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Construction and Empirical Research on the Innovative Teaching Model of "Culture + Digital Intelligence" for Design Disciplines Against the Backdrop of Urban Digital-Intelligent Development

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ABSTRACT
Urban digital-intelligent transformation reshapes design education. This study constructs an innovative teaching model of "Culture + Digital Intelligence", a four-stage dynamic practice model: "context–collaboration–construction–innovation", which is centered on cultural inheritance and takes technological innovation and social needs as the path and focus. It integrates cultural resources, digital intelligence and design education, promotes the upgrading of undergraduate design teaching, fosters the development of students' interdisciplinary creative abilities, and enhances their recognition of Chinese traditional culture.

KEYWORDS
Urban digital intelligence; Culture + Digital Intelligence; Design disciplines; Teaching model; Empirical research

1 Introduction

With the acceleration of urban digital intelligence transformation, the Ministry of Education issued the "Action Plan for Artificial Intelligence Innovation in Higher Education Institutions" in 2018, which stated: "Accelerate the innovative application of artificial intelligence in the field of education, use intelligent technology to support the innovation of talent training models and the reform of teaching methods." The powerful knowledge fitting ability of generative artificial intelligence provides new possibilities for solving interdisciplinary educational design problems (Cao & Zhang, 2024). Zhou & Liu (2025) further pointed out that artificial intelligence technology needs to be integrated into the design discipline. The excellent traditional culture of China carries rich spiritual values and teaching resources, and local universities shoulder the responsibility of inheriting national culture, enhancing cultural literacy, and strengthening cultural confidence (Yuan & Liang, 2025). Shen & Xu (2025) indicated that artificial intelligence and other digital technologies have become key driving forces for promoting excellent traditional culture towards the digital age. However, current research mostly stays at the level of "technology application" or "curriculum practice", and there is insufficient analysis of the intrinsic relationship between "cultural resources, digital intelligence technology, and teaching practice". Based on this, the project team carried out teaching reform and empirical research using the undergraduate course of "Cross Media Image Design" in our school's Digital Media Art major as a practical carrier. This study suggests that in the context of urban digital intelligence, undergraduate teaching in Design should integrate cultural resources, digital intelligence technology, and design teaching to construct an innovative teaching model of "Culture + Digital Intelligence", in order to better cultivate outstanding talents with interdisciplinary thinking of "integration of arts and sciences".

2 Constructivist Theory: The Epistemological Foundation

Constructivism, as a core theory of learning, is widely attributed to Swiss psychologist Jean Piaget (Ye, 2025). Its core concepts of "active construction" and "situational interaction" provide the underlying logic for this study: the essence of design research lies in the "digital translation of cultural meaning", which requires learners to integrate cultural experience with digital technology within specific contexts. This is highly consistent with the cognitive logic of constructivism, which holds that "knowledge originates from interaction and learning is based on experience".

In terms of knowledge perspective, constructivism breaks the traditional cognition of "absolute objectivity of knowledge" and proposes that knowledge is a dynamic explanation generated by the interaction between individuals and the environment. Different learners, due to their cultural experiences (such as emotional memory of local intangible cultural heritage) and technological backgrounds (such as differences in digital modeling abilities), will form personalized understandings of the "digital expression of cultural symbols" (such as the virtual presentation of Beijing Opera cultural symbols); And this knowledge is not a fixed "truth", it will continue to be revised with the evolution of "urban digitization scenarios (such as from offline creation to metaverse exhibition)" and "cultural cognition deepening (such as from intangible cultural heritage forms to spiritual core excavation)" - this is precisely the knowledge attribute of "Culture + Digital Intelligence" design studies: culture needs dynamic interpretation, technology needs situational application, both of which are not static "ready-made knowledge" instilled.

At the level of learning perspective, constructivism defines learning as a contextualized and socially active generative process: learners do not enter the classroom with an empty mind, but with their own cultural memories (such as childhood temple fair experiences) and technological experiences (such as digital and intelligent software operation); They need to establish a connection between "cultural connotations" and "digital technology" through "dialogue and communication (such as cross disciplinary group discussions on" how to use interactive design to convey ancient city culture ")" and "practical exploration (such as participating in the design of digital cultural walls in smart communities).

