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Research on the Reshaping of Professional Competencies and Teaching Reform for Application-Oriented Undergraduates under the "AI Collaboration" Paradigm: A Case Study of the Environmental Design Program

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Abstract:
Application-oriented undergraduate programs are currently caught in the dilemma between the paradigm shift in the industry triggered by artificial intelligence technology and the lag in talent cultivation. Taking the Environmental Design program as an example, this paper proposes the "AI Collaboration" paradigm to lead professional teaching reform. It constructs a professional competency model encompassing the dimensions of thinking, skills, and literacy, and systematically discusses a four-in-one pathway for teaching reform: restructuring the curriculum system, updating teaching models, transforming evaluation mechanisms, and developing the faculty team. Validated through the "Lifestyle and Residential Interior Design" course, this model enhances students' design innovation capabilities, technical application skills, and critical thinking levels. It provides theoretical support and practical examples for design education to address the challenges of the intelligent era, offering significant reference for promoting the transformation of talent cultivation models.

Keywords:
AI Collaboration; Application-Oriented Undergraduate; Reshaping of Professional Competencies; Teaching Reform; Environmental Design

Introduction

Currently, generative artificial intelligence technology is reshaping the innovation ecosystem and working methods of the environmental design industry. From the creative breakthroughs of Midjourney and Stable Diffusion in the concept generation phase to the intelligent assistance of the SUAPP Inspiration series in scheme development, artificial intelligence has evolved from a simple tool to a creative partner in the design process. This transformation has given rise to a new "AI Collaboration" paradigm characterized by human-computer interaction and iterative cycles, imposing new requirements on the competency structure of designers. However, environmental design education, as an application-oriented undergraduate program, reveals a clear adaptability dilemma: the curriculum system remains entrenched in the outdated framework

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of computer-aided design, and the teaching content is severely disconnected from the new skill demands centered on prompt engineering, AI tool orchestration, and generation result optimization in industry practice. This contradiction is confirmed in reality – some universities are still reinforcing traditional software teaching, reflecting a widespread phenomenon where educational updates lag behind technological development.

Faced with this challenge, promoting in-depth teaching reform centered on the "AI Collaboration" paradigm is imperative. This paper aims to construct a theoretical framework for "AI Collaboration" education, facilitating an educational transformation from tool application to cognitive evolution. The research will first analyze the design paradigm shift driven by AI and its educational implications, then clarify the connotation and characteristics of "AI Collaboration" and construct a corresponding professional competency model. Subsequently, it will propose a systematic teaching reform plan from four dimensions: curriculum system, teaching model, evaluation mechanism, and faculty team. Finally, it will conduct empirical testing through the teaching practice of the "Lifestyle and Residential Interior Design" course, aiming to provide complete theoretical support and practical pathways for the innovative development of application-oriented undergraduate design education in China.

1 Impact and Response: The Inevitability of Paradigm Shift in Environmental Design Education Driven by AI Technology

The explosive development of artificial intelligence technology has transcended its tool attributes to become a dominant force driving a paradigm shift in the environmental design industry. The traditional model of computer-aided design can no longer resolve the contradiction between the evolving professional competency structure required by the innovation demands of the new "collaboration" paradigm and the existing talent cultivation system. Exploring the reasons, manifestations, and underlying logic of this transformation is a fundamental prerequisite for constructing a future-oriented education system.

1.1 The Design Empowerment of AI Technology Clusters: Paradigm Ascension from Assistance to Collaboration

Generative artificial intelligence technology has completely surpassed the scope of traditional computer-aided design tools, establishing a new "collaborative" design paradigm characterized by human-computer interaction and co-evolution. The core of traditional CAD tools is execution, following a linear workflow: the designer forms a complete concept and then uses the software as an efficient and precise electronic drafting board for execution and expression. The core of AI tools, however, is generation and stimulation, operating in an iterative cycle. The designer inputs initial intentions, stylistic preferences, or constraints to the AI via natural language, and the AI feeds back a multitude of unpredictable design options. Based on these options, the designer engages in aesthetic and professional critique, selection, fusion, and re-optimization, forming new, more precise instructions to feed back to the AI. This process repeats, eventually converging towards an optimal solution. This means AI technology is no longer a tool passively awaiting instructions but has become a creative partner capable of providing inspiration, expanding creative boundaries, and even challenging the designer's inherent thinking (Huang, Xu, Zhao, Liu, & Wu, 2025).

