

Original Paper

Research on the Innovative Path of Traditional Lacquer Art Education Empowered by AIGC Technology

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Abstract

Traditional lacquer art education faces several challenges related to the single method of inheritance for skills and insufficient motivation for innovation. The advent of AIGC technology offers new opportunities for traditional craft education in the areas of teaching scenarios and creative processes through both intelligent generation and interaction. This research has an objective of exploring ways in which AIGC technology can be integrated into lacquer art education, creating a framework for technology-enhanced education that is innovative. Practical experience shows that intelligence design support along with a virtual simulation teaching method will effectively promote and enhance a student's ability to be creative, while a data-driven evaluation system will provide greater accuracy in teaching. The ability to integrate cross-disciplinary resources and transform teacher training will be fundamental to the modernization of traditional craft education.

Keywords

AIGC technology, traditional lacquer art education, innovative pathways, technological empowerment, educational transformation

1. Introduction

The digitization of many aspects of global culture is being advanced by New Liberal Arts education. This digitization is transforming how intangible cultural heritage is being transmitted and taught. Lacquer art represents a unique and rich form of traditional Chinese lacquer decoration. This art form conveys Eastern philosophies such as unity with one's self through one's craft and the creation of materials using strong personal aesthetics within the realm of lacquer art. Unfortunately, when lacquer art education was influenced by industrialized production methods and various disciplinary divisions, structural obstacles were created that hindered the dissemination of lacquer art education to future

generations, such as a lack of innovative creation, uniform curriculum structure, and disparities in access to quality teaching and educational resources throughout the various regions of China. Furthermore, the disconnection from the tangible cultural context of lacquer art further creates obstacles for future generations who wish to continue to learn and practice lacquer art.

2. Research Background and Literature Review

The dilemma currently associated with traditional lacquer art education is that while the primary delivery method is the sharing of individual experience, it is hard to integrate that with the large-scale demands of modern educational systems. This is compounded by the inability of institutions of higher learning to create a curriculum that adequately supports both the need for skill inheritance and the ability to foster innovation amongst students. Students in many colleges and universities have limited opportunities to engage in the practice of material crafts due, in part, to the limited hours of their classes and to the physical constraints of their school facilities. There is also a variation of availability of teaching resources across regions and, in some areas, no systematic pattern maps or process parameter records are kept, all of which limit the ability of instructors to improve quality of instruction. Additionally, the push towards increasing digitization of cultural resources through the use of intelligent technologies in craft-based educational systems is starting to open up an avenue for modernizing the methods of teaching traditional craft-based skills. Educators will be looking at how best to incorporate technological resources into their curriculum systems, including the exploration of AIGC technology (Li, Liu, & Xiao, 2025).

The existing research mainly explores the potential application of digital technology in the field of traditional craft protection, and multiple scholars have verified the effectiveness of 3D scanning technology in preserving lacquerware patterns through case analysis. These studies provide methodological support for building a lacquer art digital resource library, but there is relatively little discussion on how to transform digital resources into teaching resources. Some educational researchers have paid attention to the advantages of virtual simulation in craft training, and their developed basic operation modules can help learners become familiar with the lacquer art craft process. These technological applications often remain at the tool level and have not yet formed teaching plans that are deeply integrated with educational theory. The academic research on AIGC technology in creative generation is gradually increasing, and some scholars are trying to use algorithms to generate pattern schemes that conform to traditional aesthetic laws. These explorations provide a theoretical basis for intelligent assisted creation, but further exploration is needed on how the algorithm generated results can be integrated with traditional teaching processes. There is a clear research gap in the existing literature on the core issue of technology enabled education, especially the lack of systematic argumentation on the differentiated application strategies of intelligent tools in different teaching stages. The issue of how to transfer the experience and wisdom that are difficult to quantify in traditional skills through digital technology has not received sufficient attention from the academic community (Li,

2024).

