How can generative artificial intelligence technology empower college teachers to improve teaching ability?

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Abstract: *With the advance of the digital wave, g artificial intelligence generates content (AIGC) has brought transformative opportunities for the field of higher education. This paper deeply discusses the path of AIGC enabling college teachers to improve their teaching ability. AIGC provides systematic support for the improvement of teachers' teaching ability through intelligent lesson preparation, accurate learning situation analysis, personalized teaching, immersive interaction, intelligent feedback and multi-dimensional evaluation. The research puts forward a path of "technology integration, organizational support and teacher development", including building a new AI-driven teaching ecology, improving the policy incentive mechanism, building an intelligent teaching platform, establishing a hierarchical training system, and building a community of practice for teacher development. The research in this paper can promote the transformation of teachers from "technology users" to "innovation leaders", and provide key ideas and theoretical support for the transformation of higher education teaching paradigm.*

Keyword: *Student learning behavior analysis; Precise teaching; personalized learning; Artificial intelligence; Data privacy*

Introduction

The higher education sector is undergoing an unprecedented transformation driven by the current digital revolution. With the rapid advancement of artificial intelligence technologies, particularly the emergence of artificial intelligence generates content (AIGC), the digital transformation of education has become an irreversible trend. Characterized by its robust content generation, data analysis, and personalized recommendation capabilities, AIGC is progressively being integrated into various aspects of teaching and learning, presenting new opportunities and pathways for enhancing university instructors' pedagogical competencies[0].

Current developments indicate that the digital transformation of higher education necessitates not only innovative teaching methodologies but also significant improvements in educational quality and the promotion of equity in education. AIGC applications effectively address these requirements through intelligent teaching assistance, personalized learning path design, and precise teaching evaluation, thereby enabling instructors to overcome the limitations of traditional pedagogical approaches while simultaneously enhancing both teaching efficiency and quality[0]. Furthermore, in response to the exponential growth of knowledge and increasingly diverse student needs, AIGC provides substantial technological support, allowing educators to more effectively integrate teaching resources, innovate instructional methods, and accommodate individualized learning requirements.

The existing applications of AIGC technology in education have demonstrated remarkable potential. Models such as ChatGPT can generate high-quality educational texts, images, and videos while facilitating student interaction through natural language processing to provide immediate learning feedback. Domestic models like Wenxin Yiyan are better aligned with local educational needs, offering strong support for optimizing Chinese-language teaching environments. These technological applications not only diversify teaching approaches but also contribute to more equitable distribution of educational resources, establishing a solid foundation for enhancing university teaching competencies.

However, while benefiting from AIGC's advantages, higher education instructors face several challenges: the effective integration of AI technologies into teaching practices must be carefully managed to prevent misuse or over-reliance; the accuracy and educational value of AI-generated content require rigorous verification; and instructors' digital literacy and AI application skills need systematic development. Consequently, exploring effective approaches for AIGC to enhance university teaching competencies holds significant theoretical value for advancing educational technology and teacher development theories, along with profound practical implications for resolving critical issues in higher education reform and promoting comprehensive improvement in educational quality.

In conclusion, this study aims to conduct an in-depth analysis of AIGC applications in higher education, examining specific pathways through which this technology can enhance teaching competencies by addressing current challenges and opportunities. The findings are expected to provide valuable references for faculty professional development and contribute to the progressive digital transformation of higher education.

1. AIGC's enabling mechanism for teaching ability

1.1 Intelligent lesson preparation and learning situation analysis

Generative artificial intelligence content (AIGC) provides intelligent support for instructional preparation in higher education, significantly enhancing both the efficiency of course design and the precision of learning analytics[0]. In the context of automated lesson preparation, AI systems powered by large language models (LLMs) can rapidly generate structured course frameworks, multiple versions of teaching plans, and accompanying presentation materials based on instructor-provided topics, while simultaneously incorporating cutting-edge disciplinary developments and open educational resources. Furthermore, these systems enable the automated generation of multimodal teaching materials including virtual laboratory simulations and interactive diagrams thereby substantially reducing the technical barriers associated with creating sophisticated educational resources.

