

Peer-Review

Jiang, Nan. 2026. "Learning through the Hand: Tacit Knowledge, Material Sensitivity, and Apprenticeship in Yixing Zisha Teapot Crafting." *Journal of High School Science* 10 (3): 641–66. <https://doi.org/10.64336/001c.170888>.

This is a very well written paper and I enjoyed reading it. You state "Documentation is valuable, but it cannot fully capture the tacit dimensions of an artisan's skill."

I would like you to describe **WHY** documentation cannot fully capture the tacit dimensions... and develop this argument and hypothesis in a separate subsection.

To that effect, a formal review follows:

One area in which the manuscript could make a substantially stronger theoretical contribution is by moving beyond the descriptive observation that tacit knowledge cannot be fully codified and instead explaining the underlying mechanism responsible for this limitation. The paper convincingly demonstrates that successful Zisha craftsmanship depends on tactile judgment, aesthetic evaluation, coordinated bodily action, and temporal sensitivity. However, the discussion stops short of asking **why** these forms of knowledge resist representation through written instructions.

An interesting possibility is suggested by the paper itself, particularly the discussion of temporal sensitivity. The manuscript correctly argues that the making process unfolds sequentially through time: clay moisture changes continuously, components must be attached at the appropriate stage of drying, and each action alters the conditions for the next. In this sense, the production process is undeniably temporal and sequential. However, the artisan's judgments at each stage appear to be fundamentally different. When deciding whether the clay is "ready," the artisan does not first evaluate moisture, then wall thickness, then temperature, then resistance, and finally timing as independent operations. Rather, these perceptual cues appear to be integrated simultaneously into a single holistic judgment of readiness.

If this interpretation is correct, the manuscript could argue that the difficulty of codifying Zisha craftsmanship does not arise merely because the craft is complex or because artisans cannot adequately verbalize what they know. Instead, codification may fail because symbolic media—including written language, procedural manuals, recipes, algorithms, and computer programs—necessarily communicate information as *sequential instructions*. (The Krebs cycle is incredibly complex but it is sequential, thereby facilitating codification. This is also true of DNA transcription and subsequent translation. These processes are complex but *temporally and epistemologically sequential*). In contrast, the critical judgments governing progression through the craft appear to depend on the concurrent integration of multiple interdependent perceptual variables. The workflow itself is sequential, but the expert judgments that determine movement from one stage to the next are not reducible to a sequential evaluation of independent cues.

This distinction would also strengthen the manuscript's discussion of temporal sensitivity. The issue is not simply that artisans must know when to act, but that the "right moment" cannot be identified by evaluating moisture, temperature, thickness, geometry, and material resistance one variable at a time. Rather, readiness emerges from the simultaneous relationship among these variables at that particular instant. The artisan perceives an integrated material state, not a checklist of independent conditions.

Developing this argument would elevate the paper beyond the well-established claim that tacit knowledge cannot be fully articulated. Instead, it would propose a possible epistemological mechanism explaining why codification fails: symbolic representations necessarily serialize information, whereas the expert judgments underlying Zisha craftsmanship depend upon concurrent, relational perception. This distinction would provide a deeper theoretical explanation for the limitations of written instruction while remaining fully consistent with the manuscript's observations regarding temporal sensitivity and embodied craft practice.

In particular, I encourage the author to distinguish between the temporality of the material and the temporality of perception. The manuscript already provides an excellent discussion of temporal sensitivity by showing that the clay evolves through sequential material states: moisture changes, components must be attached at the appropriate stage of drying, and each action alters the conditions for the next. This is the temporality of the material, and it correctly acknowledges that the craft itself unfolds sequentially through time.

However, the artisan's perceptual judgments appear to operate differently. At each stage, the decision to proceed is not made by evaluating moisture, thickness, temperature, resistance, geometry, and timing as a sequential checklist. Rather, these variables appear to be perceived simultaneously as an integrated material state. In other words, while the workflow is sequential, the expert judgment that determines progression through that workflow is fundamentally concurrent and relational.

This distinction could provide a compelling theoretical explanation for why tacit knowledge resists codification. Language, programming, recipes, procedural manuals, and other symbolic media necessarily serialize information by presenting it as an ordered sequence of instructions. Expert Zisha craftsmanship, however, appears to depend upon concurrent perceptual judgments whose epistemic content is relational rather than sequential. Consequently, serialization is not merely an incomplete description of the craft—it changes the structure of the knowledge being represented. The artisan does not perceive a sequence of independent variables; rather, readiness emerges from the simultaneous relationships among moisture, pressure, geometry, material resistance, and intended action.

Developing this distinction would move the manuscript beyond the well-established observation that tacit knowledge cannot be fully verbalized. Instead, it would offer a potential epistemological mechanism explaining why codification fails: not because the craft is merely complex or difficult to describe, but because symbolic representations necessarily impose a sequential structure on knowledge that is acquired and applied through concurrent, relational perception. This would, in my opinion, constitute a deeper and more original theoretical contribution while remaining entirely consistent with the manuscript's existing discussion of temporal sensitivity.