3. The Theoretical Foundation of AIGC Technology Empowering Traditional Lacquer Art Education

3.1 The Fundamental Principles of Integrating AIGC Technology with Art Education

There is a significant alignment between how Cognitive Theory explains how we understand the world around us and the characteristics of technology as well, AIGC (Artificial Intelligence Generated Content) is a prime example of this type of alignment between Cognitive Theory and technology. AIGC has the ability to process a lot of data, in this case it's images and an example would be the large amount of images associated with traditional lacquer art patterns, and AIGC can identify the rules associated with the composition of those images and their colour relationship. When learners use keywords to express creativity, AIGC will generate a variety of design sketches that ultimately shorten the time it takes for the learner to create their art. Using the digital technology associated with the AIGC technology, learners are able to view a simulation of the actual processes of creating lacquer art, and to make adjustments to the parameters of the processes that create those artworks. In the real world AIGC technology has generated pattern designs that retain the traditional characteristics of decorative language used in lacquer art but also include thinking outside the box and creating new styles based on today's tastes. The use of Cognitive Load Theory as a basis for utilizing technical support divides the basic skill training and the creative expression into two stages of organically connected learning. This model allows learners to devote more of their attention to the essence of creating art than to the time-consuming and often repetitive technical exercises that accompany creating art. Many instructors have implemented a teaching model that changes the way master-apprentice relationships are formed by converting a process of experiential teaching to digital resources that are analyzable and can be reconfigured.

3.2 Characteristics and Development Needs of Traditional Lacquer Art Education

Traditional lacquer art education has long relied on hand to mouth transmission between teachers and students, and its teaching process often revolves around systematic training of specific techniques. Learners need to gradually master the coordination between the characteristics of lacquer and decorative techniques in long-term practice, and this experience accumulation mode requires teachers and students to maintain a stable frequency of contact. There is a disconnect between practical and theoretical teaching in the current educational environment, and students' opportunities to access materials are limited by class hours and venues. The traditional teaching model has room for improvement in cultivating personalized creative abilities, and learners are prone to falling into repetitive training with fixed paradigms. The teaching system needs to establish more flexible channels for knowledge transmission to help learners overcome the barriers between material cognition and creative expression. The special properties of lacquer art materials result in high teaching costs, and many universities face pressure in resource allocation when conducting practical teaching (Guan & Jiang, 2025). The modern educational environment requires traditional craft courses to integrate

interdisciplinary thinking, and single technique teaching is no longer sufficient to meet the needs of cultivating versatile talents.

4. The Main Challenges of AIGC Technology in the Application of Traditional Lacquer Art Education

4.1 Traditional Educators' Acceptance and Adaptation Barriers to Intelligent Technology Tools

The older generation of lacquer art teachers have developed a stable manual demonstration teaching method in their decades long teaching career, and they have a natural sense of alienation from intelligent technology tools. These teachers are more accustomed to directly modifying students' pattern sketches on the creative site, and often feel at a loss when facing the parameter adjustment panel on the digital interface. Some senior teachers believe that the pattern schemes generated by algorithms lack the lively charm of manual drawing, and they are concerned that technological intervention may weaken students' intuitive perception of material properties. Technical training courses often overlook the cognitive habits of lacquer art teachers, and it is difficult to stimulate learning interest by directly applying universal software teaching templates. The valuable experience accumulated by the teacher community in long-term practice has not yet established an effective conversion channel between algorithm logic, and this cognitive difference makes it difficult to fully transmit the essence of traditional skills through digital tools.

4.2 The Integration of Lacquer Art Teaching Resources and AIGC Technology Is Insufficient

The existing teaching resources have not yet established a digital content system that matches AIGC technology. The lacquer art teaching materials accumulated by various universities mostly exist in the form of physical works and paper documents, and the progress of digital transformation of these resources is slow. The construction of traditional pattern libraries lacks unified standards, and there are format differences in pattern data collected from different regions, making it difficult to directly import into intelligent design platforms. Developers of technical tools have limited understanding of lacquer art expertise, and the algorithm models they design often cannot accurately identify the cultural connotations of lacquer patterns. The recording of material characteristic data in teaching practice is not complete enough, and the intelligent system lacks sufficient samples to support accurate simulation of the drying process of lacquer. The specialized software suitable for lacquer art teaching needs to include professional modules such as material ratio and process parameters, and existing universal design programs are difficult to meet specific teaching needs (Liu, 2023).

