

Research on Reforming Environmental Design Quick-Design Courses for Cultivating Innovative Talent: Focusing on AI Technology Application and Academic Competitions

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Abstract: Traditional course models struggle to fulfill the core mission of cultivating innovative talent due to outdated content, students' entrenched conventional thinking, and superficial evaluation mechanisms. This study therefore focuses on exploring a dual-pathway deep reform scheme integrating AI technology application and academic competitions. The goal is to reconstruct the curriculum system, overcome teaching challenges, and ultimately establish a novel teaching model that effectively stimulates students' innovative potential and develops their multidisciplinary design capabilities. Through these reform pathways, a new rapid design process characterized by human-machine collaboration has been established within the curriculum paradigm. This liberates students from repetitive drafting tasks, allowing them to focus on higher-level creative planning, critical judgment, and integrated decision-making. At the student competency level, this approach effectively breaks habitual thinking patterns, broadening the breadth and depth of design thinking. Student design proposals now demonstrate enhanced innovation, logical coherence, and technical integration. In the teaching relationship, it redefines the roles of teachers and students, transforming educators from knowledge transmitters into learning facilitators and thought catalysts. Dual-engine driving by AI technology application and disciplinary competitions represents an efficient pathway to advance rapid design course reform in environmental design and cultivate innovative talent.

Keywords: Cultivating innovative talent, Environmental design, Creative quick-design courses, Disciplinary competitions, AI technology

1. Introduction

1.1 Research Background

As a core course cultivating students' abilities in rapid conceptualization, integrated expression, and solving complex spatial problems, the quality of environmental design quick-design instruction directly impacts the innovative literacy and professional competitiveness of design talent. Driven by both the digital revolution and industrial transformation, traditional quick-design teaching models now face unprecedented challenges and opportunities^[1]. A thorough analysis of its developmental trajectory, current predicaments, and future direction serves as the logical starting point for advancing curriculum reform and achieving the goal of cultivating innovative talent.

Currently, the development of environmental design rapid sketching courses is at a critical juncture of transformation. For a long time, this course system has been built upon the traditional paradigm of hand-drawn expression and static

functional analysis, emphasizing the completion of a full presentation from concept to drawings within an extremely short timeframe. This model once played a vital role in honing students' technical skills and decision-making speed. However, as design subjects grow increasingly complex—shifting from singular physical spaces to integrated domains encompassing social interaction, ecological intelligence, and emotional experience—and as design processes accelerate, the traditional interpretation of "speed" in quick-design remains confined to the proficiency of hand-drawing rather than the efficiency of divergent thinking and iterative refinement. The evaluation of outcomes often falls into the trap of "form over substance," where polished visual presentations sometimes mask weak design logic and a lack of innovative thinking. This creates a widening gap between course training and the realities of cutting-edge design practice, forcing graduates to spend significant time readjusting to new workflows centered on parametric analysis, sustainability simulation, and user experience.

This curriculum system reveals multiple shortcomings in cultivating innovative talent. The primary issue lies in the closed-loop nature of thinking. Within the limited timeframe of 8 to 24 hours, students are forced to rely on their personal experience reserves and existing formal language libraries for "internal circulation"-style creation, lacking sufficient external stimuli and heterogeneous information input to break out of fixed mindsets. Their innovations often devolve into superficial tweaks rather than disruptive solutions rooted in addressing the problem's core. Secondly, this manifests as process compression. In pursuit of final drawing completeness, critical preliminary phases—such as in-depth analysis, site context interpretation, and user behavior research—are drastically compressed or even omitted. Design degenerates into a reflexive compositional exercise rather than a rigorous process grounded in thorough research and logical deduction. Finally, there is the "visualization bias" in evaluation criteria. Assessment standards implicitly favor drawing skills and visual impact, while relatively weak consideration is given to deeper innovative metrics such as the underlying generative logic, ecological benefits, social value, and technical feasibility. This orientation encourages students to hone presentation techniques while neglecting the development of a robust design philosophy and critical thinking.

Integrating AI technology and disciplinary competitions as reform pathways is an inevitable choice that addresses these challenges and aligns with contemporary trends. AI technology, particularly generative AI and machine learning, is evolving from a drawing aid into a collaborator that can participate in—or even drive—design thinking. Through natural language input, AI can instantly generate vast quantities of cross-style, cross-cultural conceptual scheme sketches, providing students with a nearly limitless library of initial inspiration drafts that dramatically expands the breadth and diversity of ideas. AI transcends mere form generation, transforming into an intelligent analytical partner. During the preliminary phase of quick-design projects, students can leverage AI large models to rapidly map site histories, cultural characteristics, and user profiles, forming data-driven insights. In the refinement stage, AI tools enable preliminary sustainability and performance analyses—such as solar exposure, wind environment, and pedestrian flow simulations—shifting design decisions from subjective conjecture to scientific validation. This signifies a core shift in rapid design from "drawing fast" to "thinking deeply and judging accurately." AI technology liberates students from repetitive drafting tasks, allowing them to focus on more valuable critical thinking, logical construction, and humanistic care.

Simultaneously, academic competitions—with their forward-looking themes, comprehensive evaluation criteria, and intense competitive atmosphere—offer an ideal application scenario and value anchor for rapid design curriculum reform. High-level competition topics often address pressing social issues and cutting-edge challenges, such as "Community Micro-Renewal in the Context of Carbon Neutrality." This forces teaching to transcend purely formalistic training, guiding students to engage with the complex demands of the real world. The diverse and rigorous evaluation systems of competitions prioritize not only creativity and presentation but also emphasize a proposal's social significance, technical feasibility, and implementation potential. This provides an external driving force to counteract the tendency of courses to "prioritize visual presentation over substantive content."