In terms of teaching philosophy, constructivism proposes three major transformation directions for design teaching: firstly, the role of teachers shifts from "knowledge transmitters" to "learning scaffolding builders" - the core task is not to instill "cultural theory" or "software operation", but to create real digital cultural design tasks (such as cultural exhibition design in virtual museums), providing students with reference cases for cultural interpretation and tool guidance for technological implementation; Secondly, curriculum design should avoid separating teaching and integrate cultural knowledge and digital technology based on real issues such as the market landing of digital cultural; Thirdly, the evaluation approach has shifted from "result oriented" to "process oriented" - not only focusing on the final digital design work, but also tracking the evolution of cultural understanding, exploration of technological applications, and the collision of team collaboration.

3 Pre-Course Survey: Practical Constraints and Needs Orientation

In the fall of 2024, the project research team adopted *Intermedia Image Design*, a course delivered by Lecturer Bo Pang, as its practical course, and collaborate with teachers and students to deeply participate. Firstly, six inheritors of intangible cultural heritage, including the inheritor of Beijing engraved porcelain Chen Hailing, inheritor of Beijing colored sculpture Zhang Zhongqiang, the inheritor of Liu style Peking Opera facial makeup Hu Guomin, the inheritor of dough sculpture Yao Huimin, etc, as well as eight personnel from cultural heritage management departments, were invited for in-depth interviews. Then, a questionnaire was used to cover the design teachers and students of our school, including 10 professional teachers (2 professors, 4 associate professors, and 4 senior lecturers) and 74 students. These three key groups were surveyed to collect common knowledge around the two themes of "digital adaptability of cultural resources" and "pain points in the integration of design education and cultural inheritance"; Connect the information gap between "group commonality" and "individual vivid experience", and dig deep into the underlying logic of demand.

According to a third-party survey, the protection of cultural resources in the capital has achieved significant results in the fields of intangible cultural heritage and cultural relics, but it faces challenges such as insufficient development of niche resources, crisis in skill inheritance, and shortcomings in cultural and creative innovation. The expert team suggests building a national cultural linkage network, promoting interdisciplinary collaboration and digital resource sharing, enhancing dissemination through virtual exhibition halls and live inheritance, while being vigilant about the dilution of cultural core by digitization. The teaching team suggests that universities should add cutting-edge courses such as AI/VR, strengthen the OBE model, create school enterprise practice bases, and use big data and XR technology to optimize interactive experiences. The vast majority of student groups expect to strengthen their practical transformation ability, reduce the constraints of curriculum theory, integrate localized cases and interdisciplinary projects, and enhance innovation dimensions through cultural heritage site research, AI technology application, and international exchanges. The tripartite consensus points to deep collaboration between industry, academia, and research, emphasizing the development path of intangible cultural heritage inheritors participating in teaching, digital technology adapting to cultural temperature, hardware upgrading, and teacher training.

4 Course Teaching Process: The Digital-Intelligent Transformation of Intangible Cultural Heritage

4.1 Field Immersion: Resolving the Vagueness of Cultural Cognition through Real Scenarios

The course organized students to conduct on-site research at the store of Zhang Zhongqiang, the fifth generation inheritor of Beijing Rabbit God, allowing students to leave the classroom and delve into the real environment where design problems actually occur. As the leaders of the research, students interact with classmates, teacher, expert, and the environment based on their previous knowledge and experience during their visit to the mud painted sculpture of the Rabbit God, further deepening their understanding of the intangible cultural heritage of the Rabbit God in Beijing.

4.2 Cultural Decoding: Addressing the Fragmentation of Cultural Understanding from the Inheritor's Perspective

To help students grasp cultural essence, the project team invited the Intangible Cultural Heritage inheritor Zhang

Zhongqiang, to give a lecture on "Telling the Culture and History of the Old Beijing Rabbit God" at the school. He shared its historical evolution, shape and pattern essence, and answered students' questions on traditional culture revitalization. A 15-minute coloring co-creation session followed, deepening students' cultural understanding.