It is important to distinguish complexity from serializability. Many biological systems are extraordinarily complex yet remain amenable to codification because both the underlying process and the knowledge required to understand it are fundamentally sequential. For example, the Krebs cycle consists of numerous interconnected enzymatic reactions, feedback mechanisms, and regulatory influences, yet it can be represented as an ordered sequence of biochemical transformations in which each intermediate gives rise to the next. Likewise, DNA transcription and subsequent translation involve highly complex molecular machinery, multiple regulatory proteins, and dynamic interactions, but the central process remains temporally and epistemologically sequential: transcription proceeds nucleotide by nucleotide, producing an mRNA transcript that is subsequently translated codon by codon into a polypeptide. Although these biological processes are exceptionally complex, their essential logic can be faithfully represented through sequential diagrams, reaction pathways, and written descriptions because the order of events reflects the structure of the process itself.

Zisha craftsmanship may differ in a fundamental respect. The material certainly evolves sequentially through time—the clay dries, stiffens, and passes through successive physical states. However, the artisan's perceptual judgment at any given instant does not appear to consist of a sequential evaluation of moisture, temperature, wall thickness, geometry, pressure, and resistance. Rather, these variables appear to be perceived concurrently as a single integrated material state. Consequently, while the evolution of the material is temporal and sequential, the epistemic act that determines when and how to intervene may be fundamentally relational rather than sequential. If this interpretation is correct, it provides a possible explanation for why codification fails in this context: symbolic media such as language, algorithms, recipes, and programming languages necessarily serialize information, whereas expert Zisha craftsmanship depends upon concurrent

perceptual judgments whose meaning derives from the simultaneous relationships among multiple variables. Serialization therefore does not merely provide an incomplete representation of the craft—it alters the epistemic structure of the knowledge itself.

Response to the Editor and Reviewers

Dear Editor and Reviewers,

I sincerely thank the Editor and both reviewers for their careful reading of my manuscript, “Learning Through the Hand: Tacit Knowledge, Material Sensitivity, and Apprenticeship in Yixing Zisha Teapot Making,” and for their constructive and detailed comments. I have carefully revised the manuscript in response to all of the comments received. These revisions have substantially strengthened the theoretical framing, clarified the methodological assumptions and limitations, improved the precision and scope of the claims, expanded and verified the relevant literature, and improved the overall clarity and consistency of the manuscript.

Below, I reproduce each reviewer comment and provide a point-by-point response explaining how and where the manuscript has been revised.

Reviewer 1 – Major Comment: Mechanism underlying the limits of documentation

Reviewer comment:

“I would like you to describe WHY documentation cannot fully capture the tacit dimensions ... and develop this argument and hypothesis in a separate subsection.”

Response:

Response to Reviewer1,

Thank you for this important suggestion. I agree that the previous version established that documentation cannot fully reproduce the tacit dimensions of skilled craft practice but did not sufficiently explain the mechanism underlying this limitation. In response, I have substantially revised the manuscript at multiple levels rather than addressing this issue only through a brief addition to the Discussion. The revisions are intended to shift the paper from describing tacit knowledge as difficult to articulate toward explaining how tacit knowing is enacted during skilled craft practice and why this process cannot be fully reproduced through representation alone.

First, the Introduction has been extensively revised to reformulate the central research question. Rather than asking only whether tacit knowledge can be articulated, the paper now asks how artisans develop the capacity to recognize the action-relevant significance of evolving material conditions, and why representing craft information does not necessarily reproduce this capacity. This revised framing establishes the problem as one of skilled perception and situated action rather than merely incomplete verbalization.

Second, Section 3 has been extensively reorganized and expanded under the title "From Tacit Knowledge to Situated Tacit Knowing." While retaining Polanyi's foundational conception of tacit knowing, the revised framework now integrates subsequent developments from Collins (2010), Tsoukas (2003), Rietveld and Kiverstein (2014), van Dijk and Rietveld (2017), Hadjimichael et al. (2024), together with related scholarship on craftsmanship and embodied practice. Rather than treating tacit knowledge as hidden information, the revised framework conceptualizes tacit knowing as an embodied and situated capability that develops through the recursive interaction of perceptual attunement, situated judgment, adaptive action, and material feedback. Accordingly, the four dimensions analyzed later in the paper are no longer presented as independent categories of tacit knowledge, but as interconnected manifestations of tacit knowing in practice.

Third, Section 6 has been substantially revised so that the four analytical dimensions are interpreted through this new theoretical framework rather than being presented as descriptive categories. The revised analysis demonstrates how tactile judgment, aesthetic evaluation, bodily coordination, and temporal awareness each reflect the development of perceptual attunement and situated judgment during ongoing engagement with materials. Throughout these sections, the emphasis has shifted from identifying isolated sensory abilities to explaining how artisans learn to recognize action-relevant

relationships among multiple changing material conditions and continuously adapt their actions in response.

Fourth, Sections 5, 6.4, and 8.2 now explicitly distinguish between the temporality of the material and the temporality of perception, following the reviewer's important distinction. The revised manuscript clarifies that Zisha production unfolds sequentially through changing material states: one operation precedes another, the clay progressively changes in moisture and workability, and each intervention alters the conditions inherited by the next stage. Expert perception and judgment, however, need not proceed as a sequential checklist of independent variables. At a given moment, moisture, resistance, thickness, geometry, prior handling, and intended action may instead be encountered as mutually conditioning aspects of an integrated situation. The revised manuscript therefore characterizes the workflow as sequential while treating the perceptual organization of expert judgment as potentially concurrent and relational.

