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Research on the Innovation of Intelligent Teaching Models in Higher Education from the Perspective of Human AI Teaching

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Abstract

The breakthrough development of artificial intelligence is reshaping the instructional patterns of higher education. As an emerging teaching paradigm in which teachers and AI collaborate to jointly support learning, Human AI Teaching has become an important direction for the intelligent transformation of universities. From the perspective of Human AI Teaching, this study systematically analyzes the innovation and optimization pathways of intelligent teaching models in higher education. Drawing on constructivist learning theory and other theoretical foundations, the study proposes the Four-Dimension Driving Pathway Model: "Technology support, scenario integration, intelligent feedback, and competence cultivation" to reveal the internal mechanisms of Human AI Teaching. Representative cases from Zhejiang University and other institutions are selected to examine the practical characteristics of Human AI Teaching in instructional design, classroom interaction, learning feedback, and competence development. The results show that this model significantly enhances teaching efficiency and student engagement, strengthens teachers' AI literacy and students' self-directed learning abilities, and promotes continuous improvement in teaching quality. Based on these findings, the study constructs an innovative framework for Human AI Teaching in universities. Guided by the four-dimensional model of the technology system, scenario system, feedback system, and competence system, it develops a Five Key Elements and ten strategies Innovation System Intelligent Teaching Innovation System consisting of top-level planning, platform construction, classroom innovation, feedback loops, and Human AI collaboration. The study argues that Human AI Teaching is not merely a result of technological empowerment; rather, it represents a systematic reconstruction of educational philosophy and pedagogical ecology.

Keywords

Human AI teaching, intelligent teaching model, artificial intelligence, higher education reform, educational digitalization

1. Research Background and Significance

Driven by the rapid advancement of artificial intelligence, teaching models in higher education are undergoing a transformation from "human teaching with machine assistance" to Human AI Teaching. AI teacher assistants, intelligent assessment systems, and personalized learning platforms are continuously reshaping instructional relationships and learning scenarios. The emergence of Generative Artificial Intelligence (GAI) has further accelerated the shift from "information-supported education" to "intelligence-driven collaborative education" (Picasso et al., 2024).University instructors are no longer the sole transmitters

of knowledge; instead, they are evolving into "intelligent collaborators" and "learning facilitators."

Against this backdrop, the relationship between teachers and AI is transitioning from "using tools" to forming cognitive partners, creating a Human AI Teaching structure centered on collaborative learning and joint cultivation(Atchley et al., 2024). Despite the rapid growth of "AI + Education" applications, the integration of AI into university teaching still faces significant challenges, including insufficient AI literacy among teachers, fragmented human–machine teaching scenarios, and underdeveloped feedback systems (Dringó-Horváth et al., 2025).

Currently, universities face three major dilemmas. The first is Monolithic teaching models because AI is mostly used for auxiliary functions rather than deeply embedded in core teaching processes. The second is Blurred human–machine roles that the division of labor and collaboration mechanisms between teachers and AI remain unclear. The third is Insufficient intelligent feedback that a lack of data-driven dynamic optimization mechanisms limits personalized learning and instructional refinement.

Therefore, building a sustainable, feedback-driven, and scalable Human AI Teaching model has become a critical issue in the intelligent transformation of higher education(China National Academy of Educational Sciences, 2023)]. This study aims to construct, at the theoretical level, an innovative AI-driven intelligent teaching model from the perspective of Human AI Teaching, thereby enriching the theoretical system of intelligent education in universities. At the practical level, it seeks to provide operable intelligent teaching paradigms for university teaching reform, promoting educational equity and improving instructional quality.

2. Research Framework

Human AI Teaching refers to a teaching paradigm in which teachers and artificial intelligence form cognitive collaboration, functional complementarity, and value co-cultivation throughout the instructional process (Kim, 2024). AI is not merely an instructional tool but an active participant in teaching; through learning analytics, content generation, and intelligent feedback, AI engages in the entire instructional cycle (Giannakos et al., 2025). Compared with traditional "AI-assisted teaching," Human AI Teaching demonstrates three key characteristics:

(1) teachers and AI jointly undertake instructional functions;

(2) AI enhances teaching effectiveness through algorithms and feedback mechanisms;

(3) AI enables precise and adaptive instruction based on big data and machine learning.

