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# What Cannot Be Automated: Tacit Knowledge and Irreplaceable Processes in Yazhou Pottery

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**Abstract:** *This study explores the limits of technological substitution in traditional craft production by examining which processes in Yazhou pottery are considered irreplaceable by artisans and why these boundaries persist amid ongoing technological transformation. While existing research on intangible cultural heritage (ICH) increasingly emphasizes modernization, efficiency, and technological integration, comparatively little attention has been paid to the processes that practitioners actively resist automating. Drawing on semi-structured interviews with master potters, young craftsmen, and design professionals in Guizhou, China, this study conducts a qualitative thematic analysis focused on artisans' experiential judgment, embodied skills, and boundary-making practices. The findings reveal that key stages such as glaze control, firing judgment, and surface finishing are widely regarded as non-substitutable, not because of technical infeasibility, but because they rely on tacit knowledge, sensory perception, and situational decision-making accumulated through long-term practice. Artisans articulate technological boundaries as a form of cultural protection, selectively accepting mechanization for auxiliary tasks while reserving core aesthetic and material decisions for human expertise. This study argues that irreplaceability in craft production is not a static attribute of techniques, but a socially and experientially constructed boundary shaped by cultural values and embodied knowledge. By foregrounding what cannot be automated, this research contributes to intangible cultural heritage studies by shifting attention from technological adoption to technological limits. It offers a conceptual lens for understanding how artisans negotiate modernization without relinquishing cultural authenticity, providing insights relevant to heritage governance, craft sustainability, and debates on appropriate technology.*

**Keywords:** Yazhou Pottery; Intangible Cultural Heritage; Tacit Knowledge; Irreplaceable Processes; Craft Boundaries

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## 1. Introduction

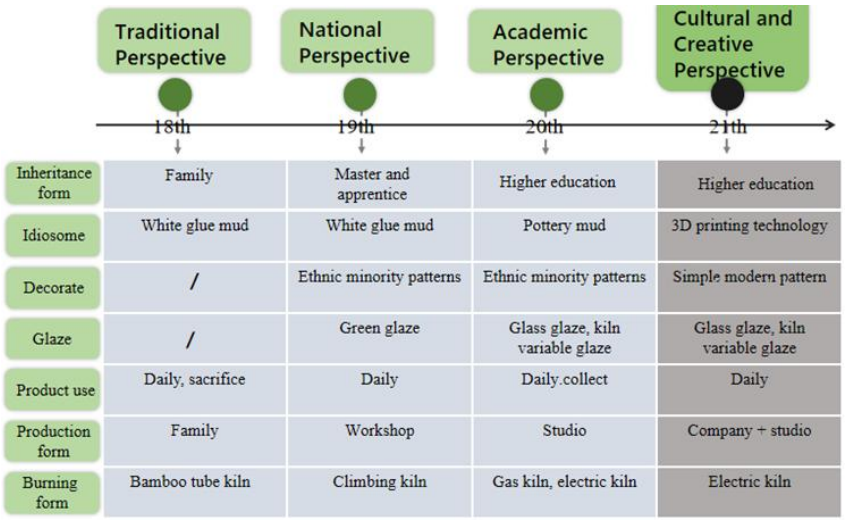
Existing studies on intangible cultural heritage (ICH) increasingly frame technological innovation as a means to enhance efficiency, scalability, and sustainability. Digital documentation, computer-aided design, and automated production tools are often presented as solutions to the structural challenges faced by traditional crafts. This orientation aligns with UNESCO's emphasis on adaptive and living heritage, which recognizes that change is inherent to cultural continuity (UNESCO, 2003).

However, while considerable attention has been devoted to how technology can be integrated into craft production, far less attention has been paid to the question of what should not be automated. This imbalance reflects a broader tendency in modernization-oriented heritage research to privilege functional improvement over epistemic and experiential considerations. As a result, the limits of technological substitution—particularly those grounded in tacit know.

Yazhou pottery, a traditional ceramic craft originating in Guizhou Province, China, offers a compelling case through which to examine this issue. Known for its celadon-green glaze and distinctive crackle patterns, Yazhou pottery relies heavily on manual skills, experiential judgment, and long-term embodied knowledge. Recent efforts to modernize production—through mechanized shaping, digital design tools, or experimental technological interventions—have brought renewed attention to the relationship between efficiency and authenticity. While some stages of production have proven amenable to technological assistance, others remain firmly guarded by artisans as the cultural core of the craft.