I have also carefully considered the reviewer's proposed hypothesis that the limitation of codification may arise because symbolic media serialize information whereas expert judgment depends on concurrent relational perception. I have adopted the central insight of this proposal while formulating the claim more cautiously. Specifically, the revised manuscript does not argue that written, computational, or other symbolic representations are inherently incapable of representing multiple variables or simultaneous relationships. Contemporary measurement, modeling, and digital technologies clearly can represent highly complex and interacting conditions. My narrower argument is that representing these relationships is not equivalent to acquiring the learned perceptual capacity to recognize their action-relevant significance in an unfolding material situation. This qualification preserves the reviewer's important distinction between sequential workflow and relational judgment while avoiding an unnecessarily strong claim about the representational limits of symbolic media.

Fifth, Section 7 has been reconceptualized as "Apprenticeship as Perceptual and Attentional Calibration." Rather than viewing apprenticeship simply as a means of transmitting information unavailable in written documentation, the revised section explains how guided participation, repeated practice, correction, and material feedback progressively cultivate the learner's capacity to notice, discriminate, interpret, and respond to task-relevant material differences. Apprenticeship is therefore connected directly to the codification problem: documentation can provide information and direct attention, but skilled participation helps cultivate the perceptual attunement and situated judgment through which such information becomes actionable.

Sixth, I have added a dedicated subsection, Section 8.2, "Why Representation Cannot Fully Reproduce Tacit Knowing," specifically to develop the mechanism requested by the reviewer. This subsection first distinguishes complexity from codifiability and explicitly rejects the assumption that tacitness follows simply from complexity or from the immeasurability of relevant material variables. It then explains the relational and context-dependent significance of perceptual cues, develops the distinction between sequential material transformation and concurrent relational judgment, and introduces a further perception–action–material feedback mechanism. Skilled action does not merely implement a prior judgment; it also transforms the material and generates new perceptual information, meaning that the context relevant to subsequent judgment is partly produced through preceding action.

Taken together, these revisions move the manuscript beyond the general observation that tacit knowledge is difficult to articulate. The revised paper now proposes a process-based explanation of why documentation and skilled enactment are not functionally equivalent: skilled performance depends on the cultivated ability to recognize action-relevant relationships among changing material conditions and to continuously coordinate perception, situated judgment, adaptive action, and material feedback. Documentation may represent many of the relevant variables, relations, and procedures, but representation alone does not reproduce the perceptual calibration through which these become meaningful for action. I hope these revisions address the reviewer's concern by providing a more explicit theoretical explanation for the limits of documentation while remaining closely grounded in the empirical analysis of Zisha craftsmanship.

Response to Reviewer 2

I sincerely thank Reviewer 2 for the careful and constructive comments. I have reviewed the manuscript in detail in response to these concerns, with particular attention to the accuracy and relevance of the references, disclosure of assistance received during manuscript preparation, the explicit statement of assumptions and limitations, the scope of the conclusions, and consistency in grammatical tense and third-person academic style. The corresponding revisions are described point by point below.

Comment 1

“Please verify that all links to the references point to the correct source.”

Response:

Thank you for drawing my attention to this important issue. I carefully reviewed the entire reference list and individually verified the bibliographic information and DOI links for all sources for which DOI links are available. The DOI links were standardized in the `https://doi.org/...` format and checked to ensure that they direct to the corresponding cited sources. I also reviewed the reference list for completeness and consistency and added the previously omitted bibliographic entry for Gibson (1979), which is cited in the theoretical discussion of affordances.

The revised reference list appears at the end of the manuscript.

Comment 2

“The authors must disclose and acknowledge any assistance received in the preparation of this manuscript, including but not limited to editorial, technical, analytical, or writing support. All such contributions must be clearly stated in the Acknowledgments section.”

Response:

Thank you for this important request. I have added a dedicated Acknowledgments section to the revised manuscript.

The new section acknowledges the artisans at the Yixing Zisha workshop for sharing their practical knowledge and providing guidance during the field study. It also acknowledges those who supported a subsequent school exhibition on Yixing Zisha culture and craftsmanship that drew on knowledge and experience gained during the workshop study.

In addition, I have explicitly disclosed the limited use of artificial intelligence tools during manuscript preparation and revision. AI tools were used only to assist with grammatical checking and literature searches. All AI-assisted outputs, including suggested corrections and bibliographic information, were independently reviewed and verified by the author, who retains full responsibility for the accuracy, interpretation, and final content of the manuscript.

The new Acknowledgments section appears immediately before the References.

Comment 3

“Include enough recent references along with foundational ones. Ensure references directly support your claims. Avoid ‘padding.’ Use credible sources (peer-reviewed journals, reputable books, official reports).”

Response:

Thank you for this valuable suggestion. I conducted a systematic review of the references used throughout the manuscript to ensure that the theoretical discussion combines foundational scholarship with recent, directly relevant research and that individual sources are used only where they substantively support the associated claims.

The revised theoretical framework continues to draw on foundational works including Polanyi (1966), Gibson (1979), Lave and Wenger (1991), Tsoukas (2003), Sennett (2008), Collins (2010), and Ingold (2013), while incorporating recent peer-reviewed scholarship concerning tacit knowledge, skilled perception, haptic perception, task complexity, cultural transmission, apprenticeship, and intangible cultural heritage. These include Rietveld and Kiverstein (2014), van Dijk and Rietveld (2017), Miton and DeDeo (2022), Chen et al. (2023), Hadjimichael et al. (2024), Cicchini et al. (2024), Song et al. (2024), Klatzky (2025), Ding et al. (2025), and Gao et al. (2025).

