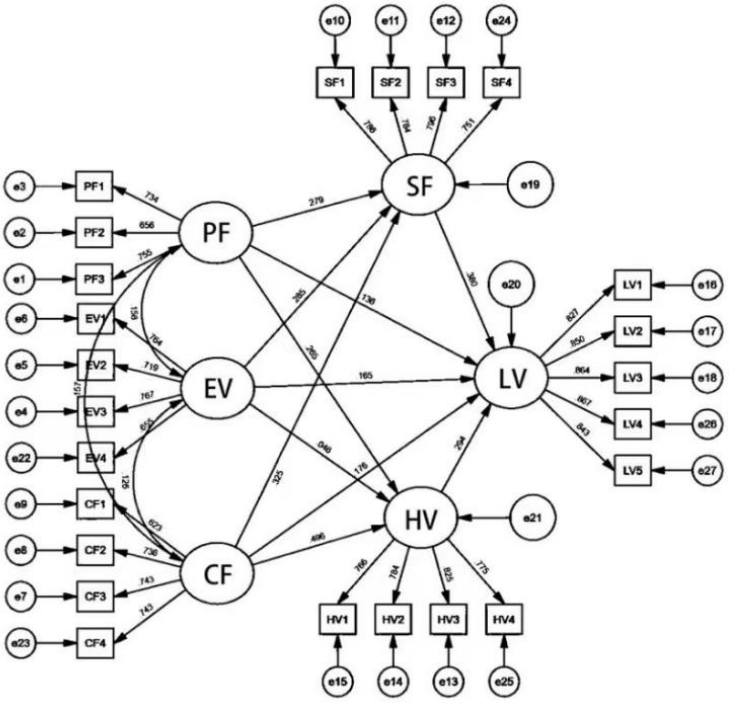

Figure 9: Structural Equation Modeling

Based on the analysis of 557 valid responses using Structural Equation Modelling (SEM), the results indicate that immersion, interactivity, and completeness of cultural narrative are the three core drivers influencing user acceptance. Specifically, physical factors exert a significant positive effect on situational value ($\beta = 0.279$, $p < 0.001$) and heritage value ($\beta = 0.265$, $p < 0.001$), and indirectly enhance living value through these mediating effects ($\beta = 0.136$, $p < 0.001$). Similarly, cognitive factors demonstrate significant positive impacts across all three value dimensions, with the strongest effect on heritage value ($\beta = 0.496$, $p < 0.001$). In contrast, economic value shows no significant effect on heritage value ($p > 0.05$) but remains positively associated with situational value ($\beta = 0.285$, $p < 0.001$) and living value ($\beta = 0.165$, $p < 0.001$). Furthermore, both situational value ($\beta = 0.380$, $p < 0.001$) and heritage value ($\beta = 0.294$, $p < 0.001$) significantly promote the development of living value. Compared with traditional video-based viewing, the immersive interactive group demonstrates significant improvements in both cultural interest enhancement and knowledge recall rates, highlighting its superior capacity for stimulating engagement and strengthening cultural cognition.Based on these findings, three strategic recommendations are proposed:

- Enhance immersive experience through multimodal feedback. Strengthen users' depth of cultural memory and participation by integrating multisensory feedback mechanisms and engaging them in action choreography, thereby improving immersion and emotional resonance.
- Balance innovation with cultural authenticity. While trying out new media and different contexts, keep the main symbols and important dance movements intact to ensure the culture remains authentic and recognizable.
- Develop an integrated online–offline cultural ecosystem. Create a mixed communication system that uses both online platforms and face-to-face interactions, enhances the overall experience, encourages ongoing participation, and allows for the easy sharing of cultural practices, helping to preserve intangible cultural heritage in today's digital world.

The findings from the questionnaire analysis not only provided design guidance and validation for the digital preservation of Foshan Lion Dance but also held decisive significance for shaping the future design and innovation direction of its dynamic digital transmission. Furthermore, it bolstered dissemination and promotion in the digital age, igniting contemporary youth's passion for this ancient intangible cultural heritage.

RESEARCH DISCUSSION

All data in this study were analyzed in a "continuous comparison" manner and systematically coded using NVivo software to ensure transparency and standardization in the data coding process [25,26]. The interaction between the virtual and the real was conducive to improving one's knowledge about embodied cognition and the value of living inheritance [27]. The study indicated that there are major differences between traditional lion dance experiences and digital lion dance experiences in terms of perception, spatiality, and interactivity, and these differences collectively contribute to the enhancement of embodied cognition and the understanding of the value of living inheritance [28].

