CINEFORUM
ISSN: 0009-7039
Vol. 65. No. 4, 2025

A Study of Artificial Intelligence Generated Content Restructuring Teaching Models in Environmental Design Education: Concepts, Case Studies, and Implementation Pathways

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Abstract

The powerful momentum by artificial intelligence generated content is driving the restructuring of teaching models in environmental design programs at universities. This study proposes a "6-level and 22-dimension" framework through which artificial intelligence generated content reshapes the teaching model of environmental design in higher education. The six levels comprise:(a) teaching concept, centered on teaching objectives, learning modes, and teacher–student relationships; (b) teaching content, centered on the structuring of knowledge systems, the multimodalization of resources, and the intelligent content supply; (c) teaching methods, centered on generation-driven learning, human–AI collaborative learning, and task chain–based instruction; (d) teaching processes, forming a closed loop that includes Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment, and Summary; (e) teaching contexts, centered on smart classroom scenarios, online immersive scenarios, and virtual industrial-chain scenarios; and (f) teaching assessment, centered on whole-process evaluation, multidimensional evaluation, and AI-assisted evaluation. Drawing on foundational disciplinary courses, core professional courses, and practice-based courses in environmental design, the study employs this systematic analytical framework to examine the characteristics and alignment patterns of typical cases. It then proposes four strategic responses:conducting intelligent design training and optimizing the interface between digital and physical design, promoting human–AI co-evaluation to enhance critical cognitive abilities,developing personalized learning pathways supported by multidimensional dynamic assessment, and integrating cross-modal resources to enable intelligent practice simulations. These findings provide theoretical and practical references for the digital transformation of environmental design education in Chinese higher education institutions.

Keywords: Artificial Intelligence Generated Content, environmental design, Chinese universities, teaching models, human–AI collaboration

Funding: This publication has been funded by Heilongjiang Provincial Higher Education Teaching Reform Research Project. *Research on the digital transformation path and application of Artificial Intelligence Generated Content (AIGC)-empowered teaching models in environmental design*. (Project No.: SJGYB2024353); Higher Education Research Project of Heilongjiang Provincial Higher Education Association. *Research and practice of the "teacher-machine-student" tripartite interactive teaching model in environmental design empowered by Artificial Intelligence Generated Content* (AIGC). (Project No.: 24GJZXC037).

1. Introduction

The 2025 World Digital Education Conference, under the theme "Educational Development and Change: The Intelligent Age," emphasized that digital technologies centered on artificial intelligence are profoundly reshaping teaching models in higher education, triggering systemic transformations across the entire chain of "teaching–learning–management–assessment–research" (Liu et al.,2025). Luckin (2019), Holmes (2022), and Wessels (2025) pointed out that by promoting the co-evolution of "human–machine–environment" interactions, AI reconstructs the logic of instructional design and the system of teacher roles, shifting educational activities from "imitative reproduction" to "co-creative production," thereby forming a new intelligent teaching paradigm characterized by adaptability and high engagement. Tang and Luo (2025), from the perspectives of information technology and data technology, elucidated the value implications, generative logic, and implementation pathways of teaching model reform. However, teaching models possess distinct temporal attributes and must be adjusted in tandem with technological advancements and the structure of talent demands (Hu, 2008). Since November 2022, Artificial Intelligence Generated Content (AIGC), represented by ChatGPT and DeepSeek, has rapidly garnered educational attention due to its capabilities in language representation, knowledge reasoning, and cross-modal generation. Based on generative adversarial networks and large pre-trained models, AIGC learns from, abstracts, and generalizes vast datasets to generate multimodal content. Its powerful impetus has triggered changes in the demand for human capital in higher education, compelling the systemic reshaping of teaching models in universities.

The major of Environmental Design integrates artistic creativity, technical practicality, and social applicability, characterized by high interdisciplinary integration, short knowledge iteration cycles, and strong practice orientation. Traditional teaching models face structural bottlenecks in curriculum content iteration, methodological innovation, intelligent resource integration, and the cultivation of innovative design talents, making it difficult to meet the demand for training interdisciplinary innovative design talents. Although present studies have explored the opportunities, challenges, and countermeasures of AIGC for the education system from a macro perspective (Liu et al., 2024;Yang et al.,2023;Zhang,2023), significant gaps remain in systematic research on design-related majors, and it is still hard to find first-hand evidence based on teaching practice, and the construction of a systematic teaching model framework.

Based on this, this study systematically reviews the content of how AIGC is reshaping the teaching model of environmental design in higher education, analyzes key challenges through typical teaching case studies, and proposes strategies to address these challenges. It aims to provide a theoretical basis and path reference for the restructuring of teaching models in the field of environmental design.

2. Research Design

2.1 Research Methods

The systematic literature review method is a research approach that establishes logical connections between the literature through content analysis and bibliometrics, aiming to systematically address specific research questions. This article adopts the systematic literature review method to organize domestic and international primary research evidence, providing a systematic reference for addressing the content, cases, and pathways of how AIGC is reshaping the teaching model of environmental design in higher education.

2.2 Sample Collection

To obtain high-quality literature on the impact of AIGC on the teaching model of environmental design in higher education, the article conducted a thematic search using the keywords “Artificial Intelligence Generated Content,” “Large Language Model,” “Higher Education,” “Environmental Design,” in Web of Science, Google Scholar, and CNKI. A total of 1,453 Chinese and English articles were retrieved. To ensure the accuracy and reliability of the literature analysis results, the following exclusion criteria were established (Indriasari,T.D., 2020): (1) Non-Chinese or English literature; (2) Non-CSSCI, SSCI, or SCI literature; (3) Articles with fewer than 3 pages; (4) Literature not focused on AIGC and environmental design education in higher education. Based on these exclusion criteria, 35 high-quality articles were selected.

3. The Connotation of Artificial Intelligence Generated Content in Reshaping the Teaching Model of Environmental Design

The concept of the “teaching model” was first proposed by Joyce and Weil (1972); its core emphasizes the structuring of the teaching system and the normativity of methodology, providing systematic support for the construction of instructional theory in higher education

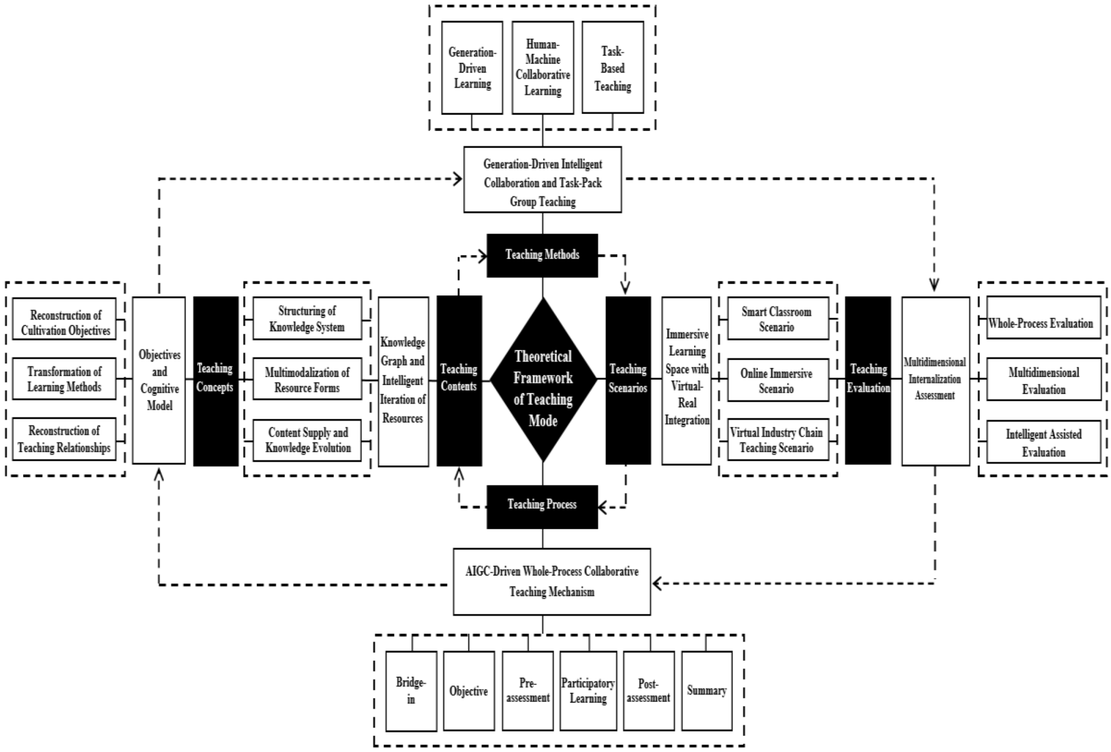
CINEFORUM
ISSN: 0009-7039
Vol. 65. No. 4, 2025

