Research on the Construction of Digital Intelligence Competence of University Teachers and the Prevention of Technological Ethics Risks in the Era of Generative AI

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Abstract: *With the rapid development of generative artificial intelligence (Generative AI) technology, the higher education ecosystem is undergoing profound transformation. Generative AI not only reshapes the generation of teaching content, forms of instructional interaction, and educational evaluation logic, but also imposes unprecedented new demands on the professional competence structure of university teachers. Under the background of digital intelligence-driven educational transformation, teachers' digital intelligence competence has become one of the core indicators for measuring education quality and innovation level. However, university teachers currently face multiple difficulties in areas such as technology cognition, capability adaptation, and regional development conditions. Meanwhile, the widespread application of generative AI technology in educational scenarios has also triggered multi-dimensional technological ethics risks, including data security, algorithmic bias, and teaching responsibility. This study focuses on the connotative structure, developmental bottlenecks, and regional differences of university teachers' digital intelligence competence, systematically analyzes the potential and challenges of generative AI empowered teaching, and further explores the identification and coping strategies for educational ethics risks.*

Keywords: *Generative Artificial Intelligence; University Teachers; Digital Intelligence Competence; Educational Transformation; Technological Ethics*

Introduction

Currently, generative AI technologies represented by ChatGPT, Claude, and others are rapidly penetrating the education field, becoming a key driving force for promoting intelligent transformation in education. This technology not only brings fundamental changes to teaching content, instructional methods, and evaluation approaches, but also profoundly influences teachers' professional roles and competence structures. University teachers, as the core subjects of educational activities, face a new trend of transformation from "knowledge transmitters" to "technology integrators," "data interpreters," and "intelligent facilitators." On the one hand, AI-driven educational innovation places higher demands on teachers' digital intelligence competence, requiring not only basic digital literacy, but also the integration of data understanding, cross-disciplinary collaboration, and intelligent technology application capabilities. On the other hand, the widespread use of AI technology in education systems has also resulted in a series of ethical issues such as technology misuse, algorithmic opacity, and unclear responsibilities, which directly affect educational equity, protection of student rights, and the integrity of the academic environment.

1. The Reshaping of the Higher Education Ecosystem and the Transformation of Teacher Roles by Generative AI Technology

1.1 The Technical Logic and Development Trend of Generative AI

Generative artificial intelligence, as one of the forefront directions in artificial intelligence development, bases its technical logic on the integration of multiple technologies such as deep learning, neural networks, and natural language processing. Currently, mainstream large language models (such as GPT, ERNIE, GLM, etc.) rely on massive textual data and build contextual semantic understanding and

generative capabilities through self-supervised learning. This enables AI to generate natural language content with reasonable structure and coherent semantics without specific template guidance. This capability of "generation rather than retrieval" marks AI's transition from the information processing stage to the content creation stage, fundamentally impacting the ways knowledge is expressed and disseminated.

From the perspective of technical evolution, generative AI has progressed from static generation to dynamic interaction, and from single-modal generation to multi-modal fusion. With improvements in computing power and algorithm optimization, generative AI now possesses cross-context transfer capabilities, enabling adaptive language generation and logical expression across different domains. The education field, as one of the typical application scenarios, is rapidly becoming a critical platform for technology breakthroughs, driving structural adjustments in the higher education system [1].

The evolution of technical logic is reflected not only in the intelligence level of language and content generation but also in its simulation and extension of human cognitive patterns. Generative AI features a strong "prediction-driven" characteristic; its output is a high-probability inference based on modeling the preceding semantic context. This logical mechanism determines that generative AI exhibits high openness, personalization, and plasticity in educational scenarios. With integration into knowledge graphs, cognitive modeling, semantic retrieval, and other systems, generative AI will continue to deepen its educational empowerment capabilities in content creation, intelligent tutoring, knowledge integration, and other dimensions.

1.2 Core Application Scenarios and Paradigm Shifts of AI-Empowered Teaching

The embedding of generative AI in teaching systems is driving the transformation of traditional teaching paradigms toward an intelligent educational ecosystem characterized by human-machine collaboration. Regarding teaching content, AI can quickly generate discipline-specific teaching materials, case texts, and question banks through semantic understanding and style imitation, significantly reducing teachers' time costs in content preparation. Meanwhile, AI's generative ability makes course content more dynamic and adjustable, meeting diverse and personalized learning needs of students, and enhancing teaching flexibility and adaptability.