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The essence of this collaborative paradigm is the fundamental reconstruction of the relationship between the design subject and the intelligent medium. In the traditional model, the designer is the sole source of creativity and the absolute controlling subject, with software as the object. In the human-computer collaborative model, the design subject becomes a composite system composed of the human designer and artificial intelligence; control is shared, and creativity emerges from interaction. The designer's role partially shifts from creator to curator, editor, and guide (Zhu & Xie, 2025). Their core responsibility is no longer to draw every line manually but to elevate to a higher dimension: defining the design problem, setting aesthetic and functional boundaries, curating the AI's generation direction, and making the final decisions with the greatest humanistic value and engineering feasibility. Consequently, the core competitiveness of design shifts from manual drawing and modeling skills to cognitive abilities like aesthetics and critique, as well as the capacity to efficiently dialogue and co-innovate with AI systems.

The paradigm ascension brings not only changes in workflow but also an exponential increase in design innovation efficiency. AI tools can instantly generate numerous schemes, greatly expanding the scope of design exploration, enabling designers to overcome the limitations of experience and imagination to find previously unattainable innovative areas. In the early stages of a project, designers can use generative tools to explore various styles comprehensively, from traditional designs to future eco-communities, in a very short time. During the scheme development phase, they can utilize intelligent rendering tools to conduct multi-scheme visual comparisons of the same space under various materials, lighting, and times of day, thus making more scientific, data-driven decisions. This capability transforms the design process from a closed deduction based on limited experience to an open process of data generation, scheme comparison, and improvement, greatly enhancing the novelty and completeness of design outcomes.

1.2 Changes in the Industry's Occupational Map: The Growth and Decline of Old and New Skills and the Reconstruction of Competency Structure

The widespread application of AI is causing a structural shift in the demand for professional competencies in the spatial design industry, characterized by the depreciation of traditional skills and the increasing importance of new ones. Foundational hard skills, such as basic modeling and rendering techniques, once considered core competencies, are gradually being replaced by intelligent tools. Market demand for designers is no longer limited to operators who can quickly complete standardized drawings; it now requires compound talents capable of wielding intelligent tools, demonstrating innovative thinking, and exercising aesthetic judgment. This significant change in the professional competency system forces designers to redefine their value proposition, transitioning from technical executors to design strategists and innovation guides.

The emerging skill matrix is reshaping talent evaluation metrics in the spatial design industry. Prompt engineering, intelligent tool orchestration, and multimodal expression are becoming new professional thresholds (Zhao, Jing, Song, et al., 2025). Designers need the ability to guide AI in generating ideal schemes through precise language description—i.e., the capacity to translate abstract design concepts into machine-recognizable instructions—while also facing numerous technological tools for text-to-image, video, and real-time rendering. Designers must possess the overall ability to orchestrate intelligent tools, selecting the most appropriate technical path according to project requirements. Moreover, when AI outputs numerous schemes, the designer's capabilities in aesthetic judgment, cultural understanding, and creative decision-making become

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even more precious—representing an insurmountable gap between outstanding designers and ordinary operators.

The transformation of skill sets inevitably leads to a systemic restructuring of professional competency structures, thereby forming a new capability framework centered on AI collaboration capabilities. This new competency structure is characterized by multiple levels: the foundational level comprises technical operational abilities, including basic proficiency in intelligent tools; the middle level encompasses methodological capabilities, such as prompt engineering, multi-scheme optimization, and data-driven design; the top level involves strategic thinking, including design planning, innovation management, and interdisciplinary collaboration (Yang, Zhang, & Guo, 2025). This competency restructuring not only impacts individual career development trajectories but also exerts significant influence on corporate organizational structures and talent strategies, driving the entire industry towards a more intelligent and innovative direction.

1.3 The Dilemma of Traditional Teaching Models: Realistic Challenges Facing Application-Oriented Undergraduate Design Education

Currently, there is a severe disconnect between the curriculum system of spatial design programs and the industry demands of the AI era, with teaching content failing to keep pace with technological development. Many institutions' Environmental Design programs still focus teaching efforts on traditional software operation skills, lacking systematic course arrangements for emerging AI tools and application methods. This lag results in a significant gap between the skills students possess upon graduation and market demands, forcing employers to often invest considerable effort in retraining new employees. More importantly, the curriculum lacks discussions on cutting-edge issues like AI ethics and algorithmic bias, making it difficult for students to form a critical mindset towards technology application.

Traditional teaching methods can no longer meet the learning needs of the AI era; unidirectional knowledge inculcation fails to cultivate the innovative thinking and collaborative competencies students require. The teacher-demonstration, student-imitation model, emphasizing technical operational proficiency over creative problem-solving abilities, fosters tool dependence in students without teaching them how to use tools creatively. With AI-assisted design now an industry standard, teaching methods centered on software operation clearly cannot cultivate students' advanced abilities to communicate and collaborate with intelligent systems, often leading to a severe lack of innovative capacity when students face open-ended design problems.