Regarding learning analytics, AI systems synthesize student assignment records, online interactions, and assessment data to construct dynamic learner profiles. These profiles accurately identify individual knowledge gaps, cognitive styles, and learning preferences. Leveraging these analytical outputs, instructors can adapt their pedagogical strategies accordingly, for instance, by generating visual learning materials for visually oriented learners or designing tiered exercises targeting specific knowledge deficiencies. This approach facilitates authentic data-driven differentiated instruction.

The integrated "intelligent preparation-precise diagnosis-dynamic optimization" cyclical model not only improves the efficiency of instructional preparation but also represents a paradigm shift from traditional experience-based lesson planning to scientifically grounded, personalized approaches. This transformation is characterized by three key dimensions: enrichment of curriculum preparation, the datafication of learner characteristics, and the continuous feedback loop enabling real-time instructional adjustments.

1.2 Personalized teaching and immersive interaction

AIGC has demonstrated significant potential in enhancing instructional delivery capabilities in higher education through its adaptive content generation and intelligent interaction technologies[0]. In personalized instruction, AIGC systems dynamically analyze student performance metrics in real time, enabling automatic adjustment of both content complexity and instructional pacing. Empirical implementations reveal discipline-specific applications: in programming courses, these systems generate targeted debugging suggestions by analyzing code errors, while in humanities classrooms, they automatically expand discussion frameworks based on student responses, achieving truly individualized pedagogical approaches. This adaptive mechanism not only addresses the long-standing challenge of catering to diverse learning needs in traditional classrooms but also operationalizes the Confucian principle of "teaching students according to their aptitude" through technological means.

Regarding classroom interaction enhancement, AIGC contributes through dual mechanisms. First, AI teaching assistants equipped with natural language processing capabilities provide immediate, accurate responses to student inquiries, thereby allowing instructors to concentrate on cultivating higher-order thinking skills. Second, through virtual scenario generation, immersive learning environments such as simulated courtrooms or digital surgical suites can be created, effectively transforming abstract theoretical concepts into concrete experiential learning opportunities. This combined "intelligent interaction + contextual reconstruction" model extends the traditional boundaries of classroom instruction both temporally and spatially, while simultaneously establishing innovative platforms for developing applied competencies.

1.3 Intelligent feedback and multi-dimensional evaluation

AIGC is promoting the reform of teaching evaluation system to the direction of intelligence and refinement[0]. In terms of intelligent feedback, AIGC breaks through the time and space limitations of traditional marking, and can automatically process standardized assignments and provide structured analysis: for math assignments, reasoning defects in problem-solving steps are accurately located, and for writing tasks, improvement suggestions are generated from the dimensions of grammar norms and logical coherence, making teacher feedback more targeted while improving efficiency. More fundamentally, AIGC facilitates the transition from reductive scoring to comprehensive competency mapping through dynamic assessment models that integrate multimodal data streams, including classroom interaction patterns, digital learning footprints, and virtual experimentation records. Representative applications include: semantic analysis algorithms that quantify cognitive engagement levels in discourse and programming behavior analytics that evaluate computational thinking strategies. Such process-oriented assessment architectures achieve two critical advancements: first, they provide a more nuanced representation of learner capabilities, and second, they generate actionable insights for curriculum optimization.

This transformation embodies three fundamental shifts in assessment epistemology: (1) from heuristic judgment to evidence-based evaluation, (2) from student-focused test analysis to process-aware analysis, and (3) from static summative assessment to dynamic formative evaluation. The convergence of these dimensions establishes a new paradigm for growth-oriented learning ecosystems.

2. Intelligent feedback and multi-dimensional evaluation

Under the background of digital transformation of higher education, the deep application of AIGC needs to build a three-in-one practice path of "technology integration - organizational support - teacher development". The following design is carried out from three dimensions: technical empowerment, organizational security, and teacher growth, and an operational plan is proposed based on practical cases of domestic and foreign universities.