disciplines (Lin, 2025). Wu et al. (2024) point out that the essence of the digital transformation of education lies in the holistic, intelligent reconstruction of the educational system, whose core goal is to promote systematic reform of teaching objectives, teaching content, teaching methods, teaching processes, teaching spaces, and teaching evaluation through intelligent technologies. In line with this logic, the teaching model of the environmental design major is not only the explicit form of curriculum organization and instructional implementation, but also the internal logical mechanism for integrating the professional knowledge system, generating design competence, and fostering practice-oriented training. Spady's (1981) outcomes-based education (OBE) proposes that teaching in environmental design programs should follow a systemically consistent framework of "objectives–content–methods–process–environment–evaluation," emphasizing the measurability of learning outcomes, the verifiability of competence attainment, and the traceability of the teaching process. On this basis, Jiang (2025) argues that, in the era of artificial intelligence, the teaching model of the environmental design major should achieve a systematic reshaping of concept, content, methods, processes, scenarios, and evaluation, in order to respond comprehensively to the paradigm shifts in teaching triggered by digital technologies. Drawing on Li's theory of the "six elements of the teaching model," Yi and Han (2025) construct a new AIGC-driven instructional model and propose a systematic generative framework centered on "concept–content–methods–process–scenarios–evaluation."

Building on this, the article systematically analyzes 35 high-quality studies and identifies"teaching concept–teaching content–teaching methods–teaching process–teaching scenarios–teaching evaluation" as the underlying analytical framework, on the basis of which it constructs the connotation of the teaching model for the environmental design major (see Figure 1). Specifically, at the level of teaching concept, and grounded in constructivist learning theory, the model reshapes educational objectives and cognitive paradigms by decomposing teaching concept into three sub-dimensions—cultivation objectives, learning modes, and teacher–student relationships—thereby promoting a transformation of cultivation objectives toward "intelligent-driven and innovation-oriented," learning modes toward "intelligent interaction and knowledge co-creation," and teacher–student relationships toward "human–AI collaboration and co-teaching/co-education" (Yuan et al., 2025). At the level of teaching content, drawing on knowledge graphs and multimodal generation theory, teaching content is expanded into three aspects—structuring of the knowledge system, multimodalization of resources, and intelligent evolution of content provision—highlighting the role of AIGC in knowledge generation and continuous updating (Yu &Wang,2025). At the level of teaching methods, based on generative learning theory, teaching methods are categorized into generative-driven learning, human–AI collaborative learning, and task chain–based instruction,

CINEFORUM
ISSN: 0009-7039
Vol. 65. No. 4, 2025

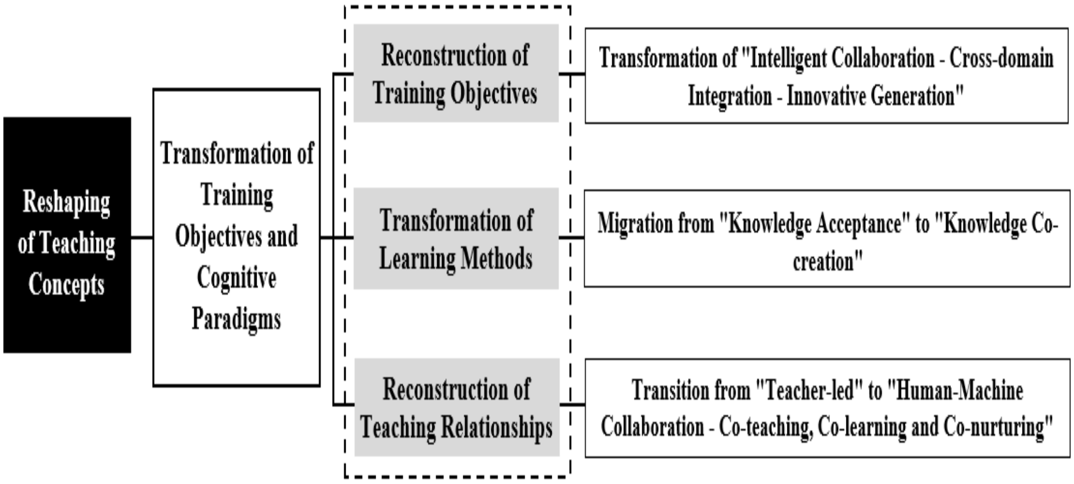
emphasizing the autonomy, exploratoriness, and creativity of the learning process, while using intelligent feedback to achieve the dynamic optimization of learning paths (Lu&Tang,2025). At the level of teaching process, drawing on the BOPPPS model and cognitive development theory, the teaching process is designed as a closed-loop system of “Bridge-in—Objective—Pre-assessment—Participatory Learning—Post-assessment—Summary,” thereby optimizing the entire process from course introduction to summative feedback (Zhang, 2022). At the level of teaching scenarios, on the basis of educational ecology theory, teaching scenarios are structured as smart classrooms, online immersive platforms, and virtual industrial-chain teaching environments, in order to foster a deeply integrated virtual–physical learning experience (Yang, 2024). At the level of teaching evaluation, supported by learning analytics and intelligent assessment theory, evaluation is expanded into process-based, multidimensional, and intelligently assisted evaluation, facilitating a shift from static outcome assessment to dynamic learning analytics and thereby constructing a systematic, intelligent, and developmental evaluation system (Yu et al., 2024).



<Figure1> The Connotation of AIGC Reshaping the Teaching Model of Environmental Design Major

3.1 Reshaping Teaching Concept: Transformation of Training Objectives and Cognitive Paradigms

In university environmental design major, teaching concepts urgently need to be repositioned around higher-order thinking and professional creativity—domains in which artificial intelligence is still difficult to replace(Zheng,2025). Unlike earlier intelligent technologies that served only auxiliary and instrumental functions, AIGC has become deeply involved in processes of knowledge construction, creative generating, and design expression, thereby placing systematic demands for change on talent-training objectives, learning paradigms, and teacher–student relationships (see Figure 2).



<Figure2> The Reshaping of Teaching Concepts

1) Reconstruction of Training Objectives: Transformation from “Skill-Based” to “Intelligent Collaboration—Cross-Domain Integration—Innovative Generation”

AIGC drives the transformation of training objectives in environmental design major from a focus on single-skill training to a composite ability structure of “intelligent collaboration—cross-domain integration—innovative generation.” First, professional capabilities are expanded from the traditional “tool operation—result presentation” to a multidimensional ability system of “intelligent generation—logical reasoning—creative expression,” emphasizing students’ ability to form advanced design reasoning and expression through text and image generation, parametric design, and AI-assisted decision-making technologies. Second, interdisciplinary integration ability is restructured into a three-dimensional framework of “design thinking + technological literacy + humanistic awareness,” enabling students to make value judgments, design adjustments, and system integration in complex contexts. Third, practical innovation ability forms a dynamic practice feedback loop of “perception—generation—feedback—optimization” under the “project-driven—task chain-driven—intelligent collaboration” mechanism, strengthening students’ abilities in solution iteration, resource integration, and outcome transformation.