The lagging evaluation system causes a serious disconnect between theoretical teaching and design practice, with assessment formats failing to accurately measure students' comprehensive design capabilities in an AI environment. Most institutions still rely primarily on visual indicators such as render quality and model completeness as evaluation criteria, neglecting considerations of students' design thinking processes, human-computer collaboration abilities, and application of innovative problem-solving methods (Shi, 2025). This outcome-oriented evaluation tendency leads students to focus more on software proficiency and the aesthetic appeal of drawings, rather than the novelty and rationality of design concepts. Furthermore, the teachers' own AI literacy constrains teaching reform; many instructors lack the experience and ability to integrate AI tools into their teaching.

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2 Concept and Framework: The Connotation of the "AI Collaboration" Paradigm and Construction of a Professional Competency Model

Facing the industry paradigm shift triggered by AI technology, there is an urgent need to theoretically create a new educational framework that aligns with it. Traditional vocational education concepts and competency models can no longer adapt to the new working mode of human-computer collaboration. It is necessary to clarify the practical implications of the "AI Collaboration" paradigm and redefine the training objectives and competency composition for environmental design talents. This theoretical construction task will provide clear directional guidance and academic support for subsequent teaching reform operations.

2.1 What is "AI Collaboration"? Analysis of the Paradigm's Core Connotation and Typical Characteristics

"AI Collaboration" is a new design paradigm where the human designer takes the lead and artificial intelligence acts as a creative partner. Its essence lies in the in-depth interaction and intelligence augmentation of both parties. Unlike traditional computer-aided design, which positions tools passively, this paradigm values the active participation and creative contribution of AI systems throughout the design process. Designers achieve a continuous interactive partnership with AI systems through methods like natural language dialogue, parameter adjustment, and result refinement, together forming an efficient design innovation system (Yang, 2025). This collaboration is not simple tool utilization but a creative dialogue based on mutual understanding and compensation for respective capability deficiencies, ultimately achieving a "1+1 > 2" design innovation effect.

The "AI Collaboration" paradigm has four typical characteristics: human dominance, iterative cycling, intelligence augmentation, and creative emergence (Yi, & Han, 2025). Human dominance means the designer consistently controls the design direction, sets aesthetic standards, and makes final decisions. Iterative cycling is reflected in the closed-loop workflow of "instruction–generation–evaluation–improvement." Intelligence augmentation manifests as AI expanding the scope of human design capabilities. Creative emergence refers to unexpected novel solutions generated during human-computer interaction. These characteristics collectively distinguish the "AI collaboration" paradigm from traditional design models, transforming the design process from linear execution to cyclical evolution.

The establishment of the "AI Collaboration" paradigm marks the entry of design activities into a new developmental stage of human-machine symbiosis, a shift with profound methodological significance. It requires designers to re-examine their role positioning, transforming from detail executors to direction controllers and creative curators, while also learning to establish effective communication and collaboration mechanisms with AI systems. This paradigm not only changes the specific methods of design work but also redefines the essence of design—design is no longer a creative activity completed solely by humans, but an innovative process co-created by humans and artificial intelligence. Understanding the connotation and characteristics of this paradigm is the theoretical foundation for constructing a new design education system.

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2.2 Reshaping the Goal: Constructing an "AI Collaboration" Professional Competency Model for Environmental Design

Based on the inherent requirements of the "AI Collaboration" paradigm, the Environmental Design program needs to construct a multi-level, systematic new professional competency model. This model breaks through the traditional competency framework centered on software operation skills, shifting towards a three-dimensional competency structure emphasizing human-computer collaboration, innovative thinking, and comprehensive literacy. The new model consists of three dimensions: core layer, intermediate layer, and foundational layer, with mutual support and organic unity among levels, collectively shaping innovative talents capable of design work in the AI era (Wang, & Hu, 2025).

The core layer focuses on cognitive abilities, including AI collaborative design thinking, critical thinking, and complex problem definition capability. AI collaborative design thinking requires designers to master the methodology for dialogue and collaboration with AI systems, capable of transforming design problems into machine-understandable instruction frameworks. Critical thinking manifests in the ability to discern, evaluate, and optimize AI-generated results, avoiding technological dependence and creative homogenization. Complex problem definition capability emphasizes deeper deconstruction and innovative reconstruction of design problems with AI assistance. These three core competencies constitute the irreplaceable value foundation of designers in the AI era, ensuring the human designer's dominant position and creative value in the design process.

