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Supporting Understanding of Tacit Craft Knowledge through Digital Mediation: Evidence from Quyang Stone Sculpture

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ABSTRACT: Craft-based intangible cultural heritage depends on tacit, embodied, and materially situated knowledge that is difficult to communicate through verbal explanation, demonstration, or visual documentation alone. This study examines how digital mediation can support understanding of such knowledge in Quyang Stone Sculpture without replacing embodied craft learning. A qualitative-dominant multi-source design combined semi-structured interviews with three craft inheritors, field observation, and a preliminary questionnaire involving 261 respondents. The analysis identified four themes: preparatory understanding before practice, tacit and judgement-based knowledge, decisions and consequences, and the boundaries of digital mediation. The findings indicate three potential supplementary functions of digital mediation: supporting orientation before practice, facilitating the interpretation of selected relationships underlying craft judgement, and providing opportunities for reflection on decisions and consequences. However, such support remains limited to interpretation and reflection, as digital environments cannot reproduce the full sensory, material, bodily, and interpersonal conditions required for developing craft competence. Digital mediation is therefore best understood as a complementary component of craft learning, while sustained engagement with practitioners, materials, and tools remains essential to embodied skill development.

KEYWORDS: Quyang Stone Sculpture, Tacit Knowledge, Craft Transmission, Digital Mediation.

I. INTRODUCTION

Craft-based intangible cultural heritage depends not only on preserving artefacts but also on sustaining knowledge embedded in making, perception, judgement, and participation. Much of this knowledge develops through repeated engagement with practitioners, materials, and tools and is therefore difficult to separate from the situations in which it is enacted.

In Quyang Stone Sculpture, practitioners respond to changing material conditions through adjustments in force, timing, direction, and tool use. The difficulty in transmission lies not simply in showing these actions, but in communicating the judgement through which such adjustments are made. Visible procedures may be demonstrated, while the perceptual and judgement-based reasoning underlying expert action may remain difficult for learners to access.

Text, photographs, demonstrations, and video can document procedures and make craft practices more accessible, but they do not necessarily reveal why practitioners modify an action in response to changing material conditions. This limitation is especially relevant to crafts in which skilled performance depends on situated interpretation rather than the mechanical execution of fixed procedures.

The relevant question is therefore not whether digital media can reproduce craft practice, but what forms of understanding they can reasonably support. Existing digital heritage research has demonstrated the value of interactive technologies for representation, interpretation, and public engagement, yet the boundary between digitally mediated understanding and embodied craft competence remains less clearly defined. Potential forms of support may include helping users access, interpret,

or revisit aspects of craft reasoning that are difficult to isolate through conventional explanation. These possibilities require empirical examination rather than an assumption that digital interaction is equivalent to direct craft learning.

Any proposed digital support must therefore preserve a distinction between mediated interpretation and the embodied competence developed through sustained engagement with practitioners, materials, tools, and workshop conditions. Against this background, the present study examines which aspects of Quyang Stone Sculpture knowledge are difficult to communicate through conventional transmission and how digital mediation may provide bounded supplementary support for their understanding.

The study addresses two research questions:

RQ1: What aspects of Quyang Stone Sculpture craft knowledge are difficult to communicate through conventional explanation and demonstration?

RQ2: In what ways can digital mediation provide supplementary support for understanding these forms of craft knowledge without replacing embodied practice?

Drawing on interviews with Quyang Stone Sculpture inheritors, field observation, and a preliminary questionnaire involving 261 respondents, the study examines both the possibilities and boundaries of digital mediation in relation to embodied craft learning.

II. LITERATURE REVIEW

This review considers three connected strands of scholarship relevant to communicating craft knowledge in Quyang Stone Sculpture: the tacit and embodied character of craft practice, the challenges of transmitting such knowledge through conventional teaching, and the potential role of digital mediation. Together, these strands suggest that the central difficulty is not simply a lack of access to visual information, but the challenge of understanding how material conditions, practitioner judgement, actions, and consequences are related. Digital mediation is therefore considered here as a possible form of supplementary interpretive support, while recognising that embodied competence continues to depend on direct engagement with practitioners, tools, and materials. This synthesis provides the conceptual basis for examining which aspects of craft knowledge are difficult to communicate and how digital mediation may support understanding without replacing craft practice.

