Volume : 3 | Issue : 4 | Received-29-03-2026 | Accepted-06-04-2026 | Published-13-04-2026

UAI JOURNAL OF ARTS, HUMANITIES AND SOCIAL SCIENCES (UAIJAHSS)

Abbreviated Key Title: UAI J Arts Humanit Soc Sci
ISSN: 3048-7692 (Online)
Journal Homepage: https://uaipublisher.com/uaijahss/
Volume- 3 Issue- 4 (April) 2026
Frequency: Monthly

From Human–Machine Interaction to Collaborative Co-Creation: A Study on the AIGC-Empowered Teaching Model for Hair Embroidery Art Courses

Yu Rui[1*], Fang Xie[2]

[1, 2] School of Humanities and Law, Jiangsu Ocean University, China

Corresponding Author: Yu Rui

ABSTRACT

Hair embroidery art education currently faces practical challenges, including a single mode of skill transmission and insufficient student motivation for innovation. With the development of Artificial Intelligence Generated Content (AIGC) technologies, their advantages in human–machine collaboration and cross-modal generation provide new pathways for teaching traditional craft arts.

This study takes a hair embroidery course at a vocational college in Yancheng, Jiangsu Province, as the research subject. By combining teaching experiments with questionnaire surveys, it conducts a comparative analysis of teaching outcomes before and after the integration of AIGC. The findings indicate that AIGC-assisted design significantly enhances students' creative expression and increases the diversity of their works. Meanwhile, the human–machine collaborative model improves learning engagement.On this basis, this study constructs a new teaching model for hair embroidery courses and proposes pathways for optimizing curriculum structure and reconstructing evaluation systems, providing practical references for the pedagogical reform of intangible cultural heritage skills in the context of digital technologies.

KEY WORDS: AIGC; Hair Embroidery Art Education; Human–Machine Collaboration; Technological Empowerment; Teaching Reform

1. Introduction

As a representative form of China's intangible cultural heritage, hair embroidery uses human hair as thread and needles as brushes, embodying profound cultural heritage and distinctive aesthetic significance. However, in actual teaching practice, hair embroidery courses commonly rely on demonstration-and-imitation methods, resulting in limited student creativity and a high degree of homogeneity in students' works. These issues make it difficult to effectively stimulate learners' innovative awareness and practical abilities. This dilemma reflects the limited adaptability of the traditional master–apprentice teaching model within modern educational systems.

However, the rapid development of AIGC technologies has provided critical technological momentum for the paradigm reconstruction of traditional craft education. With capabilities such as efficient cross-modal generation, style transfer, and intelligent interaction mechanisms, AIGC is reshaping the ontological boundaries and methodologies of artistic creation. Integrating AIGC technologies into hair embroidery art education not only broadens learners' cognitive boundaries and creative thinking while enhancing the efficiency of tacit knowledge transformation, but also aims to foster a new educational paradigm in which traditional craftsmanship is deeply integrated with digital intelligence.

DOI: 10.5281/zenodo.19549291

Against this background, this study takes the reform practice of a hair embroidery course at a vocational college in Yancheng, Jiangsu Province, as its entry point. Using a mixed-method approach that combines teaching experiments with questionnaire surveys, it investigates teaching effectiveness and teacher–student interaction mechanisms under the intervention of AIGC technologies. This study focuses on the following research questions: (1) In an AIGC-supported environment, which factors significantly influence students' learning outcomes? (2) How can an effective human–machine collaborative teaching model be constructed to optimize course structure and enhance the quality of hair embroidery education? The findings are expected to provide both theoretical insights and practical references for cultivating versatile hair embroidery practitioners with digital literacy and innovative thinking.