First, at the perceptual level, the traditional lion dance experience may focus more on the overall atmosphere and visual impact of the scene, while digital technology can reintegrate the proportion of human embodied perception. For example, "On the walls of the Digital Lion Dance museum, we can see many national treasures on display. Select any artifact and project its pattern into the kaleidoscopic digital space to experience the details of the pattern and the art treasure's pattern in an immersive way. Not only that, but also, according to individual artistic preferences and viewing styles, our bodies are right there, experiencing the extraordinary charm of the patterns on the national treasures as if we were there." This experiment shows that digitalization can mobilize the full engagement of the experiencers and achieve deeper embodied cognition and co-creation of living value [28].

Secondly, in terms of spatiality, traditional lion dance requires a real presence at the scene, while digitalization can create a three-dimensional space through technologies such as virtual reality and digital twins, generating a "digital lion dance activity space" that is no different from reality. This overcomes the barriers of time and space, allowing the experiencers who are "remotely present" to also have the embodied feeling of "arriving" at the scene. For example, "The Digital Foshan Lion Dance House can easily access different styles of lion dance venues through shortcut keys, manipulation of walking, and switching of viewing angles. Recalling my previous on-site visits, many venues were not open to the general public for protection or due to venue restrictions. However, in the Digital Foshan Lion Dance House, you can freely explore this wonderful world of lion dance without having to walk hard,

and you don't have to worry about missing some performances you originally wanted to see due to the route when visiting in person." This "hyper-real" environment can create landscapes that cannot be experienced in reality, providing a sense of being there in person. However, to reach a higher level of embodied cognition, being present alone is not enough; one also needs to reach a state of oneness with the object. The formation of embodied cognition is the result of the combined effect of external situational cues, the structure of the subject's cognition, and the stimuli of the embodied object. Technical elements provide enhanced objective conditions, but active human participation is the prerequisite for completing embodied understanding, embodied examination, embodied co-creation, and the formation of advanced embodied cognition. This aligns with museum-space studies showing that spatial configuration and movement affordances shape embodied understanding and meaning-making [29].

Finally, at the level of interactivity, traditional lion dance appreciation is mostly sedentary, and the interaction is often delayed. However, the experiencers in the digital age are in a state of immediate interaction and participation in creation, which leads to the reconstruction of embodied cognitive relationships. Digital technology empowers lion dance with an open nature, allowing the experiencer to engage, interact, have a deep embodied experience, and enrich its meaning. This interaction is a two-way communication based on embodied cognition, enabling information exchange and emotional resonance among designers, managers, and experiencers. For example, "With augmented reality tools, you can see text superimposed on the real space, corresponding to the lion dance school and key points of the movements, some devices that were previously difficult to understand at once become easier to understand cultural knowledge because of the text description, and at the same time hear the mixed stereo effect of drumbeats, cymbals and gongs in your ears, and feel the atmosphere of the lion dance scene as if you were there." This immediate feedback and multi-sensory engagement stimulate and mobilize the embodied cognition of the lion dance scene from the cognitive level, making it easier for the experiencer to resonate emotionally with the lion dance and promoting the deepening of embodied cognition.

Foshan Lion Dance goes beyond mere festival performances and carries profound folk beliefs and cultural symbolic meanings. For instance, the "eye-dotting" ceremony is seen as a key part of giving the lion its spirit, while "picking the green" symbolizes overcoming obstacles and bringing good fortune. The lion dance is deeply integrated with the ancestral temple culture and business customs of the Guangfu region (such as the lion dance performed at opening ceremonies), becoming an important carrier of local identity. Foshan Lion Dance can be divided into two major categories based on its style: the literary Lion Dance and the martial Lion Dance. The Liu Bei lion is regarded as the representative of the literary lion, with a composed and vigorous posture that exudes majesty. The Guan Gong lion and the Zhang Fei Lion are typical of the martial lion, with the Guan Gong Lion's dance being fierce and majestic, while the Zhang Fei lion's movements are rough and bold. During the lion dance, various styles exhibit distinct artistic characteristics through their unique postures, steps, and movements. Interpreting these rituals through an embodied lens underscores how meaning is enacted through bodily practice and spatial choreography rather than abstract belief alone [30].