2) Transformation of Cognitive Paradigms: Shift from “Knowledge Reception” to “Knowledge Co-Creation”

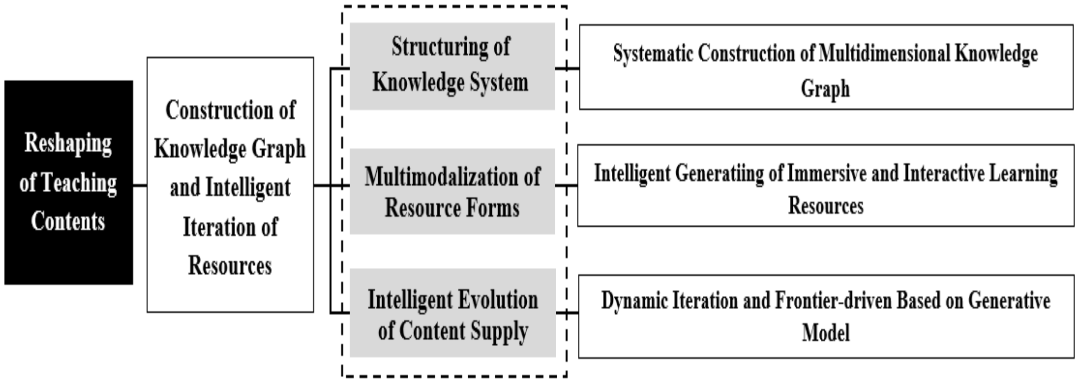
AIGC drives the transformation of learning methods in environmental design major from linear, receptive learning to generative, inquiry-based, and collaborative learning. First, cognitive processing shifts from "passive absorption" to "active construction"based on intelligent generation, multimodal interaction, and real-time feedback, forming a generative, nonlinear, and iterative cognitive structure. Second, the knowledge construction model evolves from individual learning to a collaborative cycle of "intelligent interaction—multiple feedback—knowledge generation—transfer application," with students gradually becoming co-creators of knowledge. Third, learning pathways become highly personalized and adaptively optimized, allowing students to independently plan advanced routes based on their interests, abilities, and goals. With the assistance of intelligent agents, students can make real-time corrections and deep optimizations to their learning strategies, thereby enhancing overall learning effectiveness.

3) Reconstruction of Teaching Relationships: Transition from "Teacher-Led" to "Human-Machine Collaboration—Co-Teaching, Co-Learning, and Co-Cultivation"

AIGC facilitates the formation of a tripartite collaborative teaching relationship among "teachers, students, and intelligent agents." Teachers have transformed from knowledge transmitters to learning designers, intelligent guides, and value constructors; students have shifted from passive knowledge recipients to learning subjects and co-creators of design; AIGC, as an intelligent collaborative entity for cognitive enhancement and content generation, undertakes functions such as knowledge production, design reasoning, feedback optimization, and dynamic evaluation. These three parties jointly form a collaborative structure of "co-teaching, co-learning, and co-cultivation," driving the continuous evolution of teaching concepts toward intelligence, interactivity, and generativity.

3.2 Reshaping Teaching Content: Knowledge Graph Construction and Intelligent Resource Iteration

Research indicates that universities still face issues such as insufficient awareness and inadequate resource supply in the construction of digital and intelligent course content, with high-quality teaching materials being structurally scarce (Dziuban et al., 2004). AIGC, with its powerful multimodal content generation capabilities, enables the efficient production of resources such as text, images, 3D models, and data visualizations. Through a human-machine collaborative content co-creation mechanism, it facilitates the structural optimization of knowledge systems, multimodal expansion of resource forms, and dynamic iteration and updating of content supply (see Figure 3).



<Figure3> The Reshaping of Teaching Contents

1）Structuralization of Knowledge Systems:Systematic Construction of Multidimensional Knowledge Graphs

AIGC drives the transformation of the knowledge system in environmental design from “linear transmission—static accumulation” to “graph organization—dynamic evolution.” Leveraging natural language processing, semantic analysis, and knowledge representation technologies, multidimensional knowledge graphs can be constructed to cover the major fields of environmental design, forming semantic relationships, hierarchical structures, and visual connections between knowledge nodes. This graph centers on spatial composition, environmental psychology, construction technology, digital modeling, and expression methods, while also integrating relevant knowledge from architecture, urban planning, art history, and intelligent design technologies, thereby building a triadic collaborative knowledge structure system of “design—technology—humanities.”

2) Multimodalization of Resource Forms:Intelligent Generation of Immersive and Interactive Learning Resources

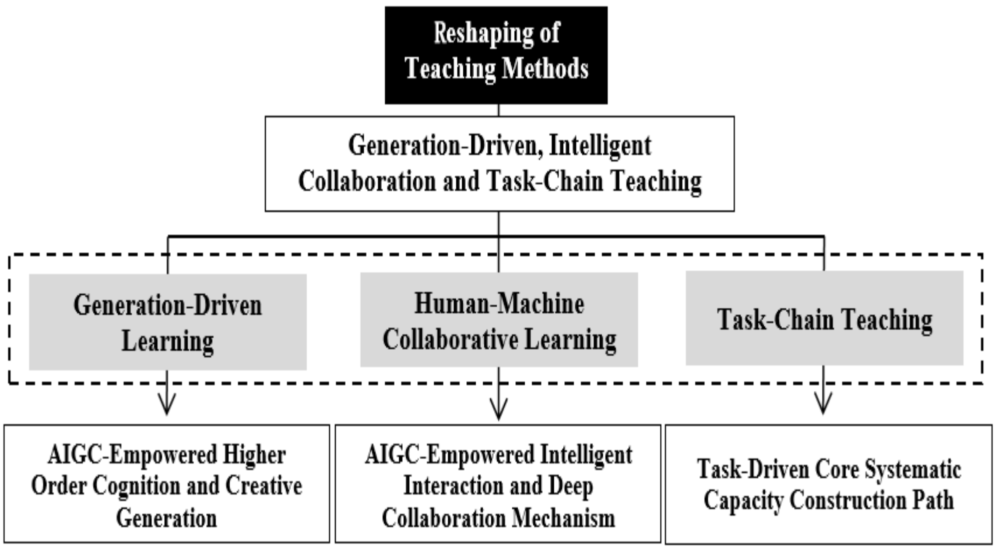
AIGC drives the transformation of teaching resources from “single media—static text” to “multimodal integration—immersive interaction.” Leveraging text generation, image synthesis, audio-video production, and 3D modeling, an immersive resource system can be constructed, covering “concept explanation—spatial demonstration—experience simulation—interactive feedback.” Images, animations, and dynamic visualizations are used to clearly present design concepts and shape evolution, while 3D models and virtual simulations enhance spatial understanding and operational experience. Audio-video resources support scene construction and user experience expression. At the same time, AIGC provides intelligent resource recommendations based on learning objectives and individual differences, enabling dynamic resource matching and adaptive optimization, thereby enhancing the effectiveness and immersion of personalized learning.

3) Intelligent Evolution of Content Supply:Dynamic Iteration and Frontier-Driven Based on Generative Models

AIGC shifts the content supply model from “teacher-led—static distribution” to “data-driven—intelligent generation.” Through big data analysis and machine learning algorithms, the system can form learning profiles based on students’ learning paths, interests, and knowledge mastery, enabling content demand prediction and precise adaptation. The intelligent recommendation engine dynamically integrates theoretical knowledge, case resources, interactive simulations, and multimedia materials, creating a content supply feedback loop of “perception-driven—demand matching—content generation—feedback optimization.” Additionally, AIGC leverages deep learning and semantic understanding technologies to achieve multi-source data fusion, continuously generating and updating cutting-edge theories, design methods, and application cases, thereby constructing an evolving system of “knowledge updates—resource optimization—content iteration” to enable real-time updates and frontier leadership of teaching content.

3.3 Reshaping Teaching Methods: Generation-Driven, Intelligent Collaboration, and Task-Chain Teaching

Traditional teaching methods, centered around teacher lectures and result presentation, struggle to effectively support the development of students’ higher-order thinking, active inquiry skills, and full participation in complex design tasks (Emerson et al., 2020). The reshaping of teaching methods empowered by AIGC optimizes teaching strategies, interaction mechanisms, and learning organization methods, shifting the learning paradigm from one-way knowledge transmission to a systematic transformation toward generation-driven learning, human-machine collaborative learning, and task-chain-based teaching (see Figure 4).



