# AI-Enabled Teaching of Cultural and Creative Product Design

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**Abstract: This study aims to explore the integration path and application value of artificial intelligence (AI) technology in the teaching of cultural and creative product design, addressing the limitations of traditional teaching such as insufficient creative divergence, inefficient personalized guidance, and disconnection between theoretical teaching and practical innovation. Adopting a combination of literature research, Delphi method, and action research, the study first systematically combs the theoretical basis of AI technology (including generative design, intelligent evaluation, and data-driven decision-making) and its intersection with design education. It then analyzes the core demands of cultural and creative product design teaching, constructs a multi-dimensional AI-enabled teaching model covering three key links: creative inspiration, design iteration, and comprehensive evaluation. the model is applied to teaching practice to verify its effectiveness through quantitative and qualitative analysis of teaching processes and learning outcomes. the results show that the AI-enabled teaching model can significantly improve the efficiency of creative generation, enhance students' ability to integrate cultural elements with innovative design, and optimize the personalized teaching feedback mechanism. This study enriches the theoretical system of technology-integrated design education and provides practical reference for the reform and innovation of cultural and creative product design teaching in the digital era.**

**Keywords: AI-Enabled; Cultural and Creative Product Design; Teaching Reform; Design Education; Technology Integration**

## 1. Introduction

### 1.1 Research Background and Significance

The global digital transformation has driven the rapid development of the cultural and creative industry, which has become a key engine of economic growth and cultural communication. This industry's demand for design talents is evolving toward compound capabilities that integrate cultural literacy, innovative thinking, and technical proficiency. Meanwhile, the continuous iteration of artificial intelligence technologies—including generative models, big data analytics, and computer vision—has reshaped educational paradigms, offering unprecedented possibilities for reforming design teaching. Traditional cultural and creative product design teaching, however, faces inherent constraints in adapting to these changes. It struggles to meet the personalized learning needs of students, lacks effective mechanisms for stimulating diverse creativity, and often fails to achieve in-depth integration of cultural elements with modern design concepts.

This research holds dual theoretical and practical significance. Theoretically, it explores the intersection of AI technology and design education, enriches the theoretical system of technology-integrated design teaching, and clarifies the intrinsic logic of AI empowerment in cultural and creative product design education. Practically, by constructing and verifying an AI-enabled teaching model, the research addresses core pain points in traditional teaching, improves the quality of talent cultivation, and provides actionable references for educational institutions and relevant industries to promote digital transformation of design teaching. It also contributes to enhancing the competitiveness of the cultural and creative industry by fostering talents capable of bridging cultural heritage and innovative practice.

### 1.2 Review of Domestic and Foreign Research Status

Overseas research on AI in design education has focused on tool application and process optimization. Scholars have developed intelligent design assistance systems to support sketch generation, design iteration, and performance evaluation, and explored personalized learning paths through data-driven approaches. These studies have achieved

 

progress in improving teaching efficiency and expanding creative boundaries but tend to prioritize technical functionality over in-depth integration of cultural elements. Few studies have constructed systematic teaching models that align with the cultural attributes of creative product design, leading to a disconnect between technological application and cultural inheritance.

Domestic research has emphasized the integration of cultural heritage with design teaching and initially introduced AI tools to enhance teaching effects. Relevant studies have explored the application of AI in specific teaching links such as cultural element extraction and design scheme optimization, but most remain fragmented and lack systematic construction of full-process teaching models. Empirical verification of these applications is also insufficient, with few studies providing quantitative and qualitative evidence of their effectiveness in improving students' comprehensive abilities. Current research globally has not yet resolved the synergistic integration of technological empowerment, cultural inheritance, and creative cultivation, nor established a mature teaching logic tailored to the characteristics of cultural and creative product design. This research aims to address these gaps.

### 1.3 Research Content and Technical Route

The core content of this research includes three key aspects: first, systematically analyzing the core pain points of traditional cultural and creative product design teaching through literature review and empirical investigation; second, constructing a multi-dimensional AI-enabled teaching model based on relevant theoretical foundations, incorporating principles such as cultural inheritance, technical adaptability, and student-centeredness; third, verifying the model's effectiveness through teaching practice, using multi-source data to evaluate its impact on students' creative thinking, cultural integration capabilities, and technical application skills.