2. Research Background and Literature Review

Currently, the core challenge in traditional hair embroidery art education lies in its heavy reliance on the *master–apprentice model* for skill transmission. While this model facilitates the precise transfer of technical details, it increasingly reveals structural limitations within modern institutional education. On the one hand, individualized mentorship struggles to meet the demands of large-scale and standardized teaching; on the other hand, a predominantly imitation-based approach keeps students in a passive learning state, restricting the development of their creativity and aesthetic expression and resulting in a pronounced homogenization of student works. Meanwhile, the contemporary transformation of hair embroidery art requires learners not only to master fine craftsmanship but also to develop cross-modal design skills and aesthetic judgment, further increasing the complexity of instructional implementation.

In recent years, with the development of AIGC technologies, the field of art education has undergone a shift from tool-assisted approaches to human–machine collaborative paradigms. At the theoretical level, relevant studies indicate that AIGC can expand learners' creative boundaries through image generation and style transfer while serving as a teaching medium that facilitates continuous interaction and deep engagement (Seo, 2025). Further research suggests that the application of AI in cultural visualization helps strengthen learners' cultural identification with traditional handicrafts (Li, 2025). At the same time, the effective implementation of human–machine collaborative learning depends not only on technological capabilities but also on the crucial role of teachers in instructional design, emotional support, and value guidance (Gorsky & Levin, 2025). At the practical level, existing studies have attempted to integrate AI tools into audiovisual courses, using intelligent generation and collaborative creation to enhance students' learning engagement and hands-on experience (Pan, 2018); however, such applications have largely been limited to digital media courses.

Against this background, research in art education and intangible cultural heritage (ICH) transmission has increasingly focused on the *ICH in schools* initiatives and their role in cultural education, emphasizing the integration of skill transmission and cultural identity through curriculum design (Yi & Ni, 2024). However, existing research largely remains grounded in traditional teaching models, with insufficient exploration of integration pathways for digital technologies, particularly AIGC. Moreover, in art and design education, the application of AI has mostly been limited to image generation or design assistance, lacking the development of systematic teaching models oriented toward craft practice.

In summary, existing research still exhibits several limitations. First, ICH skill education largely depends on traditional transmission models and lacks digitally driven pathways for pedagogical reconstruction. Second, the application of AIGC in art education has mainly focused on visual design and related fields, while its adaptation mechanisms for craft-based courses centered on hands-on practice remain unclear. Third, most studies still regard AI merely as an auxiliary tool, lacking the systematic construction of human–machine collaborative teaching models. On this basis, deeply integrating AIGC technologies into hair embroidery courses and exploring their teaching mechanisms and practical pathways within human–machine collaborative contexts hold significant value for promoting the modern transformation of intangible cultural heritage skill education.

3. Teaching Reform Pathways and Empirical Research Design

3.1 Teaching Reform Pathways: Reconstructing Traditional Hair Embroidery Art Education Courses Empowered by AIGC

To address the persistent challenges of rigid transmission models and insufficient intrinsic motivation for innovation in traditional hair embroidery education within the broader context of educational reform, this study uses a hair embroidery design course as a practical platform. By breaking through the conventional skill-focused teaching framework and introducing generative AIGC technologies, it constructs a human–machine collaborative course model that systematically restructures teaching content, practical processes, and evaluation methods.

At the level of course content, traditional hair embroidery teaching has largely focused on the imitation of classical patterns, which often leads students' creative practice to fall into path dependence. In response to this issue, *AI-assisted pattern* design and imagery translation modules were incorporated into the curriculum within the broader framework of educational reform.

During implementation, instructors first guided students to develop visual imagery concepts based on thematic exploration and to complete the initial generation of prompts. Subsequently, students used Text-to-Image tools to conduct multiple rounds of image generation and selection, comparing and refining the generated results. Building upon this process, students further integrated traditional hair embroidery techniques, such as *baimiao* (ink-outline drawing) and color shading, to redesign and translate the images, ultimately producing design drafts suitable for embroidery practice.

Through this process, the focus of learning shifted from mechanical replication to creative generation and aesthetic expression, enabling an effective integration of digital creativity with traditional craftsmanship.