4.3 The Inherent Tension between Artisanal Experience Transmission and Algorithmic Generation Models

The inheritance of traditional lacquer art relies heavily on the muscle memory and intuitive judgment formed by masters through long-term practice, which are difficult to transform into data patterns recognizable by algorithms. Experienced craftsmen can determine the viscosity of lacquer through fingertip touch, while algorithmic systems can only handle standardized parameter inputs. Students may easily obtain pattern schemes with the assistance of intelligent generation systems, but they may overlook their firsthand perception of material properties. Although the decorative composition

recommended by algorithms conforms to the principles of formal beauty, it often lacks the random and dynamic beauty of manual drawing. Excessive reliance on technical tools by young learners can lead to insufficient training in basic skills, and their designed digital solutions often encounter difficulties in process implementation during actual production. The existing technology has not yet established a corresponding relationship between traditional skill evaluation standards and algorithm logic, and the patterns generated by intelligent systems are often criticized for lacking humanistic warmth (Wang, 2025).

4.4 Cost Constraints on AIGC Technology Supporting Hardware and Operational Environments

Colleges and universities face significant hardware cost pressures when deploying AIGC teaching systems, and the procurement costs of high-performance graphics workstations and virtual reality devices often exceed the regular budget of art majors. These professional devices require powerful data processors and graphics computing cards to ensure the stable operation of intelligent generation algorithms, and daily maintenance requires continuous investment in technical support funds. Many lacquer art studios' existing computer equipment is unable to handle complex pattern generation calculations, and hardware upgrade projects also involve the circuit transformation of the entire digital classroom. The annual subscription fee for professional rendering software and the copyright expenditure for texture material libraries form a sustained economic burden, and rural universities are unable to support real-time cloud computing due to insufficient network bandwidth conditions. Remote studios often encounter problems of data transmission interruptions affecting the teaching process, and the speed of equipment updates and replacements has always been unable to keep up with the pace of technological innovation.

4.5 The Absence of a Training System for Lacquer Artisans with Digital Skills

The current teacher training system has not yet established a complete path for the integration of traditional lacquer art and digital technology, and training course design often separates software operation from professional teaching. The general technical knowledge learned by the teacher group in short-term training is difficult to directly apply to lacquer art classrooms, and they need to transform abstract operational steps into concrete teaching practices. The digital courses provided by vocational education institutions rarely involve professional content such as intelligent pattern generation algorithms and simulation of lacquer material characteristics. The standardized training provided by technology suppliers also lacks a deep understanding of the teaching rules of lacquer art. Teachers often encounter professional problems in the process of independent exploration that exceed the scope of conventional technical support, and the innovative teaching methods they develop also lack effective communication platforms. The unfamiliarity of technical guidance personnel with the lacquer art creation process often leads to solutions that deviate from actual teaching needs, and this professional barrier makes it difficult for technical applications to reach the core of teaching. The mechanism for sustained growth support is not yet perfect, and the learning resources obtained by teachers at various stages lack systematicity and coherence (Yaqi, 2021).

4.6 The Challenge of Balancing Cultural Heritage and Innovation

The design schemes generated by AIGC sometimes deviate from the unique cultural core of traditional lacquer art, and algorithms may break the inherent skeleton structure and symbolic system when recombining pattern elements. Students often find it difficult to distinguish which elements of these innovative solutions conform to traditional norms and which fall within the scope of algorithmic freedom. Teachers need to spend extra effort explaining the correspondence between intelligent generation results and traditional pattern systems during the teaching process, to ensure that innovative solutions do not violate basic manufacturing standards. The vast array of design variants provided by intelligent tools can easily lead beginners to overlook the creative principle of "upholding integrity and innovation" in traditional lacquer art, excessively pursuing visual novelty effects and losing their understanding of cultural depth. The works generated by algorithms sometimes overlook material characteristics and production logic at the level of process implementation, which limits the ability of some design schemes to be perfectly presented through traditional techniques.

5. Innovative Application Pathways of AIGC Technology in Traditional Lacquer Art Education

5.1 Intelligent Generation Assistance for Pattern Design and Composition Schemes

In the initial stage of pattern design, learners can input key parameters such as the creative theme and stylistic orientation into the intelligent system. Based on these requirements, the system automatically generates multiple composition schemes featuring traditional lacquer art characteristics. These algorithm-generated alternatives not only preserve the skeletal structure of classic patterns but also incorporate novel combinations that align with modern aesthetics, offering students a creative perspective beyond experiential limitations. By comparing and analyzing the compositional logic and decorative effects of different schemes, students can gain a deeper understanding of the integration possibilities between traditional pattern composition principles and contemporary design language (Chen, 2019).

