

Exploring Human-Computer Interaction and Cross-Media Design in Guangdong Intangible Cultural Heritage from the Perspective of Embodied Cognition

Abstract

This paper has discussed the ICH of Guangdong under the theoretical framework of embodied cognition, semiotics, and cross-media design and aimed to discuss innovative pathways of cultural dissemination in the digital era. The key research directions include dynamic symbol generation, multimodal interactive experiences, and extension services of cultural and creative products. This chapter analyzes in a systematic way the utilizations of VR, AR, and Generative AI in the protection and spreading of ICH for the purpose of deepening cultural communication and improving users' identification with cultural heritage.

Based on the philosophical position of epistemology, ontology, and constructivism, the mechanism of co-creating cultural meaning by technology users is demonstrated in this research, and a user-centered model of cultural dissemination is put forward. At the practical level, it underlines that there should be a balance between the authenticity of culture and user experience through dynamic symbol generation and multisensory interactive design. This paper will provide a theoretical basis and practical suggestions for digitization, dissemination, and industrial transformation of Guangdong's ICH.

Keywords : Guangdong ICH, embodied cognition theory, semiotics, interaction, cultural dissemination

1. Introduction

1.1 Research Background

In the context of rapid globalization, ICH worldwide is also facing severe challenges in its preservation and transmission. A trend of cultural homogenization marginalizes many local traditional cultures. Many ICH practices are facing possible extinction due to a lack of interest by younger generations (Yu, 2024). Guangdong, a culturally rich province in China, owns many forms with regard to ICH, representing Lingnan culture but also reflecting diverse Chinese heritage. These traditional cultural resources stand in danger and are highly challenged in contemporary society. The demise of ICH is indeed not just an issue in which cultural transmission crises occur but also has interfered directly with the establishment of continuity in Guangdong's cultural identity.

Meanwhile, other technologies, such as AI, Virtual, and Augmented Reality, also show good opportunities with regard to digital conservation and interactive dissemination of ICH (Giordano et al., 2024). For example, VR can reproduce ICH through 3D modeling and immersive scenarios that enhance user interaction (Doukianou et al., 2020). AR permits users to interact with ICH symbols anywhere and at any time using mobile devices. However, applying these technologies also poses potential risks, such as oversimplification of symbolic meanings or neglect of cultural authenticity in favour of technological representation (Mu et al., 2024). Balancing technological innovation with cultural authenticity has thus become a core issue in ICH preservation and dissemination research.

Due to the challenges that have been going on, the urgent task in front of Guangdong's ICH is to find new ways or practical methods by which to bridge the gaps between young generations and traditional culture. Embodied cognition theory, emphasizing dynamic interaction among body, environment, and cognition, has shed new light on dissemination research in terms of cultural symbols. This theory-while engaging users in sensory and environmental interactions-allows them to have an even deeper understanding compared to the superficial recognition of these cultural symbols through emotions and connotations hidden beneath. Coupled with advanced technologies, exploration into how the Embodied Cognition Theory can help improve user interaction and attachment to cultural symbols is considered a major focus of this study.

1.2 Research Questions

Based on the challenges in preserving and disseminating Guangdong's ICH, this study is focused on some key questions:

a. How does embodied cognition theory support the dissemination and innovation of ICH by using immersive design?

The Embodied Cognition Theory points to the interaction among cognition, the body, and the environment, which gives a new perspective to studying the cognitive process of users in the experience of ICH. By multisensory interaction and physical participation, users can be more aware of symbolic meanings of ICH. The current study will discuss how the embodied cognition theory could guide the design for ICH dissemination in order to foster users' emotional contact with cultural symbols.

b. How can technology generate and contextualize ICH symbols dynamically through ontological prospectives?

While technology is a tool for generating and disseminating ICH symbols, it goes beyond the presentation of cultural content to dynamic generation and contextual adaptation of symbols. From an ontological point of view, technology is an agent in generating symbols. The present study focuses on how technological methods can dynamically generate and contextualize ICH symbols so as to enhance their expressiveness and communicative effectiveness.

c. How do interactive experiences develop users' cognitive understanding and a sense of belonging to ICH symbols when constructing cultural meaning?

ICH dissemination requires not only technological support but also active user participation. In an epistemological approach, users can create new understandings of cultural symbols and build up the meaning of culture in constructivist approaches through interactive experiences. This study will focus on designing highly interactive technological experiences that will enhance users' attachment to and identity with the culture.