**Figure 1: Glass Glaze**

Existing scholarship on Yazhou pottery has largely focused on cultural symbolism, historical lineage, product design, and technological optimization of materials and firing conditions (Tang XD, Ye LL, & Zhang C， 2021). Although these studies provide valuable insights into heritage preservation and technical improvement, they tend to frame technology as a tool to be adopted or optimized, rather than as a force whose limits must be critically examined. More broadly, studies on craft modernization often prioritize successful cases of technological integration, leaving the question of irreversibility—processes that resist or reject automation—largely unaddressed.




| | Traditional Perspective (18th) | National Perspective (19th) | Academic Perspective (20th) | Cultural and Creative Perspective (21th) |
|---|---|---|---|---|
| Inheritance form | Family | Master and apprentice | Higher education | Higher education |
| Idiosome | White glue mud | White glue mud | Pottery mud | 3D printing technology |
| Decorate | / | Ethnic minority patterns | Ethnic minority patterns | Simple modern pattern |
| Glaze | / | Green glaze | Glass glaze, kiln variable glaze | Glass glaze, kiln variable glaze |
| Product use | Daily, sacrifice | Daily | Daily.collect | Daily |
| Production form | Family | Workshop | Studio | Company + studio |
| Burning form | Bamboo tube kiln | Climbing kiln | Gas kiln, electric kiln | Electric kiln |

**Figure 2: Changes in the Development Pattern of the Yazhou Pottery**

This gap is not merely empirical, but theoretical. Craft practices are deeply embedded in tacit knowledge, embodied skills, and situational judgment—forms of knowing that are difficult to codify or transfer to machines. Craft scholarship has long emphasized that traditional skills are deeply rooted in tacit knowledge—forms of knowing that are difficult to articulate, codify, or transfer through formal instruction. Polanyi (1966) famously argued that "we know more than we can tell," highlighting the limits of explicit representation in skilled practice. In craft contexts, such tacit knowledge is often manifested through sensory perception, bodily memory, and situational judgment rather than rule-based procedures.

Despite the centrality of tacit knowledge in craft theory, empirical studies rarely examine how such knowledge actively shapes decisions about technological substitution. This gap is particularly evident in studies of heritage modernization, where technological feasibility is often discussed without sufficient attention to the epistemic foundations of craft practice.

Against this background, the present study shifts the analytical focus from technological integration to technological boundaries. Rather than evaluating how modern tools can improve Yazhou pottery production, this research asks: Which production processes do artisans consider irreplaceable, and how are these judgments formed and justified? By foregrounding artisans' perspectives, the study examines how notions of irreplaceability are constructed through practice, experience, and cultural values, rather than determined solely by technical feasibility.

To address this question, the study draws on semi-structured interviews with ten participants, including master potters, young craftsmen, and design professionals engaged with Yazhou pottery. Using thematic analysis, the research identifies recurring patterns related to experiential judgment, embodied labor, and boundary-making. Importantly, this study does not seek to assess production efficiency or propose technological integration strategies. Instead, it aims to clarify the cultural and epistemic foundations that define the limits of automation in traditional craft production.

By examining what cannot be automated, this study contributes to ongoing debates in intangible cultural heritage studies, craft theory, and appropriate technology. It argues that technological boundaries are not obstacles to modernization, but essential mechanisms through which cultural authenticity and craft identity are maintained. In doing so, the research offers a nuanced understanding of how traditional crafts can engage with modernity without surrendering the experiential knowledge that defines their cultural value.

## 2. Literature Review

While technological change has become a central concern in contemporary discussions of intangible cultural heritage, existing scholarship remains uneven in how it conceptualizes the relationship between technology and craft knowledge. Much of the literature focuses on modes of technological adoption, documentation, and innovation, yet comparatively little attention has been paid to how limits to technological substitution are defined and negotiated within craft practice itself.

To situate the present study within international theoretical debates, this literature review draws on three interrelated bodies of scholarship: research on technological modernization in intangible cultural heritage, theoretical accounts of tacit and embodied knowledge in craft practice, and studies addressing cultural agency and appropriate technology. Rather than

treating these strands as separate, the review brings them into dialogue to highlight a shared gap—namely, the lack of empirical attention to practitioner-defined boundaries of automation. By synthesizing these perspectives, the review establishes a conceptual foundation for analyzing irreplaceability not as a technical constraint, but as an epistemic and cultural construct emerging from practice. This framing provides the theoretical basis for the subsequent analysis of how Yazhou pottery artisans articulate and justify the limits of automation in their work.

### 2.1 Technological Modernization in Intangible Cultural Heritage Studies

Research on intangible cultural heritage (ICH) increasingly explores how digital and emerging technologies affect the preservation, dissemination, and evolution of crafts. Digital creation models and development frameworks show that technology plays a significant role in enabling innovation while maintaining cultural continuity. For example, a recent digital creation development model for intangible cultural heritage crafts (ICH) highlights how digital innovation, management capacity, creative application strategies, and collaborative supports influence the digital transformation of heritage crafts.

Studies also investigate the role of digital communication in handicraft ICH, showing that digital technologies create new media, interactive platforms, and complex relationships that shape how practitioners and audiences engage with handicraft heritage. Although digital communication expands access and visibility, it also raises challenges around effectively transmitting person-specific skills and living cultural knowledge.