<Figure4> The Reshaping of Teaching Methods

1) Generation-Driven Learning: AIGC-Empowered Higher-Order Cognition and Creative Generation

AIGC drives the formation of a generation-driven learning model, utilizing intelligent generation technologies to achieve the personalized and dynamic presentation of teaching materials, including virtual scenes, design demonstrations, semantic knowledge graphs, and 3D models, among other multimodal expressions. This enhances the visualization, contextualization, and immersion of course content. Students use AIGC to engage in concept divergence, form exploration, and solution modeling, constructing a "teacher—machine—student" co-creation learning structure. Through the "generation—feedback—optimization" cycle, students achieve the construction of design logic, reinforcement of expression language, and improvement of cross-domain integration abilities, completing the cognitive leap from passive learning to higher-order generation.

2) Human-Machine Collaborative Learning:AIGC-Empowered Intelligent Interaction and Deep Collaboration Mechanisms

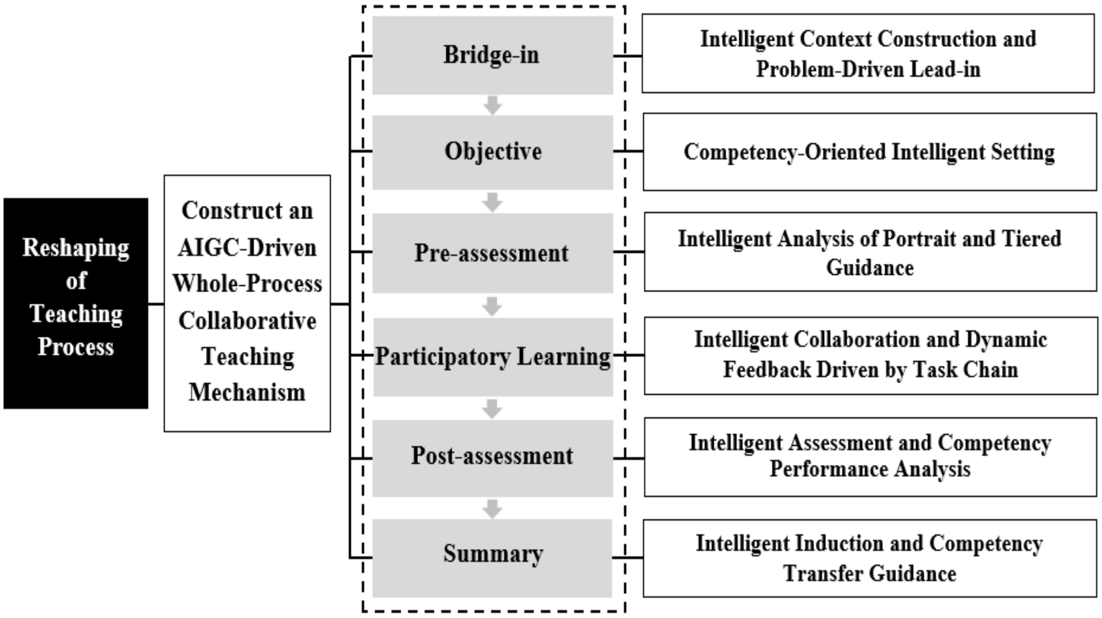
Human-machine collaborative learning relies on AIGC's intelligent resource generation, multimodal interaction, behavior analysis, and personalized feedback to achieve a collaborative loop of "task-driven—co-generation—feedback optimization." Teachers, with the assistance of AIGC, complete task design, knowledge organization, learning monitoring, and intelligent support, guiding students in creative ideation, model construction, and multi-agent co-creation activities within virtual workshops, immersive interactive environments, and cross-temporal collaboration platforms. The intelligent system, through dynamic analysis and feedback support of the learning process, facilitates the deep integration of teacher guidance, student participation, and system support, promoting the systematization, dynamization, and collaboration of knowledge construction and ability development.

3) Task-Chain-Based Teaching:Systematic Competency Development Centered on Task-Driven Learning

AIGC-powered task-chain-based teaching transforms the organization of teaching from "fragmented execution—linear progression" to "systematic construction—intelligent collaboration" through intelligent task generation, virtual scenario design, real-time behavior data collection, and dynamic assessment. Teachers, with the support of AIGC, build a complete task-chain logic, including scenario setting, design requirements, technical support, and evaluation criteria, ensuring the closed-loop and practice-oriented nature of the task chain. Students complete tasks in each phase with support from the intelligent system, which provides immediate, process-based, and diagnostic feedback, creating a dynamic learning mechanism of "real tasks—intelligent support—competency achievement," promoting the structured mastery of professional knowledge and the transfer and application of design skills.

3.4 Reshaping Teaching Processes:AIGC-Driven Collaborative Teaching Mechanism Throughout the Entire Process

The existing teaching processes in university environmental design programs generally rely on linear transmission-based teaching and stage-based assessments, lacking real-time monitoring and dynamic adjustments of the learning process. This hinders the development of students' higher-order thinking and the improvement of teaching interaction quality (Lin&Yang, 2023). The AIGC-empowered teaching process, based on the BOPPPS model, constructs a collaborative teaching mechanism that spans the entire process, including "Bridge-in—Objective—Pre-assessment—Participatory Learning—Post-assessment—Summary"(see Figure 5).



<Figure5> The Reshaping of Teaching Process

1) Bridge-in:Intelligent Text Construction and Problem-Driven Lead-in

AIGC utilizes natural language generation, image synthesis, 3D modeling, and semantic analysis to achieve "intelligent scenario creation—task-driven introduction—cognitive activation transformation" in the course introduction phase. Teachers generate immersive scenario materials based on teaching objectives and student characteristics, enhancing the authenticity, visualization, and inspiration of the course. AIGC, based on learning data and interest preferences, intelligently pushes personalized introductory content, establishing a "scenario—task—cognition" linkage mechanism. Additionally, the system automatically constructs course knowledge graphs and pre-resources chains, improving the systematization of students" cognitive preparation and the controllability of learning pathways.

2) Objective: Competency-Oriented Intelligent Setting

AIGC, leveraging natural language processing, semantic recognition, and hierarchical analysis, constructs a "cognitive—skills—affective" three-dimensional learning objective system. It also supports teachers in breaking down and logically mapping objectives, transforming abstract competency indicators into executable learning requirements. The system dynamically matches goal paths and adjusts goal difficulty in real-time based on students' cognitive characteristics, competency levels, and individual needs, creating a "smart matching—dynamic adjustment—visual monitoring" goal management mechanism. This ensures that goal setting is both professionally logical and adaptable to individual differences.

3) Pre-assessment:Intelligent Analysis of Portrait and Tiered Guidance

AIGC, based on learning analytics, multimodal data modeling, and semantic reco gnition technologies, conducts in-depth analysis of students' behavior data,knowledge mastery, and cognitive preferences to generate learning profiles and provide precise d iagnostics. Based on the diagnostic results, the system can automatically generate pre -assessment tasks, create targeted learning reports, and push differentiated learning res ources and tiered guidance paths, forming a "data-driven—intelligent diagnosis—tiered guidance" pre-class preparation mechanism,enhancing the relevance and effectiveness of classroom teaching.

4) Participatory Learning:Intelligent Collaboration and Dynamic Feedback Driven by Task Chains

AIGC reconstructs participatory learning through "task-chain guidance—intelligent collaboration—dynamic feedback," supporting teachers in building a logically progre ssive task chain consisting of learning objectives, design requirements, tool recommen dations, and evaluation criteria, thereby forming a structured learning loop. With the assistance of the intelligent system, students complete inquiry, creation, and expressio n tasks, while the system generates personalized feedback based on behavior data col lection, interaction trajectory analysis, and process diagnostics. Additionally, it pushes case resources, design paradigms, and technical tools based on the learning status, cr eating a "problem-driven—intelligent generation—collaborative innovation" learning ec osystem.