A. Tacit and Embodied Knowledge in Craft Practice

Craft knowledge includes forms of understanding that are developed through bodily action, sensory perception, and material engagement rather than through explicit instruction alone (Ingold, 2013; Malafouris, 2013; Polanyi, 1966). Polanyi's concept of tacit knowledge provides a foundational explanation for this condition. Tacit knowledge refers to forms of knowing that cannot be fully articulated in language but remain essential to skilled action (Polanyi, 1966). In craft practice, this includes forms of practical judgement that are enacted through experience rather than fully specified through verbal rules.

Embodied knowledge further emphasises that practical understanding develops through bodily and sensory engagement with materials. Material engagement is not merely a context for action but contributes to how practitioners perceive, adjust, and know through practice (Malafouris, 2013; Nimkulrat, 2020). In craft contexts, this may involve tactile sensitivity, rhythm, coordination, and recognition of subtle material change.

Ingold (2013) similarly conceptualises making as an ongoing correspondence between practitioner, material, and environment rather than the execution of a predetermined plan. From this perspective, craft knowledge is relational and situated because skilled action emerges through continuous engagement with changing material conditions.

Taken together, tacit, embodied, and situated perspectives show that craft knowledge cannot be understood solely as transferable information. Skilled practice also depends on bodily engagement, material responsiveness, and practical judgement developed through participation (Ingold, 2013; Polanyi, 1966). This distinction provides the theoretical basis for examining why some forms of craft knowledge remain difficult to communicate through conventional transmission.

B. Challenges in Traditional Craft Transmission

Traditional craft transmission depends heavily on observation, repetition, correction, and sustained participation in practice, particularly where tacit and experience-based knowledge is transmitted across generations (Bódizs & Macher, 2026). Because learning occurs within relationships among practitioners, materials, tools, and working environments, the conditions of transmission are themselves part of how craft knowledge is acquired (Giaccardi, 2012; Ingold, 2013).

A central difficulty is that demonstration can expose visible actions without necessarily making the judgement behind them explicit. Learners may reproduce an observed movement while remaining uncertain about how experienced practitioners interpret material conditions or decide when an action should change (Polanyi, 1966).

Craft learning is also situated: material variation, tool conditions, production stages, and working contexts influence how practitioners respond. Learning therefore involves developing sensitivity to changing situations rather than simply memorising a fixed sequence of operations (Ingold, 2013).

Apprenticeship adds a temporal challenge because practical judgement develops gradually through repeated observation, correction, and participation. Expert decisions may occur quickly and remain only partially explained, while written or audiovisual records can preserve visible procedures without necessarily revealing the reasoning that produced them.

A further challenge concerns learning from consequence. In subtractive practices such as stone carving, some decisions are irreversible, so understanding involves recognising how actions alter later possibilities. These relationships may be difficult to isolate during continuous workshop activity.

When prolonged apprenticeship and repeated participation are unavailable, documentation alone cannot recreate the social and experiential conditions in which practical judgement develops.

The resulting difficulty is therefore not a lack of experiential richness in apprenticeship, but the difficulty of making selected moments of expert judgement available for explanation and review. Taken together, the challenge of craft transmission lies not only in communicating procedures but also in making situated judgement and decision–consequence relationships accessible to learners. This limitation provides the basis for considering what forms of supplementary mediation may support understanding without replacing direct practice.

C. Digital Mediation as Supplementary Support

Digital heritage research has expanded from documentation and representation toward more participatory and interpretive forms of engagement (Economou, 2015; Giaccardi, 2012; Silva et al., 2023). For craft knowledge, however, the relevant issue is not simply whether digital media increase access, but whether they can help users interpret relationships that remain difficult to recognise through static or linear forms of presentation.

