

RESEARCH ON A "CRAFT-AWARE" AI FRAMEWORK FOR LACQUER PAINTING BASED ON ARTIST-SPECIFIC MODELS AND STANDARDIZED COLLABORATIVE WORKFLOWS

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ABSTRACT

This paper examines how generative AI can participate in lacquer painting practice while respecting the internal logic of the craft. Lacquer painting is a highly material- and process-dependent art form in which aesthetic value emerges from layered procedures, embodied tacit knowledge, and sensitive material judgment. However, existing general-purpose AI models often fail to capture the deeper “lacquer quality” of the medium or to respond to craft-based decision-making in a meaningful way. To address this mismatch, the paper proposes a “Craft-Aware AI” framework composed of three core elements: an artist-specific LoRA model, a multimodal art knowledge base, and a five-stage human-machine workflow consisting of Conceptualization, Generation, Iteration, Pre-materialization Rehearsal, and Physical Realization. Tacit knowledge such as “three grindings and nine coatings” and lacquer drying rhythms is encoded via semantic tagging and trigger-word structuring, mapping material depth, gloss levels, and textural features into the model. This framework positions AI as a supportive collaborator while preserving artistic agency. A pilot study comparing general-purpose AI outputs and Craft-Aware outputs, supplemented with artist feedback, demonstrates practical effectiveness. The study provides a replicable methodological structure and a transferable pathway for other craft-oriented art forms undergoing digital transformation.

Keywords: Lacquer Painting, AIGC, LoRA, Human-machine Collaboration, Craft-Aware AI

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INTRODUCTION

1.1 Background and Problem Statement

1.1.1 Material Logic and Digital Transformation Bottlenecks of Traditional Lacquer Painting

Lacquer painting is a highly material- and process-dependent art form whose aesthetic value lies not only in the final image but also in the layered processes of repeated polishing, coating, and revelation commonly described through techniques such as “three grindings and nine coatings.” The knowledge involved is usually transmitted through demonstration, imitation, and iterative correction, making it strongly tacit and embodied. Existing studies on Chinese lacquer art and craft education suggest that when such knowledge is reduced to images or static descriptions, its transmission becomes fragile (Song et al., 2019; Budge, 2016). As contemporary art increasingly shifts toward digital and conceptual expression, lacquer painting must respond to new media conditions while avoiding the weakening of its craft logic and material language in digital translation (Polanyi, 1966; Ingold, 2013).

1.1.2 Limits of General-Purpose AI

Although existing general-purpose generative models can produce visually complex images, they are typically better at handling surface-level style than at understanding the material logic, procedural rhythm, and artistic sensibility of lacquer painting. Recent human-AI lacquerware design research also suggests that simple technological layering is not enough to address the cultural structure of craft itself (Liang et al., 2025). In the context of lacquer painting, such systems may offer formal inspiration, but they struggle to account for material constraints, craft-based judgment, and individual working habits. Meanwhile, many AI-and-art applications remain limited to one-off image generation and lack structured workflows for conception, iteration, previsualization, and physical realization. The issue, therefore, is not merely whether AI can generate images, but how it can participate in creation without undermining artistic agency.

1.2 Research Questions

This study addresses the following research questions:

1. How can artist-specific models capture the visual language, compositional habits, and material sensibilities of lacquer painting practice?
2. How can a standardized human-machine workflow support creation while preserving the central role of artistic judgment?

1.3 Research Objectives

The objectives of this research are to:

1. Construct a reusable data-model-workflow pipeline for craft-oriented AI-assisted creation.
2. Develop an artist-specific model that encodes individual visual language, compositional preferences, and material characteristics.
3. Establish a five-stage collaborative mechanism (Conceptualization, Generation, Iteration, Pre-materialization Rehearsal, Physical Realization) supporting decision-making, revision, and implementation.
4. Provide a practice-oriented framework that transforms tacit artistic knowledge into a computable form, enabling reactivation within creative practice.

1.4 Significance and Innovation

1.4.1 Theoretical Significance

This study understands lacquer painting as a knowledge system jointly constituted by material properties, craft procedures, bodily experience, and aesthetic judgment, rather than as a traditional medium awaiting digitization. On this basis, the paper introduces the concept of Craft-Aware AI, referring to an AI system that can understand specific craft logic, perceive material constraints, and support creative decision-making. Unlike general generative models, Craft-Aware AI is concerned not only with whether an image looks convincing, but also with

whether the output satisfies craft feasibility, material logic, and the internal requirements of artistic language. This concept helps move lacquer painting research beyond style discussion and toward a theoretical intersection of craft, knowledge, and computation.