The technical route adopts a combination of theoretical construction and empirical verification. It begins with a systematic review of literature on AI in education, cultural creative product design teaching, and related theories to lay a solid theoretical foundation. Subsequent steps involve identifying teaching pain points through questionnaire surveys and in-depth interviews with educators and students; constructing the teaching model with clear modules, dimensions, and operational mechanisms based on pain point analysis and theoretical guidance; selecting undergraduate students majoring in design as research subjects to implement the model in actual teaching courses; collecting quantitative data (such as capability assessment scores and learning process metrics) and qualitative data (including interview records and design work analyses) to comprehensively evaluate the model's effectiveness; and finally summarizing research findings, reflecting on limitations, and proposing directions for future optimization.

## 2. Relevant Theoretical Foundations

### 2.1 Application Mechanisms of AI Technology in Education

AI technology's application in education relies on core technologies such as machine learning, natural language processing, computer vision, and generative adversarial networks, forming a data-driven teaching optimization framework. Machine learning algorithms mine and analyze multi-source data generated during teaching—including student learning behaviors, design works, and feedback—to identify individual learning characteristics, knowledge gaps, and ability development trajectories. This enables the customization of teaching content and guidance strategies to match diverse student needs.

Natural language processing technology parses and structures unstructured resources such as cultural texts, design theories, and historical documents, extracting core concepts, cultural symbols, and logical relationships. It presents these in visual and accessible forms, helping students quickly grasp the connotation of cultural elements and theoretical knowledge. Computer vision technology analyzes design works in real time, evaluating elements such as composition logic, color matching, and cultural symbol application against industry standards and excellent cases to provide objective feedback. Generative AI technology generates diverse design sketches, creative schemes, and element combinations based on user inputs such as keywords and style preferences, expanding students' creative horizons and stimulating innovative thinking. Together, these technologies form a "technology assistance—

 

creative generation—feedback optimization" cycle that drives continuous improvement of teaching effectiveness.

### 2.2 Core Elements and Objectives of Cultural and Creative Product Design Teaching

Cultural and creative product design teaching revolves around four core elements: cultural cognition, creative thinking, technical application, and practical transformation. Cultural cognition refers to the understanding and mastery of traditional cultural symbols, value connotations, and regional cultural characteristics, serving as the foundation for the cultural depth of design works. Creative thinking emphasizes breaking through conventional mindsets to realize innovative integration of cultural elements with modern design languages and market demands. Technical application encompasses proficiency in design software, AI tools, and production processes, providing technical support for translating creative concepts into tangible products. Practical transformation focuses on the market adaptability and industrial application value of design works, reflecting the practical nature of design.

The overarching objective of teaching is to cultivate compound design talents who possess solid theoretical knowledge and professional skills, while demonstrating strong cultural inheritance awareness, innovative practice capabilities, and market insight. These talents should be able to interpret cultural connotations accurately, generate innovative design schemes, apply advanced technologies proficiently, and adapt to the industry's evolving demands for cultural, innovative, and practical design works. In response to industry trends such as cultural IP development, sustainable design, and intelligent product innovation, teaching objectives also emphasize cultivating students' ability to integrate emerging technologies and market trends into cultural creative design, enabling them to contribute to the high-quality development of the cultural and creative industry.

## 3. Construction of AI-Enabled Teaching Model for Cultural and Creative Product Design

### 3.1 Pain Point Analysis of Traditional Cultural and Creative Product Design Teaching

Traditional cultural and creative product design teaching exhibits several deep-seated pain points that hinder teaching quality and talent cultivation. Creative stimulation methods are simplistic, relying heavily on teachers' experience sharing and case studies, which limits students' exposure to diverse creative perspectives and leads to homogenized creative output. the integration of cultural elements remains superficial; students often apply cultural symbols superficially without understanding their inherent connotations, resulting in design works lacking cultural resonance and uniqueness.

Personalized guidance is insufficient. Under the traditional classroom teaching model, teachers struggle to fully grasp each student's learning characteristics, ability levels, and development needs, making it difficult to provide targeted guidance and feedback. This neglects individual differences and inhibits students' personalized development. the evaluation system is rigid, focusing primarily on the final design works while ignoring the creative process—including idea generation, problem-solving, and iterative improvement. This one-sided evaluation fails to comprehensively reflect students' comprehensive abilities such as creative thinking and cultural integration.