At the level of practical implementation, to address the challenges of lengthy creation cycles and high trial-and-error costs in hair embroidery, the course introduced a blended digital–physical teaching approach. Before entering the physical embroidery stage, students used AIGC tools to conduct multimodal visual rehearsals of their design plans, including color coordination, compositional adjustments, and texture simulation. During this process, students compared and iterated different design options and continuously optimized their design paths under instructor guidance. The refined plans were then transferred to the physical embroidery stage for the

DOI: 10.5281/zenodo.19549291

completion of the final works.By following this sequence of digital rehearsal followed by physical realization, the teaching approach not only reduced trial-and-error costs during practice but also effectively enhanced students' willingness to explore and their creative confidence, making innovative practice possible even under complex craft conditions.

In terms of assessment, to address the traditional reliance on instructors' experiential judgment in hair embroidery courses, this study attempted to establish a diversified evaluation system centered on formative assessment. During the design phase, emphasis was placed on students' performance in prompt generation, image selection, and plan optimization, with records and feedback provided on their creative development paths, incorporating auxiliary analysis results offered by AI tools. In the practical phase, assessment focused on the craftsmanship, completion, and artistic expression of the embroidered works.By integrating the digital design process with the outcomes of physical embroidery, this approach establishes an evaluation system that spans the entire learning process, providing a more comprehensive reflection of students' learning trajectories and skill development.

Moreover, during the course implementation, emphasis was placed on the transformation of the teacher's role, shifting from a traditional skill instructor to a learning facilitator and process supporter. In teaching, instructors not only provide technical guidance but also guide students' creative expression and aesthetic judgment, offering targeted feedback at critical points to ensure the effective operation of the human–machine collaborative process.

As a result, AIGC technologies are no longer embedded in teaching merely as standalone tools; rather, they are deeply integrated with course structure, the learning process, and assessment mechanisms, facilitating the transformation of hair embroidery education from skill transmission to collaborative creation. This approach provides a feasible pathway for the pedagogical innovation of intangible cultural heritage skills in the digital era.

3.2 Empirical Research Design: Validating the Effectiveness of AIGC Intervention in Hair Embroidery Art Courses

To scientifically assess the instructional impact of AIGC technologies in hair embroidery courses, this study employed a mixed-methods approach, primarily quantitative with supplementary qualitative data. The participants were 60 second-year students majoring in Art Design at a vocational college in Yancheng, Jiangsu Province, China. They were randomly assigned by lot to an experimental group (n = 30) and a control group (n = 30). Both groups were taught by the same instructor with extensive experience in intangible cultural heritage education, in order to control for potential confounding effects of the teacher.

The experimental group adopted an AIGC-enabled innovative teaching framework, systematically applying generative AI tools such as Midjourney and Stable Diffusion during the pattern conception, style translation, and virtual rehearsal phases, emphasizing the concept of human–machine collaborative creation. Students first used AI to generate design sketches, which were then iteratively refined and optimized in combination with traditional hair embroidery techniques, ultimately producing design plans suitable for physical embroidery. The control group followed the traditional master–apprentice model, with the instructor guiding students to hand-draw design drafts and complete embroidery practice.Over the course of a full semester, the curriculum was divided into a foundational skills phase (weeks 1–4), a pattern innovation and intervention phase (weeks 5–12), and a physical creation and assessment phase (weeks 13–18), ensuring that both groups received identical foundational skills instruction to allow for a fair comparison of intervention effects.

In this study, the teaching model (AIGC intervention versus traditional approach) served as the independent variable, with two dependent variables: creative self-efficacy and learning engagement. Creative self-efficacy was measured using the classic scale by Tierney & Farmer (2002), assessing students' confidence in their innovative abilities when trial-and-error costs are reduced. Learning engagement was evaluated using the UWES-S scale (2003), capturing students' focus and flow experiences during extended practice. In addition, at the end of the course, an expert panel conducted a blind review of the completed embroidery works, providing comprehensive ratings on technique, creativity, and artistic expression to objectively reflect learning outcomes.