These works suggest that while digital tools and platforms offer new pathways for sustainability and outreach, the relationship between technology adoption and embodied craft knowledge remains complex, requiring an understanding of how digital methods align with artisans' lived practices.

Within international scholarship on intangible cultural heritage (ICH), technological modernization is frequently framed as both an opportunity and a necessity for sustaining traditional practices under conditions of globalization, market pressure, and demographic change. Digital documentation, mechanized production, and design technologies are often promoted as tools that enhance efficiency, scalability, and economic viability, thereby contributing to heritage sustainability (He & Wen, 2024; Li, 2022).

In heritage studies, this orientation aligns with a broader shift toward understanding heritage as dynamic and adaptive rather than static and preservative (Harrison, 2013). From this perspective, technological change is not inherently incompatible with authenticity, provided that cultural continuity is maintained. Empirical studies across craft domains—including ceramics, textiles, and metalwork—have documented cases in which selective technological integration has supported production stability and market access without eliminating traditional forms（ He & Wen, 2024).

However, critics have noted that modernization-oriented research often privileges institutional or policy perspectives, emphasizing technological feasibility and economic outcomes while marginalizing practitioners' epistemic experiences (Li, 2022; Yan et al., 2025). As a result, technology is frequently treated as a neutral instrument rather than as a force that restructures knowledge, authority, and practice. This tendency limits scholarly understanding of how technological change is negotiated at the level of everyday craft production.

### 2.2 Tacit Knowledge and Craft Expertise in ICH Research

Tacit knowledge—craft-specific skills and know-how that are difficult to articulate—is a critical focus in contemporary craft and ICH studies. A notable study in Sustainability (Guo & Ahn, 2023) emphasizes how tacit knowledge sharing supports sustainable craft–design collaboration between artisans and academics. It finds that tacit knowledge sharing occurs through stages such as knowledge accumulation, expression, diffusion, and reflection, suggesting that "living knowledge" rather than only documented steps is essential for heritage sustainability (Guo & Ahn, 2023; Yan & Li, 2023).

Although much research on tacit knowledge has historically relied on management theory, recent emphasis is on how this knowledge is shared, transferred, and sustained in practice—especially when interdisciplinary collaboration (e.g., between designers and traditional artisans) seeks to innovate without losing core skills.

### 2.3 Embodied Skill and Material Engagement in Craft Practice

Beyond tacit cognition, craft scholarship increasingly emphasizes embodiment as a constitutive dimension of skilled practice. Theories of embodied cognition argue that thinking emerges through bodily engagement with the environment rather than through abstract mental representation alone (Xia et al., 2024; Yan & Li, 2023). In making practices, perception, action, and judgment are inseparable.

Anthropological studies of craft have highlighted how artisans "learn through the hands," developing bodily memory and sensory attunement that guide decision-making in real time. Similarly, research in design studies demonstrates that material engagement functions as a mode of inquiry, enabling practitioners to respond to uncertainty through iterative bodily interaction (Xia et al., 2024).

From this perspective, mechanization does more than replace labor; it alters the knowledge–material feedback loop through which skill is enacted. Even when machines replicate the visible outcomes of manual actions, they may exclude the embodied responsiveness that allows artisans to interpret subtle changes in resistance, texture, or surface behavior. This insight has led scholars to question whether mechanized reproduction can meaningfully sustain craft knowledge beyond formal appearance (Guo & Ahn, 2023).

Yet, similar to tacit knowledge studies, research on embodiment has seldom been mobilized to analyze how artisans themselves define acceptable limits of mechanization in heritage contexts.

### 2.4 Boundary-Making, Cultural Agency, and Appropriate Technology

In recent heritage theory, increasing emphasis has been placed on community agency and practitioner authority. The UNESCO Convention (2003) explicitly positions heritage communities as primary actors in defining, transmitting, and transforming ICH. This shift has encouraged scholars to examine how practitioners negotiate change rather than merely respond to external pressures.

Emerging technologies such as artificial intelligence (AI) and virtual reality (VR) are increasingly explored in the context of intangible cultural heritage, particularly for enhancing user engagement and creative interaction (Qiu, 2024; Yi & Huang, 2025). AI-supported systems have been shown to facilitate creative reflection and participatory experiences in traditional crafts, rather than fully automating production processes (Li et al., 2025).

Nevertheless, scholars caution that such technologies primarily support representation and experimentation, while the core embodied knowledge of crafts remains resistant to full automation (Guo & Ahn, 2023).

### 2.5 Summary and Identified Research Gap

Although existing studies have addressed digital dissemination, education, and technological tools in ICH contexts (He & Wen, 2024; Li, 2022; Xia et al., 2024), relatively little attention has been paid to how artisans themselves define the limits of technological intervention.
In particular, the experiential and epistemic dimensions of tacit craft knowledge remain underexplored in discussions of automation and digital transformation (Guo & Ahn, 2023; Li et al., 2025).