Digital mediation is therefore more appropriately understood as supplementary rather than substitutive support. Research on interactive mobile narratives in museums demonstrates how digital storytelling can organise visitor engagement and cultural interpretation through interactive experiences (Roussou & Katifori, 2018). In craft contexts, such approaches may offer opportunities to revisit selected aspects of practice, although their effectiveness for communicating tacit craft knowledge requires separate empirical examination. Such mediation should not be understood as converting tacit knowledge into fully explicit instruction. Its more limited role is to make selected aspects of process, judgement, or consequence available for interpretation and reflection. This bounded interpretation is consistent with research that treats digital heritage as an interpretive environment rather than merely a repository of cultural information (Economou, 2015; Giaccardi, 2012).

Within learning contexts, digital resources may operate before, alongside, or after direct practice by supporting orientation, interpretation, or subsequent reflection. A recent controlled study of interactive craft simulation reported higher immediate procedural-knowledge test scores in a serious-game condition than in a video-instruction condition, while the conceptual-knowledge difference was not statistically significant and evidence for a knowledge-type-specific advantage remained inconclusive (Yi et al., 2026). These findings concern short-term assessed knowledge rather than embodied craft competence. Digital resources should therefore remain complementary to practitioner-led and material-based learning rather than being treated as an independent route to craft competence.

The limits of mediation are equally important. Embodied interaction research emphasises that experience is grounded in bodily activity and material and social contexts rather than in representation alone (Dourish, 2001). Digital environments can therefore mediate selected aspects of a practice without reproducing the full sensory, material, and interpersonal conditions through which skilled competence develops.

For the present study, digital mediation is therefore conceptualised as bounded supplementary support: it may assist access to and interpretation of selected aspects of craft knowledge, while embodied competence remains dependent on direct participation with practitioners, materials, and tools. This distinction provides the conceptual basis for examining both the possibilities and the limits of digital support in Quyang Stone Sculpture transmission.

III. METHODOLOGY

This study adopted a qualitative-dominant multi-source design to examine difficulties in communicating tacit craft knowledge and the bounded supplementary role of digital mediation. The analysis drew on three evidence sources from a broader doctoral research project: semi-structured interviews with Quyang Stone Sculpture inheritors, field observation of craft practice, and a preliminary questionnaire involving 261 respondents.

A. Research Context and Participants

The broader doctoral project involved a nine-member expert panel comprising three Quyang Stone Sculpture inheritors, three cultural heritage personnel, and three digital media or experience-design professionals. The present article reports a focused analysis of a defined subset of the broader doctoral dataset, specifically the three inheritors, because its research questions concern craft knowledge communication, material judgement, embodied practice, and apprenticeship-based transmission. The other expert groups contributed to broader questions of heritage safeguarding, interpretation, and digital design feasibility in the parent study; their data were not used as primary evidence for answering the two research questions addressed in this article. The three inheritors were purposively selected based on their direct involvement in Quyang Stone Sculpture practice and their experience of craft transmission, enabling the study to examine practitioner perspectives on tacit knowledge and the limitations of digital mediation.

The inheritor interviews examined how craft judgement is communicated, which aspects remain difficult to articulate, and how practitioners understood the appropriate limits of digital support. Field observation was conducted in active Quyang Stone Sculpture workshops under natural production conditions. Observation focused on interactions among practitioners, tools, stone materials, bodily movement, and workflow, providing contextual evidence for interpreting the practice-based issues described in the interviews.

The preliminary questionnaire comprised 261 valid respondents and served a supporting rather than outcome-evaluation role. It examined respondents' prior familiarity with Quyang Stone Sculpture, perceptions of craft practice, and expectations of digital experience, and was used as user-level corroboration of issues identified through the qualitative analysis. Most respondents had limited direct experience of stone carving: only 19 participants (7.28%) reported basic training or more extensive practice, while 225 (86.21%) had either never heard of Quyang Stone Sculpture or had heard of it without knowing much about it. At the same time, 223 respondents (85.44%) identified themselves as art students or practitioners. The survey therefore represents the perceptions of this predominantly art-related sample with limited craft-specific experience and is not treated as a population-level estimate of public attitudes.