1.3 Research Objectives and Significance

Theoretical Importance

a. Epistemologically, this study unfolds how the user generates a novel understanding of cultural symbols through multisensory interaction and bodily participation. It also extends the theoretical underpinning from a perspective of dissemination studies in culture and provides fresh interdisciplinary applications of theory in embodied cognition.

b. From an ontological perspective, this study elucidates the dynamic adaptability of technology in the generation of cultural symbols. By analyzing the roles of VR and AR

technologies in the contextualized dissemination of ICH, it provides theoretical support for research on technology-driven symbol generation (Floridi, 2011).

c. This study explores, under the framework of constructivist and interpretive theories, how users co-create meanings with ICH symbols in technological environments and emphasize the enhancement of user subjectivity in cultural dissemination. This paper contributes to the extension of semiotics and provides an academic basis for personalized ICH dissemination strategies.

Practical Implications

a. Based on the theory of embodied cognition, this study designs immersive dissemination strategies that allow users to experience ICH through multisensory interaction.

b. It proposes some new methods of collaboration between technology and users to balance cultural authenticity with the needs of user experience.

c. The study advocates for the integration of Guangdong's ICH with digital technologies and industrial applications, and it explores ways in which ICH content can be transformed into interactive cultural and creative products.

The theoretical support of this research work will go towards modern dissemination and protection and pioneer new ways in the creation and dissemination of cultural symbols in the ICH. Innovative in theory and practice, it will propose operable suggestions for the sustainable development of ICH in Guangdong Province within a modern society framework.

2. Literature Review

2.1 Current Research on ICH Preservation and Digital Dissemination

Significance and Challenges of ICH Digitalization

Digitalization is one of the most important strategies for safeguarding and disseminating ICH. It enables ICH to transcend space and time through digital technologies, thus making abundant cultural heritage available to people worldwide. For example, the digital archiving of Cantonese opera not only provides a comprehensive record of its performance art but also depicts dynamic stage movements through virtual performances and digital animations that enable younger generations to experience traditional culture directly. Digitalization also plays a critical role in education by expanding cultural knowledge dissemination to wider audiences.

However, the digitalization process presents significant challenges. First, simplifying cultural elements may weaken their deeper cultural meanings. For example, intricate

handicraft processes might be reduced to static displays, overlooking the skills and spirit embedded in cultural transmission. Second, the high costs of technology limit digitalization efforts for small and medium-sized ICH projects, and many inheritors lack the expertise to undertake digitalization independently (Matsumoto, 2020). Thus, balancing cultural depth while lowering the barriers to digitalization (Addison, 2020) remains a critical research priority.

Applications of Immersive Technology in ICH Preservation

Immersive technologies open new perspectives for ICH preservation. These are technologies that create a highly realistic virtual environment in which the user experiences the traditional culture firsthand (Barsalou, 2008). One will be able to appreciate and understand it from an interactive and immersive setting. At the same time, their application requires a degree of caution. The studies also note that overemphasizing the visual effect at the expense of the contextuality and depth of cultural symbols may result in the fragmentation and superficiality of the culture itself (Walsh & O' Brien, 2021; Smith & Watson, 2020).

2.2 Advances in Embodied Cognition Theory

Core Concepts and Applications in Design

Embodied cognition theory posits that human cognition arises through interactions between the body and the environment rather than relying solely on brain activity (Clark, 2015). Integrating tactile, auditory, and visual elements into interactive exhibitions has been shown to significantly enhance users' learning experiences (Spence, 2020), deepening memory retention of cultural content. Embodied cognition, on the other hand, supports interactive design for ICH dissemination. For example, simulating hand movements in traditional crafts not only allows users to learn basic techniques but also to perceive the cultural meaning underlying these practices. This is very effective with younger audiences and with international participants, breaking cultural barriers.

Role of Embodied Cognition in Cultural Dissemination and Symbol Generation

Embodied cognition emphasizes the dynamic nature of cultural dissemination, especially in the generation of symbols and the construction of meaning (Barsalou, 2008). Research has also proved that the meaning-making of cultural symbols can be better developed by users with physical engagement in a multisensory way. In this context, ICH preservation would face some particular privileges: enabling users not only to learn the traditional culture itself but also to understand its inner emotional and cultural value. This may be, for example, through digital tools illuminating the depth of traditional craft and its specific cultural contexts. It can also employ embodied experiences eliciting emotional resonance to enable users to appreciate the aesthetic value of craftsmanship and the social-emotional significance of cultural symbols while perceiving them.

2.3 Semiotics and Philosophical Perspectives on ICH

Dynamic Generation of Semantic and Pragmatic Dimensions

Semiotics provides a theoretical framework for understanding the generation and regeneration of cultural symbols. Morris (1938) indicates that semantic and pragmatic dimensions of symbols dynamically adapt to their contexts. This theory informs the application of cultural symbols in digital environments. For instance, traditional patterns in Lingnan architecture, when transformed into digital design tools, have kept their characteristic cultural features to be reused in modern contexts for decoration purposes (Zhou et al., 2022). However, deep cultural understanding can be lacking in the distortion or ambiguity of meanings of these symbols during dynamic generation (Eco, 1976). Innovation in the re-creation of symbols should, therefore, pay respect to the tradition.