4.3 Digital and Intelligent Transformation: Empowering Cultural Inheritance for a Younger Generation through Technology

To bridge digital-intelligent technologies and culture, the course adopted the way of "group collaboration + digital and intelligent tools". Students translated the Rabbit God's core cultural genes into digital works created based on artificial intelligence technology, turning technology into cultural translators instead of decorative tools, and connecting traditional culture with youth scenarios.

4.4 Effect Feedback: Verifying Model Effectiveness through Qualitative valuation

The course evaluated its effectiveness through qualitative methods including in-depth interviews and focus groups. Students stated that field research clarified vague cognition, the lecture eased concerns over traditional culture being outdated, and digital creation let them integrate technology and culture through translation, not override.

5 Post-Course Survey: Empirical Validation of Intangible Cultural Heritage Meaning Construction

The course's effectiveness was evaluated using the Delphi method and post-course survey data from 69 design students. Results indicate that integrating capital cultural resources into design education through this course significantly improved students' comprehensive competencies and facilitated cultural transmission.

5.1 Focus on Pre-Course Issues

This course focusing on the core issues before class: low familiarity of students with the cultural resources of the capital (average score of only 6.12/10), as shown in Table 1, vague understanding of inheritance responsibilities (44.6% of students have unclear understanding), and shallow understanding of cultural digital transformation (less than 38%). From the perspective of constructivist theory, this state stems from students' "initial fragmented experience" - their understanding of the capital culture mostly comes from scattered information, without forming a systematic cognitive framework, and inheritance and digitization remain at the conceptual level.

5.2 Systemic Post-Course Improvement

After the course intervention, the core issues were systematically improved: the familiarity with cultural resources in the capital increased to 7.96 points, as shown in Table 2, the recognition rate of intangible cultural resources jumped from less than 38% to 72%, and the recognition rate of digital transformation increased by 20 percentage points; More importantly, there has been a qualitative change in the awareness of inheritance -79.7% of students have formed an active communication awareness, 68.1% have a cultural innovation awareness, and 25% are able to integrate cultural characteristics into their personal design styles. This change confirms the logic of constructivist "cognitive reconstruction": field visits allow students to touch the historical context at cultural sites, and intangible cultural heritage lectures transmit the core through the experience of inheritors. The two transform abstract "capital culture" into tangible and designable objects, promoting students to shift from "passive memorization" to "active integration", and reconstructing fragmented experiences into a framework of "cultural resources design practice".

5.3 Data Verification of Course Effectiveness

5.3.1 Situational Value of Practical Components

Field research and ICH lectures were rated the most effective course components, meeting the demand for authentic practice from 78.4% of students. This aligns with constructivist context-based learning, as cultural sites and inheritor insights bridged the gap between knowledge and practice.

5.3.2 The Role of Digital-Intelligent Technology as a "Cognitive Tool"

Pre-course, 82.4% and 78.4% of students were interested in AI-aided creation and VR/AR respectively. Post-course, their

improved tool proficiency and design expressiveness showed technology's "cognitive enabling" role: AI efficiently translates cultural elements into design prototypes, with technology evolving from a simple tool to a "translator" for cultural understanding and design expression.

5.3.3 Systemic Nature of the Course Structure

The course achieved high satisfaction, with an 8.28/10 score for "culture and design" integration and 8.49/10 for overall teaching. Its success came from three synergistic approaches: creating authentic problem scenarios, promoting social collaboration via group cultural research, and using digital-intelligent technologies as cognitive tools, guiding students to actively reconstruct knowledge connections.

5.4 Course Optimization Suggestions

Students suggested improvements in three areas: technically, introducing more VR/AR and cultural relic digitalization technologies, and balancing cultural essence with innovation to avoid overemphasizing technology; pedagogically, strengthening practical activities to turn design concepts into tangible products; and for deeper practice, hoping for more field research and real project participation, demanding more situated learning and cultural immersion.