To quantify these pain points' impact, a survey was conducted among educational institutions offering cultural and creative product design programs. The survey data indicates that homogenization of creative output and superficial integration of cultural elements are the most prominent issues, characterized by high occurrence frequency and impact severity, requiring priority resolution. Insufficient personalized guidance also exerts a significant negative impact on teaching effectiveness, while the rigid evaluation system—though less urgent—still undermines comprehensive assessment of students' abilities.

### 3.2 Principles and Core Dimensions of Teaching Model Construction

The construction of the AI-enabled cultural and creative product design teaching model adheres to four core principles. the principle of balancing cultural inheritance and innovation emphasizes that the model should simultaneously promote the inheritance of traditional cultural connotations and the cultivation of innovative thinking, facilitating the creative transformation and development of cultural genes. the principle

 

of technical adaptability requires that selected AI technologies align with the disciplinary characteristics of design teaching, specific teaching links, and students' cognitive levels, avoiding disjointed application of technology and teaching needs.

The principle of student-centeredness highlights students' core position in the teaching process. It leverages AI technology to provide students with autonomous learning spaces and active exploration opportunities, stimulating their learning enthusiasm and initiative. the principle of closed-loop optimization mandates that the model incorporate a cyclic mechanism of data collection, analysis, feedback, and adjustment, enabling continuous optimization of model functions and operational processes based on teaching practice results.

The model's core dimensions are constructed around the entire teaching process, including creative stimulation, cultural integration, technical practice, personalized guidance, and multi-dimensional evaluation. the creative stimulation dimension uses AI technology to expand creative sources and break thinking limitations. the cultural integration dimension relies on intelligent parsing technology to deepen students' understanding of cultural elements and promote in-depth integration of cultural connotations with design concepts. the technical practice dimension focuses on enhancing students' proficiency in AI design tools, strengthening technical support for creative implementation. the personalized guidance dimension provides precise teaching guidance and feedback through data-driven demand identification. the multi-dimensional evaluation dimension establishes a comprehensive evaluation system covering process and outcome, quantitative and qualitative indicators, to fully reflect students' comprehensive abilities.

### 3.3 Key Modules and Operational Mechanisms of the Model

The AI-enabled cultural and creative product design teaching model comprises four interconnected key modules, which operate synergistically to form a complete teaching empowerment system. the AI-driven creative stimulation module integrates generative AI tools and a massive design resource library. By inputting keywords, style preferences, and cultural themes, it rapidly generates diverse design sketches, creative schemes, and element combinations, providing students with creative references and inspiration. This module expands the breadth of creative sources and encourages students to explore unconventional design directions.

The intelligent cultural element parsing module utilizes natural language processing and knowledge graph technology to structure resources such as traditional cultural documents, symbol systems, and craft techniques. It extracts core cultural elements and their connotations, presenting the historical evolution, application scenarios, and design adaptability of cultural elements through visualizations such as knowledge maps and case analyses. This helps students deeply understand cultural cores and master effective methods for integrating cultural elements into design.

The real-time design process feedback module employs computer vision and machine learning technology to dynamically monitor students' design processes. It analyzes key indicators of design sketches—including element application, composition logic, and color matching—compares them with industry standards and excellent cases, and generates targeted optimization suggestions in real time. This assists students in adjusting their design directions promptly and improving the quality of design iterations.

The multi-dimensional intelligent evaluation module integrates quantitative and qualitative evaluation methods. It analyzes quantitative indicators of design works such as cultural relevance, innovation, technical proficiency, and practicality, and combines teacher evaluations, peer reviews, and AI intelligent scoring to generate comprehensive evaluation reports. These reports clarify students' strengths and weaknesses, providing clear guidance for further improvement.

The model's operational mechanism centers on data flow. Data generated during students' learning—including creative schemes, design drafts, interaction records, and feedback—are collected in real time and transmitted to a data processing center. AI algorithms analyze this data to identify students' learning characteristics, demand differences, and ability shortcomings, driving each module to accurately output creative resources, cultural parsing results, real-time feedback, and evaluation reports. Students adjust their learning and design behaviors based

 

on this feedback, forming a closed-loop operational logic of "data collection—analysis processing—precision empowerment—behavior adjustment. " This logic realizes dynamic optimization of the teaching process and continuous improvement of students' abilities.

## 4. Effectiveness Verification of the Teaching Model

### 4.1 Verification Objects and Implementation Process

The verification objects were undergraduate students majoring in design, covering different learning stages to ensure sample representativeness and diversity. the implementation process consisted of four core phases. the pre-test phase used tools such as a creative thinking ability scale, cultural element integration test, and design work evaluation form to comprehensively assess students' initial ability levels, establishing baseline data for subsequent comparison.