1.2 Research Significance

This study aims to explore a reform path for environmental design quick-design courses driven by dual engines: AI technology application and academic competitions. Its significance extends far beyond optimizing a single teaching method, touching upon a paradigm shift at the core of design education. This is manifested across three dimensions: theory, practice, and pedagogy.

At the theoretical level, it drives a structural shift in the foundational teaching paradigm of environmental design. Traditional rapid design pedagogy, rooted in the "hand-mind unity" concept of skill transmission, centers on training students to externalize internal concepts through proficient manual techniques^[2]. This research challenges and transcends this paradigm by pioneering a "human-machine collaborative creative thinking" teaching theory. It redefines AI technology not merely as an efficiency tool but as an active collaborator within the design thinking process. This theoretical exploration will profoundly address how human designers' intuition, experience, and critical thinking can effectively integrate and complement AI's massive data processing, cross-disciplinary form generation, and rational analytical capabilities under extreme time constraints. This represents not merely a pedagogical update but a redefinition and expansion of the essence of "creativity" within environmental design theory for the intelligent era, providing a core pillar for constructing a future-oriented design education philosophy.

At the practical level, it aims to resolve two persistent challenges in environmental design rapid-response teaching: conceptual inertia and logical abstraction, offering an operational and replicable solution. The integration of AI technology fundamentally reshapes the rapid design workflow. Through prompt engineering, students can access AI-generated concept clusters exceeding their personal experience boundaries during the initial ideation phase. This elevates thinking from mere "scraping memory" to a strategic level of planning and selection, effectively overcoming conceptual inertia. Simultaneously, leveraging AI for preliminary performance-based simulation analysis compels students to consider physical environmental factors like lighting, ventilation, and pedestrian flow during the conceptual phase. This grounds design decisions in quantifiable rationality rather than abstract speculation, thereby eliminating logical abstraction. This approach transforms quick-design outcomes from hastily sketched works prioritizing "visual completeness" into micro-research reports and innovative proposals demonstrating "depth of thought," significantly aligning course training with real-world industry demands.

For individual student development, the focus lies in guiding them through a critical role transformation from draftsmen to design instigators. As AI assumes extensive foundational generation and drafting tasks, students' core competency value must shift upward. Curriculum reform will compel and motivate them to develop higher-order competencies: precisely defining problems, crafting design prompts, critically selecting and refining AI-generated outputs, and making value judgments and optimal decisions based on multidimensional data provided by AI. The introduction of academic competitions provides a real-world pressure test and litmus paper for honing these competencies, validating students' innovative value against high-standard peer benchmarks. The cultivation model no longer produces merely technically proficient students, but future design leaders who can master intelligent tools, steer design processes, and possess strategic vision.

The profound significance of this research lies in establishing forward-looking educational standards for environmental design programs to navigate technological disruption. The explosive growth of generative AI like ChatGPT and Sora is fueling deep global anxiety about whether design will be replaced by AI. Passively avoiding or simplistically rejecting technological waves will only disconnect education from real-world demands. By leveraging the core course of rapid design as a breakthrough point, this research proactively integrates AI as a central component of the teaching system. This approach cultivates a healthy, constructive "technological perspective" in students: neither fearing nor blindly following technology, but becoming its masters. Through this approach, we are not merely imparting skills but shaping the professional confidence and adaptive capabilities needed to thrive in the intelligent era. This ensures the quality and resilience of environmental design talent cultivation, enabling us to consistently lead—rather than follow—the evolving trends of society and industry.

2. Current State of Environmental Design Creative Quick-Design Courses

2.1 Outdated Course Content and Disconnect from Practice

The core challenge facing environmental design creative quick-design courses today lies in the widening gap between their teaching content and cutting-edge industry practices. This disconnect is not merely a slow update of knowledge in a single dimension, but a systemic lag permeating the entire framework—from design thinking and technical tools to value propositions and evaluation criteria. The "design scenarios" simulated in these courses are largely oversimplified, even imagined static environments that clash with the dynamic, complex, and technology-integrated realities of professional practice.

The design questions addressed in these courses often remain confined to a binary exploration of form and function, severely neglecting core contemporary issues that spatial design must confront: sustainability, social responsibility, and digital interaction. In real-world industry practice, a project's creation is no longer merely an expression of an architect or designer's personal aesthetic vision. It must comprehensively consider hard ecological metrics such as the project's full lifecycle carbon footprint, biodiversity restoration, and material recycling. Yet most quick-design assignments—such as "Designing a Community Park" or "Renovating a Small Bookstore Interior"—still prioritize composition, circulation, and style in their briefs. They rarely provide foundational environmental data like site solar exposure, wind patterns, or hydrology, let alone require energy consumption simulations or carbon calculations. This leaves students' design thinking suspended at the abstract level of "aesthetics" and "functionality," failing to establish causal links between spatial decisions and ecological impacts. Consequently, it remains severely disconnected from the industry's new standards under globally advocated initiatives like the "Green New Deal" and the "dual carbon" goals^[3].

Methodologically, the design processes taught in these courses retain strong characteristics of the craft era. The concept of "rapid" is narrowly interpreted as proficiency in freehand drawing rather than the high efficiency of intelligent decision-making and iteration. The actual industry design process has long advanced into the frontier of digital twins and performance-driven approaches. Designers leverage parametric platforms for generative design, using algorithms to identify optimal solutions for form, structure, and energy consumption among thousands of possibilities. During scheme development, real-time rendering and virtual reality technologies enable immersive experiences and design validation. Yet, quick-design courses still hold watercolor and marker hand-rendering as the gold standard, squandering precious time pursuing brushstroke freedom and vibrant color palettes. While the industry processes massive datasets with cloud computing, our classrooms continue to test students on how to cram out a solution with a pen in a few hours.