B. Data Analysis

Interview and field-observation materials were analysed using a thematic approach informed by Braun and Clarke (2006, 2021). Interview materials were initially coded to identify recurring descriptions of craft knowledge, judgement, transmission challenges, and digital support. Related codes were subsequently examined and grouped into broader themes in relation to the research questions. NVivo was used to organise and retrieve coded materials, with attention to embodied knowledge, material judgement, transmission difficulties, decision–consequence relationships, and the perceived possibilities and limitations of digital mediation. The analysis generated four themes: preparatory understanding before direct craft practice, tacit and judgement-based knowledge, decisions and consequences, and the boundaries of digital mediation. Field observations were used to contextualise the interview findings through observable relationships among practitioners, tools, materials, bodily actions, and working procedures, without inferring practitioners' internal reasoning from observation alone.

Questionnaire data were analysed descriptively using frequencies, percentages, means, and sample standard deviations. For the seven Likert-type items reported in Table 1, the proportion of responses rated 4 or 5 was also calculated to indicate the proportion of responses in the two highest response categories. The survey findings were interpreted as respondents' perceptions and expectations and were not used to infer learning effects, practical competence, or causal impacts of digital media.

The three evidence sources were interpreted comparatively rather than treated as equivalent measures. Inheritor interviews provided practitioner accounts, field observation supplied contextual evidence of practice, and the questionnaire provided user-level corroboration. Comparison across these complementary sources informed the interpretation of the four themes reported in the Results section.

C. Ethical Considerations

Participation was voluntary, and informed consent was obtained before data collection. Interview and questionnaire records were anonymised for analysis and reporting, and participants were informed of the non-commercial academic purpose of the research. Data were handled confidentially and used only for the purposes of the study. The research was conducted under ethical approval granted for the broader doctoral project by the relevant ethics committee at Mahasarakham University.

IV. RESULTS

The analysis generated four related themes concerning difficulties in communicating Quyang Stone Sculpture knowledge and the perceived supplementary role of digital mediation. The themes were derived primarily from inheritor interviews, with field observation and questionnaire data used as supporting evidence.

A. Preparatory Understanding Before Direct Craft Practice

The first theme concerned the need for basic conceptual preparation before direct craft practice. Inheritor accounts indicated that novices may not initially recognise key conditions of stone carving, including irreversibility, hidden material defects, the need to retain sufficient material, and the risks associated with inappropriate timing or force.

One inheritor described digital media as providing "cognitive preparation" before workshop participation, particularly by introducing learners to irreversibility, material uncertainty, and stage-specific judgement. The participant framed this role as preparation for, rather than replacement of, direct craft learning.

Questionnaire responses showed generally high agreement across items concerning situational adjustment, stopping decisions, and the consequences of incorrect judgement (M = 4.02–4.07). Detailed descriptive statistics are presented in Table 1. These responses reflect respondents' perceptions of risk, timing, and adaptive judgement rather than evidence of practical competence.

B. Tacit and Judgement-based Knowledge

The second theme concerned the difficulty of communicating the reasoning embedded in expert action. Inheritor accounts distinguished visible carving movements from the less visible processes of perception and judgement that guide them.

One inheritor described skilled practice through "seeing", "listening", and "touching", together with hesitation, testing, and confirmation, noting that novices may imitate visible movements before developing the perceptual capacities underlying them. A second inheritor described decisions such as when to stop, how to follow the stone grain, and how much material to remove as judgements that are often made through experience and not fully verbalised during instruction.