According to constructivist learning theory, learning is a process in which individuals actively construct meaning. AI-supported scenario generation, interactive feedback, and adaptive guidance can strengthen learners' meaning-making processes in authentic tasks (Du Plooy et al., 2024). Meanwhile, the Stimulus–Organism–Response (SOR) theory explains how external stimuli influence learners' psychological states and behavioral outcomes. In AI-supported teaching, the generated content, feedback mechanisms, and interactive learning environment constitute the stimuli (S); learners' emotional and cognitive reactions represent the organism (O); and their learning performance forms the response (R) (Mehrabian and Russell, 1974, Tan et al., 2025). From the perspective of human–machine collaboration theory, teachers and AI engage in "division of labor, knowledge sharing, and intelligent co-governance" within instructional tasks (Kim and Ziewitz, 2024), thereby improving both teaching efficiency and instructional innovation capacity.

Building upon these theoretical foundations, this study proposes a Four-Dimension Driving Pathway for Human AI Teaching in higher education, consisting of technology support, scenario integration, intelligent feedback, and competence cultivation, forming an innovative pathway for the intelligent transformation of university teaching.

Table 1. Four-Dimension Driving Pathway for Human AI Teaching in Higher Education

Driving Dimension	Key Elements	Mechanism of Human AI Teaching
Technology Support	AI-powered learning platforms, AI assistants, generative content systems	AI acts as an intelligent knowledge generator and task structuring agent
Scenario Integration	Co-created instructional design, interactive Human AI classrooms, virtual/immersive simulations	Teachers provide pedagogical guidance while AI supports content generation and responsive feedback
Intelligent Feedback	Learning analytics dashboards, predictive monitoring, formative assessments	AI conducts data-driven analysis, and teachers interpret results to guide instructional adjustments
Competence Development	AI literacy cultivation, innovation skills, autonomous learning capabilities	Human AI collaboration jointly enhances students' intelligent and self-regulated learning skills

The four-dimension driving model proposed in this study as Table 1 shows constitutes the innovative pathway for AI-enabled intelligent teaching in higher education. AI platforms, generative content tools, and intelligent analytics systems serve as the foundational infrastructure of intelligent instruction. Through natural language generation, semantic understanding, and data mining, AI provides teachers with instructional content, classroom support, and learning data analysis.AI is deeply integrated into curriculum design, classroom interaction, and experimental teaching, thereby enabling triadic collaboration among humans, machines, and learning processes (Wang and Wu, 2025). In practice, AI-assisted classrooms, virtual simulation laboratories, and intelligent question-answering systems have emerged as typical applications of this integration.AI can dynamically analyze student learning data and generate precise recommendations, supporting instant feedback and personalized learning. Teachers can leverage AI-generated feedback to refine instructional strategies, thus achieving adaptive enhancement of teaching quality. The ultimate goal of AI-supported teaching is to promote the co-development of teacher and student competencies. Therefore, the collaborative advancement of teachers' AI literacy and students' innovative thinking is essential to the intelligent transformation of education. Meanwhile, the improvement of student competencies, in turn, influences the dimensions of technology support, scenario integration, and intelligent feedback, forming a closed-loop system driven by cognitive and developmental processes.

3. Case Studies

This study selects AI-based teaching cases and analyzes their application effects in courses based on the instructional process. Following the "technology support–scenario integration–intelligent feedback–competence cultivation" four-dimension driving pathway for Human AI Teaching in higher education, an intelligent collaboration framework is proposed to construct a Human AI Teaching model for universities.

Zhejiang University relies on three major carriers—curriculum, textbooks, and faculty—to promote general education in artificial intelligence and explore a vertically integrated and interdisciplinary talent cultivation model for intelligent courses. The university has established an AI micro-major to cultivate students' AI literacy that integrates systematic knowledge, constructive abilities, creative value, and human-centered ethics. In practice, the university has developed a diversified and open AI practical training system and built a learning platform supported by generative AI foundations, enabling personalized learning for students and creative instruction for teachers. Teachers adjust their classroom guidance based on AI feedback, forming a blended teaching structure of "Human AI interaction and teacher–student cocreation" (Wang, 2024). With the assistance of Generative AI (GAI), classroom interaction has significantly increased, and both the quantity and quality of student questions have improved. Students reported that AI's instant feedback helped them understand complex concepts more quickly and enhance their expressive abilities. Teachers believed that AI assistants effectively reduced repetitive tasks, allowing them to focus on cognitive scaffolding and affective guidance. Human AI collaborative teaching not only improved instructional efficiency but also facilitated the shift of teachers' roles from "knowledge transmitters" to "learning facilitators."