After establishing the basic composition framework, students can utilize the editing features provided by intelligent tools to refine the intricate details of the patterns. They are free to adjust the curvature and rhythm of traditional cloud or scroll motifs, experiment with different lacquer color combinations, and the system will instantly display the visual changes resulting from these adjustments. This dynamic modification process helps students develop an intuitive connection between pattern design and visual expression, whereas traditional hand-drawing methods often require sketching multiple drafts to achieve the same effect. When translating the optimized digital design into physical creations, students must comprehensively consider the fluidity characteristics of lacquer and the craftsmanship challenges of decorative elements. This cross-media transformation process encourages them to deeply contemplate the constraints between digital design and material properties.

5.2 Virtual Simulation Training on the Characteristics of Lacquer Art Materials and Craftsmanship Processes

The virtual simulation system can simulate the curing process and color changes of lacquer under

different temperature and humidity conditions by establishing an accurate material reaction model. When learners adjust the material parameters of the bottom tire in the virtual operation interface, they can observe the real-time change of the paint penetration. This dynamic feedback helps them understand the internal relationship between material properties and process effects. The built-in paint film generation simulator in the system predicts the drying time based on environmental parameters. By changing ventilation conditions and temperature settings, students can master the key factors that control paint quality.

In the process training module, the virtual system provides a complete process practice environment from mounting to pushing light. Learners can perform multiple repetitions of training without consuming physical materials. The system will record the force trajectory and operation duration of each action, and generate an evaluation report containing detailed issues. Based on these data reports, teachers guide students to adjust their wrist angles and force application methods. This precise feedback effectively corrects the operational essentials that are difficult to convey intuitively in traditional teaching. Virtual training also includes simulations of common error scenarios, such as when a student selects a paint layer thickness that exceeds a reasonable range, the system will immediately display possible wrinkling phenomena and solutions (Lin, 2012).

5.3 Adaptive Course Content Adjustment Based on Learner Characteristics

The adaptive curriculum system continuously collects learners' operational data on the virtual training platform to construct an ability profile that reflects their individual skill characteristics. The system analyzes the creative trajectory of students in pattern design software and the operational accuracy of the process training module, identifying the differences in modeling ability and process mastery among different students. The platform dynamically adjusts the presentation of teaching content based on these analysis results, providing more three-dimensional modeling decomposition demonstrations for students with weaker spatial imagination abilities, and adding specialized training sessions for those who are not proficient in technical operations.

The curriculum system relies on learners' ability profiles to generate personalized knowledge graphs, automatically planning learning paths that are in line with individual progress levels. Learners with fast mastery speed will unlock comprehensive practical projects in advance, and the system will recommend creative tasks that require the integration of multiple techniques for them; Learners who progress slightly slower will receive targeted consolidation exercises, and the system will break down their decoration techniques that they have not yet mastered into more detailed training units. Teachers can timely understand the overall situation of the class through the learning progress report provided by the system, adjust the focus of classroom lectures based on the knowledge weak points prompted by the system, and achieve the organic unity of group teaching and individual guidance (Wang, Chen, & Gu, 2025).

5.4 Innovative Experience of Audience Interaction in Augmented Reality Displays

The augmented reality display system has created digital twins for lacquer art works, and viewers can

activate the dynamic information layer overlaid on the physical object by scanning the physical work through their mobile devices. The system overlays and displays the decomposition steps and process characteristics of pattern drawing on the surface of lacquerware, allowing the audience to intuitively understand the production process of techniques such as eggshell inlay or gold and silver flat detachment. When the audience moves the perspective of the device, the augmented reality system will correspond to the decorative details of the display object at different angles, and even reproduce the usage of lacquerware in historical scenes. This display method breaks through the static limitations of traditional exhibitions, allowing the audience to deeply understand the cultural connotations and craftsmanship values of lacquer art works.