Before and after instruction, the research team conducted two rounds of surveys, collecting a total of 120 questionnaires. After data cleaning, 116 valid responses were retained, with 57 from the first round and 59 from the second. Descriptive statistics were performed using SPSS 27.0, and paired-sample t-tests were applied to compare changes in creative self-efficacy and learning engagement between the experimental and control groups, in order to evaluate the significance of the AIGC intervention.Classroom observation served as a qualitative supplement, documenting students' behaviors during pattern conception, color rehearsal, and creative iteration. Observations focused on whether students used AI-generated content appropriately, and whether AI tools enhanced learning efficiency or led to dependency. Instructors also recorded their own instructional adjustments and human–machine collaborative guidance to ensure that teaching was not dominated by technology. All observational data were collected from classroom videos and images, triangulated with the quantitative survey results to provide a comprehensive depiction of the instructional mechanisms in hair embroidery courses driven by AIGC technologies.

This comparative experimental approach allows for a more accurate depiction of the operational mechanisms underlying AIGC-driven hair embroidery education reform, enabling a systematic evaluation of the practical application of AIGC technologies in hair embroidery courses. It provides both scientific evidence and practical guidance for higher education institutions to advance the reform of intangible cultural heritage craft courses in the era of digital intelligence.

4. Discussion and Results

To further understand the instructional effects of AIGC technologies in hair embroidery courses, the study organized and analyzed the collected valid samples and combined them with classroom observation data for behavioral classification and coding. Through the integrated analysis of quantitative and qualitative methods, the learning behavior patterns and cognitive changes of students under AIGC intervention can be identified, providing a foundation for subsequent in-depth discussion of instructional effectiveness and collaborative mechanisms. The analysis not only focuses on students' performance in skill acquisition and creative practice but also examines the transformation of teacher–student interaction patterns in the human–machine collaborative environment, thereby establishing a logical framework for understanding the evolution of hair embroidery education from traditional interactive learning to collaborative learning.

4.1 Analysis of Student Learning Performance After AIGC Intervention

DOI: 10.5281/zenodo.19549291

After one semester of instructional intervention, statistical results from SPSS 27.0 indicated significant differences between the experimental and control groups on key learning variables. Specifically, in the dimension of creative self-efficacy, the post-test mean score of the experimental group was 4.35 (SD = 0.42), significantly higher than that of the control group, which was 3.68 (SD = 0.55; $t = 4.21$, $p < 0.001$). These results suggest that AIGC effectively alleviated students' psychological pressure arising from the low tolerance for errors in hair embroidery creation, enabling them to attempt complex cross-modal compositions with greater confidence. Students received immediate feedback from high-quality AI-generated preview images, which enhanced their confidence in autonomous experimentation and innovative exploration.

Regarding learning engagement, the experimental group achieved a higher overall mean score of 4.21 (SD = 0.39) compared with 3.75 (SD = 0.47; $t = 3.72$, $p = 0.001$) for the control group. Analysis of specific subdimensions revealed that in cognitive engagement, the experimental group averaged 4.28 (SD = 0.36), while the control group scored 3.80 (SD = 0.44; $t = 3.98$, $p < 0.001$); in behavioral persistence, the experimental group scored 4.14 (SD = 0.41) versus 3.71 (SD = 0.50; $t = 3.56$, $p = 0.002$) for the control group. These findings indicate that students in the experimental group experienced cognitive immersion during the iterative refinement and optimization of prompts, which in turn led them to devote greater effort to subsequent physical embroidery practice.

Classroom observations further corroborated the quantitative findings: approximately 86% of students in the experimental group engaged in multiple rounds of AI-assisted iterations during the pattern design phase, experimenting with different stitching techniques and color combinations. In contrast, only about 40% of students in the control group attempted minor innovations while hand-copying traditional design drafts, with the remainder primarily engaged in passive imitation. These observations indicate that AIGC intervention not only enhanced students' creative self-efficacy and learning engagement but also facilitated a shift from one-way interactive learning to human–machine collaborative learning, providing empirical support for the modernization of hair embroidery education.