Table 1 Familiarity with the Capital's Cultural Resources Prior to the Course

Problem	Options	Number of People	Percentage	Average Score
Before taking this course, how familiar were you with the capital's cultural resources? (0 indicates completely unfamiliar, 10 indicates fully familiar; please select the corresponding numerical value)	1	0	0.00%	6.12
	2	4	5.41%	
	3	1	1.35%	
	4	9	12.16%	
	5	11	14.86%	
	6	17	22.97%	
	7	16	21.62%	
	8	9	12.16%	
	9	5	6.76%	
	10	2	2.70%	

Table 2 Familiarity with the Capital's Cultural Resources After the Course

Problem	Options	Number of People	Percentage	Average Score
After taking this course, how familiar are you with the capital's cultural resources?(0 indicates completely unfamiliar, 10 indicates fully familiar; please select the corresponding numerical value)	1	0	0.00%	7.96
	2	0	0.00%	
	3	0	0.00%	
	4	1	1.45%	
	5	6	8.70%	
	6	2	2.90%	
	7	13	18.84%	
	8	21	30.43%	
	9	16	23.19%	
	10	10	14.49%	

6 Construction of the Innovative Teaching Model of "Culture + Digital Intelligence" for Design Disciplines

The construction of the "Culture + Digital Intelligence" design teaching model centers on learners' principles of active knowledge construction, contextualized practice and social interaction. It integrates cultural resources, digital intelligence technology tools and urban digital-intelligence scenarios to form a four-stage dynamic practice model: "context – collaboration–construction–innovation".

6.1 Cultural Context Creation: Building an Authentic Digital Intelligence Learning Environment

Constructivism holds that learning occurs in authentic contexts. Design education should use real cultural and digital scenarios and intelligent technologies to build an immersive "Culture + Digital Intelligence" environment, enabling students to gain first-hand cultural experience and lay a contextual foundation for knowledge construction.

6.2 Collaborative Knowledge Construction: Interdisciplinary Teams and Digital Interaction

Constructivism holds learning is meaning negotiation through social interaction. "Culture + digital intelligence" design education should break classroom boundaries to build a multidisciplinary network of students, teachers, inheritors, experts and engineers. Guided by teachers, students do project-based learning on real problems and

collaborate with all parties. Digital platforms can enable cross-time and space communication, helping them collectively build a culture-technology integrated knowledge system.

6.3 Empowerment Through Digital Intelligence Tools: Supporting Personalized Knowledge Construction

Constructivism emphasizes the active construction of learners. Students can use digital intelligence technology as a personalized creative tool. Intelligent systems can enable structured cultural information visualization, and AI design platforms reduce technical barriers for cultural innovation. In the task of Beijing Rabbit God, students used AI to deconstruct its features and integrate Gen Z aesthetics, realizing innovative translation of traditional symbols, as shown in Figure 1.



Figure 1 The Rebirth of Beijing Rabbit God: Modern Cross-Boundary Dissemination of Traditional Culture. Designers: Qu Siwei, Tang Leyi.

6.4 Innovation Output and Cultural Value Validation

Constructivism holds learning aims at knowledge application and internalization. "Culture + digital intelligence" design education focuses on practical projects, cultural value verification and cognitive internalization. A 3D evaluation framework with multi-stakeholder participation, process tracking and outcome verification should be established, combining digital quantitative assessment and inheritor-expert qualitative feedback. Teaching guides students to internalize knowledge into awareness and responsibility; outcomes can be exhibited and spread to enhance social value.

7 Conclusion and Prospects

The "Culture + Digital Intelligence" teaching model includes four aspects, namely the creation of cultural context for building a real digital intelligent learning environment, collaborative knowledge construction of interdisciplinary teams and digital interactions, empowerment of digital intelligent tools to support personalized knowledge construction, innovation output and cultural value verification. It integrates cultural interpretation and digital intelligence tools to fix the fragmentation of traditional design teaching and cultivate students capable of activating cultural symbols and transforming cultural value. It promotes the revitalization of cultural resources by turning it into digital works by AI and other digital tools to enhance engagement and influence. There are still some shortcomings in the attendance rate of the lecture on Beijing Rabbit God, interdisciplinary collaboration and other aspects of this curriculum reform practice, which need further research and improvement. in the current era of artificial intelligence, this study provides a practical research perspective and reference method for undergraduate design education.

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