I also revised several passages so that the strength and scope of individual claims more closely match what the cited literature directly supports. For example, research on task complexity is now used

specifically to support the role of element interactivity rather than as direct evidence about Zisha expertise, while ecological and affordance-based scholarship is used to support the interpretation of relational and action-relevant perception. Materials-science research is used specifically to establish the material properties and variability of Zisha clay rather than to make claims about artisans' cognitive processes.

These revisions are reflected particularly in Sections 3, 4, 7, and 8 and in the revised References section.

Comment 4

“All assumptions (including implicit assumptions) must be explicitly stated and clearly justified. The authors should explain why each assumption is reasonable and discuss its impact on the results and conclusions.”

Response:

Thank you for identifying this issue. I agree that the original manuscript did not sufficiently distinguish direct observations from the interpretive assumptions underlying the theoretical analysis. I have therefore expanded the Methodology section to make these assumptions explicit and to clarify their implications for the scope of the conclusions.

Specifically, the revised manuscript now states that the analysis assumes that observed contrasts between novice and experienced performance can provide case-based evidence for examining situated tacit knowing. At the same time, I explicitly acknowledge that such observations cannot establish how these capacities develop across the broader population of Zisha artisans.

I further clarify that my interpretation of expert judgment as relational or potentially concurrent is a theoretical inference derived from observed practice in combination with relevant scholarship, rather than a direct cognitive or experimental measurement of artisans' perceptual processes.

Finally, the revised manuscript explicitly states that the interpretation of apprenticeship as a process of perceptual and attentional calibration should be understood as a case-based theoretical proposition supported by the observations and existing literature, rather than as a longitudinally demonstrated model of skill acquisition.

These qualifications have been added to the final paragraph of Section 2, Methodology, and they now establish the evidentiary boundaries for the subsequent theoretical analysis.

Comment 5

“Avoid overreaching conclusions that extend beyond what is supported by the data and analysis.”

Response:

Thank you for this important caution. I carefully reviewed the manuscript to ensure that the claims remain proportionate to the exploratory and case-based nature of the study.

Several statements that previously risked implying broad generalization or definitive causal explanation have been revised. The manuscript now consistently characterizes the study as an exploratory, field-based analysis of one workshop context and explicitly states that its claims should be interpreted as case-based theoretical propositions rather than population-level generalizations.

I also moderated the language used in the theoretical discussion and conclusion. For example, claims concerning concurrent or relational judgment are now framed as interpretations that “may” characterize skilled perception rather than as experimentally established cognitive facts. The discussion of codification now proposes that relational organization may be one source of difficulty in representing situated tacit knowing, rather than presenting it as the single definitive explanation. Similarly, implications for heritage preservation are expressed as suggestions arising from the analysis rather than as universal prescriptions.

The Conclusion has also been revised to emphasize that representation may support craft transmission without being equivalent to the cultivated ability to respond to changing material situations. The preservation implications are therefore presented cautiously as considerations suggested by this case rather than conclusions claimed for all forms of traditional craftsmanship.

These revisions appear throughout the manuscript, particularly in Sections 2, 3.4, 7, 8.1–8.4, and 9.

Comment 6

“Verify that you have used past perfect tense and third person throughout the manuscript wherever applicable.”

Response:

Thank you for this stylistic and grammatical observation. I conducted a sentence-level review of the manuscript for tense and person.

The Methodology section has been revised so that completed research activities are consistently described in the past tense and in the third person. For example, first-person formulations describing observation, participation, and analysis have been replaced by formulations such as “the fieldwork included,” “the researcher’s position as a novice learner,” and “the analysis drew on field notes, direct observation, and informal conversations with artisans.”

I interpreted the reviewer’s reference to past perfect as applying where the temporal relationship between past events requires that tense, rather than applying past perfect mechanically throughout the manuscript. Accordingly, completed fieldwork activities are reported primarily in the simple past, while present tense is retained where appropriate for established theoretical positions, general characteristics of craft practice, and arguments advanced by the present manuscript.

The manuscript was also reviewed throughout for inappropriate first-person wording and revised into third-person academic style wherever applicable.

I appreciate the reviewer’s careful attention to these matters. The comments prompted a more rigorous review of the manuscript’s evidentiary scope, language, reference practices, and transparency, and I believe that the resulting revisions have substantially improved the clarity and methodological precision of the paper.

I am grateful to the Editor and both reviewers for the time and care they devoted to evaluating the manuscript. Their comments prompted substantial revisions that have helped us clarify the theoretical contribution, strengthen the methodological framing, improve the precision of the claims, and enhance the overall quality of the manuscript.

I hope that the revised manuscript and the detailed responses above satisfactorily address all of the comments and concerns raised during review. I sincerely appreciate the opportunity to revise and resubmit the manuscript for further consideration.

The manuscript has been substantially improved, and the author has clearly made a serious effort to address the previous comments. In particular, the revised manuscript now goes beyond simply stating that tacit knowledge is difficult to document and attempts to explain why representation is not equivalent to skilled enactment. The Introduction has been reframed around perceptual attunement and situated action, the four previously rather descriptive dimensions have been integrated into a common theoretical framework, apprenticeship has been reconceptualized as perceptual and attentional calibration, and a dedicated subsection has been added to explain the proposed limits of representation. These are meaningful improvements. The manuscript also now appropriately acknowledges that its observations derive from a short, two-day study in a single workshop and that claims regarding relational judgment and perceptual calibration are theoretical interpretations rather than direct measurements of cognitive processes.