4.2 Role Reconfiguration in the Human–Machine Collaborative Mechanism

Analysis of classroom videos and observation coding indicated that AIGC-enabled hair embroidery instruction not only altered students' operational processes but also prompted a profound role reconstruction. In the early phase of the course, some students exhibited dependency on AI during the pattern generation stage, often using vague prompts such as "draw a beautiful landscape." As instruction progressed, approximately 70% of students began employing specialized prompt engineering, for example, "traditional flat-stitch technique, ink wash shading style, teal color palette, high contrast," and were able to autonomously iterate and refine their designs. This behavioral shift reflects the gradual evolution of students' cognitive patterns, transitioning from passive reception to active design and strategic thinking.

Meanwhile, the role of the teacher was also redefined. Teachers no longer acted solely as technical demonstrators but became aesthetic curators, with their primary responsibilities focused on guiding students to evaluate the cultural accuracy of AI-generated patterns, preventing misinterpretation or distortion of traditional intangible heritage symbols, and providing technical and aesthetic scaffolding during the virtual-to-physical transition. Classroom observations showed that, on average, teachers offered approximately five intervention suggestions per session on AI-generated patterns, covering color coordination, stitching technique selection, and interpretation of cultural symbols, significantly enhancing the effectiveness of human–machine collaborative learning.

In summary, AIGC-enabled hair embroidery instruction has established a human–machine–human closed-loop model. In this model, students first input their creative intentions into the AIGC system, which generates patterns or design proposals based on the input; teachers then provide aesthetic and cultural accuracy guidance on the generated outputs; finally, students transform the refined designs into tangible hair embroidery works through embodied craftsmanship. This model not only effectively addresses the issues of outdated patterns and constrained innovation in traditional courses but also preserves the value of embodied craftsmanship, providing a practical reference for the innovation of intangible cultural heritage education in the digital era.

5. Conclusion

Through experimental implementation and data collection, this study explored the empowerment pathways of AIGC technology in hair embroidery education. The results indicate that the systematic integration of AIGC not only serves as an efficient visual generation tool to lower creative barriers and reduce trial-and-error costs, but also functions as an innovative pedagogical medium that effectively stimulates students' intrinsic motivation for innovation, promoting a shift in instructional models from traditional passive imitation to human–machine collaboration. Meanwhile, the data-driven evaluation system renders the assessment of traditional craftsmanship more scientific and systematic.

However, this study has certain limitations. The sample size was relatively small, and the experimental period lasted only one semester, so the long-term effects of AIGC intervention still require verification through longitudinal research. Future studies could further explore the ethical boundaries of generative AI in intangible cultural heritage education and investigate the development of domain-specific large models tailored to Chinese traditional crafts, providing sustained momentum for the digitalization and modernization of hair embroidery and other intangible cultural heritage education.

References:

1. Gorsky, M., & Levin, I. (2025). Cognifying education: Mapping AI's transformative role in emotional, creative, and collaborative learning. *arXiv preprint arXiv*:2509.25266.
2. Li, R. (2025). AI-enhanced traditional crafts in art education: A digital approach to revitalizing Chinese tie-dye in high school. *Asia Pacific Economic and Management Review*, 2(5).
3. Pan, X. (2018). The future is here: What kind of journalism and communication talents are needed in the intelligent media era? *China Editor*, (09), 45–50.
4. Schaufeli, W. B., & Bakker, A. (2003). *UWES Utrecht work engagement scale preliminary manual*. Occupational Health Psychology Unit, Utrecht University, 1, 4–58.
5. Seo, K., Yoo, M., Dodson, S., & Jin, S. H. (2025). Augmented teachers: K–12 teachers' needs for artificial intelligence's complementary role in personalized learning. *Journal of Research on Technology in Education*, 57(40), 876–893.
6. Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to

DOI: 10.5281/zenodo.19549291

creative performance. *Academy of Management Journal*, 45(6), 1137–1148.

7. Yi, L., & Ni, S. (2024). Research on the coordinated development of intangible cultural heritage transmission and ideological education in universities. *Educational Theory and Research*, 2(9), 24–26.

DOI: 10.5281/zenodo.19549291