Addressing this gap, the present study examines how Yazhou pottery artisans articulate irreplaceable processes through experiential judgment, embodied labor, and boundary-making practices. By shifting attention from technological capability to practitioner-defined limits, this research contributes to ongoing debates on automation, appropriate technology, and sustainable heritage transformation.

## 3. Results

The thematic analysis of interview data revealed three interrelated themes that articulate how artisans define and justify the limits of technological substitution in Yazhou pottery production. Rather than framing technology as inherently incompatible with tradition, participants described a nuanced process of boundary-making grounded in experiential judgment, embodied practice, and cultural responsibility. These themes collectively illustrate how irreplaceability is constructed through practice rather than determined by technical capability alone.

**Table 1: Basic information of interview respondents. （Compiled by the author）**

| Role | Name | Gender | Age | Title | Background |
|---|---|---|---|---|---|
| Designer 1 | Kang Yang | female | 38 | adjunct professor | Ceramic design major |
| Designer 2 | Yuan Keyun | female | 42 | adjunct professor | Art design major |
| Designer 3 | Zhao Dan | female | 36 | lecturer | Landscape design major |
| Designer 4 | Yao Xiaoxi | female | 35 | lecturer | Art design major |
| Designer 5 | Luo Bing | male | 37 | lecturer | Head of ceramic company |
| Potter 1 | Jiang Zekuo | male | 38 | Senior ceramicist | Yazhou pottery expert |
| Potter 2 | Liu Yuanhai | male | 40 | Senior ceramicist | Yazhou pottery expert |
| Potter 3 | Shi Guojia | male | 22 | Ordinary potter | Worked for 3 years |
| Potter 4 | Li Weiqing | female | 21 | Ordinary potter | Worked for 3 years |
| Potter 5 | Chang Demin | male | 41 | Ordinary potter | Head of ceramic company |

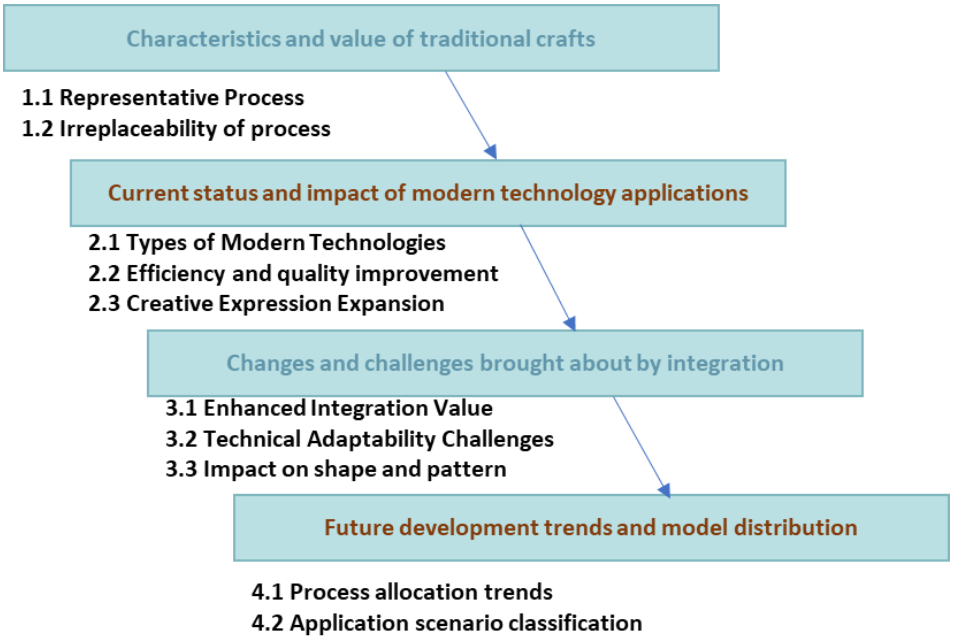



**Figure 3: Theme Coding Model**

Given the tacit and experiential nature of craft knowledge, qualitative methods are particularly suited to investigating the limits of technological substitution. Tacit knowledge is embedded in practice and often cannot be fully accessed through quantitative measurement or standardized instruments (Polanyi, 1966). Semi-structured interviews therefore provide an effective means of eliciting practitioners' experiential judgments, value orientations, and boundary-making rationales.

This study adopts a qualitative thematic analysis approach to explore how artisans articulate irreplaceable processes and define technological boundaries. Such an approach is consistent with prior research on embodied cognition and craft practice, which emphasizes the importance of first-person accounts in understanding knowledge that is enacted rather than explicitly formulated (Varela et al., 1991; Groth, 2016).