Field observation documented repeated adjustments in carving rhythm, tool orientation, bodily posture, and working sequence in response to changing material conditions. Questionnaire responses also showed relatively high agreement with the view that written or video information alone may be insufficient for fully understanding craft experience and that digital media may help make otherwise less visible reasoning more accessible (M = 3.98–4.00; see Table 1).

C. Decisions and Consequences

The third theme concerned the difficulty of revisiting decisions and consequences during continuous craft practice. Inheritor accounts indicated that expert decisions may occur rapidly and are not always easily isolated for later explanation or comparison.

One participant proposed comparing correct and incorrect carving paths, excessive removal and appropriate material retention, and the different outcomes produced by alternative decisions. The participant described this as a form of staged review rather than a substitute for physical training.

The irreversibility of subtractive carving was repeatedly associated with the consequences of judgement, because material removal changes the possibilities available at later stages. Questionnaire responses also showed positive agreement that presenting the consequences of mistakes could help users understand craft difficulty (M = 3.95; see Table 1).

D. The Boundaries of Digital Mediation

The final theme concerned the perceived limits of digital support. Across the inheritor accounts, digital media were not regarded as capable of replacing the bodily and material conditions through which craft competence develops.

Inheritors distinguished between aspects that could be digitally supported and those dependent on physical practice. Stone weight, tool vibration, subtle acoustic differences, bodily timing, and the relational rhythm of apprenticeship were identified as conditions that screen-based experience could not reproduce. Another inheritor characterised digital media as a "translator rather than a substitute", distinguishing mediated explanation from the bodily and material experience of actual carving.

Questionnaire respondents also expressed generally positive views toward interactive experience compared with video alone (M = 4.08; see Table 1). This result reflects perceived preference rather than demonstrated learning effectiveness.

Table 1. Descriptive Questionnaire Results Supporting The Four Qualitative Themes (N = 261)

Questionnaire item	M	SD	Rating 4–5
Need to adjust judgement according to conditions	4.02	1.01	80.46%
Importance of knowing when to stop	4.03	0.96	80.46%
Incorrect judgement may damage the work	4.07	0.95	81.23%
Craft experience is difficult to acquire through text/video alone	3.98	1.07	77.39%
Digital media can help reveal otherwise invisible reasoning	4.00	0.98	79.31%
Showing error consequences can help explain craft difficulty	3.95	1.01	73.56%
Interactive experience perceived as preferable to video alone	4.08	0.99	77.78%

Note. M = mean; SD = standard deviation. "Rating 4–5" indicates the proportion of respondents selecting ratings of 4 or 5 on the five-point response scale.

Across the four themes, the qualitative and questionnaire evidence consistently distinguished between forms of craft knowledge that participants considered potentially accessible through digital support and aspects of competence that remained dependent on direct material and practitioner-led experience.

V. DISCUSSION

The findings support a shift in how digital support for craft transmission is conceptualised. The key issue is not simply how more procedural information can be delivered, but how selected relationships within expert judgement can become more accessible to interpretation without being mistaken for embodied competence. This distinction is consistent with the literature on tacit, embodied, and situated knowledge, which emphasises that skilled practice develops through participation, material engagement, and context rather than through explicit instruction alone (Ingold, 2013; Malafouris, 2013; Polanyi, 1966).

A. From Information Transfer to Interpretive Support

The first implication is that digital mediation should be understood as interpretive support rather than as a mechanism for transferring tacit knowledge in complete form. Its value lies in making selected relationships among condition, judgement, action, and consequence more available for recognition and reflection.

The qualitative findings suggest that the communicative problem lies less in showing actions than in revealing how experienced practitioners relate changing conditions to subsequent decisions. Digital mediation may support the selective externalisation of decision contexts, but this should not be interpreted as the complete conversion of tacit knowledge into explicit instruction.

This interpretation extends existing digital heritage discussions that distinguish access and representation from deeper forms of cultural interpretation (Economou, 2015; Giaccardi, 2012). In craft contexts, the relevant contribution of interaction is therefore not simply increased visibility, but the possibility of directing attention toward relationships that would otherwise remain implicit.