1.4.2 Practical Significance

At the practical level, this study establishes a LoRA-based training path for artist-specific models, enabling the transformation of an artist's localized experience, stylistic tendencies, and compositional habits into a callable generative capability at relatively low cost. It also proposes a five-stage human-machine workflow—conceptualization, Generation, Iteration, Pre-materialization Rehearsal, Physical Realization—through which AI moves beyond one-time image generation and becomes a collaborative support system embedded throughout the creative process. This workflow helps connect digital conception with physical making, reduces trial-and-error costs, and preserves the artist's final authority and agency.

1.5 Scope

This study focuses on two-dimensional lacquer painting practice and does not treat three-dimensional lacquerware or other craft types as its core object. The AI component is defined as support for artistic thinking rather than the main technological contribution of the paper. The research emphasis is placed on the creative chain from digital conception to preproduction, with particular attention to multimodal data collection, artist-specific model training, and the construction and validation of the five-stage collaborative workflow. The physical making stage is regarded as the final verification and realization phase, but not as the primary target of optimization. In addition, the study uses only artist-authorized data for model training, ensuring alignment among the research object, technical pathway, and ethical boundaries.

LITERATURE REVIEW

2.1 Ontological Features of Lacquer Painting

The essence of lacquer painting lies not merely in visual decoration, but in the coupling of material, process, and aesthetic judgment. It is therefore better understood as a process-oriented art rather than a form of static image production (Voharn, 2014). Natural lacquer is highly sensitive to environmental conditions, and layered techniques such as coating, polishing, and inlay produce depth, gloss, and texture that emerge progressively in practice rather than being fully predetermined. The resulting “lacquer quality” can be seen as the outcome of interactions among material, craft, and aesthetic experience. It functions both as a marker of style and as a form of tacit knowledge that is difficult to externalize. Such knowledge is typically transmitted through demonstration and guided correction rather than verbal instruction (Marinkovic, 2021; Budge, 2016).

2.2 AIGC and Personalized Style Modeling

2.2.1 Diffusion Models and LoRA

Generative AI in the arts has been shaped by diffusion-based image generation, represented by models such as Stable Diffusion, which enable controllable generation of style, composition, and structure (Rombach et al., 2022). As artistic practice demands greater personalization and stability, lightweight fine-tuning methods such as LoRA have become key tools for constructing artist-specific models. Compared to full training, LoRA requires fewer parameters and lower cost while preserving base model capabilities. In this study, LoRA is significant not only for efficiency but also for enabling the computational representation of individual artistic style (Hu et al., 2021).

2.2.2 Workflow Gaps in Craft-Oriented Contexts

Despite strong generative capabilities, most AIGC research remains focused on image output or style transfer, with limited attention to craft logic and material constraints. In lacquer painting, creation is shaped by material response, temporal control, procedural continuity, and experiential judgment. Generic AI workflows, while effective for iteration, do not align with

this logic. Moreover, existing studies rarely define artistic agency clearly—where AI intervenes, who decides, and how final authority is maintained. This study therefore shifts from generation capability to collaborative structure, proposing Craft-Aware AI as a way to embed AI into craft processes with defined boundaries.

2.3 Theoretical Foundations for Human–AI Collaboration

2.3.1 Computational Translation of Embodied Knowledge

Embodied cognition suggests that knowledge emerges through bodily interaction with materials rather than abstract representation. In lacquer painting, artistic judgment is grounded in tactile memory, timing, and material sensitivity. This study interprets artist-specific models as partial computational translations of embodied knowledge. The model captures not only visual features but also traces of compositional preference and aesthetic judgment developed through practice (Dourish, 2001; Malafouris, 2013). Thus, Craft-Aware AI functions as an externalization and reorganization of experience rather than a replacement for creativity.

2.3.2 Distributed Creativity and Reconfigured Agency

Theories of distributed creativity suggest that artistic production emerges from interactions among agents, tools, and environments. In AI-assisted lacquer painting, authorship becomes a system involving artistic intention, training data, model behavior, interface interaction, and material feasibility. AI is therefore neither an independent creator nor a passive tool, but a computational participant embedded in the process. Artistic agency is consequently reconfigured through workflow design, decision allocation, and final validation mechanisms (Hutchins, 1995; Glăveanu, 2013; Hayles, 1999).