Insights from Ontology and Epistemology in Technology-Enabled Cultural Dissemination

From an ontological perspective, technology is not merely a tool for cultural dissemination but a redefinition of the existence of cultural symbols. For instance, AI has been applied to analyze traditional design patterns in Lingnan Guangcai ceramics, generating new patterns through algorithms. This approach digitizes the core aesthetic elements of traditional crafts, providing new pathways for modern applications of cultural symbols (Li, 2019).

Contrary to epistemological studies research how users create their knowledge about cultural symbols using technology. As for example, augmented reality applications superimpose virtual information and thereby let users acquire an intuitive perception of the historical background and technical aspects of ICH. These studies demonstrate that technology does not act as a medium for dissemination but rather it reshapes user cognition schemes in regard to cultural symbols during the interaction.

2.4 Technological Empowerment and User Experience in ICH

In the digital era, technological empowerment will necessarily have a big impact on the safeguarding and presentation of ICH. These VR and AR technologies open new paths for the presentation of cultural content: immersive experience and interactiveness introduce new levels of user engagement in boosting their own cultural identity. Meanwhile, AI will support digital recreation of traditional craftsmanship, dynamic symbolic generation by data analysis, and algorithms. On the other hand, such widespread use of technology also raises questions about cultural authenticity and technological ethics. Maintaining the core values of ICH while integrating technology presents significant challenges for both research and practice (Matsumoto, 2020). For instance, designing immersive user experiences requires a careful balance between technical precision and the authenticity of cultural semantics (Mu et al., 2024).

The depth and breadth of cultural dissemination represent the essence of technological empowerment. The application of various kinds of new media enables the transcendence of cultural content over spatial and temporal limits, constructing immersive sensory experiences for users. For example, AR-based Lingnan culture exhibition platforms make cultural symbols more appealing while enhancing users' perception of cultural semantics through interactive design. On the other hand, AI plays a vital role in the digital preservation of traditional crafts, as it can reproduce all the intricate details with high precision and generate symbolic patterns dynamically, fitting culture and technology together seamlessly.

Interdisciplinary communication, in turn, guarantees success in fusing technology and culture. In many protection projects of ICH, either in state-level or provincial projects within Guangdong province, it is mutual development between researchers within cultural studies and the technological group which enables the latter group to enable ICH to disseminate more dynamically and diversely, some of which even enable dissemination by tourists in a combination of digital cultural products with on-the-spot experiences. The various practices indicate that technological innovation and cross-disciplinary collaboration may provide an immense lift to cultural dissemination, deepen the involvement of users, and better safeguard the core value of ICH.

3. Theoretical Framework

3.1 Embodied Cognition Theory

According to the theory of Embodied Cognition, cognition is not a full-brain internal process but is closely tagged with the interactions between the body and the environment. This belief opposes the traditional framework of cognitive science, which locates the cognizing agent's cognitions within the head, while the embodiment and environmental aspects become merely marginal issues in this cognitive process. Clark (1997). From the point of view of ICH dissemination, embodied cognition theory opens up a new perspective on how users interact with cultural symbols (Chandler, 2017).

In the dissemination of ICH, users create multisensory cognition of cultural symbols in interaction with the body and the environment. The dissemination methods based on embodied cognition have gone beyond traditional unidirectional visual communication and moved toward multisensory immersive experiences (Johnson 2007).

It is the theory of embodied cognition that has emphasized the role of the body in emotional engagement. In physical interaction, users do not only perceive the external forms of symbols but also develop emotional resonance through physical contact. For instance, when users go through the process of Chaozhou woodcarving with gesture-controlled tools in a virtual environment, they appreciate the complexity of the craftsmanship while deeply understanding the historical and cultural value embedded in the woodcarving. It is here that Embodied Cognition offers the much-needed theoretical underpinning and practical guidelines for ICH dissemination.

3.2 Introduction of Philosophical Perspectives

Philosophical perspectives can provide a theoretical basis in many respects for the generation and dissemination of cultural symbols through epistemology, ontology, constructivism, and interpretivism. All these will give an all-rounded framework through which the relationship between technology, users, and cultural symbols can be studied.

3.2.1 Epistemology: How Users Generate Personalized Cognition of Cultural Symbols Through Technology

Epistemology examines how users create their cognition of cultural symbols in interaction with technology. The cognition is based not only on the external presentation of symbols but also on users' background knowledge and sensory experiences. With multisensory interactive experiences, users create their personalized cognition and enrich the meanings and interpretations of cultural symbols.