The questionnaire findings provide supporting evidence at the level of user perception, indicating that respondents valued explanations concerned with judgement, consequence, and less visible reasoning. These responses support the relevance of interpretive support but do not establish gains in practical skill or learning effectiveness.

A related contribution concerns reflection. Because expert decisions in craft practice are embedded in continuous activity, they may be difficult to isolate and revisit during direct observation. Digital media may therefore provide a complementary space in which selected decisions and consequences can be reviewed before, alongside, or after physical practice.

Taken together, these findings reposition digital mediation from information delivery toward three complementary functions: orientation before practice, interpretation of selected relationships underlying craft judgement, and reflection on decisions and consequences. The contribution lies not in reproducing craft knowledge digitally, but in making selected aspects of its practical logic more available for understanding.

B. Digital Mediation within a Broader Ecology of Craft Learning

The second implication is that digital mediation should be positioned within a broader ecology of craft learning rather than treated as an independent route to competence. Embodied skill remains dependent on sustained participation in material, social, and practitioner-led contexts.

This position is consistent with embodied and material perspectives in which skilled action develops through ongoing relations among practitioner, material, environment, and bodily activity (Dourish, 2001; Ingold, 2013; Malafouris, 2013). Digital mediation can reorganise access to selected relationships within that practice, but it does not reproduce the full conditions through which expertise is formed.

The inheritor description of digital media as a "translator rather than a substitute" captures this relationship particularly well: mediation can support interpretation of selected craft relationships while leaving embodied competence dependent on direct practice. Digital resources may therefore be positioned before practice for orientation, alongside practice for interpretation, or after practice for reflection, while physical craft learning remains necessary for embodied competence.

Craft transmission can consequently be understood as a broader learning ecology in which different forms of access perform different functions. Documentation preserves explicit information, demonstration exposes visible action, digital mediation may support interpretation and review, and apprenticeship provides the material, bodily, social, and temporal conditions required for developing skilled competence.

Digitalisation should therefore not be treated as a solution to the wider problem of craft continuity, because the sustainability of transmission also depends on practitioner participation and the social conditions that support learning. The principal contribution of this study is therefore a bounded interpretation of digital mediation in craft transmission. Digital support is most defensible when it helps learners orient to, interpret, or reflect on selected relationships within practice, while maintaining a clear distinction between mediated understanding and the embodied competence developed through sustained physical participation.

The three supplementary functions identified in this study should be understood as evidence-informed possibilities derived from practitioner accounts and user perceptions, rather than as experimentally verified outcomes of a digital intervention. Their practical effectiveness requires further examination through the design and evaluation of specific interactive experiences.

VI. CONCLUSIONS

This study examined how digital mediation may provide supplementary support for understanding tacit and embodied craft knowledge in Quyang Stone Sculpture. The findings indicate that the principal transmission challenge lies not in communicating procedural steps alone, but in making situated, sensory, material, and judgement-based knowledge more accessible to interpretation. Across the four themes, digital mediation was most consistently associated with three bounded functions: orientation before practice, interpretation of selected relationships underlying craft judgement, and reflection on decisions and consequences. At the same time, the findings clearly distinguished these forms of mediated understanding from the embodied competence that develops through sustained engagement with practitioners, materials, tools, and workshop conditions.

Overall, the study positions digital mediation as a bounded component within a broader ecology of craft learning. Digital support can make selected aspects of craft reasoning more accessible and reviewable, but it should complement rather than replace practitioner-led and material-based learning. This distinction clarifies the role of digital media as interpretive support rather than as a substitute for the social, sensory, and material conditions through which craft competence develops.

The questionnaire evidence should be interpreted cautiously: it reflects respondent perceptions rather than demonstrated learning or skill acquisition, and the predominance of art-related participants limits population-level generalisation. Future research should compare how digital support functions before, alongside, and after physical craft learning, while distinguishing perceived understanding from demonstrated performance and embodied competence.

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