5) Post-assessment:Evaluation and Competency Performance Analysis

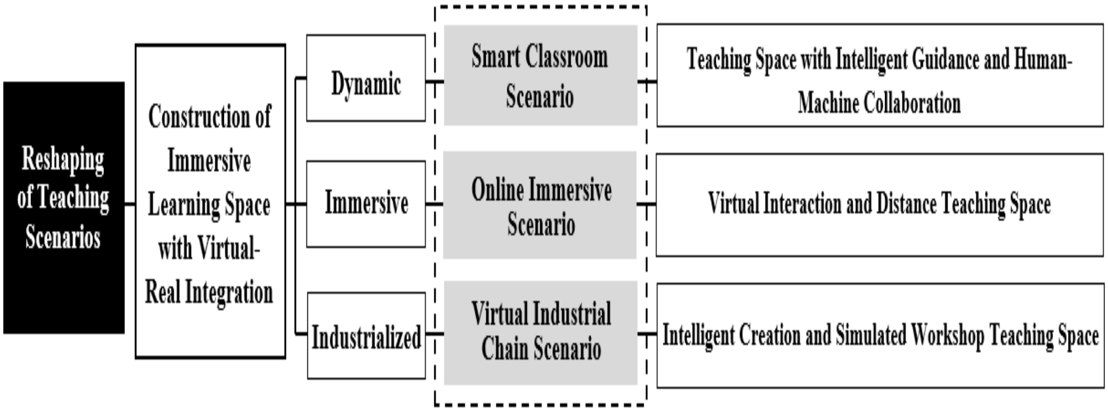
AIGC utilizes natural language processing, image recognition, and behavior analysis to build an intelligent assessment system, enabling automatic grading of open-ended questions, design evaluation, and learning trajectory analysis. This system performs multidimensional measurement of students' knowledge, skill application, and overall competency. It generates student competency profiles and growth paths, transforming assessment from outcome-based evaluation to process diagnosis and competency development. Teachers, based on intelligent analysis results, implement refined interventions and create personalized tutoring plans, forming a feedback loop of "assessment—diagnosis—feedback—optimization."

6) Summary: Intelligent Induction and Competency Transfer Guidance

AIGC analyzes and models students' task execution, interactive behavior, and generative outcomes, automatically generating knowledge graphs, competency structure maps, and learning profiles to provide teachers with scientific bases for learning summaries and transfer guidance. The system, based on students' competency structures, pushes related tasks, application cases, and optimization suggestions, creating an intelligent enhancement mechanism of "knowledge integration—competency transfer—literacy improvement." This guides students to systematically organize knowledge, identify competency gaps, and plan development paths. With the support of the intelligent system, teachers implement personalized guidance, promote student self-reflection and cross-context transfer, and achieve dynamic summarization and value-added outcomes in the conclusion phase.

3.5 Reshaping Teaching Scenarios:Construction of Immersive Learning Space with Virtual-Physical Integration

AIGC reshapes the teaching scenarios in university environmental design programs, presenting a trend of "dynamic—immersive—industrialized" system reconstruction (Xing et al., 2025). By deeply integrating real-world scenes with virtual spaces, clear learning tasks with open-ended social contexts, it forms an intelligent cognitive learning space represented by the "smart classroom scene," a virtual interactive learning space represented by the "online immersive scene," and a productive learning space in the form of a "virtual industrial chain scene"represented by a simulated workshop (see Figure 6).



<Figure6> The Reshaping of Teaching Scenarios

1) Smart Classroom Scenario:Teaching Space with Intelligent Guidance and Human-Machine Collaboration

The smart classroom empowered by AIGC drives the transformation of the environmental design teaching from the traditional "teacher-centered—content delivery"model to "intelligent guidance—collaborative generation—dynamic feedback."

Teachers use multimodal modeling, visualized reasoning, and real-time rendering technologies to efficiently construct the course knowledge structure, spatial simulation scenarios, and 3D model resources, thereby enhancing the visual expression and immersive experience in the classroom. With the support of intelligent tools, students participate in task-driven, contextualized, and project-based learning, and through conceptual design, spatial reasoning, and iterative solutions, form a knowledge construction path of “teacher-guided—AI-assisted—student-led.”

2) Online Immersive Scenario:Virtual Interaction and Distance Teaching Space

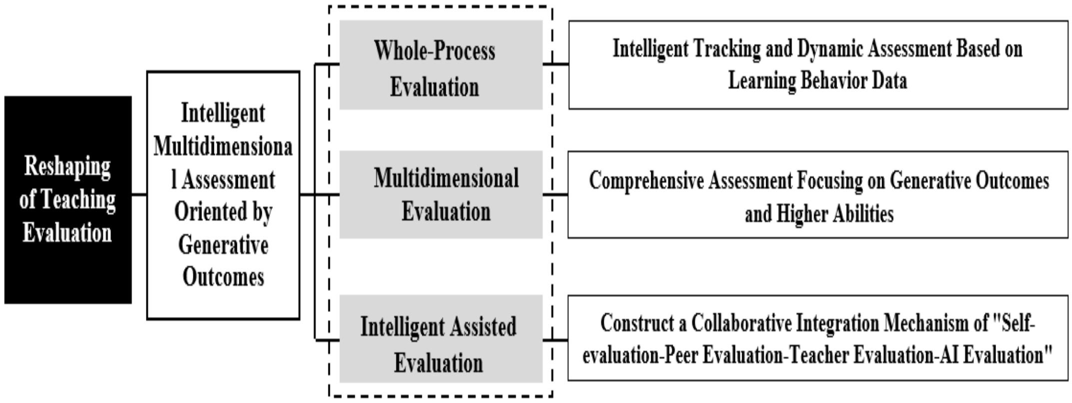
AIGC-Supported Online Immersive Teaching Scenarios achieve the Paradigm Upgrade of Teaching Models from “Two-Dimensional Presentation—One-Way Transmission” to “Immersive Interaction—Intelligent Collaboration.” In virtual classrooms, students engage in project discussions, creative collaboration, model review, and achievement presentation. Through real-time interaction with AI agents and peers, they realize an online learning model characterized by “Virtual-Real Integration—Task-Driven—Generative Feedback.” Based on learning behavior data, AIGC conducts dynamic identification and intelligent push, providing students with personalized learning pathways, resource recommendations, and scheme optimization, thus forming an online learning closed loop covering “Knowledge Acquisition—Skill Training—Achievement Generation.”

3)Virtual Industrial Chain Scenario:Intelligent Creation and Simulated Workshop Teaching Space

The virtual industrial chain teaching scenario constructed by AIGC reproduces the complete design and production process from “concept generation-scheme construction-parametric modeling-rendering expression-interactive testing-virtual delivery” in a highly simulated manner.Integrating technologies such as AI image generation, material rendering, user experience testing, and intelligent evaluation, it forms a systematic virtual design and production environment. Students complete the whole-process training from creative conceptualization to virtual implementation in the form of project-based learning, mastering industrial logic, method systems, and delivery processes, and enhancing their understanding and adaptability to the real industry ecosystem. Meanwhile, the platform can access enterprise task libraries, industry specifications, and real cases, realizing a collaborative mechanism of “teaching tasks—industry cases—intelligent delivery.”

3.6 Reshaping of Teaching Evaluation:Intelligent Multidimensional Assessment Oriented by Generative Outcomes

For a long time, the teaching evaluation of environmental design majors in universities has had structural problems such as overemphasizing “knowledge” while neglecting “abilities,” a single evaluation dimension, and delayed feedback (Zhang, 2023). The reshaping of teaching evaluation in environmental design majors by AIGC achieves a systematic transformation of the evaluation mechanism from a single summative evaluation to whole-process evaluation, multi-dimensional evaluation, and intelligent-assisted evaluation through intelligent means and generative outcome orientation (see Figure 7).



<Figure7>The Reshaping of Teaching Evaluation

1) Whole-Process Evaluation:Intelligent Tracking and Dynamic Assessment Based on Learning Behavior Data

AIGC-empowered whole-process evaluation relies on learning behavior data colle ction, process analysis, and intelligent diagnosis technologies to achieve real-time mo nitoring of students' behavioral paths, task execution efficiency, interaction depth, and cognitive engagement during learning. By modeling learning data, the system accura tely identifies students' strengths and weaknesses in knowledge, skill application, and thinking development, and provides actionable improvement suggestions based on dia gnostic results, forming a continuous evaluation closed loop of "behavioral monitorin g—competency diagnosis—immediate feedback."