East China Normal University independently developed an integrated cloud-based intelligent education SPOC platform named Xiaoya, which includes multiple intelligent modules such as course knowledge graphs,

intelligent question-answering, and smart recommendation systems. The platform supports continuous teaching data collection and data-driven analysis (East China Normal University, 2023). This intelligent education platform demonstrates a high degree of integration between AI and teaching. The introduction of the AI platform not only improves the efficiency of teaching organization but also provides a foundation for teachers to develop "data-driven instructional decision-making."(Cukurova, 2025)

These cases verify the universality and effectiveness of the four-dimension driving pathway of Human AI Teaching across different disciplinary contexts. Although the two cases differ in application scenarios, technological implementation, and instructional goals, both reflect the four-dimension logic of Human AI Teaching: universities rely on AI technologies as the core of teaching innovation, and AI is deeply embedded in the entire teaching process, thus realizing scenario-based intelligent collaboration and simultaneously enhancing teachers' AI literacy and students' innovative abilities. In summary, the application of AI teaching assistants in different types of universities shows that the Human AI Teaching model has strong adaptability and scalability. Through technological empowerment and pedagogical reconstruction, this model is promoting the development of higher education toward intelligence, precision, and co-evolution.

4. Five-Key Element and ten strategies Innovation System

In constructing the intelligent teaching model of Human AI Teaching, the Four-Dimension Driving Model of technology support, scenario integration, intelligent feedback, and competence cultivation, which serves as the theoretical foundation. At the practical level, to achieve systemic innovation in the intelligent transformation of higher education, it is necessary to establish a progressive Five Key Elements and ten strategies Innovation System. This innovation system is guided by top-level design, supported by platform development, centered on classroom innovation, safeguarded by feedback loops, and oriented toward Human AI Teaching. Together, these components form a dynamic cycle of "theory, technology, practice, feedback, and optimization." Therefore, under the guidance of the four-dimension driving pathway, this study proposes an innovative Five Key Elements and ten strategies Innovation System for intelligent education in universities, consisting of top-level planning, platform construction, classroom innovation, feedback enhancement, and Human AI Teaching as Table 2 shows.

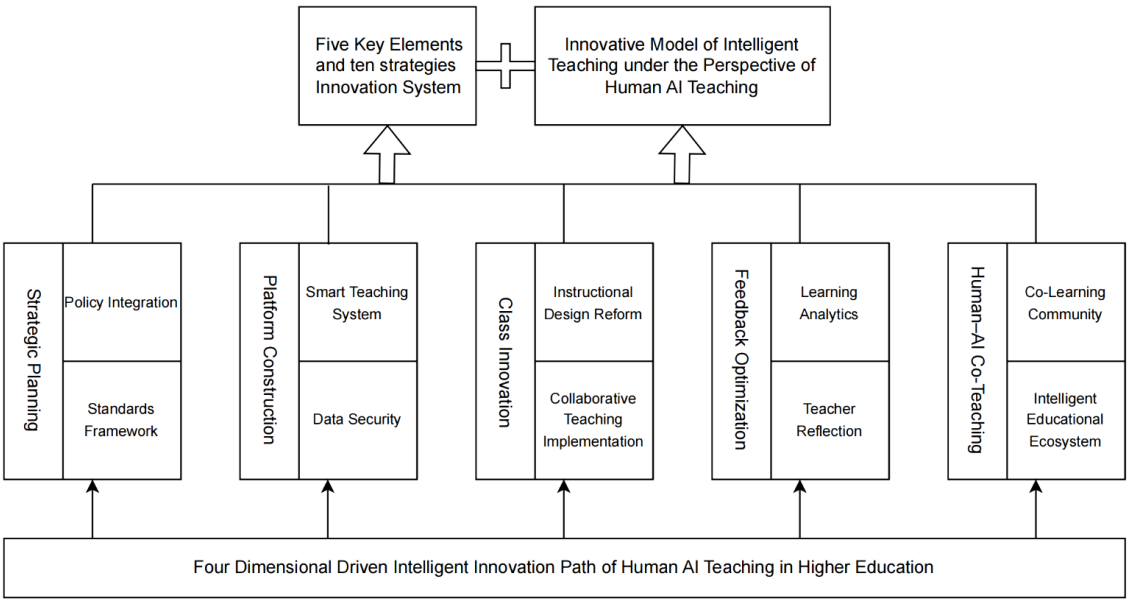
Table 2. Five Key Elements and ten strategies Innovation System.