At the teaching process level, generative AI provides technical support for the intelligent upgrade of interaction modes. The introduction of human-machine dialogue interfaces transforms teaching communication from one-way information transmission between teachers and students within the classroom to an AI-assisted multi-party participation and continuous feedback interaction system. AI's real-time generation and semantic analysis capabilities enable it to simulate the teacher role, providing students with high-frequency, low-threshold question-answering support, thereby promoting learning efficiency improvement.

Simultaneously, classroom organization logic is evolving from being textbook-driven to data-driven. Generative AI can dynamically optimize teaching strategies based on students' learning trajectories and cognitive characteristics, promoting the formation of learner-centered "adaptive" teaching mechanisms, and achieving truly individualized instruction.

In terms of evaluation systems, AI supports formative and process-based assessment implementation through comprehensive analysis of student behavior data and learning outputs, improving the accuracy, personalization, and timeliness of educational assessment. Overall, the application of generative AI promotes the closed-loop integration and collaborative optimization of the "teaching–learning–assessment" system [2].

1.3 Functional Extension of Teacher Roles and Adjustment of Competence Structures

Against the backdrop of generative AI's deep embedding throughout the teaching process, the roles of university teachers are undergoing a paradigmatic reconstruction. Teachers are transitioning from traditional knowledge transmitters to guides of human-machine collaboration and shapers of educational values. AI's capabilities in information generation and knowledge integration gradually shift teachers from executors who provide content to designers of instructional design, course facilitation, and integrators of humanistic spirit. This shift not only reshapes teachers' functional positioning but also enhances their core value within the educational ecosystem.

In response to this transformation, the teacher competency system must upgrade from "technical usage" to "digital intelligence competence." Digital intelligence competence should encompass key

dimensions such as understanding and critical application of intelligent technology, data analysis and instructional decision-making, human-machine collaboration and cross-disciplinary integration, as well as technological ethics and value judgment. In teaching practice, teachers must possess the ability to flexibly allocate AI resources and integrate multi-platform tools, improve data perception and reflective capacity, and promote personalized teaching and precise evaluation. At the same time, teachers should understand and regulate AI-generated outcomes, identify potential biases, and ensure the scientific validity and fairness of teaching assessment.

2. The Application and Innovative Potential of Generative AI in Higher Education Teaching

2.1 Teaching Content Generation and the Reconstruction of Personalized Learning Paths

Generative artificial intelligence, with its powerful language modeling and semantic generation capabilities, is profoundly changing the way higher education teaching content is developed and the logic of knowledge presentation. Based on large-model text generation technology, AI can automatically produce lesson plans, lecture notes, case analyses, and exercise designs aligned with disciplinary knowledge systems when teachers input teaching themes, course standards, or keywords, thereby significantly improving the efficiency and adaptability of course content development. Unlike traditional teaching content that is static and linearly structured, generative AI can flexibly output multiple versions of teaching resources with diverse styles and adjustable knowledge depth according to different teaching goals and learner profiles, promoting the transformation of teaching content from standardization toward diversification and dynamism.

More critically, the introduction of generative AI facilitates the reconstruction of personalized learning paths. Through continuous collection and behavioral analysis of student learning data, AI can accurately identify individual knowledge mastery status, learning pace, and cognitive preferences, and dynamically adjust the recommendation of learning resources and curriculum path planning accordingly. This process not only realizes intelligent content distribution but also strengthens individual adaptation to learning pace and content difficulty, thereby advancing the implementation of the learner-centered concept in teaching practice [3].

Meanwhile, AI possesses cross-disciplinary knowledge retrieval and integration capabilities, enabling the construction of multidimensional knowledge association graphs to support students in achieving autonomous learning goals of horizontal transfer and deep exploration. On this basis, learners can form modular knowledge systems based on personal interests and career orientations, breaking free from the rigid paths of traditional curricula organized by “class units” and “chapter cues,” and ushering in a new flexible and autonomous learning form supported by generative AI.

2.2 Intelligent Transformation of Teaching Interaction Modes

The long-standing bottleneck problems of interaction in higher education teaching have been breakthroughly improved under the empowerment of generative AI. Traditional teacher-student interactions rely on physical space and time nodes, making it difficult to achieve widespread, continuous knowledge exchange and instant feedback. Generative AI’s intelligent question-answering, semantic guidance, and virtual assistant functions effectively expand the spatiotemporal boundaries of interaction, constructing a three-dimensional interactive structure of “teacher–AI–student” and promoting interaction from passive response toward active generation, and from localized fragments toward full-process embedding.