3.2.2 Ontology: How Technology Dynamically Adapts Cultural Symbols and Contextualizes Their Expression

The core competence of ontology shows that technology can be used not just to carry information, but also to provide an impetus to generate symbols in a dynamic process. This generates and holds at their core some cultural symbols by flexibly fitting them into different contexts of dissemination. According to an ontological perspective, the relationship between technology and the generation of cultural symbols can be seen as symbiotic in the nature of its dynamism (Heidegger, 1977)..

3.2.3 Constructivism: How Users Co-Construct Cultural Symbols and Memories Through Technology

Constructivism does not focus on the meaning derived by users themselves as active co-authors of what happens around them, rather than as passive recipients of cultural symbols. Through technological interactions, users may be more actively involved in the process of the regeneration of cultural symbols. This collaborative construction process not only deepens users' cultural identification but fosters co-creation of cultural memory itself (Vygotsky, 1978).

3.2.4 Interpretivism: How the Meanings of Symbols Are Reinterpreted Through Diverse User Experiences

Interpretivism emphasizes that symbolic meaning is dynamic, and the interpretation of symbols is closely related to users' personal experiences and cultural backgrounds (Gadamer, 2004). In ICH dissemination, virtual reality technologies can reappear in cultural scenarios, providing users with various possibilities for interpretation.

Diversity strengthens the inclusiveness of cultural dissemination and rejuvenates ICH symbols in a globalized context.

3.3 Semiotics and Cross-Media Design

Semiotics have become an indispensable analytical tool in the dissemination and design of ICH. The spread of cultural symbols depends not only on semantic, pragmatic, and emotional dimensions but also on the dynamic support that technological tools provide to them. Through semiotics, it is possible to delve into the meaning of symbols at the semantic level, to discuss their interactive function at the pragmatic level, and to dig deep into the levels of emotional resonance with users (Cobley, 2021).

The generation of semantic, pragmatic, and emotional dimensions through technological facilities creates dynamic conditions for the dissemination of ICH. For instance, in traditional semantic meaning, the pattern design in Guangcai ceramics underlines their practical usage as a form of decoration with rich cultural meaning at the pragmatic level. Meanwhile, immersion through virtual reality technology puts the user inside the process of creating Guangcai patterns, emotionally experiencing every delicate touch in craftsmanship.

Cross-media design further develops the dissemination of ICH symbols. The development of design has shifted from static to dynamic and multisensory, which is a main trend in ICH dissemination. Supported by AR technology, the dynamic presentation allows users to explore historical and cultural meanings by gesturing or using voice. In such a cross-media way, it not only enlarges the active range of users but also releases more cultural symbols, allowing ICH to thrive in the digital era.

Summary

This chapter develops the conceptual framework through embodied cognition theory, philosophical interpretation, and semiotics, which can be used for dissemination of Guangdong's ICH. Embodied cognition theory underlines multisensory interaction, while philosophical interpretation identifies, epistemologically and ontologically from a constructivist and interpretivist perspective, the pivotal role that technology and users play. Semiotics support the dynamic construction and dissemination of the signs of culture. Generally, the theories stated above comprehensively theoretically guide the innovative dissemination of ICH.

4. Research Content and Methods

4.1 Research Content

4.1.1 Analysis of ICH Symbol Characteristics

The symbolic characteristics of ICH not only embody the historical memory and regional features of specific cultures but also show unique communicative value in cross-cultural dissemination. From a semiotic perspective, the symbol of ICH can be analyzed in three dimensions: semantics, pragmatics, and emotions.

a. Semantic Characteristics:

Semantic features relate to the aspect of the cultural meaning of symbols. Symbols in ICH may reflect complex information related to culture with condensed and intuitive presentations. Symbolic gestures, for example, may mean some natural element, belief in religion, or a role one performs in society within traditional dances. These are embedded in very specific cultural contexts and historical traditions; semantic depth has, therefore, a great centrality in ICH dissemination.

b. Pragmatic Characteristics:

Pragmatic features underline the efficiency and elasticity of signs and symbols. Very often, ICH symbols serve some practical ends or help in establishing social contact. For instance, festivals add ritualistic value to the symbols and increase social contact through dance, music, or ornamentation. In addition, when the ICH symbol merges into modern design, its pragmatic functions will increase. For example, traditional symbols can be modified for the needs of contemporary society through cultural and creative products or multimedia applications.

c. Emotional Characteristics:

The emotional features emphasize the capability of the symbols to provoke cultural identity and emotional resonance. ICH symbols are not merely carriers of cultural information but also connect community members and cultural consumers emotionally. These symbols, through tactile, auditory, and visual stimuli, often stir strong emotional responses and reinforce cultural memory, enhancing a sense of belonging among users.

4.1.2 Practical Applications of Cross-Media Technologies

The integration of advanced technologies provides new impetus to the dissemination and preservation of ICH. This paper discusses the practical application of VR, AR, and Generative AI technologies in the dissemination of ICH..