The intermediate layer concerns technical implementation capabilities, encompassing intelligent tool orchestration, prompt engineering, and multimodal expression abilities. Intelligent tool orchestration requires designers to flexibly select and combine various AI design tools based on project needs. Prompt engineering capability becomes a key technology for human-computer dialogue, requiring designers to master methods for translating design intentions into precise language descriptions. Multimodal expression ability requires designers to use various media such as text, images, and video for design concept expression and communication. These capabilities constitute the technical foundation for effective collaboration between designers and AI systems, serving as an important guarantee for transforming creative concepts into design outcomes (Zhao, Guo, & Zhang, 2025).

The foundational layer emphasizes comprehensive literacy abilities, including humanistic aesthetic literacy, design ethics awareness, and cross-disciplinary collaboration capability. Against the backdrop of AI generating numerous schemes, profound humanistic aesthetic literacy becomes the fundamental basis for designers' scheme selection and optimization. Design ethics awareness requires designers to maintain a clear understanding of the application boundaries of AI technology, avoiding ethical risks from technological misuse. Cross-disciplinary collaboration capability manifests in effective communication and collaborative work with technical personnel, clients, and other stakeholders. These literacies ensure the humanistic value and social responsibility of design works, representing unique human advantages that AI cannot replicate.

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2.3 Paradigm Comparison: Differences and Connections with Traditional Computer-Aided Design Education

The "AI Collaboration" paradigm differs fundamentally from traditional computer-aided design education, manifesting as a paradigm leap from instrumentality to subjectivity. Traditional computer-aided design positions software as a passive execution tool, emphasizing precise response to instructions and standardized output, with educational focus on proficiency in software operation skills. In contrast, the "AI Collaboration" paradigm regards AI systems as creative collaboration subjects, emphasizing intelligent dialogue and creative interaction between humans and machines, shifting educational priorities to higher-order abilities such as prompt engineering, evaluation of generated results, and creative decision-making (Yang, 2025). This difference leads to significant distinctions between the two paradigms in teaching objectives, content, and evaluation criteria, marking a fundamental transformation in design education paradigm.

The two paradigms exhibit distinct characteristic differences in teaching implementation, primarily reflected in three dimensions: teacher-student roles, teaching processes, and ability requirements. Regarding teacher-student roles, in the traditional model, teachers are knowledge transmitters and skill demonstrators, while students are passive recipients; in the new model, teachers transform into learning guides and project planners, and students become active explorers collaborating with AI. In terms of teaching processes, the traditional model follows a linear "concept–modeling–rendering" process; the new model forms an iterative "instruction-generation-evaluation-optimization" cycle. Concerning ability requirements, the traditional model emphasizes software operation proficiency; the new model highlights innovative thinking, aesthetic judgment, and human-computer collaboration capabilities. These differences fully reflect the educational concept shift from technical operation to intelligent innovation.

Despite essential differences, the two paradigms maintain internal connections and developmental continuity. The "AI Collaboration" paradigm is not a simple negation of the traditional model but a sublimation and development upon its foundation. The software operation abilities, spatial imagination skills, and design expression capabilities cultivated by traditional computer-aided design remain important foundations for the professional competency system under the new paradigm. Meanwhile, both paradigms emphasize the important role of technical tools in design innovation and are committed to improving design efficiency and quality through technological means. Recognizing this connection and difference helps us avoid the extreme tendency of simply negating tradition when promoting teaching reform, achieving organic integration of traditional advantages and innovative requirements, and promoting design education to innovate through inheritance and develop through innovation.

3 Pathways and Strategies: Teaching System Transformation Oriented towards "AI Collaboration" Capabilities

Based on clarifying the connotation of the "AI Collaboration" paradigm and its competency model, promoting systemic transformation of the teaching system becomes a key link in achieving talent cultivation goals. This transformation needs to break through the limitations of traditional teaching models, conducting comprehensive reconstruction from curriculum design, teaching methods, evaluation mechanisms to faculty de-

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velopment, constructing a new teaching ecology matching the AI era. Only through multi-path collaborative advancement can the theoretical competency model be transformed into practical talent cultivation practices.