More fundamentally, the course's understanding of human behavior contradicts contemporary user-experience-driven design philosophy. The success of modern environmental design hinges on precisely addressing the physiological, psychological, and social behavioral needs of specific user groups. This requires a foundation of rigorous design research—including thorough user interviews, behavioral observations, and data analysis. Yet the extremely compressed timeframe of quick-design courses virtually eliminates any possibility for substantive user research. Students are forced to design based solely on limited personal experiences and vague assumptions about users. This reduces people in their proposals to abstract symbols, with behavioral patterns simplified into mere circulation paths. The resulting spaces often become projections of the designer's subjective will rather than organic entities rooted in genuine user experience. This disconnect means that even if students master proficient presentation techniques, they cannot design places that truly resonate with people or possess enduring vitality.

The disconnect between curriculum content and emerging technological paradigms and future career demands leaves graduates at risk of becoming obsolete upon graduation. Concepts like AI-assisted design, metaverse space construction, and digital twin operations are no longer science fiction scenarios but unfolding industrial realities. The industry urgently requires innovative talent capable of understanding and applying these new technologies to design within emerging contexts. Graduates from this training model will have their knowledge structure exposed as fragile when confronting a future workplace demanding AI for preliminary analysis and game engines for creating interactive proposal presentations.

2.2 Students' Rigid Thinking Patterns and the Challenge of Innovative Breakthroughs

In environmental design rapid-response courses, students' thinking patterns exhibit pronounced rigidity. This mental inertia manifests not only in superficial similarities among design outcomes but more profoundly reflects systemic deficiencies in cultivating innovative thinking. Its diverse manifestations and complex causes constitute a primary obstacle in nurturing innovative talent.

The repetition and cyclical nature of design language serve as the most direct manifestation of this inertia^[4]. Confronted with the time constraints of quick-design assignments, students often unconsciously retreat to familiar design comfort zones. Form combinations proven effective through repeated practice become default solutions—such as moon gates and blue-brick walls in New Chinese-style designs, or geometric cuts and pure white facades in modern styles. This self-replication of formal language fundamentally stems from a subconscious avoidance of innovation risks. Within limited timeframes, experimenting with untested new forms carries the tangible risk of failing to complete drawings, making repetition of known forms the safest strategy.

The spatial conception process exhibits mechanical linearity. While ideal creative design should be filled with serendipity and exploration, in actual quick-design training, this process is reduced to a fixed sequence: interpreting the brief, functional zoning, and form generation. This formulaic approach ensures basic functionality but sacrifices design uniqueness. When different students tackle the same task following similar thought paths, the resulting solutions inevitably exhibit regrettable homogeneity.

The superficiality of conceptual expression also warrants caution. Students habitually assign flashy conceptual labels to their designs—terms like "mountain-water aesthetics" or "dialogue across time and space"—yet these concepts often remain mere vocabulary, failing to translate into profound spatial experiences. So-called ecological design may manifest only as routine rooftop greening, lacking deep understanding of local ecosystems; cultural heritage is frequently reduced to the simplistic appropriation of traditional decorative elements, failing to achieve genuine dialogue between tradition and modernity.

Psychological defense mechanisms under time pressure further reinforce rigid thinking. The timed nature of quick-design projects fosters a unique psychological state where students, under constant time anxiety, instinctively default to their most familiar thought patterns. Any innovative attempt requiring deep contemplation risks running out of time, and this latent threat makes students more inclined to adopt proven design strategies.

A deeper issue lies in the lack of awareness about the thinking process itself. While most students can execute design procedures proficiently, they rarely question their own thought patterns. Metacognitive questions—such as why a particular layout was chosen or whether better solutions exist—are often overlooked during the intense design process. Design decisions are frequently based on the experience of "how it's usually done" rather than rigorous logical reasoning.

This predicament is not accidental but an inevitable outcome of the existing educational system. When course evaluations overemphasize visual outcomes while devaluing thought processes, and when teaching demonstrations stick to standard solutions without showcasing diverse approaches, students' choice of conservative design strategies becomes a rational default. Breaking this impasse requires systemic reform—from curriculum philosophy to assessment criteria. Only by providing ample space for exploration and diverse cognitive guidance can we truly unlock students' innovative potential, enabling their essential transformation from technical executors to creative leaders.

2.3 The Systemic Formalization Dilemma from Concept to Critique

A concerning systemic tendency toward formalization exists within the teaching process of environmental design quick-concept courses. This tendency persists from initial ideation through final critique, forming a complete yet substantively hollow teaching cycle. The superficial execution of each stage continually dilutes the course's inherent value in fostering innovation^[5].

During the conceptual phase, the pursuit of speed masks a lack of intellectual depth. Strict time constraints imposed by the curriculum prompt students to develop reactive design strategies. Faced with a new design task, most students' first instinct is not to deeply analyze site characteristics and design problems, but to rapidly search their minds for familiar

reference cases. This case-retrieval mindset traps design thinking at the superficial level of formal borrowing. A cultural space design requiring regional expression might be reduced within five minutes to a modern reinterpretation of traditional architectural symbols, while the underlying cultural logic and spatial philosophy are entirely overlooked. The conceptual process becomes a game of finding formal correspondences rather than genuine problem-solving.