- **VR and AR Technologies:**

VR technology will simulate the scenes of ICH with 3D modeling and immersive experience, thus presenting users with interactive cultural experiences. AR technology integrates Guangcai patterns into real-world environments using mobile devices. For instance, AR applications provide users with an opportunity to change colors and adjust designs of the Guangcai pattern in real time for personalized customization.

- **Innovative Applications of Generative AI:**

Generative AI allows for the dynamic creation and innovative expression of ICH symbols. For example, through the construction of a database of Guangcai patterns, AI is able to generate customized designs based on user input according to traditional aesthetics. This technology retains the intrinsic semantics of cultural symbols while promoting more user interactions by modernizing the design.

4.1.3 Strategies to Enhance User Experience and Cultural Identity

User experience plays a critical role in increasing engagement and fostering cultural identity in ICH dissemination. Dynamic design and multisensory interaction are key strategies that make ICH dissemination more engaging and interactive.

- **Dynamic Design:**

Dynamic design can enhance user participation and creativity by allowing symbols to change in form, color, arrangement, or behavior in real time to meet personalized needs. Unlike static presentations, dynamic design emphasizes users' ability to adjust cultural symbols during interactions, transforming cultural dissemination from passive reception to active creation. This approach extends the adaptability of symbols, enriching their cultural connotations and offering users personalized avenues for cultural expression.

- **Multisensory Interaction:**

It can be used to deepen users' cognitive and emotional connection with the symbols of ICH through the integration of visual, auditory, and tactile stimuli in multisensory interaction. Compared to experiences with single sensory stimulation, multisensory ways establish stronger emotional connections between users and symbols. For instance, tactile engagement, auditory transmission of musical symbols, and visual dynamic changes let users fully express the cultural values of symbols. This can make the dissemination of culture more vivid, immersive, and emotionally resonant, bridging the interactional gap between users and symbols.

The combination of dynamic design and multisensory interaction opens an innovative pathway for ICH dissemination, deepens users' understanding and identification with cultural symbols, and thus improves dissemination effectiveness and cultural influence.

4.2 Research Methods

4.2.1 Literature Analysis

Literature analysis forms the foundation for theoretical construction and research design. This study systematically reviews literature on embodied cognition theory,

semiotics, and cross-media technologies in ICH dissemination to provide theoretical support for the research framework.

- **Embodied Cognition Theory:** It emphasizes that cognitive generation is rooted in interactions between users' bodies and their environments, offering a cognitive model for dynamic user-symbol interaction (Clark, 1997).
- **Semiotics:** Semiotic analysis examines the semantic, pragmatic, and emotional dimensions of symbols, providing theoretical tools for ICH dissemination and symbol design (Chandler, 2007).
- **Cross-Media Technologies:** The review includes studies on VR and Generative AI, emphasizing their role in enhancing user cultural experiences and fostering cultural identity.

This method clarifies the theoretical background and identifies the role of technology in ICH dissemination, establishing a robust academic foundation for the study.

4.2.2 Case Study

Case studies validate the application of technology and practical strategies. This research analyzes exemplary cases and conducts comparative studies to draw insights for ICH dissemination practices.

- **Successful Cases:**

The Dunhuang digital preservation project employs VR technology to recreate historical murals and cultural contexts. This approach not only visualizes cultural preservation but also significantly expands the influence of cultural dissemination. The project's success demonstrates that technology can transcend its role as a presentation tool to become a dynamic medium for generating and disseminating cultural symbols.

- **Comparative Analysis:**

This study examines the current state of digital dissemination in Guangdong ICH projects. Despite attempts to adopt digital technologies, limitations remain in the dynamic presentation of symbols and the exploration of cultural depth. For instance, simplistic virtual scenes fail to fully represent cultural elements, restricting users' comprehensive understanding of cultural connotations. Comparative analysis helps identify best practices and provides recommendations for improving Guangdong ICH projects.

4.2.3 User Experiments

User experiments validate the effectiveness of design strategies and technological approaches. These experiments focus on analyzing users' cognitive understanding of symbols, satisfaction with interaction experiences, and changes in cultural identity.

- **Quantitative Analysis:** Surveys evaluate user participation, satisfaction, and cognitive changes.
- **Qualitative Analysis:** In-depth interviews capture subjective user feedback and perceptions (Bryman, 2016).

This dual-method approach provides a comprehensive understanding of how user experiences impact ICH dissemination effectiveness and offers insights for optimizing design strategies.

5. Synergistic Innovation of Technology and Theory

5.1 Technology Empowering ICH Dissemination

5.1.1 Applications of VR/AR in Immersive Exhibitions

VR/AR technologies have been able to promote intangible cultural heritage through virtual reality. These technologies overcome the limitation of time and space, enabling users to sink deep into the virtual environment and feel the cultural symbol and appreciate the meaning and values that come with them.