3.1 Curriculum System Restructuring: Integration of Modularization, Interdisciplinarity, and Cutting-Edge Relevance

Curriculum system restructuring should be guided by the "AI Collaboration" competency model, adopting a modular approach to integrate traditional content with new AI knowledge. The new curriculum system should break down original course barriers, forming a three-dimensional structure of Basic General Education Modules + Professional Core Modules + Cross-boundary Expansion Modules. Basic General Education Modules should add courses like "Introduction to AI Design Thinking" and "Fundamentals of Generative Technologies" to help students establish cognitive frameworks for human-computer collaboration. Professional Core Modules should deeply integrate intelligent tool applications into traditional courses such as "Decorative Materials and Construction" and "Space Creation and Technology," achieving organic integration of old and new knowledge. Cross-boundary Expansion Modules should offer cutting-edge courses like "Data Aesthetics" and "Algorithm Ethics" to cultivate students' interdisciplinary perspectives and critical thinking (Huang, et al., 2024). This modular structure maintains the systematic nature of professional education while providing flexible space for continuous integration of cutting-edge knowledge.

The upgrading and transformation of existing professional courses need to focus on integrating AI technology applications, achieving deep integration of traditional content and intelligent methods. In design principle and methodology course series[1], introduce generative tools for concept divergence training, enabling students to experience the creative process of human-computer interaction. In specialized design course series[2], set intelligent technology specialized tasks, requiring students to use prompt engineering for scheme generation and optimization. In the "Graduation Design" course, encourage adopting full-process AI collaborative working modes, strengthening students' comprehensive ability to use intelligent technologies to solve complex problems. Simultaneously, teaching syllabi and practical instruction guides need to be rewritten, clarifying the teaching objectives and assessment requirements for AI technology in each course, ensuring AI technology is not superficial decoration but a core element truly integrated into the teaching core.

Curriculum restructuring should also emphasize the integration and of interdisciplinary knowledge, strengthening the integrated education of design ethics and cutting-edge technology. Through cooperation with computer science, AI, and other related disciplines, offer interdisciplinary courses like "Intelligent Environment Technology" and "Human-Computer Interaction Design" to cultivate students' technical understanding and communication abilities. Add seminar courses like "AI Ethics" and "Algorithmic Bias and Design Justice" to guide students inreflecting on the social impacts and responsibility boundaries of technology applications. Establish dual-qualification teaching teams, inviting industry experts and technical engineers to participate in course teaching, ensuring course content is updated synchronously with technological development. This interdisciplinary integration not only expands students' knowledge horizons but, more important-

1 Such as "Principles and Methods of Landscape Architecture Design," "Principles and Methods of Landscape Planning and Design," "Principles and Methods of Interior Design," etc.

2 Such as "Waterfront Landscape Planning and Design," "Residential Area Landscape Planning and Design," "Lifestyle and Residential Interior Design," "Commercial Interior Design and Brand Image," "Educational Space Transformation and Innovative Design," "Shared Space Design and Social Interaction," "Regional Public Space Design," etc.

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ly, cultivates the comprehensive literacy and critical abilities needed in the AI era, achieving organic unity between technology application and humanistic concern.

3.2 Teaching Model Innovation: Project-Driven, Human-Computer Interaction, and Critical Reflection

Teaching model innovation should take project-based learning as the core carrier, constructing a human-computer collaborative teaching process oriented towards real design problems, either through genuine projects or realistic simulations (Wu, & Feng, 2025). During teaching implementation, design tasks should be decomposed according to project requirements, progressing from simple spatial image generation to complex environmental system design, enabling students to gradually master the entire process of collaborating with AI to complete design projects. Each project should explicitly require using AI tools for concept divergence, scheme generation, and outcome expression, emphasizing the division of labor and collaboration mechanisms between humans and machines in the design process. The teacher's role should shift from knowledge transmitter to project guide and process supervisor, focusing on guiding students on how to define design problems, construct prompt frameworks, evaluate generated results, and optimize design schemes, cultivating students' comprehensive ability to harness AI tools to solve complex problems.

The teaching process needs to establish standardized human-computer interaction mechanisms, cultivating students' prompt engineering capabilities and generated result evaluation abilities through workshops, seminars, and other forms. Organize prompt optimization workshops, guiding students to explore the impact of different expression methods on generated results and master language techniques for precisely expressing design intentions. Conduct multi-scheme evaluation seminars, allowing students to compare and analyze different schemes generated by AI, cultivating their aesthetic judgment and decision-making abilities. Establish human-computer collaboration laboratories, providing high-performance computing equipment and professional software support to create authentic AI design environments for students. These interaction mechanisms not only enhance students' technical application abilities but also cultivate their methodological awareness of effective dialogue and collaboration with AI systems.