In the interactive experience stage, viewers can simulate “deconstruction” of lacquered objects using gestures, view the connections made between mortise and tenons of different parts, as well as learn how different lacquering techniques are organised hierarchically. An augmented reality system will enable viewers to create their own unique pattern re-creations, to be used as decorative accents while keeping the original pattern's framework, provide a mechanism to develop new design ideas in real-time, and allow for the projected display of their designs on the surface of 3-D printed products. Additionally, the system will provide data on the preferred ways different groups of people have expressed their creativity through traditional crafts, as well as information regarding how long they interacted with the creative process. This information will allow educators to monitor how well different groups of people are drawn to traditional craft-related subjects, as well as how to develop educational curricula and product displays that reflect those interests. The Multi-User Collaboration capability allows different groups of people to contribute their unique creative ideas to the same lacquerware piece; this collaborative creative experience will encourage traditional craft knowledge to spread through social networks.

5.5 Data Collection in the Learning Process and Optimization of Teaching Effect Evaluation

Data Collection Systems provide a continuous record of Learner Operational Actions (LOAs) and Creative Direction (CDs) throughout the lacquer art teaching-learning experience. The data recorded detail the number of modifications made by students when developing their Pattern Designs, the final Solution adopted, the actual Operating Time of a student, as well as the manner in which they represent action consistency (standardization) through Virtual Learning. Fine-grained Learning Data is processed through algorithm models resulting in a personalised Learning Ability Map of individual student Skill Profile and Learning Progression Trends. Teachers can easily access visual dashboards to review overall student learning activity, as well as determine students' common mistakes across similar technology processes.

The teaching system can modify how teaching materials are presented, including the order of presentation and the strength of the focus, based upon the information from an analysis of students' data. Students in different skills progress can also be provided with customized training projects. When students are at different ability levels with regard to the technical skills involved in painting, the system

will provide additional basic and sequential demonstrations to the slower progressers while providing the quicker progressers with more inventive and challenging assignments. Educators will use the personalized approaches developed from student data to provide a centralised solution to many of the difficulties students encounter while offering individualized guidance based upon the way each student is progressing in the classroom setting. Additionally, the evaluation of the success of education has evolved from a single project rating to a much more comprehensive method of analysing students' work based upon process data, including the "evolutionary trajectory" of each student's "creative ideas" and the "curve" of the "technology," as well as all constituent components of the learning process (Li, 2025).

5.6 Digitization of Traditional Cultural Resources and Copyright Protection Mechanisms

The digitization of traditional cultural resources requires the establishment of a standard collection process, and a professional team uses high-precision scanning equipment to record the morphological characteristics and pattern details of lacquerware artifacts. The digitalization process should fully record metadata such as material information, craftsmanship techniques, and cultural background of the work, forming a structured teaching resource library. The classification system needs to establish multidimensional labels based on the intrinsic characteristics of lacquer art, covering key dimensions such as pattern themes and decorative techniques. Digitalized resources are managed securely through encryption technology and permission control, and educational institutions must follow corresponding authorization protocols when using them.

The copyright protection mechanism needs to clarify the ownership of digital content rights and track resource usage paths through digital watermarking and blockchain technology. Educational institutions should follow citation standards and indicate the source of materials when using traditional elements in their creations. The resource platform can establish a hierarchical authorization model, with open sharing for teaching purposes and strict approval for commercial applications. Intelligent generation of works requires the establishment of a rights distribution mechanism to balance technological innovation and cultural heritage value.

6. Implementation Path and Development Recommendations

6.1 Cross-disciplinary Collaboration and Resource Integration

Cross disciplinary cooperation mechanisms require joint efforts from digital technology companies, lacquer master studios, and educational institutions to build a technology empowerment platform, where participants contribute professional resources based on their own strengths. Technology companies provide intelligent algorithm development and hardware device support, lacquer art inheritors are responsible for sorting out the traditional craft knowledge system and technique essentials, and educational institutions build application scenarios that transform technical resources into teaching practices. The collaborative team should systematically sort out the scattered lacquer art literature and physical materials in various places, transform these precious resources into standardized

digital assets, and lay the foundation for subsequent technological development. In the process of resource integration, all parties should establish regular communication channels, regularly exchange information on the matching between technical implementation and professional needs, and adjust the direction and focus of cooperation in a timely manner. The results of resource integration should form an open and shared lacquer art digital resource library, covering core content such as pattern data, process parameters, and teaching cases, providing basic support for educational institutions in different regions. This cross disciplinary collaboration model can effectively break through the limitations of a single institution's capabilities and achieve the organic integration of technological resources, artistic inheritance, and educational needs.