RESEARCH METHODOLOGY

3.1 Data and Research Design

This study adopts a practice-based design research approach, treating generative AI as a creative medium. The dataset consists of artwork images, process documentation, and interview materials. These are organized through semantic tagging and trigger-word structuring into a trainable dataset. The methodology integrates literature analysis, case comparison, prototyping, and practice-based validation to evaluate Craft-Aware AI in terms of style fidelity, efficiency, and agency.

3.2 Artist-Specific Model Training

LoRA is employed as a lightweight fine-tuning method to reduce cost while preserving base model capability. The goal is to reproduce an artist’s compositional, tonal, and material tendencies rather than achieve general generation. Training parameters are adjusted to balance fidelity and overfitting, while trigger-word optimization strengthens prompt–output alignment. The resulting model functions as a callable unit representing individual artistic style (Hu et al., 2021).

Semantic tagging and trigger-word structuring encode tacit knowledge, including material depth, gloss, texture, and temporal rhythms (“three grindings and nine coatings”, lacquer drying cycles). For example, high-gloss layers are tagged as Gloss_Level_High, intermediate polishing stages as Polish_Stage_2, and drying time intervals are mapped to latent variables, allowing LoRA to reproduce process-aware outputs.

3.3 Five-Stage Collaborative Workflow

The proposed workflow includes five stages: onceptualization,Generation,Iteration,Pre-materialization Rehearsal,Physical Realization. The artist defines intent, AI generates proposals, iterations refine outputs, previsualization evaluates feasibility, and final realization is completed by the artist. Pre-materialization Rehearsal allows artists to simulate layering, gloss, and drying cycles digitally before physical realization, reducing trial-and-error costs. This structure embeds AI into the process through defined stages and decision points, ensuring controllability and reversibility.