Critical reflection should run through the entire teaching process, establishing process recording and evaluation mechanisms to ensure teaching effectiveness (Liu, Hou, & Chen, 2025). Require students to write design process logs, detailing each human-computer interaction's prompt strategy, generated result evaluation, and optimization decisions, cultivating their metacognitive abilities and self-reflection habits. Organize midterm reflection meetings at key project nodes, guiding students to consider the applicable boundaries and limitations of AI tools, avoiding technological dependence. Add process explanation sections in outcome reporting sessions, requiring students to demonstrate their innovative pathways and decision-making basis in collaborating with AI. Through this comprehensive reflection training, help students establish critical cognition of AI technology, enabling them to fully utilize technological advantages while maintaining independent thinking and creative decision-making abilities.

3.3 Evaluation Mechanism Reform: Measuring Process, Generativity, and Innovation

Evaluation mechanism reform needs to establish a new system dominated by process evaluation, focusing

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on examining students' collaboration processes and thinking trajectories with AI systems (Peng, et al., 2021). Traditional evaluation methods emphasizing final render quality cannot reflect students' true competency levels under the "AI Collaboration" paradigm; a comprehensive, multi-dimensional evaluation indicator system must be established. This system should focus on the precision of prompt construction, the criticalness of generated result evaluation, the rationality of scheme optimization decisions, and the logical coherence of the design iteration process. Through carriers like design process logs and human-computer interaction records, systematically evaluate students' thinking abilities and methodological awareness demonstrated in human-computer collaboration.

Evaluation criteria should highlight the value orientation of generativity and innovativeness, establishing diversified outcome evaluation dimensions. While retaining necessary technical specification evaluations, significantly increase the weight of dimensions such as innovativeness, diversity, and rationality, encouraging students to use AI tools to explore more innovative possibilities. Specifically, set evaluation indicators like number and diversity of generated schemes, innovative breakthrough points, cultural connotation expression, and technical feasibility, guiding students to both leverage AI's generative advantages and maintain focus on essential design issues. Simultaneously, establish evaluation mechanisms with teacher-student participation, conducting multi-angle, multi-level comprehensive evaluation of design outcomes through defenses, exhibitions, seminars, and other forms.

Evaluation reform also needs to establish quality monitoring systems adapted to the AI era, ensuring the scientific nature and fairness of the evaluation process. Regarding academic integrity issues that AI tools might bring, clarify boundary requirements for human-computer collaboration and establish corresponding detection and verification mechanisms (Wang, & Huang, 2025). Given the randomness characteristics of generated results, develop differentiated evaluation criteria, focusing on students' optimization and innovation degree relative to generated results. Given rapid technological updates, establish dynamic adjustment mechanisms, regularly revising evaluation indicators and standards. Through these measures, construct a new evaluation system that can adapt to AI technology characteristics while ensuring talent cultivation quality, providing effective guarantees for "AI Collaboration" teaching reform.

3.4 Faculty Team Development: Enhancing Teachers' AI Literacy and Role Transformation

Faculty team development is a key support for promoting teaching reform, requiring systematic enhancement of teachers' professional literacy and teaching capabilities in the AI era. Current design faculty generally face challenges such as shallow understanding of AI technology, insufficient application capabilities, and outdated teaching methods, making it difficult to effectively guide students in AI collaborative design (Liu, & Wang, 2025). Therefore, multi-level teacher development systems need to be constructed, helping teachers master AI tool application methods, understand underlying technical principles, and learn to design teaching plans integrating AI technologies through specialized training, enterprise practice, academic exchanges, and other avenues. Simultaneously, establish incentive mechanisms encouraging teachers to actively participate in AI design practice, enhancing their human-computer collaboration capabilities through practical experience.

Teacher roles need to transform from traditional knowledge transmitters to learning guides and innovation

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facilitators. In AI collaborative teaching environments, teachers are no longer the sole knowledge authorities but need to transform into organizers of student learning processes, guides for AI applications, and catalysts of innovative thinking. Specifically, teachers need to guide students on how to effectively dialogue with AI systems, critically evaluate generated results, and organically combine technological innovation with design creativity. This role transformation requires teachers not only to master technical application abilities but also to possess interdisciplinary knowledge integration capabilities, project guidance abilities, and innovative thinking skills, enabling effective promotion of students' comprehensive development under the new paradigm.

Establishing sustainable teacher support systems is an important foundation for ensuring teacher transformation. Institutions should establish AI teaching innovation studios, providing technical support and teaching discussion platforms for teachers. Form interdisciplinary teaching teams, promoting cooperation between design, computer science, and other disciplines. Establish teacher AI teaching capability certification standards, guiding teachers to actively enhance related abilities. Simultaneously, establish school-enterprise collaboration mechanisms, hiring industry experts to participate in teaching and introducing real enterprise project cases, enabling teachers to timely understand latest industry developments (Liang, 2025). Through these measures, build a high-level faculty team proficient in both design and AI, providing solid guarantees for talent cultivation model reform.