The model introduction phase included specialized training for both students and teachers, covering the core functions, operational processes, and application methods of the AI-enabled teaching model. It also clarified teaching objectives, evaluation criteria, and collaboration mechanisms between teachers and AI tools, ensuring all participants were proficient in using the model.

The teaching implementation phase applied the model to a complete cultural and creative product design course, covering the entire process from creative conception and cultural element integration to design iteration and final work improvement. Students completed design tasks from idea to final product with support from the model, while teachers used the model to monitor learning progress, provide targeted guidance, and adjust teaching strategies in real time.

The data collection phase adopted a multi-source data collection method. Quantitative data included pre-test and post-test scores of ability scales, design work evaluation scores, learning duration, and frequency of model use. Qualitative data included student interview records, teacher teaching reflections, design work analysis reports, and focus group discussion minutes. This multi-source data collection ensured the comprehensiveness and reliability of verification data.

### 4.2 Analysis and Discussion of Verification Results

Quantitative analysis results showed significant improvements in students' abilities after the implementation of the teaching model. the average scores of the creative thinking ability scale, cultural element integration test, technical application ability assessment, and comprehensive design quality evaluation all increased substantially compared with pre-test scores. The data reveals that the AI-enabled teaching model achieved remarkable results in improving students' comprehensive abilities. the highest improvement rate was observed in cultural element integration ability, confirming the model's effectiveness in addressing the superficial cultural integration problem in traditional teaching. Significant improvements in creative thinking ability and comprehensive design quality also indicate that the model effectively stimulates students' innovative potential and enhances the overall quality of design works. Technical application ability improved steadily, reflecting the model's role in enhancing students' proficiency in AI tools and design technologies.

Qualitative analysis of student interviews and design works showed that students expressed high satisfaction with the personalized guidance and real-time feedback provided by the model. They reported increased confidence in exploring cultural elements independently and integrating them into design, with their works demonstrating deeper cultural connotations and more diverse creative expressions. Teachers noted that the model optimized the teaching process, reduced the workload of repetitive guidance, and allowed them to focus more on in-depth academic guidance and creative inspiration.

Discussion of the results indicates that the model's effectiveness stems from its accurate identification of teaching pain points and rational application of AI technology, which realizes the organic integration of technological empowerment and teaching needs. the closed-loop operational mechanism ensures timely adjustment and optimization of the teaching process, while the multi-dimensional evaluation system provides comprehensive feedback for students' ability development. Potential influencing factors include students' technical acceptance and adaptability, as well as teachers' ability to integrate the model into teaching

 

design. These factors should be considered in subsequent promotion and application, with targeted training and guidance provided to improve overall adaptability.

## 5. Conclusion

This research focuses on AI-enabled teaching of cultural and creative product design, achieving valuable theoretical and practical results through systematic analysis of teaching pain points, model construction, and empirical verification. the research identifies core pain points in traditional teaching—including homogenized creativity, superficial cultural integration, insufficient personalized guidance, and rigid evaluation systems—and constructs an AI-enabled teaching model with four key modules and five core dimensions based on relevant theoretical foundations. the model's closed-loop operational mechanism, centered on data flow, realizes precise empowerment throughout the teaching process.

Empirical verification confirms that the model effectively improves students' creative thinking ability, cultural element integration ability, technical application ability, and comprehensive design quality, providing an effective solution to traditional teaching challenges. the theoretical contribution of this research lies in enriching the theoretical system of design education integrated with AI technology, clarifying the core logic and implementation path of AI empowerment in cultural and creative product design teaching, and expanding the application scenarios of technology-integrated education theory.

The practical value is reflected in the model's strong operability and promotion potential, which provides a specific practical paradigm for the reform of cultural and creative product design teaching. It helps educational institutions improve the quality of talent cultivation, meet the development needs of the cultural and creative industry, and enhance the industry's core competitiveness. This research has certain limitations: the sample coverage and implementation cycle can be further expanded, and the model's adaptability in different teaching scenarios requires continuous optimization. Future research will deepen the in-depth integration of AI technology with design teaching, explore interdisciplinary integrated teaching models, and strengthen the model's intelligence and personalization to provide more comprehensive support for the digital transformation of design education.

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