The design development process exhibits pronounced path dependency. After establishing a basic concept, students often advance linearly along the initial direction, lacking essential self-questioning and multi-solution comparisons. This linear mindset transforms the design process into mechanical labor filling predetermined positions, rather than an exploratory journey brimming with possibilities. When encountering design conflicts, students' first instinct is often to tweak the form, rather than re-examine the validity of the design premises. This excessive attachment to initial concepts stifles many promising possibilities in their infancy, ultimately reducing design solutions to products of mental inertia.

The rendering phase suffers from severe technical alienation. Driven by the pursuit of visual impact, students devote excessive time to refining photorealistic renderings. The refinement of rendering techniques supplants the deepening of design thinking, while the glossy surface of drawings masks the poverty of design substance. This phenomenon creates a paradox: students' software proficiency increases, yet their design thinking capacity regresses. Drawings cease to be faithful expressions of design ideas and instead evolve into independent visual performances. This inversion of priorities transforms quick-design exercises into competitions of visual artistry rather than genuine tests of design ability.

The imbalance in critique standards further reinforces the system's formalistic tendencies. Constrained by time, instructors often conduct only cursory evaluations of design proposals. Under this assessment model, visually striking schemes naturally command more attention, while design subtleties requiring careful consideration are easily overlooked. Feedback predominantly focuses on superficial elements like formal composition and visual impact, while paying relatively little attention to deeper qualities such as the rigor of design logic or the richness of spatial experience. This evaluative orientation inadvertently sends students a misleading signal: formal innovation is more important than logical rigor, and visual presentation is more worthy of pursuit than spatial quality.

The root of this systemic formalization dilemma lies in misaligned curriculum objectives. When completion becomes the paramount criterion, students naturally gravitate toward the safest, most efficient design paths. When visual presentation dominates evaluation, the value of deep thinking diminishes. To overcome this impasse, a comprehensive overhaul is needed—from pedagogical philosophy to assessment standards—shifting the focus from superficial completion to fostering innovative thinking. Only then can quick-design projects reclaim their role as vital platforms for sparking creativity.

3. Implementation of AI Technology and Disciplinary Competitions in Curriculum Reform and Talent Development

3.1 AI-Integrated Rapid Design Courses Strengthen New Paradigms for Reform

The reform of environmental design rapid design courses urgently requires establishing a new teaching paradigm, and the deep integration of artificial intelligence technology provides critical support for this transformation. This fusion does not merely treat AI as an auxiliary tool but fundamentally redefines the essence of rapid design, comprehensively reconstructing both thought patterns and working methods to form a new teaching ecosystem centered on intelligent collaboration.

During the preliminary analysis phase, AI technology overcomes traditional information processing bottlenecks in rapid design. By incorporating large language models and data analytics tools, students can achieve deep site interpretation within minimal timeframes. Specifically, students input basic site parameters, and AI generates multidimensional reports encompassing historical context, climatic characteristics, and human activity patterns. This intelligent preliminary research not only ensures the scientific rigor of design decisions but, more importantly, liberates students from tedious information gathering. This allows them to devote greater energy to the creative conceptualization phase. Building on this foundation, the application of AI image generation tools further expands the boundaries of design inspiration. Students can explore

possibilities across different stylistic orientations and spatial typologies through flexible keyword combinations, opening broader imaginative spaces for subsequent design development.

The transformation in the conceptualization phase is particularly striking. The linear, experience-dependent thinking characteristic of traditional quick-design exercises is being replaced by AI-supported divergent thinking. Students can employ specific prompting techniques to instruct AI to generate multiple design proposals with fundamentally different conceptual orientations. These proposals transcend mere formal variations, encompassing complete conceptual frameworks from spatial organization to material applications. Confronted with these auto-generated options, students assume the role of curators, critically evaluating and selecting the most promising directions for further refinement and innovation. This process effectively cultivates students' design judgment and decision-making abilities, transforming them from passive executors of proposals into proactive design leaders.

The design refinement phase highlights the unique value of human-machine collaboration. As designs enter the concretization stage, AI provides real-time technical support—automatically generating code-compliant construction drawings, performing precise material quantity estimates, and even simulating light and shadow effects across different times of day. Technical tasks that once required specialized team collaboration can now be independently completed by students with AI assistance. This deep collaboration not only enhances the feasibility of design proposals but also builds students' sensitivity to technical parameters during practice, cultivating their ability to organically integrate creative concepts with technical requirements.

The innovation in the critique session is equally noteworthy. By introducing an AI evaluation system, the course establishes a more objective and multidimensional assessment framework. This system performs multidimensional analysis of design proposals—assessing functional organization, spatial sequence richness, and technical specification fulfillment—while providing instructors with quantifiable reference data. This human-machine collaborative review model preserves faculty subjective judgment while integrating objective technical analysis, ensuring more comprehensive and impartial course evaluation. Additionally, the AI system generates tailored improvement suggestions for each proposal, offering students clear pathways for continuous optimization.

Crucially, the entire teaching process incorporates authentic competition requirements. From task design to evaluation criteria, it aligns with major domestic and international competitions. AI serves a dual role: as a tool enabling competition-level innovation and as a guide helping students understand competition evaluation systems. This competition-driven, AI-supported teaching model effectively stimulates students' innovative potential and cultivates their comprehensive abilities to tackle real-world design challenges.

This new paradigm of fast-track courses deeply integrated with AI technology is redefining the essence of foundational environmental design education. It breaks away from traditional teaching's overreliance on individual experience and manual skills, instead emphasizing the cultivation of students' innovative thinking and comprehensive design capabilities through human-machine collaboration. This shift not only aligns with the technological trends shaping industry development but, more importantly, forges new pathways for nurturing innovative talent. It transforms fast-track courses into true incubators for future design leaders.