2) Multidimensional Evaluation:Comprehensive Assessment Focusing on Generative Outcomes and Higher Abilities

AIGC-supported multi-Dimensional evaluation system takes"achievement performance—process participation—human-machine collaboration" as the core, forming a comprehensive evaluation covering the entire chain of content, process, and technology. At the achievement level, evaluation is conducted based on the originality, aesthetic expression, feasibility, and social value of works, emphasizing the requirements for the comprehensive quality of design achievements; at the process level, real-time data collection is used to track students' participation depth, problem-solving strategies, and exploration paths in task execution, highlighting the transparency and evaluability of the learning process; at the human-machine collaboration level, the focus is on evaluating students' technical literacy and integration capabilities in creative generation, model construction, scheme iteration, and collaborative optimization.

3) Intelligent Assisted Evaluation: Construction of a Collaborative Integration Mechanism of "Self-evaluation-Peer Evaluation-Teacher Evaluation-AI Evaluation"

AIGC-Enpwered intelligent-assisted evaluation forms a multi-subject collaborative evaluation mechanism through efficient analysis, intelligent scoring, and personalized feedback on students' generative outcomes. In the self-evaluation phase, AIGC guides students to conduct outcome reflection, strategy reconstruction, and cognitive transfer, promoting the development of metacognitive abilities; in the peer evaluation phase, the intelligent system improves the objectivity and consistency of peer evaluation through task assignment and scoring calibration; in the teacher evaluation phase, AIGC assists teachers in conducting in-depth analysis of complex spatial design outcomes, enhancing the professionalism and reliability of evaluation; at the AI evaluation level, the system generates comprehensive competency profiles and growth curves based on learning behaviors and outcome indicators, driving an intelligent closed loop of "diagnosis—feedback—improvement."

4.A Case Study of Artificial Intelligence Generated Content Reshaping the Teaching Model of Environmental Design

This study takes three types of typical courses in the environmental design major as research samples, including:a foundational discipline course, Principles of Landscape Design; a required professional course, Residential Space Design; and a professional practice course, Skill Training (Sand Table Production). Based on previous teaching practice experience, this study systematically analyzes the characteristics of typical teaching cases (see Table 1) using the specific manifestations of AIGC reshaping the teaching model of environmental design as a framework.

[Table 1] Analysis of Typical Teaching Cases

Levels and Dimensions		Foundational Discipline Course *Principles of Landscape Design*	Required Professional Course *Residential Space Design*	Professional Practice Course *Skill Training (Sand Table Production)*
Teaching Concepts	Reconstruction of Training Objectives	From "skill-oriented" to "intelligence-empowered—innovation-driven," emphasizing	From "functional layout" to "experience innovation—intelligent verification," highlighting user experience and digital validation	From "craftsmanship training" to "intelligent manufacturing—process innovation," emphasizing digital processing, material understanding, and

		landscape system analysis and intelligent generation capabilities		structural optimization
	Transformation of Learning Methods	From "passive acceptance" to "case-oriented—generative co-creation,"achieving knowledge construction through case comparison and intelligent feedback	From "teacher-centered instruction"to "project-driven—collaborative co-creation," forming an iterative path of research—prototype—testing	From "repetitive practice"to "task chain collaboration—immediate feedback," achieving closed-loop learning through digital cutting and rapid prototyping
	Reconstruction of Teaching Relationships	Teachers transform from "knowledge transmitters" to "learning guides—intelligent collaborators"	Teachers transform from "design leaders" to "project mentors—industry connectors," participating in decision-making alongside AIGC	Teachers transform from "demonstrators" to "process supervisors—quality evaluators,"with AIGC assisting in precision and process control
Teaching Contents	Structuralization of Knowledge System	Constructing a knowledge graph of "theory—analysis—ecological strategies—case methods"	Constructing a design system of "user research—functional layout—detailed structure—environmental control"	Constructing a process system of "material technology—scale proportion—component production—safety specifications"
	Multimodalization of Resource Forms	Integrating text, images, 3D models, AIGC scenarios, and video resources	Adopting VR roaming, material samples, and interactive videos to enhance immersive experience	Integrating physical prototypes, CNC files, and assembly animations to achieve online-offline connection

	Content Supply and Knowledge Evolution	AIGC-driven theoretical updates and rapid case iteration	Introducing industry standards, innovative materials, and AIGC-assisted analysis	Integrating digital manufacturing processes with traditional craftsmanship, AIGC optimizes structural strategies
Teaching Methods	Generation-Driven Learning	On"problem—concept—genera-tion," AIGC provides drafts and analysi	AIGC assists in generating multiple versions of spatial schemes for students to screen and verify	Promoting process innovation through AIGC examples and parametric components
	Human-Machine Collaborative Learning	AIGC acts as a cognitive partner in ecological simulation and landscape generation	AIGC assists in photothermal analysis and behavior simulation to enhance design scientificity	AIGC-driven equipment control and parameter optimization to improve production precision
	Task Chain Teaching	Constructing a task chain of "analysis—generation—verification—presentation"	Forming a project closed loop of "research—design—rendering—testing—optimization"	Constructing a standardized process chain and schedule management system
Teaching Process	Bridge-in	Constructing problem scenarios with typical landscape cases and ecological issues	Introducing problem domains through user research and residential scenarios	Introducing process tasks through practical demonstrations and safety education
	Objective	Defining three-dimensional objectives (cognitive, skill, and innovative) oriented toward	Focusing on analytical, spatial organization, detailed structure, and expressive capabilities	Focusing on tool operation, material identification, and time management capabilities

		competence		
	Pre-assessment	AIGC analyzes students' learning profiles and provides tiered guidance	Assessing practical capabilities through sketches and research reports	Skill assessment and intelligent matching of group division of labor
	Participatory Learning	Task chain-driven collaborative discussions and on-site practice	Project-based team collaboration and real-scenario design	Combining tutorial system with workshop practice for real-time error correction and feedback
	Post-assessment	AIGC generates diagnostic reports to dynamically analyze learning performance	Generating comprehensive feedback through AIGC and expert evaluation	Adopting AIGC precision testing and process quality assessment
	Summary	Portfolio compilation and reflection on knowledge transfer	Peer review and design achievement presentation to promote capacity extension	Process review and manual compilation to realize knowledge precipitation
Teaching Scenarios	Smart Classroom Scenario	AIGC-assisted case retrieval and interactive projection supporting real-time generation	VR equipment and collaborative whiteboards facilitating visual reasoning	CNC equipment and display platforms supporting full-process demonstration teaching
	Online Immersive Scenario	VR/AR supporting virtual roaming and environmental simulation	Constructing virtual show flats and circulation testing	Cloud-based presentation and virtual sand table design drills
	Virtual Industrial Chain Scenario	Simulating the full-process connection of landscape design—construction	Covering full-chain drills of design, construction, and budget control	Reproducing the complete process of component production—assembly—transportation

Teaching Evaluation	Whole-Process Evaluation	AIGC tracks learning behaviors to achieve dynamic diagnosis	Phased milestones and joint evaluation by multiple subjects	Combining full-process process testing with summative presentation assessment
	Multidimensional Evaluation	Focusing on theoretical mastery, logical construction, ecological integration, and expressive collaboration	Focusing on functionality, experience, feasibility, and innovation	Focusing on precision, efficiency, innovation, and safe execution
	Intelligent Assisted Evaluation	AIGC evaluates similarity and performance indicators, with teachers making final remarks	AIGC simulates user behaviors and generates improvement reports	AIGC image recognition and dimension detection supporting process assessment

Source: Compiled from Relevant Teaching Practices and Literature

4.1Foundational Discipline Course:Principles of Landscape Design

To address the issues of abstract theories, fragmented knowledge, and inadequate application transfer in traditional landscape design theory teaching, this study constructs a multimodal landscape knowledge graph and generative learning system based on AIGC's knowledge modeling and intelligent generation capabilities, reshaping the curriculum's teaching structure and cognitive logic (Zhao & Chen, 2025). In teaching practice, AIGC is utilized to realize the visualized expression of hierarchical relationships, characteristics, and ecological logic of landscape systems, enabling students to complete knowledge integration and transfer through a cyclic learning chain of "theoretical understanding—case deduction—intelligent generation—scheme verification." The diverse scheme drafts generated by AIGC have promoted students' abilities in systematic thinking, ecological strategy integration, and innovative expression in complex scenarios.