Comparison with prior work

Our finding that embodied VR outperforms passive video on engagement and cultural understanding aligns with the Cognitive–Affective Model of Immersive Learning (CAMIL), which highlights presence, agency, and affect as key mechanisms of learning in immersive environments [27]. Extending this mechanism to a performative intangible-heritage context, our mixed-methods evidence indicates that bodily participation is central to meaning-making in the Lion Dance scenario. In parallel, reviews of cultural-heritage VR/AR underscore that multisensory orchestration enhances presence and meaning-making, which is consistent with our observations [28].

Building on those foundations, we contribute operational design rules specific to performative ICH: (i) structuring spatial depth and intentional occlusion to strengthen realism and scale perception, and (ii) integrating the user's body with the lion avatar to increase body ownership and authenticity. A distinctive addition is the parameterization of interaction distance: Maintaining a distance of approximately 2.5 to 4 meters between the user and the virtual lion significantly enhances tracking stability and immersion. Whereas immersive-learning research often argues at a principle level [27], this distance guideline offers a deployable parameter that mitigates occlusion and supports consistent embodiment, complementing multisensory recommendations in heritage VR [28].

Methodologically, our transparent pipeline—continuous comparison for qualitative coding (supported by NVivo)

coupled with quantitative testing—adds replicability to prior conceptual and review-oriented work [25,26]. Linking thematic insights to measurable outcomes clarifies how embodied-design choices (e.g., depth/occlusion, avatar mapping, distance) translate into user engagement and understanding and outlines boundary conditions for transferring the framework to other performative ICH contexts.

CONCLUSION

Foshan Lion Dance performances are characterized by large martial arts movements, such as jumps on a plum blossom pole, so it is crucial to create an interactive environment that accurately captures these movements and provides realistic feedback. Specifically, context construction should focus on the following aspects: first, physical distance and motion perception. We need to make sure there is enough space between the user and the interactive interface (whether it's a screen or a VR device) so that the system can fully capture the user's body movements. The ideal distance is about 2.5 to 4 meters, which prevents the user from being too close and having their limbs obscured or too far and causing data distortion, thus ensuring the accuracy of motion capture and making the user feel as if their movements are truly mapped onto the performance. Next is visual depth and realism. We can enhance the depth of space through ingenious visual perspective processing, such as using virtual plum blossom stump arrays to guide users' perception of depth through variations in distance levels. It is also crucial to introduce occlusion relationships, such as when the lion's tail swings, part of its body or background is temporarily obscured, which can significantly enhance the realism of the movement and the immersion of the performance, making the user feel as if they were in a real lion show. The last is the integration of the user's image with the context. We can overlay the user's virtual image (such as through skeleton marker points) with the lion dance animation to create a human-lion experience. To enhance immediate feedback and avoid visual confusion, high-contrast color combinations can be used, such as marking the user's skeleton in a striking yellow and combining it with a red lion head. Also, be sure to handle the hierarchy of visual elements well, such as ensuring that the user's virtual arm does not overlap with the virtual lion teeth, so that the user can clearly perceive how their movements blend with the Lion Dance performance, thereby enhancing physical presence and self-efficacy.

Cultural knowledge is not just mental but grounded in physical movement, sensory experience, and interaction with the environment. Foshan Lion Dance knowledge is transmitted through embodied performance, rhythm, spatial practice, and kinesthetic memory. The key concepts and dimensions of Foshan Lion Dance were shown through the virtual reconstruction of cultural practices, the use of AIGC (AI-Generated Content) for dynamic, adaptive environments, and the authenticity of intangible cultural elements. The integration of bodily movement data (gesture capture, choreography) and sensory immersion (visual, auditory, kinesthetic) demonstrated the embodied interaction. Moreover, embodied cognition was applied as the guiding lens to design virtual modules that preserve and transmit the authentic embodied knowledge of the Foshan Lion Dance.

Future Research Directions

Future work can build on this framework in several ways. First, extending the system to multi-user interactions could simulate lion dance groups, enabling collaborative embodiment. This would involve tracking multiple bodies and synchronizing dance patterns, potentially uncovering new social learning effects. Second, integrating additional sensory modalities could deepen immersion. For example, synchronized haptic feedback (vibrations when the virtual drum is hit) and auditory cues (directional lion roars) would engage proprioceptive and auditory senses. Beyond that, exploring olfactory or airflow cues (e.g. incense scent, wind) could make the experience even more "multi-sensory," following the multi-sensory interaction strategy suggested by Luo, et al.[31]. Third, the framework could be applied to other cultural practices (e.g. dragon dance, martial arts rituals) to test generalizability. Longitudinal studies assessing retention and repeated use effects would also be valuable, as would user studies with diverse age groups to examine educational outcomes. Finally, as technology evolves, incorporating AR or mobile-based versions of the experience could increase accessibility, especially for community outreach and education. Extending multisensory channels (e.g., synchronized haptics, spatialized audio, airflow cues) is likely to deepen embodiment, in line with evidence from immersive built-environment studies [32].