3.2 AI-Empowered Optimization of the Entire Competition Evaluation Process

As a vital component of environmental design education, the scientific rigor and fairness of academic competition evaluation mechanisms directly impact the quality of cultivating innovative talent. Traditional competition assessment models, constrained by judges' subjective perceptions and limited time and energy, struggle to conduct in-depth analysis of large volumes of submissions. The integration of artificial intelligence technology is reshaping the entire competition evaluation process, establishing a more scientific, comprehensive, and efficient assessment system.

The preliminary evaluation stage faces the practical challenge of sifting through massive volumes of submissions. Within limited timeframes, judges must rapidly review hundreds of design entries, a high-intensity task that inevitably leads to aesthetic fatigue and diminished focus. The integration of AI visual recognition systems effectively addresses this issue. By learning from extensive datasets of exemplary design cases, the system establishes a multidimensional evaluation

matrix to automatically perform initial screening. Unlike traditional screening methods, AI focuses not only on visual presentation but also identifies deeper characteristics such as spatial organization logic and technical parameter completeness within design proposals. This intelligent screening not only reduces the workload for judges but, more importantly, ensures every entry receives equal consideration, preventing high-quality works from being overlooked due to random factors like display positioning.

During the in-depth review phase, the AI system demonstrates analytical capabilities that transcend human cognitive limitations. While traditional evaluations primarily rely on individual judges' experience and intuitive judgment, AI can simultaneously process multiple evaluation dimensions, including innovation, functionality, technical feasibility, and environmental responsiveness. Through algorithmic analysis, the system quantifies professional metrics such as spatial efficiency, optimization of circulation patterns, and the effectiveness of ecological strategies. For instance, with green building designs, AI can simulate and calculate hard metrics like energy consumption levels and daylight utilization efficiency. For urban renewal proposals, it analyzes social parameters such as public space coverage and transportation connectivity convenience. This human-machine collaborative review model preserves judges' professional judgment while supplementing it with objective data analysis, making selection outcomes more persuasive.

Assessing design innovation has long been a challenge in competitions. Traditional methods often rely on judges' subjective perceptions, lacking unified metrics. By integrating natural language processing and image recognition, AI can deeply analyze the logical connections between design concepts and spatial expressions. The system traces the entire process from concept generation to formal transformation, evaluating the consistency and breakthrough nature of innovative thinking. Simultaneously, by cross-referencing vast design databases, AI identifies the originality of proposals, preventing unconscious imitation or duplication. This big-data-driven innovation assessment provides judges with reliable reference points, allowing genuinely original designs to stand out.

Transparency and educational value in the judging process are significantly enhanced through AI technology. Traditional competitions often conclude with result announcements, leaving participants unclear about the specific strengths and weaknesses of their work. The AI system generates detailed analytical reports for each submission, clearly outlining the strengths and weaknesses of each design proposal. These reports not only include quantitative scores but also provide specific improvement suggestions, such as directions for optimizing spatial organization or adjustments to technical strategies. This in-depth feedback transforms the competition from a mere contest into a vital learning process. Participants can clearly identify their knowledge gaps through the analysis reports, guiding their future learning.

Deep mining of competition data offers invaluable insights for instructional design. The AI system integrates and analyzes outstanding entries from past competitions to identify emerging trends and innovation hotspots in design education. These findings can be directly applied to reforming quick-design course curricula, helping instructors promptly adjust teaching priorities and update content. For instance, when the system detects sustainable design strategies gaining industry prominence, courses can strengthen training in this area. If students show widespread weaknesses in technology integration, teaching can specifically reinforce related skill development. This data-driven instructional adjustment ensures curriculum content remains synchronized with industry evolution.

AI-empowered competition evaluation mechanisms are reshaping environmental design education's assessment systems. This represents not merely a technological upgrade of selection tools but a profound transformation in educational philosophy. By establishing more scientific, fair, and transparent evaluation standards, this new selection mechanism provides precise guidance for nurturing innovative talent. Participants gain not only competition rankings but also clear insights into their design capabilities and pathways for improvement. This new model—where evaluation drives learning and competitions foster talent—will undoubtedly propel environmental design education toward more scientific and efficient development.

3.3 Building a Diverse Thinking Cultivation System to Drive Innovation Talent Development

The essence of environmental design education lies in cultivating students' creative thinking abilities. Traditional quick-design courses, however, suffer from limitations in their one-dimensional and formulaic approach to mental training.

The deep integration of artificial intelligence technology with academic competitions presents a new opportunity to construct a diverse thinking cultivation system, fundamentally transforming the path for nurturing innovative talent.

The introduction of artificial intelligence disrupts the linear model of traditional design thinking. During the initial stages of rapid design, students are often constrained by their personal experience and knowledge structures, struggling to break free from established mental frameworks. AI technology, with its powerful data processing and pattern recognition capabilities, can present students with diverse design possibilities. Take site analysis as an example: traditional methods typically rely on limited environmental observation and functional zoning, whereas AI systems can integrate multidimensional information such as geographic data, climate data, and crowd behavior patterns to generate entirely new perspectives on site interpretation. This data-driven, multi-angle analytical training effectively cultivates students' systemic and dialectical thinking abilities, enabling them to transcend superficial observations and grasp the essential characteristics of design problems.

The introduction of academic competitions provides a practical platform for validating diverse thinking. The complexity and forward-looking nature of competition topics require students to break free from single-disciplinary perspectives and adopt interdisciplinary approaches to problem-solving. For instance, when tackling competition topics like historic district renewal, students must consider not only the aesthetic value of spatial design but also integrate factors such as sociocultural impact, economic benefits, and ecological sustainability. This comprehensive thinking training prompts students to establish multidimensional value judgment systems and learn to balance competing demands. The process of comparing and optimizing proposals during competitions further serves as a continuous journey of breaking mental patterns and achieving cognitive upgrades.