### 3.1 Theme 1: Experiential Judgment as an Irreplaceable Skill

Across interviews, artisans consistently emphasized that certain stages of Yazhou pottery production rely on experiential judgment that cannot be replicated by machines. In particular, processes related to glaze application, firing control, and surface evaluation were described as fundamentally dependent on sensory perception and situational decision-making accumulated through long-term practice. Participants frequently used terms such as "feeling," "intuition," and "experience" to describe the knowledge required at these stages.

One master potter explained that while machines may reproduce predefined parameters, they cannot respond to subtle variations that emerge during firing: "A machine follows numbers, but it cannot judge the feeling of the glaze when it starts to change." Another participant noted that glaze behavior often deviates from expectation, requiring immediate human intervention based on visual cues, smell, and embodied familiarity with the kiln environment. Such judgments are not codified as explicit rules, but are learned through repeated exposure to uncertainty and failure.

Importantly, interviewees did not frame these processes as technically impossible to mechanize, but as epistemically incompatible with automation. The value of experiential

judgment lies in its responsiveness to indeterminacy—what several artisans described as outcomes that go "beyond intention." In this sense, irreplaceability is not defined by a lack of technological capacity, but by the nature of knowledge involved. The findings suggest that artisans perceive experiential judgment as central to the aesthetic and cultural integrity of Yazhou pottery, making it a non-substitutable component of production.

### 3.2 Theme 2: Embodied Labor and the Limits of Mechanization

A second theme highlights the role of embodied labor in shaping perceptions of technological limits. Participants repeatedly emphasized that key aspects of Yazhou pottery production are inseparable from bodily engagement, including hand shaping, surface finishing, and real-time adjustment during firing and cooling. These practices were described not merely as manual tasks, but as forms of embodied cognition through which artisans "think with their hands."

Several interviewees explained that bodily memory—developed through years of repetitive practice—enables artisans to detect subtle changes in material resistance, moisture, and surface tension. One craftsman stated: "You know whether something is right through your hands before you see it." This form of knowledge was contrasted with mechanized processes, which were perceived as operating independently of sensory feedback.

While some participants acknowledged that machines could imitate the outward form of certain actions, they argued that mechanization disrupts the feedback loop between body, material, and environment that underpins craft practice. In this context, mechanization was seen as introducing distance between the artisan and the material, potentially undermining the responsiveness required for high-quality outcomes.

Notably, artisans did not reject mechanization in principle. Instead, they differentiated between tasks where bodily engagement is essential and those where it is not. Embodied labor was consistently invoked to justify why certain stages must remain human-controlled. These findings indicate that the limits of mechanization are defined not by physical capability alone, but by the degree to which bodily presence is considered integral to knowledge production within the craft.

### 3.3 Theme 3: Boundary-Making as Cultural Protection

Beyond technical considerations, participants framed the delineation of irreplaceable processes as a form of cultural responsibility. Artisans described themselves not only as producers, but as custodians of cultural knowledge, tasked with safeguarding the defining characteristics of Yazhou pottery. In this context, boundary-making emerged as an active and reflective practice rather than a reactionary resistance to change.

Several interviewees expressed concern that uncritical automation could lead to the erosion of craft identity, even if product appearance remained superficially similar. One senior potter remarked: "If those parts disappear, it may look the same, but it is no longer Yazhou pottery." Such statements reveal that boundaries are drawn to protect meaning and lineage, not merely technique.

Importantly, these boundaries were not fixed or universal. Participants acknowledged that technological roles could evolve, but emphasized that decisions about substitution must be guided by cultural values rather than efficiency alone. In this sense, irreplaceability functions as a negotiated boundary shaped by collective norms, personal experience, and ethical considerations regarding heritage transmission.

This theme underscores that technological limits in traditional crafts are socially constructed and culturally mediated. By actively defining what should remain human-controlled, artisans assert agency over modernization processes. Boundary-making thus serves as a mechanism through which technological change is selectively filtered, ensuring continuity of cultural identity while allowing for adaptation at the periphery.

### 3.4 Summary of Findings

Taken together, the three themes demonstrate that irreplaceability in Yazhou pottery is grounded in experiential judgment, embodied labor, and cultural responsibility. Rather than being determined by technological feasibility, the limits of automation are shaped by how artisans understand knowledge, skill, and cultural value. These findings provide an empirical foundation for rethinking modernization in intangible cultural heritage, emphasizing the importance of recognizing and respecting the boundaries defined by practitioners themselves.

## 4. Discussion

This study shifts attention from technological adoption to technological limits by examining how artisans define irreplaceable processes in Yazhou pottery production. Rather than treating automation as a neutral or inevitable force, the findings demonstrate that technological boundaries are actively constructed through experiential judgment, embodied practice, and cultural responsibility. The concept of tacit knowledge, described as the kind of knowing that cannot easily be articulated, originates in the work of Polanyi, who famously argued that “we can know more than we can tell” (Polanyi, 1966). In this section, the results are interpreted in relation to theories of tacit knowledge, craftsmanship, and intangible cultural heritage (ICH), highlighting their broader theoretical implications.