However, after considering the revised conceptual model carefully, I believe that the manuscript stops short of what may actually be its most scientifically interesting and potentially novel insight. The revised framework remains predominantly state-dependent, whereas the properties of the material being manipulated provide good reason to consider whether Zisha craftsmanship should instead be conceptualized as history-dependent, or non-Markovian.

This distinction is important. In a purely state-dependent or Markovian description, the appropriate action at a particular moment can, in principle, be determined from a sufficiently complete specification of the current state. Thus, if the artisan knows the present moisture, resistance, thickness, geometry, temperature, elasticity, intended form, and other relevant variables, previous states do not independently contribute once the present state has been completely specified. In simple terms:

Appropriate action at time t = function of the current material state at time t .

The revised manuscript substantially enriches the description of this current state. It argues that artisans do not independently evaluate moisture, resistance, thickness, geometry, and other properties, but perceive these variables relationally and in terms of their action relevance. It also distinguishes the sequential evolution of the material from the potentially concurrent organization of expert judgment. This is a useful clarification. However, increasing the number of variables and interactions included in the current state does not fundamentally transform a state-dependent model into a history-dependent one. An artisan simultaneously integrating ten interacting current variables is still operating within a Markovian description if those current variables are sufficient to determine the appropriate next action.

Similarly, the newly emphasized perception-action feedback loop does not by itself establish history dependence. The manuscript now argues that an artisan acts upon the clay, observes or feels the resulting response, modifies the action, and thereby generates new information for subsequent judgment. This can be represented simply as:

current material state $\rightarrow$ perception $\rightarrow$ judgment $\rightarrow$ action $\rightarrow$ new material state $\rightarrow$ new perception

This is an appropriate feedback model. However, a recursive feedback system can still be Markovian. If the new material state completely contains all of the information necessary to determine the next response, the trajectory through which that state was reached has no independent explanatory role. Consequently, the manuscript's present argument—that skilled action continuously creates a new material situation that must then be perceived and interpreted—is theoretically coherent, but it is not by itself a particularly novel mechanism. Perception-action coupling, affordance-based perception, embodied cognition, situated judgment, and apprenticeship-based perceptual learning are already well-developed concepts in the literature cited by the author. The manuscript itself comes close to a more consequential idea. It states that resistance can have different significance depending upon moisture, thickness, geometry, previous handling, developing form, and current action. It also states that what the artisan perceives at a particular moment is shaped by the preceding sequence of actions through which the present state developed. Moreover, the Introduction already invokes serial-dependence literature to note that present perception may be influenced by recent perceptual history. These observations point toward history dependence, but the manuscript does not develop their theoretical consequence.

This is particularly important because clay itself provides a reasonable physical basis for expecting history-dependent behavior. Thixotropy, hysteresis, structural rearrangement, deformation history, drying and rewetting history, resting time, and prior mechanical manipulation can influence the subsequent rheological behavior of clay systems. Thus, the action-relevant condition of clay need not necessarily be characterized adequately by a limited collection of instantaneous macroscopic measurements. Its present mechanical response can contain consequences of its previous deformation, shear, resting, drying, wetting, or manipulation history.

This leads to a substantially more interesting conceptual model:

Appropriate action at time t = function of both the current material state and the material's previous history.

In such a model, craftsmanship is not simply the ability to recognize a complicated present state. It potentially involves sensitivity to how the material arrived at that state.

This distinction could substantially strengthen the paper's argument concerning tacit knowledge.

Consider two pieces of clay that have approximately identical measured moisture content, thickness, geometry, temperature, and perhaps even similar instantaneous resistance, but that reached those conditions through different trajectories. One may have gradually dried to the target condition; another may have been drier, subsequently rewetted, manipulated, compressed, or rested before reaching nominally the same measured condition. If their subsequent responses to manipulation differ, then the limited instantaneous state description is insufficient. The history of the material carries information relevant to its future behavior.

In that situation, an experienced artisan's apparent "tacit" sensitivity might partly consist of recognizing consequences of the material's trajectory that are not represented by the obvious

instantaneous variables. This possibility provides a substantially deeper interpretation of the manuscript's central concept of "learning through the hand." The expert may not merely learn that a particular combination of moisture, resistance, geometry, and thickness requires a particular response. The expert may learn to interpret the present tactile condition in relation to what has happened to the material previously.

The conceptual distinction can therefore be expressed without mathematical notation as:

State-dependent craftsmanship:

The appropriate action is determined by the material's present measurable and perceptible condition.

History-dependent craftsmanship:

The appropriate action is determined by the present condition plus the trajectory through which the material reached that condition.

The latter is a non-Markovian description.

This provides a much more compelling explanation for why documentation may fail to reproduce skilled knowing. Documentation is not necessarily inadequate because it is incapable of representing many variables simultaneously—the revised manuscript correctly rejects that overly strong argument. Rather, the difficulty may be that the relevant informational object is not simply a multidimensional state, but a trajectory through a sequence of states.