- **VR Technology:**

The new displays and preservations of ICH will be realized with VR's high-precision 3D modeling and virtual scene reconstruction. For instance, using a VR device, users can watch traditional dances in a virtual environment, get closer to the details of the architectural texture, and even feel the skillful art of handicrafts. Such immersive interaction will not only bring more comprehensive comprehension about cultural signs but also light up the memories of culture in many ways. Dynamic features of VR enable the personalization of scene elements through pattern designs, color schemes, or lighting effects to user preferences, hence allowing personalized dissemination of the symbols.

- **AR Technology:**

AR does the same but in a more flexible way, embedding ICH symbols into the user's daily life. Using mobile devices, a user could see virtual traditional Guangdong patterns in his home or integrated into clothes or furniture. It turns the passive observation of cultural symbols into an interactive one,

strengthening emotional connections between users and cultural symbols. Moreover, AR can be combined with educational content, offering enhanced learning experiences that provide a more thorough understanding of the historical and cultural importance of ICH symbols.

5.1.2 Dynamic Generation of Symbols with AI

Generative AI has given new support to the dynamic creation of ICH symbols. Applying deep learning, AI innovates in creating and disseminating cultural signs based on big data analysis and feature extraction.

- **Dynamic Symbol Creation:**

AI maintains the semantic essence of ICH symbols and produces multiple versions according to varied circumstances or the individual's preference. This versatility ensures that ICH symbols meet contemporary dissemination needs and fulfill individual users' specific aesthetic requirements (Goodfellow et al., 2014). In this sense, for instance, by incorporating the design of Guangdong ICH symbols into the generative model, AI will be able to produce occasion-based symbols, including festival-based designs or exclusive decoration patterns that would appeal to users' preferences.

- **Optimization through User Data Analysis:**

AI analyzes user behavior and visual preference, dynamically adjusting the design of Guangdong ICH symbols, thus greatly enhancing dissemination efficiency and improving user satisfaction. In balancing the duality of cultural preservation and innovation, AI opens up new dimensions to ICH symbols in manifestations of new forms.

5.2 Theory-Guided Practical Implementation

5.2.1 Balancing Dynamic Symbol Generation and Cultural Symbol Dissemination

While dynamic generation technologies create new avenues of dissemination for ICH, inappropriate uses of such technologies might lead to the oversimplification or dilution of cultural depth. During technological implementation, a balance between dynamic generation and the dissemination of cultural symbols has to be struck.

- **Ontological Perspective:**

From an ontological perspective, technology is not only a tool to create cultural symbols but also an adaptive agent in their distribution. For instance, VR technology has to embed the core semantics of Guangdong ICH symbols into contextual expressions in virtual scenarios to give full play to more cultural

significance. The semantic, pragmatic, and emotional dimensions of the symbols should be kept intact so that the original cultural authenticity can be preserved in technological innovation.

- **Epistemological Perspective:**

Epistemology emphasizes that the user constructs meaning by interacting with symbols. Dynamic generation technology should allow users to join in the creation of symbols by being more user-centered. For instance, users can reedit elements or recombine designs of Guangdong ICH symbols, turning from passive receivers to active co-designers, which will help them better identify with the symbols and increase the power of cultural dissemination.

5.2.2 Collaborative Design Pathways: Integrating Epistemology, Ontology, and Constructivism

The synergy between epistemology, ontology, and constructivism therefore forms a core pathway to innovative ICH dissemination. In this study, the collaborative design framework integrating the proposed theoretical perspectives shall guide the technological applications.

- **Epistemology:**

Epistemology provides a foundation for understanding how users generate cognition, emphasizing the supportive role of technology in disseminating cultural symbols. For example, multisensory interactive experiences allow users to develop deep understandings of Guangdong ICH symbols through tactile, visual, and auditory integration.

- **Ontology:**

Ontology focuses on the dynamic adaptation of technology and cultural symbols, underlining the proactive role of technology in generating and disseminating symbols. For example, generative AI could build expressions of Guangdong ICH symbols with personalized dimensions of contexts for users while retaining their core connotation and allowing their various dissemination.

- **Constructivism:**

Constructivism underlines the active users in cultural dissemination and proposes some possibilities for co-creation of cultural meaning between users and technology. For instance, during dynamic interaction, users can create new forms of symbols about Guangdong ICH to deepen the cultural dissemination and form an emotional bond between technology and culture.

This co-design pathway furthers user agency in cultural dissemination while making considerations toward the appropriateness of technology and the integrity of the cultural values. It provides hands-on guidance on how to innovatively integrate technology and culture. Summary

This chapter explores the innovative pathways from both technological and theoretical aspects on how ICH is disseminated. Based on technological empowerment, immersion, and dynamic generation capabilities for the symbols of ICH have greatly increased. It points to how theories guide technology by integrating epistemology, ontology, and constructivism with collaborative design methodologies. This harmonious relation between technology and theory modernizes big-time, from digital representation and dissemination, innovation diversifies expressions of ICH, furthers modern development, hence enlightening valuable insight toward sustainable innovation.