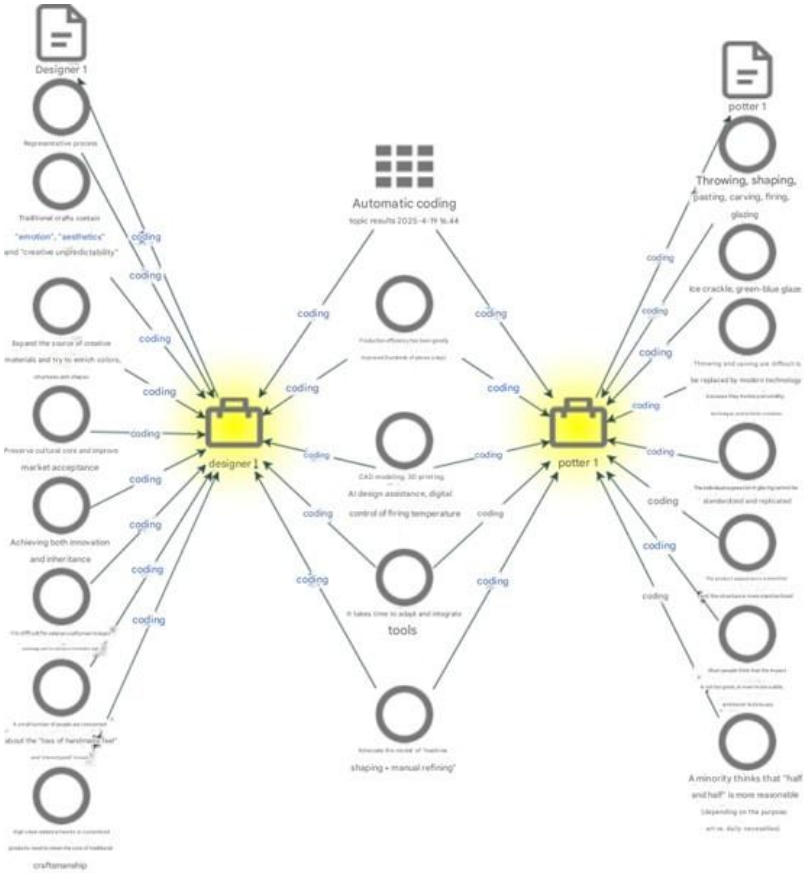



**Figure 4: Contrastive Analysis of Opinions**

### 4.1 Irreplaceability and Tacit Knowledge in Craft Practice

The findings strongly support theoretical accounts of craft knowledge as tacit, embodied, and context-dependent. Artisans' emphasis on "feeling" and intuition closely aligns with Polanyi's (1966) concept of tacit knowledge, which emphasizes that skilled action often precedes verbal articulation. In Yazhou pottery, experiential judgment functions as a form of knowing-in-practice that resists codification, particularly under conditions of uncertainty and material variability.

This observation echoes organizational knowledge theory, which distinguishes between tacit and explicit forms of knowledge and cautions against assuming that all practical knowledge can be converted into formalized procedures (Nonaka & Takeuchi, 1995).

Importantly, the study demonstrates that irreplaceability is not rooted in technical impossibility. Participants did not argue that machines could never replicate specific actions, but rather that automation cannot reproduce the epistemic conditions under which craft knowledge operates. Experiential judgment is valued precisely because it responds to uncertainty, variation, and emergent outcomes—conditions that resist full formalization. This finding extends existing craft theory by empirically illustrating how artisans distinguish between actions that can be standardized and those that depend on tacit, non-codified knowing.

By foregrounding irreplaceability as an epistemic rather than technical issue, this study contributes to a more nuanced understanding of automation limits in craft production. It suggests that debates about technological substitution should move beyond questions of capability to consider the nature of knowledge involved in specific practices.

### 4.2 Embodied Skill and the Knowledge–Material Feedback Loop

Artisans' descriptions of "thinking with the hands" resonate with theories of embodied cognition, which argue that cognition emerges through bodily engagement with the environment rather than abstract mental representation alone (Varela et al., 1991). In craft production, the body functions as a site of perception, memory, and decision-making.
Studies of design and craft practice similarly emphasize that embodied interaction with materials constitutes a distinct mode of thinking, one that cannot be separated from physical action (Groth, 2016). The present findings extend this literature by demonstrating how embodied skill delineates the limits of acceptable mechanization in heritage crafts.

Mechanization, from this perspective, does not simply replace labor; it alters the epistemic structure of practice by disrupting this feedback loop. Even when machines replicate the outward form of an action, they may sever the embodied connection that enables artisans to detect and respond to subtle material changes. This insight helps explain why certain processes remain resistant to mechanization despite apparent technical feasibility.