The restructured teaching process further enhances the development of diverse thinking. In AI-supported rapid design courses, the design process is explicitly segmented into distinct cognitive phases: from divergent exploration to convergent refinement, and from conceptual innovation to technical implementation. Each phase is equipped with corresponding AI tools and methodological guidance, helping students grasp the characteristics and application scenarios of different thinking modes. For instance, the concept generation phase emphasizes intuitive and associative thinking; the scheme refinement phase focuses on logical and systemic thinking; and the technical implementation phase prioritizes critical and decision-making thinking. This systematic cognitive training enables students to flexibly apply diverse thinking approaches according to the specific demands of design tasks.

4. Challenges Faced

4.1 Time Constraints in Teacher Role Transformation

Within traditional teaching models, educators have long served as knowledge authorities and skill instructors. This role is particularly pronounced in rapid design courses, where teachers directly impart years of accumulated design experience and presentation techniques through methods like demonstrating revisions and analyzing case studies. However, the introduction of AI technology is deconstructing this unidirectional transmission dynamic. Teachers are surprised to discover that during concept generation and proposal refinement, AI tools can offer diverse solutions beyond the scope of individual experience. This capability gap undermines the teacher's position as a knowledge authority, compelling them to reevaluate their teaching value proposition. Shifting from being the sole provider of correct answers to becoming a guide for exploring multiple possibilities requires profound psychological adjustment and role identity transformation.

The core of teaching shifts from knowledge transmission to thought guidance, demanding that teachers develop entirely new pedagogical competencies. In AI-supported rapid design workshops, the teacher's primary focus is no longer hands-on technical instruction but rather guiding students to develop critical thinking skills. They must cultivate students' ability to sift through, evaluate, and refine the vast array of solutions generated by AI. This transformation requires teachers not only to master AI tool operation but also to possess a macro perspective of design thinking and interdisciplinary knowledge reserves. For instance, when guiding students in ecological design, educators must move beyond traditional formal aesthetic evaluations to focus on a design's performance across sustainable dimensions like

carbon footprint and biodiversity. This restructuring of competencies cannot be achieved through short-term training alone but requires continuous exploration and reflection within teaching practice.

The reconfiguration of teaching processes imposes new demands on teachers' classroom management skills. Traditional quick-design courses follow a relatively fixed linear sequence: task assignment, sketching and conceptualization, proposal refinement, and final critique. With the integration of AI technology, this process becomes more dynamic and nonlinear. Students may encounter technical issues at any point while using AI tools, or generate profound questions requiring immediate answers during the proposal generation phase. Instructors must learn to flexibly switch between technical guidance, conceptual inspiration, and process management. This multitasking capability matures only through repeated teaching practice. Simultaneously, the introduction of academic competitions further increases the unpredictability of the teaching process, demanding stronger adaptability and personalized guidance skills from educators.

4.2 Insufficient Protection of Design Originality

In AI-assisted design environments, defining originality becomes increasingly difficult. Traditional design education emphasizes originality through novel conceptual ideas, distinctive expressive techniques, and innovative solutions. However, when students employ AI tools for design, their creative process transforms into an ongoing dialogue and collaborative effort between human and machine. In this context, students' creative contributions increasingly manifest in meticulously crafted prompts, discerning evaluation of generated outputs, and subsequent refinement—rather than conventional freehand creation. This shift in creative methodology makes it challenging to assess originality using conventional standards. For instance, two students might employ similar prompts yet achieve vastly different outcomes due to minor parameter adjustments; conversely, entirely distinct prompts could yield strikingly similar design solutions. This uncertainty poses a significant challenge to existing evaluation systems.

The absence of a process-based evaluation system hinders the implementation of originality protection. In traditional quick-design exercises, instructors could assess originality by observing the evolution of students' sketches. However, this process becomes more concealed and complex with AI-assisted design. A seemingly innovative design might result from merely tweaking prompt parameters, while an ordinary-looking proposal could conceal deep critical thinking and meticulous refinement of AI-generated outputs. Existing evaluation frameworks typically focus solely on final deliverables, struggling to trace and assess students' creative contributions throughout the design journey. This limitation not only compromises assessment accuracy but also risks fostering excessive reliance on AI tools, undermining the cultivation of students' inherent design capabilities.

4.3 Teaching Resources Urgently Require Reintegration

The deep integration of AI technology and academic competitions has created an urgent need for systemic restructuring in the integration of teaching resources for environmental design quick-design courses. This challenge involves not only updating hardware facilities and software tools but also comprehensive adjustments to course content, faculty teams, and support services. It necessitates establishing a resource ecosystem aligned with new teaching models.

The reconstruction of technical platforms presents a foundational challenge in resource integration. Traditional rapid design courses relied on relatively simple resources centered around drafting tools, modeling materials, and reference libraries. However, the introduction of AI technology has fundamentally transformed resource requirements. Now, a comprehensive technical support system is needed, including high-performance computing equipment, specialized AI design software, and cloud storage services. These technological resources are not only costly but also demand specialized personnel for maintenance and management. For instance, stable diffusion models require high-end GPU workstations, while certain cloud-based AI tools necessitate stable network environments and account systems supporting multi-user collaboration. The introduction of these new technological resources breaks the spatial boundaries of traditional classrooms, requiring corresponding adjustments to instructional space design, equipment management, and technical support services.