6. Optimizing User Experience and Strategies for Cultural Heritage Transmission

6.1 User Needs Analysis

6.1.1 Interests of Young Users and Expectations for Digital Dissemination

Since they are among the key targets of ICH dissemination, interests and expectations among the young population contribute most to shaping the dissemination strategy roadmap in regard to Addison (2020). Born into a world of diversity and instantaneity in digital information flows, the digital native generation requires an approach to ICH dissemination that fully meets their media consumption habits. Research indicates that young users favor highly interactive, vividly presented, and immersive forms of digital dissemination (Prensky, 2001). Popular approaches include short videos, gamified interactions, and real-time personalized customization.

Besides, young users' expectations for cultural content often reflect their aesthetic preferences and alignment with the values of society. They hope that ICH symbols combine with modern design elements, and at the same time, they expect cultural heritage itself to blend in with global values such as sustainability and creative innovation. These demands have driven the transmission of ICH from static traditional settings to dynamic interaction, catering to diversified experiential expectations of younger generations.

6.1.2 The Impact of a Rapidly Digitalized Lifestyle on User Needs

The rapid digitalization of lifestyles has changed user behavior and the ways of cultural consumption. Under the circumstances of fragmented information acquisition, users prefer to acquire cultural experiences in a short and efficient way. For example, creatively presented ICH content, such as dynamic symbol short videos or interactive filters on social media, draws more user attention (Boyd, 2014).

Meanwhile, the demand of users for convenience and personalization increases. Picked up from the fact that digital tools are freely available nowadays, the users can receive the cultural content anytime and anywhere; it is organically expected to be a part of their lives. Such as allowing users to preview the cultural products with AR technology on an e-commerce website or even design the pattern of symbols in real time according to their preference. These demands for personalization place new design challenges on the dissemination of ICH, which will have to balance strategy between maintaining symbols' cultural core and aligning them to everyday contexts of its users.

6.2 Immersive Design Strategies

6.2.1 Multimodal Interaction and Dynamic Symbol Presentation

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6.2.2 Extending Virtual Experiences to Cultural Products

The value of immersive experiences is not only in creating virtual environments but also in extending such experiences into the daily lives of users by transforming them into tangible cultural and creative products. Such a strategy will bridge the gap between the virtual and real and make the dissemination and application of ICH more multi-dimensional and sustainable.

- **Inspiration for Cultural Products:**

Virtual experiences can inspire the creation of cultural products. The dynamic patterns of symbols created within the virtual sphere can be directly applied to the design of clothes, home decor, or accessories. These digital symbols, through technology, can be produced as 3D-printed models or laser-engraved patterns that show the most detailed workmanship in physical products. This transition from digital to physical not only maintains the cultural importance of

virtual experiences but also strengthens users' identification with culture and a sense of belonging by way of material consumption.

- **Functions of Cultural Product Extensions:**

Integration into Daily Life: Integration into Daily Life: Displaying cultural symbolism in everyday objects makes ICH more usable for the modern-day consumer.

Symbolic Communication: High-quality and well-designed products are the best communicators of the cultural meaning of symbols. Dynamically generated symbols may be applied on various materials, ranging from ceramics to textiles, with each one reflecting a different aspect of ICH heritage.

Furthermore, cultural product strategies can meet the principles of sustainability. It caters to users' use preferences for green consumption while embedding social responsibility into ICH dissemination by using recyclable materials or producing in an environmentally friendly way. For example, adopting eco-friendly dyes or reducing environmental impacts during production achieves the dual objectives of cultural and ecological sustainability. The green cultural product strategy will improve the competitiveness of ICH dissemination in a globalized context.

- **Online Dissemination Through Digital Platforms:**

The virtual experiences can further be extended onto the digital cultural products on websites for online dissemination and interactions. Websites and social media in e-commerce enable users sharing in the design of the symbols created in experiences, thereby sharing, collaboration, and discussion with others. Online and offline disseminations put together increase the scale of cultural heritage dissemination and deepen user participation in ICH transmission from an individual to communities, identifying and binding people more tightly with their cultures.

The emphasis of this chapter is on how user needs analysis and immersive design strategies align the digital dissemination strategies with media habits and aesthetic expectations of users, especially young audiences. By harnessing multimodal interaction and dynamic symbol presentation, ICH symbols can get vividly articulated with cultural significance. Again, by carrying the virtual experiences into cultural product consumption, new avenues are opening on methods of consuming and passing on cultures. This user-centered dissemination strategy enhances not only the effectiveness of ICH dissemination but also provides sustainable pathways for cultural preservation and innovation.