Study Limitations

Several limitations should be noted. The prototype focused on core Foshan Lion Dance sequences and one style variant; it did not cover all regional styles or complex choreography. Thus, the findings may not generalize to every

form of lion dance. The sample size was modest and localized; broader testing (e.g. international participants) could strengthen confidence in the results. The evaluation measured immediate learning gains and satisfaction, but we did not assess long-term retention or behavioral change. Additionally, while VR provides strong visual and some haptic cues, it cannot yet replicate the full social and acoustic environment of a live performance (e.g. crowd interaction, fireworks). These factors may influence cultural experience in ways our study did not capture. Despite these constraints, this work lays a solid foundation; future research can address these gaps by expanding content scope, sample diversity, and sensory realism.

REFERENCES

1. PAN, Y. and CHEN, X. "Digital conservation of intangible cultural heritage: A case study of Lion Dance in Guangdong." *Journal of Cultural Heritage Management and Sustainable Development*, 2020, vol. 10, no. 3, pp. 241-254.

2. LIU, Y.; YIN, Y. and LIU, Z. "Immersive virtual reality for intangible cultural heritage: A case study of Nanyin performance in China." *Journal of Cultural Heritage*, 2021, vol. 48, pp. 207-214.

3. WANG, J. and LI, S. "Digital heritage framework for Chinese lion dance: Design principles and practice." *Journal of Heritage Tourism*, 2022, vol. 17, no. 1, pp. 14-31.

4. NGO, Sarah T. *Communing with lions: A critical literature review exploring pan-asian lion dance traditions through the lens of expressive arts therapy*. Master's Thesis, Lesley University, 2025. https://digitalcommons.lesley.edu/expressive_therapies_theses/59

5. XU, Danlei; PHANLUKTHAO, Peera and KE, Yihan. "Cultural identity of guangdong lion dance in chinese intangible cultural heritage through anthropological perspectives." *International Journal of Sociologies and Anthropologies Science Reviews*, 2024, vol. 4, no. 4, pp. 391-400. DOI: https://doi.org/10.60027/ijsasr.2024.4511

6. FAVRO, Diane. *In the eyes of the beholder: Virtual Reality re-creations and academia*. The Art Bulletin, 2006. https://www.academia.edu/494287/In_the_eyes_of_the_beholder_Virtual_Reality_re_creations_and_academia

7. GIACCARDI,Elisa.*Heritageandsocialmedia:Understanding heritage in a participatory culture*. 1 ed., Routledge, 2012. DOI: https://doi.org/10.4324/9780203112984

8. CHAMPION, Erik. *Critical gaming: Interactive history and virtual heritage*. 1 ed., Routledge, 2015. DOI: https://doi.org/10.4324/9781315574981

9. ROUSSOU, Maria. "Virtual heritage: from the research lab to the broad public." In *Virtual archaeology: Proceedings of the VAST Euroconference, Arezzo* 24–25 November 2000, vol. 1075, 2002, pp. 93-100. https://www.researchgate.net/profile/Maria-Roussou-2/publication/243767413

10. SANTIKA, I. G. P. *Lexicons in barongsai (lion dance) in singaraja*. Undergraduate thesis, Universitas Pendidikan Ganesha, 2025.

11. SHI, M. and ZHAN, X. "China's experience in promoting intangible cultural heritage creative transformation and innovative development through tourism." *Tourism*, 2024, vol. 39, no. 3, pp. 12-15.

12. ZHAN, Sudan and WAN ABDULLAH THANI, Wan Jamarul Imran. "Embracing traditions and innovations of suixi lion heads in lion dance performances in china." *International Journal of Applied and Creative Arts*, 2023, vol. 6, no. 1, pp. 65-90. DOI: https://doi.org/10.33736/ijaca.5663.2023

13. ZHAN, Sudan and THANI, Wan Jamarul Imran Bin Wan Abdullah. "Conveying spirit through form: An exploration on the shape symbols of foshan awakening lion head." *Art and Society*, 2024, vol. 3, no. 1, pp. 89-100. DOI: https://doi.org/10.56397/as.2024.02.08

14. HU, Peng-lin. "The esports industry chain, development index, and future trends in the Guangdong-Hong Kong-Macao Greater Bay Area." *Journal of Shenzhen University (Humanities and Social Sciences)*, 2024, vol. 41, no. 3, pp. 17-26.