Key Element	Constitutive strategy	Core Action
Top Level Planning	Policy Coordination	Incorporate Human AI Teaching into university education governance systems
	Standards Development	Establish AI teaching standards and ethical norms
Platform Construction	Intelligent Teaching Platform	Build a unified AI-enabled teaching cloud platform
	Data Security	Develop mechanisms for algorithmic transparency and privacy protection
Classroom Innovation	Instructional Design Reform	Involve AI in the generation of course tasks and learning activities
	Collaborative Classroom Implementation	Establish an "AI-assisted classroom" system
Feedback Enhancement	Learning Analytics	Use AI for real-time monitoring of learning behaviors and feedback
	Teacher Reflection	Teachers optimize instructional strategies based on AI-generated reports
Human AI Teaching	Co-development of Teachers and Students	Enhance AI literacy and innovative capacities of both teachers and students
	Intelligent Ecosystem	Build an AI-driven collaborative teaching ecosystem in universities

The top-level planning layer provides the policy framework and strategic orientation, ensuring the institutionalization and standardization of AI-driven educational innovation, and establishing policy-driven

and institutionally guaranteed foundations. The platform construction layer offers technological support and ecological infrastructure. The classroom innovation layer implements instructional practice reform, forming a technology-driven teaching ecology and building a sustainable, secure, and trustworthy AI educational environment. The feedback loop layer facilitates quality improvement and intelligent feedback, enhancing course innovation, instructional efficiency, classroom interactivity, and learning immersion. The Human AI Teaching layer represents the final realization of educational value, establishing an intelligent monitoring system for teaching quality and enabling dynamic feedback and continuous optimization. In all layers, AI technologies and data serve as the connective infrastructure, enabling an integrated linkage of the entire process of "teaching, learning, assessment, and management." This forms an intelligent Human AI Teaching system and a mechanism for the continuous evolution of intelligent higher education. Ultimately, it promotes the collaborative development of teacher and student competencies as dual subjects in the learning process.

Figure 1. Five Key Elements and ten strategies Innovation System in the Human AI Teaching Model



In the context of AI-enabled educational intelligence, Human AI Teaching has become the core trend of intelligent instruction in higher education. The collaborative co-cultivation relationship between teachers and AI reshapes instructional structures and educational values. The four-dimension driving pathway for AI-supported university teaching reveals the systemic logic of intelligent instruction, establishing a progressive relationship from technology to competence and enabling the optimization of the entire teaching process. The Five Key Elements and ten strategies Innovation System framework provided an actionable model for innovation, offering pathway guidance for universities from top-level design to classroom implementation. The key to educational intelligence lies in Human AI Cultivation. Teachers must enhance their AI literacy and innovative mindset, while students need to develop self-directed learning and critical thinking, ultimately achieving "educating through intelligence while remaining learner-centered."

5. Research Summary

Human AI Teaching represents the core trend in the development of educational intelligence (Kong et al., 2025). This study proposes an innovative framework for intelligent Human AI Teaching, aiming to move beyond the "tool-oriented" limitations of AI instruction toward a collaborative and co-evolving model of co-teaching intelligence. Guided by the four-dimension driving pathway of "technology support, scenario integration, intelligent feedback, and competence cultivation," the study constructs a triadic collaboration model involving teachers, AI, and students, and elucidates the role relationships and interaction mechanisms within Human AI collaboration. Through a data-driven pathway for instructional improvement, the study achieves a closed-loop optimization of "technology support–scenario integration–intelligent feedback–competence cultivation." The proposed Five-Key Element and ten strategies Innovation System offered a replicable solution for intelligent teaching in universities, enabling AI to transition from "instructional

assistance" to "co-cultivation" and achieving a qualitative shift in educational value. Future research may incorporate Structural Equation Modeling (SEM) to validate the effectiveness of the four-dimension model and extend the Five Key Elements and ten strategies Innovation System pathway to different disciplines and course types. On the basis of forming a replicable paradigm for intelligent teaching reform in higher education, future studies should also expand the sample to vocational and lifelong education systems. Furthermore, with deeper exploration of AI educational ethics and algorithmic governance, future work should investigate the emerging personalized teaching ecosystem driven by Generative AI (GAI) within the paradigm of intelligent co-teaching.

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Conflicts of Interest

The authors declare no conflict of interest.

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