2.1 Build a new AI-driven teaching ecology

The development of an AI-enhanced teaching ecosystem in higher education requires systematic technological integration strategies[0]. For cultivating faculty AI literacy, a tiered professional development framework should be implemented, modeled after the "awareness-application-innovation" triad approach pioneered by Chuzhou University. Discipline-specific adaptations include: natural language processing tool training for humanities faculty, and algorithmic integration practicums for STEM instructors, with pedagogical scenario simulations employed to reinforce skill transfer. Regarding intelligent platform development, the integrated system architecture demonstrated by Wenzhou University provides an exemplary model, incorporating multimodal content generation, learning analytics, and intelligent interaction modules. Notable implementations include Sichuan Film and Television College's virtual production platform, which utilizes AI for storyboard generation and scene previsualization, demonstrating a 300% efficiency gain over conventional training methods.

The strategy lays a key foundation for a teacher-led, AI-enhanced education paradigm through differentiated professional development pathways, interoperable technology systems, and subject-specific application validation. Particularly noteworthy is how discipline-specific adaptations maintain pedagogical relevance while leveraging AI's cross-cutting capabilities, ensuring both wide applicability and subject-matter appropriateness.

2.2 Establish a collaborative innovation mechanism

Universities need to provide systematic support for AI teaching application through institutional innovation and organizational change[0]. In terms of policy guarantee, a hierarchical guidance system should be established, including the formulation of the AIGC Teaching Application Guide to clarify ethical boundaries, the inclusion of AI teaching ability in teacher development evaluation indicators, and the establishment of special incentive funds. For example, Qiong Tai Normal College effectively promotes the innovative practice of AI teaching through assessment orientation and financial support for dual-wheel drive. In terms of institutional transformation, the Teaching Development Center needs to restructure its functional positioning: establish an AI teaching consultant team to provide accurate guidance, develop intelligent diagnostic tools to achieve dynamic assessment of teachers' abilities, and build a cross-school resource sharing platform (such as the EduChat model of East China Normal University) to promote the circulation of quality experience. The above typical cases show that regularly holding AI teaching innovation competitions can significantly stimulate teachers' enthusiasm for exploration, promote the formation of a trinity of collaborative development mechanisms of "system guarantee-professional support-exchange and innovation", and create a benign ecology for AI education application.

2.3 Construct hierarchical and progressive cultivation mode

A systematic approach to enhancing faculty AI pedagogical competencies necessitates the integration of tiered professional development with practitioner communities. The stratified training model comprises three progressive stages: For novice instructors, foundational competency development is prioritized through introductory AI workshops. These employ platforms like Doubao for automated syllabus generation and iFLYTEK Spark for voice-to-text transcription, enabling rapid acquisition of basic implementation skills. Mid-career faculty focus on innovative application development, as exemplified by Nanjing University's "AI+History" initiative where instructors utilize AI to create historical simulations. Through virtual role-playing exercises, students gain deeper engagement with historical events. Senior faculty are supported in discipline-specific AI tool development. The intelligent mathematical formula analysis system developed at Tsinghua University represents such advanced applications, automatically diagnosing problem-solving approaches while generating personalized feedback. This "foundational-implementation-innovation" tri-phase framework addresses differential competency requirements across career stages while establishing a virtuous cycle of professional growth. Three critical success factors emerge: (1) alignment with faculty development trajectories, (2) discipline-contextualized applications, and (3) sustainable communities of practice.

Furthermore, the establishment of robust communities of practice requires the implementation of a tripartite collaboration framework integrating faculty, technical specialists, and industry mentors. This approach can be operationalized through models such as the Chengdu Mindtailor-Higher Vocational College partnership, where joint AIGC training laboratories enable faculty to enhance AI application competencies through participation in authentic industry projects. Concurrently, discipline-specific seminars on emerging "AI+Subject" trends, conducted by industry experts, should be institutionalized to maintain faculty awareness of technological advancements. A complementary digital ecosystem should be cultivated through online professional communities, exemplified by the creation of dedicated "AIGC Pedagogical Applications" channels on platforms like Bilibili. Such platforms facilitate continuous knowledge exchange through sharing of successful implementation cases and best practices among educators.