15. BARSALOU, Lawrence W. "Grounded cognition." *Annual Review of Psychology*, 2008, vol. 59, pp. 617-645. DOI: https://doi.org/10.1146/annurev.psych.59.103006.093639

16. PAN, L. "The application of embodied cognition theory in primary school mathematics concept teaching." *Examination Weekly*, 2024, vol. 33, pp. 83-88.

17. KENDERDINE, Sarah. "Place-Hampi: Co-evolutionary interfaces for heritage visualisation." In *Museums and Digital Culture*, Springer, 2013, pp. 351-364.

18. JIANG, L. "Research on the digital display design of intangible cultural heritage based on the experience concept." *Footwear Craft and Design*, 2024, vol. 4, no. 16, pp. 186–188.

19. LIN, Z. & Law, R. "The heritage tourism experience of Chinese martial arts: Embodied cognition and narrative transportation." *Tourism Management Perspectives*, 2020, vol. 35, p. 100709.

20. DOURISH, Paul. *Where the action is: The foundations of embodied interaction*. vol. 36, MIT Press, 2001. DOI: https://doi.org/10.1162/leon.2003.36.5.412

21. KAPTELININ, Victor and NARDI, Bonnie. *Acting with technology: Activity theory and interaction design*. MIT Press, 2007. DOI: https://doi.org/10.5210/fm.v12i4.1772

22. MADSEN, J. K. and MADSEN, C. M. "Embodied cognition and human--computer interaction: Theoretical foundations and practical implications." *International Journal of Human--Computer Interaction*, 2020, vol. 36, no. 6, pp. 533-545.

23. WALLER, M. and LEHN, D. V. "Embodied cognition in museum learning: The role of bodily experience in the interpretation of artifacts." *Curator: The Museum Journal*, 2017, vol. 60, no. 4, pp. 435-448.

24. WANG, F. and ZHANG, Y. "Preservation and revitalization of intangible cultural heritage through digital storytelling: A case study of Cantonese Opera." Heritage Science, 2019, vol. 7, no. 1, pp. 1-13.

25. BAZELEY, P. and JACKSON, K. *Qualitative data analysis with nvivo*. SAGE Publications, 2013. https://books.google.com.au/books?id=wBeEkQEACAAJ

26. GLASER, Barney G. "The constant comparative method of qualitative analysis." *Social Problems*, 1965, vol. 12, no. 4, pp. 436-445. DOI: https://doi.org/10.2307/798843

27. MAKRANSKY, Guido and PETERSEN, Gustav B. "The cognitive affective model of immersive learning (camil): A theoretical research-based model of learning in immersive virtual reality." *Educational Psychology Review*, 2021, vol. 33, no. 3, pp. 937-958. DOI: https://doi.org/10.1007/s10648-020-09586-2

28. MARTO, Anabela; GONÇALVES, Alexandrino; MELO, Miguel and BESSA, Maximino. "A survey of multisensory VR and AR applications for cultural heritage." *Computers and Graphics*, 2022, vol. 102, pp. 426-440. DOI: https://doi.org/10.1016/j.cag.2021.10.001

29. TZORTZI, K. "Space and embodied cognition in museum design." *Museum & Society*, 2015, vol. 13, no. 2, pp. 147-166.

30. SCHILBRACK, Kevin. *Philosophy and the study of religions: A manifesto*. John Wiley & Sons, 2014. https://books.google.com.pk/books?id=oqVMAgAAQBAJ

31. LUO, Dan; DOUCÉ, Lieve and NYS, Karin. "Multisensory museum experience: an integrative view and future research directions." *Museum Management and Curatorship*, 2024, pp. 1-28. DOI: https://doi.org/10.1080/09647775.2024.2357071

32. LYU, Kun; BRAMBILLA, Arianna; GLOBA, Anastasia and DE DEAR, Richard. "An immersive multisensory virtual reality approach to the study of human-built environment interactions." *Automation in construction*, 2023, vol. 150, p. 104836. DOI: https://doi.org/10.1016/j.autcon.2023.104836