5. Improvement Measures

5.1 Strengthening Faculty Development and Evaluation

Establishing a multi-tiered faculty development system is the foremost task in elevating teaching standards. This system should encompass comprehensive training from foundational skills to pedagogical philosophy. Technologically, systematic workshops on AI design tools must be organized—not merely teaching software operation, but deeply analyzing the underlying algorithmic logic and design thinking behind these tools. For instance, dissecting the operational principles of Stable Diffusion helps educators grasp the relationship between prompts and generated outputs, thereby better guiding students in creative expression. In teaching methodology, modern approaches like case-based teaching and project-based learning should be integrated, with particular emphasis on developing teachers' classroom organization skills in human-machine collaborative environments. Regular interdisciplinary exchange activities should also be organized, inviting experts from fields such as computer science and humanities/social sciences to deliver lectures, thereby broadening teachers' knowledge horizons and cultivating their ability to design cross-disciplinary curricula.

Teacher evaluation mechanisms require timely reform. Traditional assessment systems often prioritize research output and teaching hours, failing to fully reflect educators' contributions to curriculum innovation. New metrics should incorporate dimensions like digital teaching proficiency and course innovation outcomes, while integrating teachers' exploration of AI-course integration into evaluations. For instance, key metrics could include AI teaching cases developed by faculty, technology-integrated lesson plans designed, and digital innovation projects supervised. Concurrently, a long-term tracking mechanism for teaching outcomes should be established, focusing on the tangible impact of faculty in cultivating students' digital literacy and innovation capabilities, rather than solely on short-term teaching workloads. This development-oriented assessment mechanism can effectively incentivize faculty to proactively engage in teaching reform and continuously enhance their professional competence.

Building a sustainable support platform is crucial for faculty development. This platform should integrate high-quality resources both within and outside the institution to provide comprehensive support services. Internally, establishing a Digital Teaching Innovation Center staffed with a dedicated technical support team can assist teachers in resolving technical challenges encountered during curriculum reform. Simultaneously, creating a teaching resource repository to collect and organize exemplary teaching cases, training materials, and tool tutorials ensures easy access for teachers. Externally, actively promote university-industry collaborations by establishing long-term partnerships with leading design firms and technology companies. Organize faculty participation in corporate practice projects to stay abreast of the latest industry developments. Additionally, invite industry experts to engage in teaching activities, fostering deep integration of industry, academia, and research through dual-qualified teaching models.

Teacher development pathways require personalized design. Educators of different ages and disciplinary backgrounds face distinct challenges and needs during instructional transformation. For seasoned teachers, their extensive pedagogical experience should be leveraged, with a focus on equipping them with essential digital skills to seamlessly integrate traditional teaching wisdom with modern technology. Younger faculty, meanwhile, should be encouraged to boldly experiment with new technologies and methodologies, fostering rapid growth through innovative practice. Simultaneously, differentiated training programs and career pathways should be provided based on faculty members' professional specializations and development aspirations. For instance, practical tracks emphasizing technology application and academic tracks focusing on teaching research should be offered, enabling each educator to identify a suitable development direction.

Establishing effective incentive mechanisms is crucial for advancing faculty transformation. Beyond incorporating teaching reform achievements into performance evaluations, dedicated incentive funds should be established to provide both material and recognition rewards for faculty members demonstrating significant accomplishments in course innovation. Simultaneously, a supportive professional development environment should be cultivated, offering teachers actively engaged in teaching reform more opportunities for advanced training, pathways for professional title advancement, and international exchange platforms. These measures will help teachers tangibly recognize the value and significance of

participating in teaching reform, thereby stimulating intrinsic motivation and fostering proactive adaptation to new educational demands.

Refining the faculty development and evaluation system is an ongoing process of continuous improvement. Regular assessment mechanisms must be established to gather faculty feedback, gauge the actual effectiveness of development measures, and make timely adjustments. Simultaneously, an open mindset should be maintained to draw on advanced domestic and international experiences, continually enriching development content and innovating evaluation methods. Only by constructing a scientific and comprehensive faculty development system can we provide robust talent support for the digital transformation of environmental design education and ensure the achievement of curriculum reform objectives.

5.2 Establishing a Comprehensive Evaluation Mechanism

Reforming the evaluation mechanism for environmental design quick-design courses is crucial for ensuring the quality of talent cultivation. In a teaching environment where AI technology and academic competitions are deeply integrated, traditional outcome-oriented evaluation methods struggle to meet the demands of this new pedagogical model. There is an urgent need to establish a scientific evaluation system that is comprehensive, multidimensional, and process-oriented.

Building a process-based evaluation system is the core task of this reform. This process must be tracked from the inception of design thinking and extend throughout the entire creative cycle. During the concept generation phase, evaluation should focus on the breadth and depth of design thinking, including the accuracy of problem definition, the comprehensiveness of research analysis, and the diversity of creative divergence. Instructors can assess the logical reasoning and innovation in students' thinking through process documents such as research notes, mind maps, and conceptual sketches. During the solution development phase, attention should be paid to students' criteria for selecting AI-generated outputs, their thought processes in refining designs, and the rationale behind technical decisions. Evaluation at this stage should emphasize critical thinking and decision-making abilities, rather than solely focusing on the novelty of design proposals. In the design presentation phase, beyond traditional assessments of visual quality, greater emphasis should be placed on the accuracy of design concept communication and the standardization of technical drawings. This phased evaluation approach provides a more comprehensive understanding of students' design thinking development and skill growth.