This dual-component model (which combines layered professional development with community) enables a faculty that is both skilled in AI application technologies and capable of sustainable innovation, aiming at three key outcomes: (1) development of AI application capabilities; (2) Maintenance of technical money; (3) Establish self-sustaining knowledge networks. Together, these elements provide the human capital base necessary for the success of digital transformation in higher education.

Conclusion

The deep application of AIGC provides a structural reform path for the improvement of university teachers' teaching ability, and its empowerment path should be based on technology integration, guaranteed by organizational support, and driven by teacher development. Through the construction of a hierarchical training system, the establishment of an intelligent teaching platform, and the improvement of policy incentive mechanisms, teachers can be promoted from "technology users" to "innovation leaders", and finally realize the fundamental reform of the higher education teaching paradigm. In the future, we need to continue to pay attention to the ethical risks of AI to ensure that technology empowerment always serves the essential goals of education. Through the three-dimensional collaboration of technology integration, organizational support, and teacher development, the leap from tool application to teaching paradigm innovation can be realized.

Future research should focus on three key directions: First, to deepen the application value of generative AI in the field of education. In terms of emotional intelligent interaction, it is necessary to break through the limitations of existing technologies and develop an emotional computing system with cross-cultural adaptability (such as the improved MIT Affectiva model) to analyze the classroom emotional state of teachers and students through multi-modal data to provide real-time emotional support strategy suggestions for teachers. This research direction will promote AI to upgrade from a cognitive tool to an emotional partner, and achieve the dual empowerment of "IQ + EQ". Secondly, in the construction of meta-universe education scene, we can learn from the experience of Harvard University's virtual history class, and focus on the development of disciplinary characteristics of meta-universe space. The research needs to overcome two major technical difficulties: to improve the natural interaction ability of AI virtual teaching assistants, and to optimize the visual presentation of knowledge in a three-dimensional environment. For example, the development of immersive teaching modules that support the dismantling of molecular structures and the repetition of historical events, so that abstract concepts can be expressed concretively. Finally, the research on the construction of new education ecology should focus on the system design of "human-machine collaboration" mode, and explore the new professional development path of teachers as "AI trainers ". Priorities include: establishing a dynamically updated teacher-AI collaborative capability framework, developing an AI teaching ethics assessment tool, and building an open educational resource circulation mechanism. For example, with reference to the UNESCO artificial intelligence education strategy, we will study how to narrow the digital divide in education through technology empowerment, and ultimately achieve the organic unity of large-scale education and personalized training. These studies need the deep cross-integration of pedagogy, computer science, psychology and other disciplines to jointly promote the evolution of the education system to the direction of intelligence and humanity.

Reference

[1] Michel-Villarreal, R., Vilalta-Perdomo, E., Salinas-Navarro, D. E., Thierry-Aguilera, R., & Gerardou, F. S. (2023). Challenges and opportunities of generative AI for higher education as explained by ChatGPT. Education Sciences, 13(9), 856.

[2] Chan, C. K. Y., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. International Journal of Educational Technology in Higher Education, 20(1), 43.

[3] Yeralan, S., & Lee, L. A. (2023). Generative AI: Challenges to higher education. Sustainable Engineering and Innovation, 5(2), 107-116.

[4] Chan, C. K. Y., & Colloton, T. (2024). Generative AI in higher education: The ChatGPT effect (p. 287). Taylor & Francis.

[5] Lee, D., Arnold, M., Srivastava, A., Plastow, K., Strelan, P., Ploeckl, F., ... & Palmer, E. (2024). The impact of generative AI on higher education learning and teaching: A study of educators' perspectives. Computers and Education: Artificial Intelligence, 6, 100221.

[6] Batta, A. (2024). Transforming higher education through generative AI: Opportunity and challenges. Paradigm, 28(2), 241-243.

[7] Hoernig, S., Ilharco, A., Pereira, P. T., & Pereira, R. (2024). Generative AI and Higher education: Challenges and opportunities. Institute of Public Policy.