Teaching practice results indicate that students have transformed from "knowledge recipient" to "knowledge co-creators," with their critical thinking and research awareness significantly enhanced. However, it has also been found that some students exhibit phenomena of "algorithm dependence" and "semantic deviation" in the screening of AI-generated results and theoretical analysis, failing to accurately grasp ecological logic and cultural imagery. This has led to a tendency of "formal rationality but semantic deficiency" in their design outcomes. Therefore, in subsequent teaching, it is necessary to strengthen teachers' guidance and critical evaluation mechanisms in the AI-assisted decision-making process, so as to achieve cognitive progress through human-AI collaboration.

4.2Required Professional Course: Residential Space Design

To address the issues in the Residential Space Design course, such as rigid thinking in functional layout, insufficient user experience analysis, and weak spatial logic deduction, AIGC is deeply integrated into the entire curriculum process, constructing a human-AI collaborative learning pathway of "scenario lead-in—intelligent generation—behavior simulation—optimization iteration" (Kurdi, Leo, Parsia, et al., 2020). Students use AIGC to generate spatial layout and visual drafts, and verify the livability of residential environments through VR roaming, behavior simulation, and comfort analysis, realizing a closed-loop learning process from intuitive creativity to experience feedback. Project-based team collaboration enables students to master comprehensive design capabilities, such as spatial organization, detailed structure, human-centered design, and visual expression, in the advancement of task chains.

The results of teaching practices show that AIGC has effectively enhanced students' spatial construction thinking, logical reasoning, and multimodal expression skills, while significantly improving classroom participation and the depth of design innovation. In particular, the parallel generation and comparison of multiple schemes have promoted students' ability to form scientific decision-making under multi-objective constraints. However, problems such as aesthetic convergence, over-reliance on AI drafts, and improper use of materials have also emerged, with some works showing a tendency of "strengthened visualization but weakened logic." To this end, the course plans to construct a three-stage review mechanism of "AIGC generation—manual revision—user feedback," ensuring that students maintain design subjectivity, aesthetic judgment, and humanistic value orientation under intelligent empowerment.

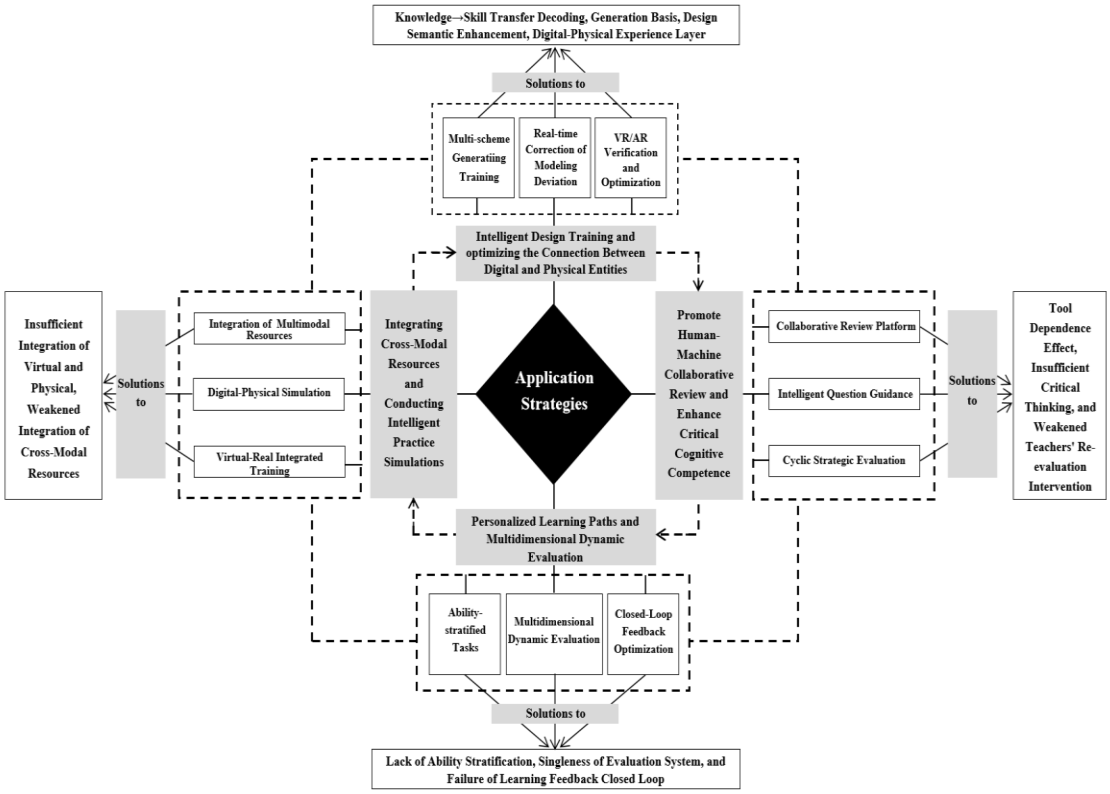
4.3Professional Practice Course: Skill Training (Sand Table Production)

To address the limitations of traditional sand table production courses, such as simplistic manual training, fragmented craft practice, and insufficient integration of digital technologies, this study constructs an intelligent craft learning system of "digital modeling—parametric generation—physical fabrication—process feedback" based on AIGC's 3D modeling and parametric expression capabilities, combined with constructivism and experiential learning theories (Rudolph & Tan,2023). In teaching practice, students first use AIGC to generate spatial models and component parameters, then complete physical construction using digital fabrication equipment such as CNC cutting and 3D printing. The system can real-time compare fabrication results with parametric models and generate error diagnosis reports, realizing a craft feedback chain of “process visualization—error perceptibility—quality traceability.” This initiative breaks the traditional “demonstration—imitation" model, promoting students to develop precision control, structural understanding, and craft innovation capabilities in virtual-real integrated practice.

Teaching practice results indicate that AIGC empowerment has significantly enhanced students’ comprehensive cognitive abilities regarding material properties, structural logic, and process flows, while strengthening the bidirectional transformation of theoretical knowledge into practical skills. However, it has also been found that some students encounter issues such as proportional deviations and inconsistent structural logic in the connection between “digital models and physical fabrication.” Additionally, differences in equipment operation skills have led to uneven collaborative efficiency. In subsequent practice, it is necessary to improve the intelligent error correction module and operational behavior data tracking mechanism of the learning pathway, so as to achieve refined management and personalized guidance in craft training.

5. The Path to Reshaping the Teaching Model of Environmental Design through Artificial Intelligence Generated Content (AIGC)

Through a systematic analysis of teaching practices in the environmental design program, key issues such as limited knowledge and skill transfer, inadequate human-machine collaboration mechanisms, incomplete learning paths and evaluation systems, and limited integration of practice and multimodal resources were identified. Based on this, a practical path for reshaping the teaching model of environmental design programs in universities through AIGC, supported by the collaboration between “government, universities, and enterprises,” is proposed. This includes: conducting intelligent design training and optimizing the digital-physical transition, promoting human-machine collaborative evaluation to enhance critical cognitive abilities, developing personalized learning paths and implementing multidimensional dynamic evaluation, and integrating cross-modal resources for intelligent practice simulations (see Figure 8).



<Figure8>The Practice Path to Reshaping the Teaching Model of Environmental Design through AIGC

5.1 Intelligent Design Training and Optimizing the Connection Between Digital and Physical Entities

To address the issues in environmental design teaching, such as the disconnect between theory and practice, students' over-reliance on AI-generated schemes, insufficient understanding of design semantics, and inaccurate connection between digital models and physical fabrication, it is necessary to improve students' design cognitive abilities through systematic training and strengthen the precise matching of digital design and physical fabrication (Jin et al., 2025).