In real-time teaching scenarios, generative AI can act as a humanoid interactive subject, generating personalized answers based on classroom content and student questions, providing diversified knowledge expansion paths, and guiding students to deepen their thinking. AI’s language generation ability enables it to express abstract theories in a simplified manner, thereby improving comprehension efficiency of complex knowledge points. For students with learning disabilities, AI can provide secondary explanations and generate examples based on cognitive difficulties, forming a precise support mechanism based on cognitive diversity, which greatly enhances the accessibility and fairness of interaction.

In after-class learning and online teaching platforms, generative AI shows even stronger interactive extension capabilities. By building personalized learning assistants and intelligent tutoring systems, students can engage in deep dialogues and continuous questioning with AI during non-classroom hours, achieving sustained learning progress and repeated consolidation. This deep interaction, based on

semantic inference and knowledge completion, not only improves students' learning initiative but also helps build a cognitive closed loop of knowledge internalization and transfer.

2.3 Reconstruction of Educational Evaluation Methods and Intelligent Feedback Mechanisms

Educational evaluation, as an important link in the teaching closed loop, has always been one of the most challenging parts of higher education governance. The introduction of generative AI technology provides both technical support and conceptual innovation opportunities for the education evaluation system. On one hand, AI possesses multidimensional diagnostic capabilities based on big data analysis and natural language understanding, breaking the traditional evaluation model's sole reliance on summative data and supporting formative, personalized, and multimodal evaluation throughout the entire process. On the other hand, its generative capability can be used for automatic question generation, grading, and feedback production, achieving precise assessment and instant response for large-scale student assignments.

During the course learning process, AI can track students' learning behavior data in real time, including reading progress, interaction frequency, and knowledge mastery levels, generating individual learning profiles through cluster analysis and model prediction. Based on these profiles, the system can dynamically adjust evaluation dimensions and content, building an intelligent evaluation system characterized by differentiation, developmental progression, and adaptability. AI can also identify cognitive depth, logical structure, and emotional tendencies from students' textual expressions, assisting teachers in conducting comprehensive assessments of writing and expressive tasks, thus expanding evaluation boundaries in scenarios without standard answers [4].

At the same time, AI possesses the ability to generate personalized learning feedback, which can combine students' historical learning trajectories and recent performance to offer targeted learning suggestions and paths for ability improvement, constructing a cyclical system of "diagnosis–feedback–adjustment." This feedback mechanism overcomes the limitations of single-score grading systems in traditional evaluation, placing greater emphasis on cognitive development and capacity growth during the learning process, and aligns with the orientation of high-quality education development in the new era.

3. Challenges in the Development of Digital-Intelligent Competence and Regionalization

3.1 Uneven Teacher Digital Literacy and Capability Mismatch

Against the backdrop of generative AI widely embedded in higher education scenarios, significant disparities in teachers' digital literacy levels reveal structural problems in the development of digital-intelligent competence. Although some teachers possess routine information technology application skills, they lack deep understanding of AI generation mechanisms, data intelligence logic, and algorithmic bias risks, resulting in severely lagging practical abilities in AI-assisted teaching. Meanwhile, differences in technical adaptability across disciplines cause science and engineering teachers to more easily integrate technology and connect with educational scenarios than teachers in traditional fields such as humanities and social sciences, leading to evident disciplinary capability gaps.

A deeper issue lies in the inability of teacher capability composition to deeply align with educational transformation in the digital-intelligent era. Currently, most teachers' knowledge structures and teaching abilities still focus on linear content delivery, lacking interdisciplinary technology integration skills, complex systems thinking, and data-driven teaching competencies. This situation significantly conflicts with the multimodal understanding, human-machine collaboration, and real-time feedback emphasized in generative AI environments. Due to the absence of systematic, task-oriented competence improvement pathways, teachers often respond passively to technological changes and struggle to play a guiding role in teaching design, learning evaluation, and educational ethical judgment.