This is where I believe the author has stopped short of the manuscript's main potential novelty. The revised paper has successfully progressed from "tacit knowledge cannot be written down" to "experts relationally integrate multiple action-relevant variables within a perception-action feedback loop." That is an important improvement, but much of this conceptual territory is already contained within existing theories of embodied cognition, ecological perception, affordances, situated action, and skilled practice. The potentially more original synthesis is that Zisha craftsmanship may involve skilled interaction with an intrinsically history-dependent material, such that expertise consists partly of sensitivity to material trajectories rather than merely increasingly sophisticated recognition of instantaneous material states.

I therefore encourage the author to make history dependence/path dependence a central part of the revised theoretical argument. I do not suggest claiming that Zisha craftsmanship has already been experimentally demonstrated to be non-Markovian. The present two-day observational study cannot establish that conclusion. Rather, the manuscript should formulate this as a scientifically motivated and falsifiable hypothesis arising from the conjunction of: the observed temporality of Zisha making; the author's own observations concerning previous handling and prior actions; established history-dependent behavior of clay systems; and evidence that human perception itself may depend upon recent perceptual history. This would appropriately distinguish an evidence-supported theoretical hypothesis from an empirically demonstrated mechanism.

The distinction between apparent and fundamental non-Markovianity should also be acknowledged. A material that appears history-dependent when described using only moisture, resistance, thickness, and geometry might become state-dependent if additional latent state variables, such as microstructural organization, are measured. In other words, the relevant scientific question is whether the apparent influence of history can be completely incorporated into an expanded description of the instantaneous material state, or whether explicit trajectory information remains necessary. Recognizing this distinction would make the proposed hypothesis considerably more rigorous.

Importantly, this hypothesis immediately generates a falsifiable experimental design. Clay samples could be prepared so that they reach approximately matched observable present states through different histories—for example, gradual drying to a target condition versus drying followed by rewetting and manipulation to the same nominal moisture condition. Experienced artisans could then be blinded to the preparation histories and asked to assess readiness, workability, appropriate subsequent manipulation, or expected behavior. If samples with nominally equivalent measured current states systematically elicit different judgments or behave differently during manipulation, the results would demonstrate that the measured instantaneous state description is incomplete.

Subsequent experiments could determine whether the difference can be explained by additional measurable microstructural variables or requires explicit incorporation of material history. This would transform the present theoretical discussion into a clear experimental research program. There is also a second, potentially independent source of history dependence: the artisan. Even if two pieces of material were physically identical at the instant of measurement, the artisan's interpretation of a tactile signal could potentially depend on immediately preceding sensory and motor experience. The manuscript already cites serial dependence in perception but does not integrate this idea into its framework. Thus, the potentially interesting system is not simply a history-dependent material, but the coupling of a potentially history-dependent perceptual system with a history-dependent material:

previous material states + previous artisan actions/perceptions → present interaction → next skilled action

This is substantially richer than the current model of relational perception of the present state. The manuscript should therefore reconsider the claimed mechanism underlying the limits of documentation. At present, Section 8.2 argues primarily that representation does not itself create the perceptual capacity needed to recognize the action-relevant significance of multiple changing variables. This is reasonable, but the history-dependent argument would be substantially more powerful. Documentation that records only procedures or snapshots of material states may omit the trajectory-dependent relationships through which the present material condition acquired its action relevance. Documentation could theoretically encode such trajectories, so the argument should again not be that representation is inherently incapable of doing so. Rather, the point is that the information that must be represented and learned may be much richer than the present framework recognizes.

I therefore recommend revision rather than rejection, because the author's response to the previous review has been thoughtful and has moved the manuscript in the correct direction. The previous concern—why documentation cannot simply reproduce tacit knowing—has largely been addressed at the level requested. The remaining issue is now more interesting: the revised explanation reveals a deeper hypothesis that the manuscript has not yet developed. The author has moved from isolated variables to relational state perception and from static perception to recursive perception-action feedback, but has stopped short of asking whether the craft is fundamentally trajectory-sensitive.

I strongly encourage the author to develop this final conceptual step. The manuscript's most potentially novel contribution is not simply that Zisha artisans integrate multiple sensory cues, nor that action generates subsequent perceptual information. Rather, it may be the proposition that skilled Zisha craftsmanship involves interaction between an experienced perceptual system and a history-dependent material, such that the meaning of the present material condition depends partly on the trajectory through which that condition was produced. Framed cautiously as a hypothesis rather than a demonstrated fact, this would provide the manuscript with a considerably sharper scientific contribution and a clear path toward future experimental validation.

As an additional implication, this framework may also help explain why highly history-dependent craftsmanship is difficult to translate into a conventional assembly-line production model. In a classical assembly line, different workers typically encounter an object at successive stages and perform operations largely according to its state when it arrives at their station. The worker at one station does not necessarily possess the continuous tactile and perceptual history accumulated by the worker at the previous station. Such organization works particularly well when the object can be treated approximately as state-dependent: if its relevant current dimensions, position, temperature, moisture, tolerances, or other specifications fall within a defined range, the next worker can perform the prescribed operation without needing to know the complete trajectory through which the object arrived there.

History-dependent craftsmanship presents a fundamentally different organizational problem. If the correct manipulation depends not merely on what the clay is like now, but also on how it has been drying, how much and in what manner it has previously been worked, how its resistance has evolved, which corrections were made, and how it responded to previous manipulations, then

transferring the object to another worker can involve a loss of information. The second artisan receives the physical object in its current state but does not necessarily inherit the first artisan's accumulated perceptual experience of its trajectory. The object may therefore be physically transferred without fully transferring the informational history required for optimal subsequent action.