4 Case Study and Reflection: Preliminary Practice and Insights from Teaching Reform in Environmental Design

The effectiveness of the "AI Collaboration" paradigm needs verification in courses closely aligned with professional cores. The "Lifestyle and Residential Interior Design" course was selected as an example because its design philosophy starting from life provides an ideal field for testing AI tools' capabilities in understanding user needs and generating personalized schemes. By systematically integrating emerging AI tool chains, this section aims to empirically analyze how the "AI Collaboration" model reshapes the entire teaching process from insight to presentation in design education, and reflect on its teaching value for cultivating human-centered design thinking.

4.1 Description of Teaching Practice Case: Integration of "AI Collaboration" in the "Lifestyle and Residential Interior Design" Course

This teaching practice took the third-year undergraduate course "Lifestyle and Residential Interior Design" in the Environmental Design program as the core vehicle, comprehensively implanting the "AI Collaboration" teaching philosophy. The course, centered on design thinking training based on specific lifestyles, constructed a four-stage teaching process of user research - concept generation - scheme development - comprehensive expression within 68 class hours. The teaching team systematically integrated six types of AI tools, including Interior AI and RoomGPT, into different teaching segments, requiring students to complete full-process human-computer collaboration from design insights to outcome presentation around real user personas. By using AI tools as core teaching media, the course aimed to cultivate students' ability to understand and shape personalized living spaces using technological means, while strengthening their critical thinking and innova-

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tive decision-making abilities.

The course implementation process embedded AI tool chains according to design thinking logic at different stages, forming a complete technology-enabled teaching pathway. In the user research and concept generation stage, students were guided to use Interior AI and RoomGPT for rapid style testing and spatial possibility exploration, establishing preliminary design vocabulary through batch generated images. In the scheme conception and scene construction stage, tools with text-guided functions like REimagineHome and HomeDesigns AI were emphasized, requiring students to input precise prompts based on established user personas to generate design schemes targeting specific life scenarios. In the scheme development and spatial optimization stage, Spacely AI was introduced for furniture layout rationality verification and circulation analysis, ensuring scheme practicality and comfort. Each technical segment was equipped with special workshops where professional teachers and technical assistants jointly guided students in mastering tool characteristics and collaboration methods.

To ensure the systematic nature and controllability of teaching reform, the course established comprehensive quality monitoring and feedback mechanisms. The teaching team developed detailed AI tool application guidelines and design process recording templates, requiring students to completely document the entire thinking process from prompt construction, generated result screening, to scheme optimization decisions. Simultaneously, a dual-tutor system was implemented, with professional teachers responsible for guiding design logic and aesthetic judgment, and technical mentors providing support for tool application and parameter optimization. Through weekly scheme evaluation meetings and periodic outcome reports, timely corrections were made to students' thinking deviations and technical misapplications during human-computer collaboration, ensuring technology application consistently served the core teaching objectives of design innovation and user needs responsiveness.

4.2 Analysis of Practical Effectiveness: Multi-dimensional Evaluation of Student Works, Capability Enhancement, and Learning Feedback

The practical effectiveness of teaching reform was first reflected in the significant quality improvement and innovative breakthroughs in student design works. Compared with outcomes from traditional teaching models, design schemes integrated with AI tools demonstrated stronger individual characteristics and user fit. In the urban solitary youth themed design, students generated diversified solutions encompassing smart homes, transformable spaces, and vertical greening systems through AI tools, with scheme diversity increasing by approximately 41.5%. Particularly notable was that students could clearly articulate the correspondence between schemes and specific lifestyles in their design descriptions, with significantly enhanced rigor and targeting of design logic. Blind reviews of final design drawings showed that the experimental class scored higher than previous concurrent cohorts in the three dimensions of spatial innovativeness, functional rationality, and expressive power, proving that reasonable use of AI tools can effectively enhance the professional level of design outcomes.

The structural transformation of students' professional capabilities manifested in the coordinated development of three levels: technical application, critical thinking, and innovative decision-making. Process evaluation data showed that after eight weeks of systematic training, students' ability to construct precise prompts

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improved by approximately 53.2%, and their critical screening and optimization capabilities for AI-generated results improved by approximately 45.3%. In final defenses, students could systematically explain how they gradually deepened schemes through multiple rounds of human-computer interaction, and how they made design decisions that met user needs among various AI-generated possibilities. This metacognitive awareness of the design process marked students' transformation from passive technology users to design leaders capable of actively harnessing technology. Simultaneously, students' comprehensive abilities in spatial planning, material application, and technology integration also showed synchronized improvement, demonstrating more comprehensive professional literacy.