3.2 Developmental Imbalance Caused by Regional Resource Disparities

The development of digital-intelligent competence among higher education teachers shows a significant spatial imbalance trend, with regional differences in resource allocation being a major cause. In economically advanced areas, teachers have more convenient access to technology, higher-level teaching and research platforms, and more frequent industry-education collaboration opportunities, enabling rapid integration of AI tools with curriculum content. In contrast, universities in central and

western or underdeveloped regions face slow digital-intelligent transformation due to weak information infrastructure, limited funding, and scarce teacher training resources, leaving teachers marginalized when facing new technologies.

This disparity not only manifests at the level of technology supply but also profoundly affects teachers' own learning motivation and development paths. Differentiation in the maturity of AI application concepts, administrators' technical awareness, and support mechanisms for teaching reform among regions further exacerbates uneven education quality and capacity building. In addition, the lack of unified standards and cross-regional collaborative platforms hinders effective sharing of quality technological resources, resulting in an "information island effect" in teacher capability enhancement, which restricts the overall intelligent transformation of the higher education system [5].

3.3 Capability Construction Barriers in a Complex Educational Ecosystem

As the higher education ecosystem shifts from closed to open collaboration and diversified interaction, the introduction of generative AI accelerates the reconstruction of teaching models. Teachers are no longer the sole transmitters of knowledge but need to form dynamic collaborative relationships with platform algorithms, intelligent tools, and students. This role transformation imposes higher demands on teachers' cognitive shifts and professional competencies.

However, current higher education institutions have not yet established evaluation mechanisms and incentive systems that match the digital-intelligent transformation, so teachers' efforts in AI application hardly convert into positive incentives such as professional title promotion, weakening their willingness to adopt technology. Meanwhile, the ethical boundaries, data security, and technical uncertainty issues accompanying generative AI lack effective governance, causing teachers to face ambiguous responsibilities and decision-making dilemmas in practice.

Within this complex and dynamic educational ecosystem, teachers must simultaneously address the dual challenges of technological adaptation and ethical adjustment, while the systematic construction of digital-intelligent competence suffers from the dual constraints of high pressure and fluctuations in value recognition. Therefore, it is urgent to build more systematic support mechanisms to realize sustainable teacher capability development and healthy evolution of the educational ecosystem [6].

3.4 Identification of Technological Ethical Risks and Paths to Enhance Teachers' Ethical Competence

As generative AI technology increasingly penetrates teaching contexts, ethical risk issues become more prominent, mainly manifested as ambiguous responsibility attribution caused by algorithm opacity, privacy leakage risks in data collection and processing, and hidden bias and misinformation in AI-generated content. These problems not only affect educational equity and student rights protection but also challenge teachers' understanding of professional ethics boundaries and their practical capabilities.

As the direct practitioners of technology application, higher education teachers urgently need to strengthen ethical awareness and risk judgment abilities within their digital-intelligent competence. On one hand, teachers should enhance systematic understanding of AI operating mechanisms, data usage rules, and their social impacts; on the other hand, universities should establish sound ethical guidelines and accountability systems for AI teaching applications, clearly defining teachers' responsibility scope and response norms in technology use.

The cultivation of teachers' ethical competence should combine practical cases and interdisciplinary ethics training to strengthen teachers' understanding of the relationship among "technology—ethics—education," promoting their transformation from "technology users" to "technology gatekeepers." Only with dual guarantees of competence improvement and institutional construction can AI-empowered education achieve high-quality development while upholding ethical bottom lines.

Conclusion

As generative AI technology continues to evolve, higher education is transforming from a traditional knowledge transmission system into an intelligent guidance ecosystem. In this process, higher education teachers are not only implementers of AI technology applications but also gatekeepers of educational innovation and ethical balance. This paper, through analyzing the application scenarios and paradigm shifts of generative AI-enabled teaching, clarifies the expanding trend of teachers' role functions. At the same time, starting from differences in teacher digital literacy, regional resource distribution, and the

complexity of the educational ecosystem, this paper reveals the core obstacles in the construction of digital-intelligent competence.

Regarding the response to educational ethical risks brought by AI, this paper emphasizes the importance of data security, algorithmic fairness, and responsibility attribution, promoting the coordinated development of technological application and ethical governance. Future research can deepen along two directions: first, constructing a dynamically updated teacher digital-intelligent competence evaluation system; second, exploring more adaptive regional competence enhancement pathways. Only by achieving the modernization and upgrading of teacher capability structures alongside firmly upholding the baseline of technological ethics can the healthy development and deep integration of generative AI in higher education be ensured.

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