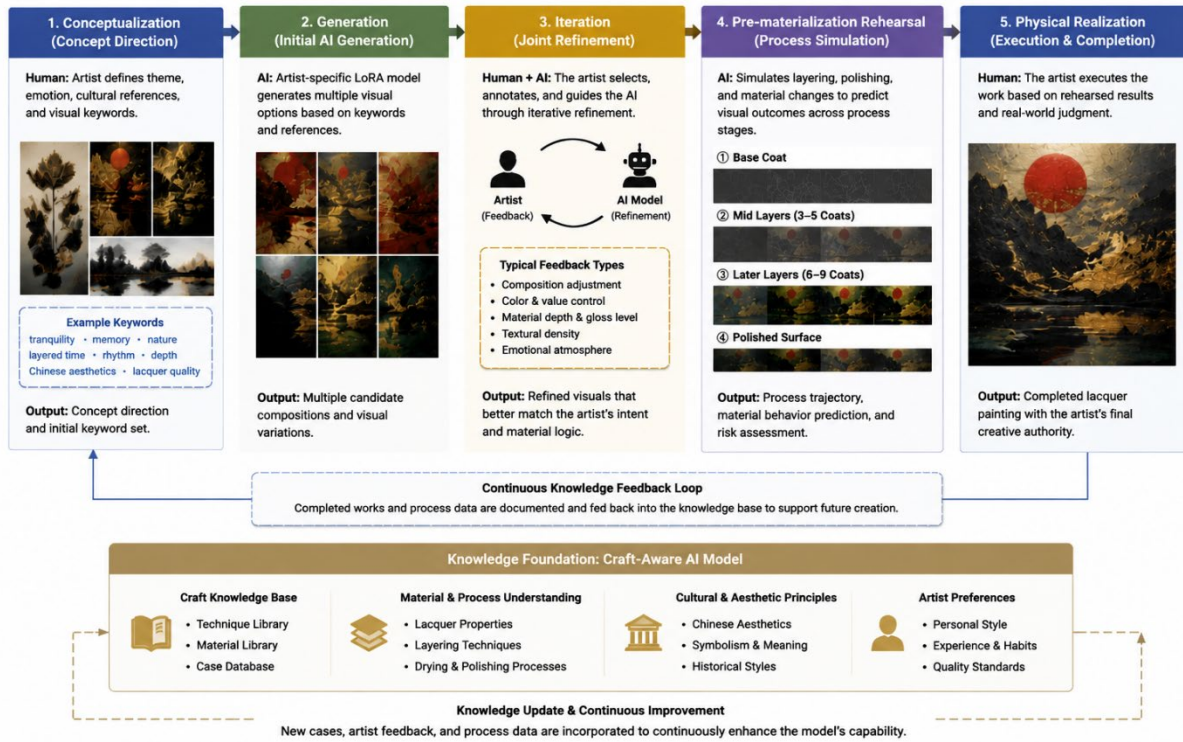


Figure 1 Five-stage human-machine collaborative workflow

Source: Author, 2026

3.4 Craft-Aware AI Framework

Craft-Aware AI refers to an AI system that understands craft constraints, responds to practice-based knowledge, and supports creative decision-making. Its focus is not visual plausibility alone, but alignment with material logic and feasibility. The framework integrates multimodal knowledge, artist-specific models, and workflow design into a unified system, positioning AI as a contextual collaborator. It shifts emphasis from aesthetic plausibility to practical usability while preserving artistic agency through human final judgment.

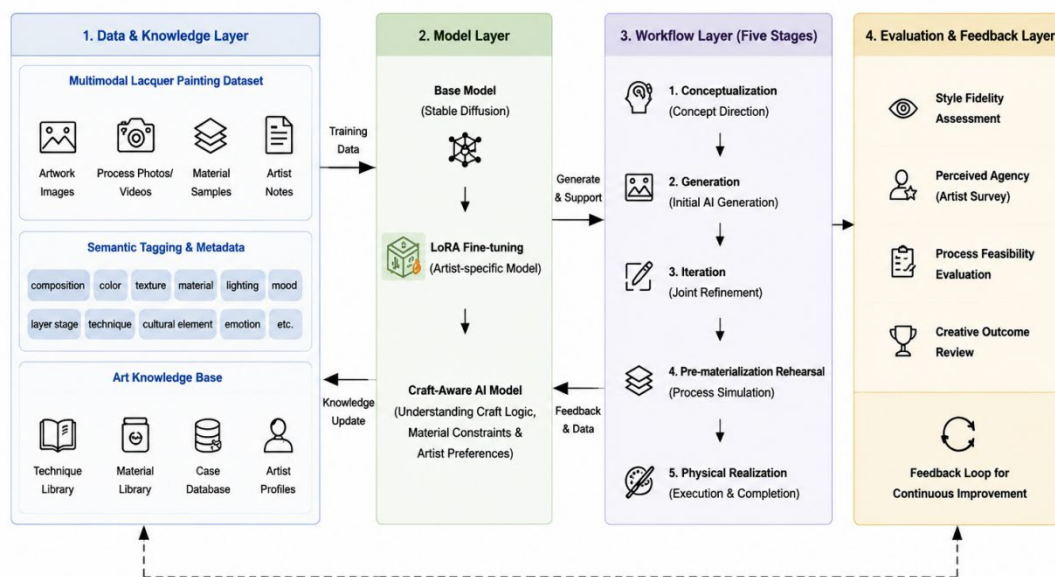


Figure 2 Craft-Aware AI framework

Source: Author, 2026

Note: integrates the artist-specific LoRA model, multimodal knowledge, and the five-stage workflow. Semantic tagging and trigger-word structuring encode tacit knowledge (material depth, gloss, texture, temporal rhythms). AI assists in simulating creative decisions, particularly during Pre-materialization Rehearsal.

3.5 Evaluation Framework

A pilot study compared general-purpose AI and Craft-Aware AI outputs. Evaluation combines style fidelity, efficiency, usability, and perceived artistic agency. Technical metrics serve as references, but final assessment relies on artist validation—whether outputs align with their visual language and can be used in practice. Note that Figure 1 illustrates the conceptual workflow; experimental outputs are presented separately. Results indicate the five-stage workflow effectively guides AI-assisted creation, especially during Pre-materialization Rehearsal.

CONCLUSION

The main conclusions and contributions of this study are as follows:

1. A Craft-Aware AI framework is proposed based on the craft ontology of lacquer painting, situating AI within a material- and process-oriented artistic context.
2. Through an artist-specific model and a five-stage workflow (Conceptualization, Generation, Iteration, Pre-materialization Rehearsal, Physical Realization), generative AI is repositioned as a creative support system, rather than a replacement for artistic subjectivity.
3. Theoretically, AI is defined as a mediating mechanism embedded within craft logic, linking material experience, visual judgment, and creative decision-making, rather than merely functioning as an image generator.
4. A unified data-model-workflow framework is established, providing an operational pathway for translating tacit knowledge and embodied practice into computable forms, with potential applicability to other craft-based art domains.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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