The findings thus contribute to scholarship on craft and embodiment by demonstrating that bodily presence is not incidental, but constitutive of craft knowledge. Automation limits arise where bodily engagement is central to sense-making, suggesting that the evaluation of technological intervention in heritage contexts must account for embodied epistemologies rather than solely functional outcomes.

### 4.3 Boundary-Making as Cultural Agency in Intangible Cultural Heritage

From an intangible cultural heritage perspective, boundary-making can be understood as a form of cultural agency. UNESCO's (2003) Convention emphasizes that ICH is continuously

recreated by communities in response to their environment, suggesting that adaptation must remain community-driven. The artisans in this study actively define which processes should remain human-controlled, thereby asserting authority over the direction and limits of modernization.

Recent studies on ICH sustainability similarly highlight the central role of tacit knowledge transmission in maintaining craft vitality (Guo & Ahn, 2023). By framing irreplaceability as a practitioner-defined boundary, this study reinforces the view that technological limits are integral to, rather than opposed to, sustainable heritage development.

Crucially, the boundaries identified by participants were neither fixed nor universal. Instead, they were negotiated, context-dependent, and open to reassessment over time. The finding challenges binary narratives that portray artisans as either resistant to change or fully embracing modernization. Instead, artisans emerge as active agents who selectively filter technological intervention according to cultural values, ethical considerations, and experiential understanding.

By conceptualizing irreplaceability as a form of boundary-making, this study contributes to ICH theory by highlighting how communities actively define the limits of acceptable transformation. Such boundaries function not as obstacles to innovation, but as frameworks that guide culturally legitimate adaptation. In this sense, technological limits are integral to sustainability, ensuring that modernization does not erode the meanings and practices that constitute heritage value.

### 4.4 Rethinking Appropriate Technology in Heritage Contexts

The findings also have implications for the concept of appropriate technology, which has traditionally been associated with economic efficiency, accessibility, and contextual suitability. In heritage contexts, appropriateness must also encompass epistemic and cultural dimensions. Technologies may be technically appropriate yet culturally inappropriate if they displace forms of knowing that define craft identity.

This study suggests that appropriate technology in traditional crafts is not determined solely by performance metrics, but by its relationship to irreplaceable knowledge practices. Technologies are perceived as acceptable when they support peripheral or auxiliary tasks, but unacceptable when they intrude upon core experiential and embodied processes. This distinction provides a practical framework for evaluating technological intervention that is grounded in artisan perspectives rather than external efficiency criteria.

By reframing appropriate technology through the lens of irreplaceability, the study offers a culturally sensitive approach to modernization that respects practitioner-defined boundaries. This perspective is particularly relevant for policymakers, designers, and technologists engaged in heritage-related innovation initiatives.

### 4.5 Theoretical Contributions

This study makes three primary theoretical contributions. First, it introduces irreplaceability as an analytical concept for examining technological limits in traditional crafts, shifting attention from adoption to boundary definition. Second, it empirically links tacit knowledge and embodied skill to the persistence of non-automatable processes, extending craft theory into contemporary debates on automation. Third, it reframes boundary-making as a form of cultural agency within ICH, demonstrating how practitioners actively shape modernization trajectories.

Together, these contributions suggest that the future of traditional crafts does not lie in maximizing technological integration, but in carefully negotiating its limits. Recognizing what cannot—and should not—be automated is essential for sustaining the cultural, epistemic, and experiential foundations of intangible cultural heritage.

## 5. Conclusion

This study examined the limits of technological substitution in Yazhou pottery by focusing on production processes that artisans consider irreplaceable. Rather than approaching modernization through the lens of efficiency or technological integration, the research shifted attention to how boundaries of automation are defined, justified, and maintained through craft practice. By foregrounding artisans' experiential judgments, embodied skills, and cultural responsibilities, the study offers an alternative perspective on modernization in intangible cultural heritage (ICH).

The findings demonstrate that irreplaceability in traditional crafts is not determined by technical feasibility alone. Processes such as glaze control, firing judgment, and surface finishing persist as non-substitutable not because machines are incapable of replicating actions, but because these practices rely on tacit knowledge, sensory perception, and situational responsiveness that resist full formalization. Irreplaceability, therefore, emerges as an epistemic condition rather than a technological limitation.

At the cultural level, the study shows that boundary-making functions as a form of agency through which artisans actively shape the trajectory of modernization. By distinguishing between core and peripheral processes, practitioners do not reject technological change outright, but selectively negotiate its scope in ways that preserve craft identity and cultural meaning. The challenges simplified narratives that frame traditional artisans as either resistant to innovation or passive recipients of modernization.