First, universities should rely on AIGC platforms to construct a multi-scheme generation and semantic analysis training module, guiding students to analyze generated schemes from multiple dimensions such as functional layout, spatial logic, aesthetic norms, and design semantics. This facilitates the effective transfer of theoretical knowledge to practical abilities. Meanwhile, governments can provide digital educational resources and policy support, and enterprises can offer real project cases and practical data to ensure that training content aligns with industry standards. Second, AI deviation prediction and optimization functions should be introduced in the digital modeling phase to provide real-time prompts and corrections for deviations in proportion, structure, and material. University teachers offer guidance, enterprises provide professional software and modeling standards, and governments coordinate the establishment of university-enterprise joint laboratories and training programs to ensure a high degree of consistency between digital models and physical fabrication. Finally, virtual reality (VR) or augmented reality (AR) technologies are integrated to simulate the physical fabrication process, enabling students to verify and optimize schemes based on digital models. Universities are responsible for teaching organization and evaluation, enterprises provide technical support, and governments participate in resource allocation and standard certification, thereby realizing a closed-loop learning cycle of theory—digital—physical.

5.2 Promotion of Human-Machine Collaborative Review and Critical Cognitive Competence

To address the issues that students are prone to develop a dependency mindset and insufficient critical thinking skills under AI assistance, as well as inadequate teacher intervention in the guidance and re-evaluation stages, it is necessary to construct a tripartite collaborative review process involving students, teachers, and AI, so as to enhance students' design cognitive abilities and scheme optimization capabilities (Liu, Zhang, Nyagoga, et al., 2023).

First, universities should build a human-AI collaborative review platform, organic ally integrating AI-generated schemes, students' self-assessments, and teachers' guidan ce to achieve multi-dimensional and iterative scheme optimization. Meanwhile, govern ments should provide support for informatization construction and data security stand ards, and enterprises should participate in offering real project evaluation criteria and practical data. Second, intelligent prompt and problem-guidance functions should be i ntroduced in the scheme generation stage to encourage students to identify functional conflicts, spatial logic anomalies, and aesthetic deficiencies. University teachers and enterprise mentors provide joint guidance, and governments promote university-enterpr ise collaborative competitions and training programs to strengthen students' critical th inking and judgement abilities. Finally, teachers conduct strategic evaluations on high -order issues, enterprises offer practical optimization plans, and governments participat e in formulating evaluation standards, forming a dynamic cycle of "generation—critic alanalysis—improvement—re-evaluation" to promote the synchronous enhancementof s tudents' design cognitive abilities and practical capabilities.

5.3Personalized Learning Paths and Multidimensional Dynamic Evaluation

To address the issues of insufficient differentiated guidance based on ability levels, over-reliance on traditional assessments in the evaluation system, and an incomplete closed-loop of learning feedback, it is necessary to rely on AIGC's intelligent analysis to realize the design of personalized learning pathways and full-process dynamic evaluation (Emerson, Cloude, Azevedo, et al., 2020).

First, universities use AI to analyze students' spatial thinking abilities, aesthetic preferences, and design logic levels, generating stratified and differentiated learning tasks. Governments provide educational informatization support and data security guarantees, while enterprises offer industry evaluation indicators and project data to ensure that learning tasks align with professional practice needs. Second, a multi-dimensional evaluation index system covering "learning process—design outcomes—innovation—team collaboration capabilities" is constructed, with AI used to track students' learning trajectories in real time. Universities are responsible for teaching implementation, enterprises provide practical cases and evaluation standards, and governments supervise quality control and policy guidance to achieve full-process monitoring. Finally, based on targeted feedback reports generated by AI, students are guided to optimize their design schemes. University teachers and enterprise mentors provide joint tutoring, and governments participate in formulating evaluation norms, forming a closed-loop dynamic optimization to promote the coordinated improvement of students' comprehensive design capabilities and innovative abilities.

5.4 Integrating Cross-Modal Resources and Conducting Intelligent Practice Simulations

To address the issues of insufficient integration of virtual and physical practice, as well as limited integration of cross-curricular multimodal resources, it is necessary to construct a cross-modal resource platform to achieve efficient linkage between digital modeling, virtual simulation, and physical production (Liu et al., 2024).

First, universities integrate multimodal resources such as VR, CNC, AIGC-generated models, and digital sand tables to establish a unified operation platform. Enterprises provide technical and data support, while governments assist in building shared platforms and formulating standards to ensure resources are available and cross-curricularly accessible. Second, AI is used to simulate the digital-physical conversion process, predicting proportional, structural, and material deviations in advance. University teachers offer operational guidance, enterprises provide practical optimization plans, and governments participate in project certification and policy guidance to improve the precision of physical production. Finally, intelligent practical training is carried out through the combination of virtual simulation and physical operation. Under the guidance of universities and the support of enterprise practice, students complete design projects. Governments participate in the evaluation and promotion of teaching achievements, realizing the comprehensive improvement of students' design thinking, operational skills, and team collaboration capabilities.

6.Conclusion

Based on a systematic literature review, this study integrates 35 high-quality domestic and international publications to construct a “6-level and 22-dimension” analytical framework for examining how AIGC reshapes the teaching model of environmental design programs in higher education. The framework systematically reveals the mechanisms through which AIGC reconfigures teaching concept, instructional content, teaching methods, teaching processes, learning environments, and assessment practices. The findings indicate that AIGC—characterized by “generation-driven, intelligent collaboration, and cross-modal integration”—drives a profound transformation of environmental design education: from “static transmission” to “dynamic co-creation,” from “linear processes” to “closed-loop monitoring,” and from “single classrooms” to “integrated virtual-physical ecosystems.” As such, AIGC has become a significant technological force in reshaping talent-cultivation systems within environmental design disciplines.

Furthermore, through an analysis of teaching practices in representative courses, the study identifies the logical features and adaptive patterns of AIGC integration in instruction and proposes four actionable pathways: intelligent design training with digital-physical collaborative optimization; human–AI co-evaluation with enhanced critical cognition; personalized learning trajectories with dynamic assessment systems; and cross-modal resource integration with intelligent practice simulation. These pathways offer a transferable model framework to support the intelligent transformation of environmental design education.

The innovations of this study are reflected primarily in three aspects. First, it constructs a systematic theoretical framework for AIGC-based teaching models in environmental design education, thereby providing structural support to the research system in this field. Second, it proposes an analytical paradigm centered on the logical axis of “concept–content–methods–process–context–assessment,” enabling a comprehensive depiction of how AIGC reshapes instructional models and overcoming the fragmentation and instrumentality prevalent in existing studies. Third, based on teaching practices in representative courses, it summarizes the implementation pathways of AIGC-integrated instructional models, offering a set of model-based insights that can inform educational practice.

Despite these contributions, the study has several limitations. First, the number of literature samples is limited, making it insufficient to fully represent all research paradigms and practical outcomes related to AIGC-enhanced design education. Second, the case analyses rely primarily on the context of a single institution, lacking comparative validation across regions or institution types. Third, given the rapid iteration of AIGC technologies, some findings may be time-sensitive and subject to the influence of technological updates, necessitating continuous tracking and dynamic refinement.

Future research may be expanded in several directions: (a) establishing a multi-institutional AIGC teaching-practice database to conduct empirical studies and longitudinal tracking with large samples; (b) deepening research on intelligent assessment, learning analytics, and the quantification of competency indicators to advance the intelligent evaluation system for environmental design education; and (c) exploring new instructional ecosystems based on "virtual design studios–intelligent collaboration platforms–industry-chain practice scenarios" to construct more universal, transferable, and sustainable intelligent teaching models for environmental design programs.

In conclusion, AIGC is becoming a key technological force driving the transformation of teaching models in environmental design education. Through systematic analysis and the construction of pathways, this article provides theoretical support and practical guidance for higher education institutions to reshape their professional education systems in the digital and intelligent era, offering significant value for educational reform and disciplinary development.

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