Establishing a diversified evaluation mechanism is crucial. In AI-assisted design environments, the limitations of single-instructor evaluation become increasingly apparent. A multi-stakeholder evaluation system should be introduced, involving faculty, industry experts, technical engineers, and students. Faculty assess the academic rigor and compliance of design proposals; industry experts evaluate feasibility and innovative value from a practical perspective; Technical engineers can offer professional insights on the technical soundness and digital application level of design proposals; student self-assessment and peer review help cultivate reflective abilities and critical thinking. This multi-dimensional evaluation mechanism not only ensures comprehensive and objective assessment outcomes but also helps students recognize their design capabilities from multiple perspectives and identify areas for improvement.

Refining the linkage mechanism between academic competitions and course assessments is a vital component of evaluation reform. The cutting-edge and innovative nature of academic competitions provides valuable reference standards for course evaluation. A correspondence should be established between competition evaluation criteria and course assessment indicators, integrating elements emphasized in competitions—such as innovation, practicality, and technological integration—into routine teaching evaluations. Concurrently, mechanisms for credit recognition and course substitution based on competition achievements can be implemented to encourage active participation in high-level competitions, transforming the preparation process into opportunities for deep learning. Additionally, a teaching improvement mechanism based on competition feedback should be established. Through in-depth analysis of award-winning works, course evaluation standards can be continuously optimized to maintain the advanced nature of teaching content.

Developing intelligent evaluation tool support systems is an effective approach to enhancing assessment efficiency. Leveraging AI technology, specialized process recording and evaluation systems can be developed to automatically collect diverse data on student behavior during the design process, including time allocation, solution iterations, and tool usage. Through data analysis, the system can generate personalized learning analysis reports, helping students understand their design habits and capability characteristics. Simultaneously, AI systems can provide preliminary work evaluations, including technical compliance checks and innovation assessments, offering reference points for instructor evaluations. However, it is crucial to note that AI evaluation should only serve as an auxiliary tool; final assessments must still be completed by instructors based on professional judgment.

Establishing a dynamic evaluation standard update mechanism is paramount. With the rapid advancement of AI technology and the constant evolution of industry demands, evaluation standards must also undergo dynamic updates. A regular review system should be instituted, inviting industry experts, education specialists, and current students to participate in discussions and formulation of standards. Concurrently, a tracking and feedback mechanism for evaluation outcomes must be established. Long-term monitoring of graduates' career development will validate the scientific rigor and effectiveness of these standards. Furthermore, sensitivity to emerging technologies and tools is essential, ensuring new industry requirements are promptly integrated into the evaluation framework to keep standards aligned with contemporary advancements.

5.3 Real-Time Updates to Course Syllabi

The effectiveness of reforms in environmental design quick-design courses ultimately depends on systematic, scientifically grounded syllabi. In the digital age, syllabus updates should no longer be periodic revisions but rather a dynamic process of continuous optimization. This ensures teaching content remains aligned with technological advancements and industry demands.

Establishing a dynamic adjustment mechanism for course content is the primary task. This mechanism should incorporate regular industry demand surveys, analysis of technological trends, and collection of graduate feedback. By forging close partnerships with enterprises, institutions can promptly understand shifts in industry expectations for talent competencies; by tracking cutting-edge technological developments, they can anticipate future technical demands in the design field; and by monitoring graduates' career trajectories, they can validate the practicality and foresight of course content. Based on this information, the curriculum team should make minor adjustments to teaching content each semester and conduct systematic evaluations annually to ensure the curriculum remains aligned with industry developments. For instance, when the increasing adoption of parametric design and generative design in the industry is observed, relevant content and training modules should be promptly incorporated into the curriculum.

Building a modular curriculum structure is an effective strategy for maintaining flexibility. Traditional linear structures struggle to adapt swiftly to technological advancements and shifting demands, whereas modular design significantly enhances curriculum update efficiency. Quick-design courses can be decomposed into three tiers: foundational modules, core modules, and extension modules. Foundational modules focus on cultivating fundamental skills like spatial cognition and design communication; core modules train comprehensive design abilities through diverse project types; extension modules address emerging topics such as AI-assisted design, sustainable design, and digital construction based on technological progress and industry needs. This modular structure enables curriculum updates by adjusting or replacing specific modules without disrupting the overall framework, greatly enhancing the program's contemporary relevance.

Deepening the organic integration of AI technology with the curriculum requires systematic planning. Course outlines should clearly define the application objectives and specific requirements for AI technology across different teaching phases. During the foundational training stage, AI-assisted concept generation tools can be introduced to help students rapidly expand their design thinking. During the scheme refinement stage, AI analysis tools can be employed for performance optimization and comparative evaluations; in the design presentation phase, AI rendering tools can enhance visualization efficiency. Concurrently, emphasis must be placed on cultivating students' critical use of AI technology,

including establishing evaluation criteria for generated outputs and ethical considerations in technological application. These elements should be explicitly outlined in the syllabus, accompanied by corresponding teaching activities and assessment standards.

Summary

The core lies in establishing a new course paradigm centered on "AI-empowered, competition-driven" education. This paradigm reverses the traditional quick-design course's overreliance on hand-drawn representation and individual experience. By deeply embedding intelligent tools—such as generative AI and parametric analysis—throughout the entire process from concept generation to technical refinement, the course successfully shifts the teaching focus from proficiency in drawing completion to high-quality innovative thinking. The introduction of academic competitions provides this new paradigm with authentic, high-standard application scenarios, enabling seamless alignment between course instruction and cutting-edge industry demands and academic innovation trends.

Looking ahead, the exploration initiated by this research holds profound significance. As AI technology continues to evolve and deepen its integration with environmental design, the human-machine collaborative creative process, the definition of design originality, and the corresponding ethical frameworks will emerge as critical areas warranting sustained research attention.

Qualified Course:

SJC4153 Creative Design Sketch – School of Creativity and Design, Environmental Design Major.

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