Theoretically, this research contributes to three interconnected domains. First, it advances craft and tacit knowledge theory by empirically demonstrating how embodied judgment underpins the persistence of non-automatable practices. Second, it enriches intangible cultural heritage studies by conceptualizing technological boundaries as dynamic, practitioner-defined constructs rather than fixed constraints. Third, it refines discussions of appropriate technology by emphasizing cultural and epistemic appropriateness alongside functional considerations.

By shifting the analytical focus from what technology can do to what it should not do, this study invites a rethinking of modernization strategies in heritage contexts. Sustainable transformation, it suggests, depends not on maximizing automation, but on recognizing and respecting the limits defined by those who embody and transmit craft knowledge. Acknowledging irreplaceability is therefore not an obstacle to innovation, but a necessary condition for culturally grounded and ethically responsible modernization.

Several limitations should be acknowledged. The study is based on a relatively small number of interviews concentrated in a single regional craft context, which may limit the generalizability of the findings. Additionally, the analysis focuses on practitioner perspectives and does not incorporate quantitative assessments of production outcomes or consumer perceptions. These limitations point to opportunities for future research rather than weaknesses of the approach.

Future studies could extend this research by comparing irreplaceable processes across different crafts or cultural contexts to explore whether similar boundary-making logics apply elsewhere. Longitudinal research could also examine how perceptions of irreplaceability evolve as technologies and generational structures change. Such work would further clarify how traditional crafts navigate modernization while sustaining the experiential knowledge that defines their cultural value.

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**Conflict of Interest Statement**
The authors declare that there is no conflict of interest regarding the publication of this study.

**References**

Groth, C. (2016). Design- and craft thinking analysed as embodied cognition. FormAkademisk – Research Journal of Design and Design Education, 9(1). https://doi.org/10.7577/formakademisk.1481

Guo, J., & Ahn, B. (2023). Tacit knowledge sharing for enhancing the sustainability of intangible cultural heritage (ICH) crafts. Sustainability, 15(20), Article 14955. https://doi.org/10.3390/su152014955

Harrison, R. (2013). Heritage: Critical approaches. Routledge. https://doi.org/10.4324/9780203108857

He, Z., & Wen, C. (2024). Construction of digital creation development model of intangible cultural heritage crafts in China. Humanities and Social Sciences Communications, 11, Article 1745. https://doi.org/10.1057/s41599-024-04331-4

Li, Y. (2022). Research on the digital communication of handicraft intangible cultural heritage based on grounded theory. Heritage Science, 10, Article 126. https://doi.org/10.1186/s40494-022-00760-z

Li, Y., Chen, Y., Hou, Y., Chen, C., Han, Y., Han, J., Dai, W., Li, Y., Tang, X., Li, M., Dong, Q., & Li, H. (2025). LacAIDes: Generative AI-supported creative interactive circuits crafting to enliven traditional lacquerware (arXiv:2510.08326) [Preprint; withdrawn]. arXiv. https://doi.org/10.48550/arXiv.2510.08326

Nonaka, I., & Takeuchi, H. (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. Oxford University Press.

Polanyi, M. (1966). The tacit dimension. University of Chicago Press.

Qiu, T., Li, H., Chen, Y., Zeng, H., & Qian, S. (2024). Continuance intention toward VR games of intangible cultural heritage: A stimulus-organism-response perspective. Virtual Reality, 28, Article 149. https://doi.org/10.1007/s10055-024-01043-7

Tang, X., Ye, L., & Zhang, C. (2021). Research on the development status and schools of Yazhou pottery [In Chinese]. Research on Art Education, (18), 46–48.

UNESCO. (2003). Convention for the safeguarding of the intangible cultural heritage. United Nations Educational, Scientific and Cultural Organization. https://ich.unesco.org/en/convention

Varela, F. J., Thompson, E., & Rosch, E. (1991). The embodied mind: Cognitive science and human experience. MIT Press.

Xia, J., Yuizono, T., Wang, T.-Y., & Kim, E. (2024). Intangible cultural heritage course design in the digital age and its effects of interdisciplinary workshop. Education Sciences, 14(3), Article 325. https://doi.org/10.3390/educsci14030325

Yan, W.-J., & Li, K.-R. (2023). Sustainable cultural innovation practice: Heritage education in universities and creative inheritance of intangible cultural heritage craft. Sustainability, 15(2), 1194. https://doi.org/10.3390/su15021194

Yan, Z., Lim, C. K., Hu, D., Ahmed, M. F., Halim, S. A., & Li, L. (2025). Construction of digital dissemination effects evaluation indicator system of traditional techniques of intangible cultural heritage. npj Heritage Science, 13, Article 224. https://doi.org/10.1038/s40494-025-01793-w

Yi, C., Huang, J., & Song, L. (2025). Enhancing intangible cultural heritage dissemination through digital experience: An Affective Events Theory approach. npj Heritage Science, 13, Article 438. https://doi.org/10.1038/s40494-025-02017-x