This provides a particularly interesting interpretation of why traditional craftsmanship often emphasizes continuity between artisan and material. The same artisan repeatedly touching, observing, modifying, and reassessing the same developing object is not merely performing multiple production steps. The artisan may be accumulating a temporally extended record of the material's behavior. In this interpretation, the artisan's previous interactions with the clay become part of the information available for the next judgment. The "unit" of expertise is therefore not simply an isolated operation performed on an object in a specified state; it is the continuous artisan-material trajectory.

I would nevertheless caution against stating categorically that such craftsmanship can never be placed on an assembly line. That conclusion would be stronger than the evidence presently permits. In principle, sufficiently rich sensing, recording, process control, and communication could transfer relevant historical information between stations, and some apparent history dependence might ultimately be reducible to measurable latent state variables. The scientifically stronger argument is that a conventional assembly line organized around state-dependent handoffs may be intrinsically poorly matched to a craft in which material history and continuous perceptual interaction contribute to the appropriate next action. This prediction follows naturally from the proposed non-Markovian framework and provides another reason why developing the history-dependent interpretation would significantly increase the conceptual value of the manuscript.

Response to the Editor and Reviewers

Dear Editor and Reviewers,

I sincerely thank the Editor and Reviewer for the careful and thoughtful evaluation of my revised manuscript, "Learning Through the Hand: Tacit Knowledge, Material Sensitivity, and Apprenticeship in Yixing Zisha Teapot Making." I sincerely appreciate the considerable time and intellectual effort that the Reviewer devoted to this manuscript over two rounds of review. Your comments have not only improved the clarity of the paper but also led me to rethink its central theoretical contribution. I have carefully reconsidered the manuscript in light of this comment. I agree with the Reviewer's central distinction: a model that integrates many interacting present-state variables, or even a recursive perception-action feedback loop, may still remain state-dependent if the current state contains all information necessary for the next judgment. The more consequential question is whether skilled judgment may also be sensitive to the history through which the present material condition has emerged.

In response, I have substantially revised the manuscript again. Rather than claiming that Zisha craftsmanship has been demonstrated to be non-Markovian, I now formulate history-sensitive judgment as a theoretically motivated and empirically testable hypothesis. The revised manuscript explicitly distinguishes state dependence from potential history dependence, reconstructs temporal sensitivity around the artisan's judgment of material readiness, revises the explanation of why representation is not equivalent to skilled enactment, distinguishes apparent history dependence from effects that might be captured through additional latent state variables, and proposes a concrete future experimental program. I have also considered the Reviewer's further implication concerning continuity between artisan and material and the potential limitations of state-based production handoffs.

The detailed response is provided below.

Reviewer 1 – Major Comment: History dependence as a deeper theoretical account of skilled Zisha craftsmanship

Response to Reviewer1,

Thank you very much for this thoughtful and constructive comment. I am grateful that the Reviewer recognized the progress made in the previous revision and, more importantly, identified a deeper theoretical implication that had not yet been developed sufficiently. I agree with the Reviewer's central point that neither the relational integration of multiple current variables nor a recursive perception–action feedback loop is, by itself, sufficient to establish history dependence. A system may remain state-dependent if an adequately specified present state contains all information necessary for determining the appropriate next action.

This distinction prompted a substantial reconsideration of the manuscript's central theoretical argument. In the revised manuscript, I have therefore moved beyond the previous formulation of relational perception of a dynamically changing present state and developed the possibility of history-sensitive situated judgment as a central theoretical hypothesis. At the same time, consistent with the Reviewer's caution and with the limited empirical basis of the present two-day observational study, I do not claim that Zisha craftsmanship has been experimentally demonstrated to be non-Markovian. Instead, history dependence is presented throughout the manuscript as a theoretically motivated and empirically testable hypothesis.

The revisions were made at several interconnected levels.

1. History sensitivity has been incorporated into the theoretical framework

I added a new subsection, Section 3.4 “From Present State to Material History,” which distinguishes between:

- (a) a state-dependent interpretation, where appropriate action is determined by the currently observable material condition; and
- (b) a history-sensitive interpretation, where the meaning of the present condition may depend partly on the trajectory through which it emerged.

This revision extends the previous framework beyond relational perception of present material states and proposes that skilled judgment may involve sensitivity not only to what the material is now, but also to how it became this way.

Meanwhile, I explicitly acknowledge the distinction between apparent and fundamental history dependence. The revised manuscript notes that some apparent historical effects may ultimately be explained by additional latent material variables that are not captured by simple macroscopic measurements. Therefore, the manuscript does not claim irreducible non-Markovianity, but proposes history sensitivity as a question requiring further empirical examination.

I use history dependence as the primary theoretical term because it most directly captures the Reviewer's distinction between judgments determined by the current state alone and judgments for which prior material history retains explanatory relevance. Although the Reviewer discusses this issue in relation to “non-Markovian” descriptions, I intentionally avoid presenting Zisha craftsmanship as demonstrably non-Markovian, because the present qualitative study cannot determine whether apparent historical effects would persist after a sufficiently rich specification of the material's current internal state.

2. Temporal awareness has been reconceptualized as temporally situated judgment

Following the Reviewer's suggestion, Section 6.4 has been substantially revised.