7. Discussion

7.1 Contributions to Theory and Practice

This research contributes to bringing together for the first time embodied cognition theory, multimodal interaction design, and semiotics in support of an alternative academic framework for contemporary ICH dissemination. Traditional activities in cultural heritage dissemination have often been represented as a non-changing display for one-way transmission, underestimating users' contributions in creating the cultural meaning. By integrating such theories, this work shows that technological and user interactions support dynamic generation of symbols, thus extending the theory of embodied cognition (Gallagher, 2017).

This makes semiotics and the philosophical approaches of inquiry rich for the contextualized dissemination of the ICH symbols. Ontologically, the research proposed a model in which technology is serving as an adaptive agent for dissemination, making sure that a dynamic and flexible nature of the symbols is going to maintain cultural semantics throughout the various dissemination contexts in the digital era (Ihde 2009). Epistemology underlines the active role that users play in cultural dissemination, while constructivism extends the view to include possibilities of users and technology jointly creating cultural meaning. This integration thus opens new perspectives for the combination of digital technologies and cultural dissemination..

On the practical level, it creatively proposes a set of all-rounded strategies including dynamic symbol generation, multi-modal interaction, and cultural product extension. These approaches transcend the limitations of traditional dissemination modes, unlocking more possibilities for ICH to generate social impact and economic value.

7.2 Insights and Critical Reflections

Despite its theoretical and practical contributions, the study identifies several areas for further exploration:

a. **Risk of Cultural Superficiality in Dynamic Symbol Generation:**

While dynamic symbol generation enhances flexibility in symbol expression, it may risk cultural superficiality if the core semantics of symbols are not adequately preserved during dynamic transformations. Neglecting cultural depth could lead to detachment from historical contexts (Bolter & Grusin, 2000). Future research should prioritize contextualized expressions in symbol generation to ensure the authenticity and integrity of cultural symbols.

b. **Technical Cost Constraints:**

The high technological investment required for immersive experience design and dynamic generation technologies may pose barriers to adoption, especially

for resource-constrained small and medium-sized ICH projects. Future studies should explore cost-effective technological solutions to make these tools more accessible and inclusive.

c. Value Conflicts in Cultural Dissemination:

As a convergence point of local traditions and global values, ICH may face challenges of cultural homogenization during modern dissemination. Balancing the need for international dissemination with the preservation of cultural uniqueness is a challenge requiring in-depth exploration (Throsby, 2001).

8. Conclusion

8.1 Research Summary

Focusing on Guangdong's ICH, this study integrates embodied cognition theory, semiotics, and philosophical perspectives to explore innovative pathways for ICH dissemination in the digital era. Through literature analysis, case studies, and user experiments, the study reveals the critical roles of technological empowerment and user interaction in cultural dissemination.

Key contributions include:

- Proposing a framework for dynamic symbol generation, multimodal interaction experiences, and cultural product extensions.
- Demonstrating how technology acts as an adaptive tool to enhance the depth of dissemination and strengthen user identification with ICH.
- Expanding the theoretical applications of embodied cognition in cultural dissemination by introducing a new perspective on dynamic user-symbol interaction.

By integrating the semantic, pragmatic, and emotional dimensions of semiotics with technology, this study offers new theoretical foundations for the generation and dissemination of ICH symbols. Additionally, it presents a user-centered cultural dissemination model that emphasizes the dual roles of technology in dynamic symbol generation and contextual adaptation, as well as the active participation of users in cultural cognition and meaning construction. The contributions are new perspectives and academic support for digital technologies in ICH dissemination.

The findings note that ICH dissemination should always be user-oriented and make good use of the dynamism presented by technologies for personalization in symbolic expressions and contextualization. This study emphasizes balancing technological adoption against the presentation of authentic culture-the symbols retaining cultural meaning but satisfying the expectations for personalization experiences required of users.

8.2 Future Directions

a. Deep Integration of Technology and Culture:

The future research in the coming years should be oriented to how to have a deep integration of technology with culture, keeping the ICH symbols in depth when using dynamic technologies. More intelligent technological instruments need to be prepared that retain, during generation, the symbolic cultural connotation and historical backgrounds.

b. Cost-Effective Technological Solutions:

While digital technology becomes more pervasive, future research should aim at cost reduction and the development of easy-to-use tools. Offering open platforms or promoting collaborative models will assist the broader dissemination of ICH, especially for smaller projects.

c. Balancing Localization and Globalization:

ICH dissemination should be disseminated to meet local needs and expand internationally. Research might be done to attain cross-cultural adaptation of the cultural symbols in global dissemination, keeping the local characteristics and integrating them into international cultural contexts.

In view of the above directions, future studies will be able to further promote sustainable and inclusive development in the digital dissemination of ICH.

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