6.2 Synergy Between Technological R&D and Educational Practice

The technical research and development team should go deep into the lacquer art teaching site to observe the actual operation process of teachers and students, and record the specific difficulties and innovative needs they encounter in traditional technique training. Based on these real-life teaching scenarios, R&D personnel adjust the technical solutions and transform the unique lacquer art process into operational logic suitable for intelligent tool processing. Education practitioners continuously record students' acceptance and operational barriers during the use of technology tools, and these frontline teaching experiences provide clear direction for technological optimization. The technical team continuously simplifies the operating interface based on classroom feedback provided by teachers, and adds specialized functional modules that are in line with the characteristics of lacquer art teaching, such as a large lacquer drying time predictor and a pattern deformation correction tool. The R&D process should establish a rapid iteration mechanism to timely integrate effective improvements in teaching practice into technological upgrades, forming a complete closed loop from classroom requirements to technical implementation and teaching verification. This bidirectional collaborative mechanism ensures both the practicality of technological development and the technical support for educational innovation, enabling intelligent tools to truly serve the essential requirements of lacquer art teaching.

6.3 Policy Support and Industrial Promotion

The existing cultural policies have included the digital inheritance of intangible cultural heritage in the key support scope, and some local cultural and tourism departments have directly supported universities to carry out the construction of lacquer art digital resource libraries through the establishment of special project funds. The education regulatory authorities have explicitly encouraged the integration of traditional crafts and information technology in the "New Liberal Arts" construction guidelines, which has prompted universities to incorporate the application of intelligent technology into the teaching reform projects of related majors. In the revision process of the intangible cultural heritage protection regulations in some regions, specific provisions promoting technological empowerment have been added, providing institutional basis for the joint construction of laboratories by schools and enterprises. In terms of industrial policies, some special funds for the development of cultural industries

have included intelligent upgrading and transformation in the subsidy scope, supporting lacquer art workshops to introduce virtual simulation and other teaching equipment. The intellectual property department is also exploring copyright protection and trading mechanisms for traditional craft digital content, providing policy guarantees for the legal circulation of technological achievements. These scattered policy measures in different fields collectively constitute the initial policy environment supporting the digital transformation of lacquer art education.

6.4 Teacher Training and Curriculum System Restructuring

Teacher training programs should collaborate with technology companies to develop intelligent tool application courses specifically designed for lacquer art teachers. The course content should be combined with specific pattern design teaching cases to demonstrate technical operation methods. Educational institutions can cultivate a group of backbone teachers who are proficient in digital technology within their existing teaching staff. These teachers are responsible for helping colleagues solve practical problems in the application of technology during teaching and research activities. The reconstruction of the curriculum system requires the integration of the use of intelligent tools into the traditional lacquer art teaching syllabus, while maintaining the core position of the original technique training and adding digital design modules. The new curriculum structure should arrange for students to master the basic process flow in virtual simulation before entering the physical studio for creation. This segmented teaching can effectively improve learning efficiency. Colleges can establish a shared digital resource library to support course implementation, which includes organized classic pattern data and process parameters for teachers and students to access and use. The teaching evaluation mechanism needs to include technical application ability in the assessment scope, while paying attention to students' comprehensive performance in both traditional techniques and digital innovation.

7. Conclusion

AIGC technology has built a new ecosystem of virtual and real integration for traditional lacquer art education, and intelligent generation and data-driven approaches are reshaping the underlying logic of skill inheritance. Technological empowerment is not a simple replacement for traditional teaching methods, but rather the expansion of creative perspectives and improvement of teaching efficiency through human-machine collaboration. Future research should focus on the balanced development of technological applications and cultural cores, while maintaining the essence of lacquer art language, and continuously optimizing the connection mechanism between virtual practice and physical creation. This fusion innovation is not only related to the effectiveness of skill inheritance, but also affects the vitality of traditional crafts in the digital age.

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