The previous discussion mainly emphasized that artisans cannot rely on fixed time intervals. The revised version further explains how artisans know when to act. Temporal sensitivity is now interpreted as the learned capacity to recognize when changing material conditions become appropriate for a specific subsequent operation.

Accordingly, “waiting until the clay is ready” is no longer treated as simple time estimation, but as a situated judgment integrating moisture, resistance, surface condition, previous manipulation, and intended action.

The section now describes temporal sensitivity as temporally situated and potentially history-sensitive judgment, in which present perception may acquire practical meaning through the preceding sequence of material transformations.

3. The explanation of representation limits has been strengthened

I also revised Section 8.2 “Why Representation Cannot Fully Reproduce Tacit Knowing.”

Following the Reviewer's suggestion, I clarified that the limitation of documentation does not arise because symbolic representations are incapable of encoding multiple variables or complex trajectories. Modern sensing, modeling, and digital technologies can represent increasingly rich information.

The revised argument is more specific: representation of information is not equivalent to the cultivation of the perceptual capacity required to recognize the action relevance of that information in an unfolding situation.

I further incorporated the history-sensitive perspective by explaining that documentation based only on procedures or instantaneous states may omit trajectory-dependent relationships through which present material conditions acquire practical significance. At the same time, I acknowledge that sufficiently rich representations could theoretically encode such trajectories.

4. A future experimental pathway has been added

Following the Reviewer's suggestion, I added a more explicit discussion of future empirical validation.

The revised manuscript proposes that clay samples could be prepared to reach similar observable present states through different histories (e.g., different drying, resting, or manipulation trajectories). Expert judgments regarding readiness and appropriate subsequent actions could then be compared. Such experiments would help determine whether historical information contributes predictive value beyond measured current-state variables, while also allowing investigation of whether apparent history dependence can be explained by additional measurable internal states.

5. The organizational implication has been discussed cautiously

I also incorporated the Reviewer's insightful suggestion regarding production organization.

The revised manuscript now discusses that, if skilled judgment depends partly on accumulated artisan-material interaction history, conventional production systems based mainly on state-dependent handoffs may lose information relevant to subsequent decisions.

However, I explicitly avoid claiming that history-sensitive craftsmanship is incompatible with industrial production. Rich sensing, recording, and communication technologies may in principle preserve relevant historical information. The revised argument is therefore limited to suggesting that production systems relying primarily on current-state handoffs may be less naturally aligned with craftsmanship based on continuous material interaction.

More importantly, your comment has changed the way I think about the theoretical contribution of this work. Rather than viewing history sensitivity as an extension of the original framework, I now regard it as a scientifically testable hypothesis that may guide future empirical research on tacit knowing in craft practice. I sincerely thank the Reviewer for encouraging this conceptual development, which has substantially clarified the theoretical contribution and future research direction of the manuscript.

Thank you for addressing my comments. Accepted with two caveats:

1. The manuscript is accepted in the 'case study' category.

2. I have added a 'perspectives' section that affords a broader lens to the artisan and the craft. I have reproduced it below:

The present framework suggests that craftsmanship is especially, although not exclusively, valuable when heterogeneous materials or process-sensitive transformations leave consequential variation that cannot be reliably captured by standardized procedures and current-state measurements. This often applies to natural materials such as clay, wood, and leather, but the operative distinction is not "natural" versus "manufactured." It is the degree of compositional variability, history dependence, and residual uncertainty remaining during production. Natural materials can be incorporated into assembly-line manufacture when their initial composition is screened or homogenized and critical processing conditions are controlled. As this standardization becomes more complete, continuous artisan judgment may become less technically necessary. Craftsmanship may nevertheless retain cultural and economic value through authorship, customization, aesthetic distinction, provenance,

rarity, and demonstrable mastery, even when standardized production can achieve equivalent functionality.

Similar relationships occur beyond Zisha making. In artisanal wine, grape properties reflect interacting effects of soil, climate, cultivar, vintage, and geographically structured microbial communities, while fermentation, oxygen exposure, temperature, aging, and blending add further process dependence. Traditional blades provide a materials-science example: Japanese tamahagane is compositionally and microstructurally heterogeneous, whereas wootz-derived Damascus blades depend on process-sensitive carbide distributions produced through solidification and thermal-mechanical history. In Kolhapuri chappal making, artisans must accommodate local differences in hide thickness, fibre orientation, stiffness, moisture response, and surface condition while cutting, stretching, braiding, stitching, and fitting leather whose collagen structure has already been altered by tanning. Comparable interactions occur in violin making, glassblowing, cheesemaking, sourdough production, lacquerware, hand papermaking, natural dyeing, timber joinery, tea processing, and ceramic firing. These practices are not scientifically inexplicable; rather, their relevant composition-process-structure relationships may not yet be measurable or controllable with sufficient completeness and economy to determine every production decision prospectively. The future of craftsmanship may therefore lie neither in resisting industrialization nor in mechanically reproducing artisanal movements, but in identifying where material variability, processing history, exploratory interaction, and aesthetic discretion remain consequential. Hybrid systems could assign repeatable operations to standardized technologies while retaining artisans—or adaptive sensing systems—at stages where present-state specifications are insufficient. Future research should consequently compare production systems according to the material histories, judgments, and forms of value that they preserve or eliminate, rather than assuming an inherent opposition between craft and industrial production.