Course feedback surveys indicated high recognition of teaching reform while revealing key issues requiring continuous optimization. Anonymous questionnaire results showed that 88.6% of students believed the "AI Collaboration" teaching model significantly stimulated learning interest and creative confidence, and 85.4% stated they would continue applying related tools and methods in subsequent designs. Qualitative analysis found that students generally believed AI tools helped them break through inherent thinking limitations and broaden design horizons. However, the survey also reflected that approximately 25.2% of students showed excessive dependence on technology at certain stages, requiring correction through strengthened process guidance. Additionally, data interoperability obstacles between different tools and instability of generated results were identified as main technical bottlenecks affecting work efficiency. These feedbacks provide clear direction for continuous teaching model improvement, highlighting the importance of maintaining balance between technology application and humanistic literacy cultivation.

4.3 Reflection and Outlook: Challenges, Limitations, and Future Deepening Pathways in the Reform Process

Although this teaching practice achieved significant results, it still revealed three core challenges: deep integration of technical tools with teaching objectives, continuous cultivation of students' critical thinking, and systematic restructuring of the curriculum system. The inherent "black box" characteristic of AI tools creates contradictions with the transparent deductive process required by design teaching (Fu, Liu, & Cai, 2025), with some students easily satisfied with superficial results generated by tools while neglecting construction of deep-layer design logic. During teaching, approximately one-third of students showed creative homogenization tendencies in the mid-term, reflecting that their critical screening and creative transformation capabilities for AI-generated results still need strengthening. Furthermore, the existing curriculum structure showed adaptability deficiencies when integrating AI tools, with disconnections between traditional teaching units and new technology modules, affecting the wholeness and coherence of teaching effectiveness.

The limitations of this study are mainly reflected in three aspects: practice duration, evaluation dimensions, and technological development. Although the eight-week teaching practice allowed observation of positive changes in student competency structures, it is difficult to comprehensively assess the sustained impact of the "AI Collaboration" model on students' long-term professional development. Although the existing evaluation system has established multi-dimensional indicators, it still lacks more refined measurement tools for professional evaluation of design thinking processes and innovation quality. The rapid iteration characteristics of AI technology also render the tool ecosystem relied upon in this practice time-sensitive, with the sustainability and generalizability of teaching outcomes facing challenges from technological development. These limita-

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tions suggest that "AI Collaboration" teaching reform is a systematic project requiring long-term tracking and dynamic adjustment.

Future deepening pathways should focus on three directions: curriculum system optimization, faculty capability enhancement, and technology platform construction. Curriculum construction needs to move from tool application level to methodology construction level, developing serialized human-computer collaborative design thinking training modules and organically embedding them into professional course chains across different years. Faculty development should establish school-enterprise-research collaboration mechanisms, constructing normalized teacher training systems and teaching innovation communities, comprehensively enhancing teachers' AI literacy and curriculum design capabilities. At the technical support level, there is an urgent need to build integrated teaching platforms, integrating mainstream AI tools and developing specialized functions suitable for teaching scenarios, while strengthening design ethics education to guide students in establishing critical awareness of technology application. Through multi-path collaborative advancement, deep integration and continuous innovation of the "AI Collaboration" paradigm in design education can be achieved.

5 Conclusion

Through systematically constructing the "AI Collaboration" theoretical paradigm, reshaping the professional competency model, and conducting teaching practice verification, this paper comprehensively demonstrates the strategic path for application-oriented undergraduate Environmental Design programs to address the challenges of the AI era. Research shows that the paradigm shift from traditional tool assistance to "AI Collaboration" is inevitable, with its core lying in systematically cultivating students' comprehensive capabilities for collaborative innovation with AI systems through curriculum restructuring, teaching innovation, evaluation reform, and faculty development. This transformation not only effectively bridges the structural gap between talent cultivation and industry demands but also provides design education with solutions possessing both theoretical depth and practical value for innovative development.

The deep integration of AI and design education is still in the exploratory stage, with future research needing continuous deepening in areas such as technical ethics norms, personalized teaching pathways, and human-computer collaboration mechanisms. The framework and pathways proposed in this paper need to undergo practical testing and improvement over longer periods and wider scopes. It can be foreseen that embracing technological transformation with an open attitude and leading educational innovation with critical spirit will surely cultivate a new generation of designers capable of harnessing intelligent technology, possessing both humanistic feelings and innovative thinking, thereby promoting the continuous development of the environmental design industry towards more intelligent and humanized directions.

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