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Research Article

Empowering University Teachers with Artificial Intelligence: Challenges and Optimization Pathways for Professional Development

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Abstract

The rapid iteration of artificial intelligence technology continues to promote the digital transformation of higher education and become the core of enabling college teachers to improve their teaching quality and professional growth. As the core subject of higher education, teachers' digital literacy and intelligent teaching ability directly determine the effectiveness of digital education reform and the quality of talent training. At present, although the development of AI-enabled teachers in domestic universities has achieved initial results, the gradual popularization of intelligent teaching tools and the continuous improvement of teachers' digital participation, there are still many outstanding problems in practice: teachers' cognition of AI technology is polarized, and there are double misunderstandings of technology worship and technology fear; the application of AI technology is seriously out of touch with subject teaching and teachers' professional growth, and man-machine collaborative teaching is a mere formality. At the same time, risks such as data leakage, academic anomie, and lack of digital ethics have become increasingly prominent, which seriously restricts the effectiveness of AI empowerment. In order to solve the above-mentioned difficulties and promote the deep integration of technology and education, this paper systematically combs the current situation and core pain points of AI-enabled university teachers' development based on the four theories of educational digitization, teacher professional development stage, TPACK and human-machine collaboration. The study found that insufficient technical adaptation, lack of hierarchical training, lack of institutional guarantee, and imbalance of human-computer education are the key cruxes that hinder the improvement of teachers' digital ability. Based on this, the research constructs a comprehensive optimization development path from four dimensions: subject adaptation technology upgrading, hierarchical progressive AI cultivation, systematic institutional guarantee, and humanistic human-machine collaboration. The purpose of this study is to break the practical barriers of AI empowerment, reshape the man-machine collaborative education mode, balance the value of technical tools and the humanistic value of education, and provide theoretical reference and practical reference for colleges and universities to promote the construction of teachers' digital ability and realize the high-quality development of teaching in the new era.

Keywords

Artificial Intelligence, University Teachers, Teaching Ability, Professional Development

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1. Introduction

The new round of technological revolution and industrial transformation is driving generative AI, big data, and other intelligent technologies to deeply integrate into the education sector. The digital transformation of higher education has become an important support for achieving the goal of building a leading nation in education [1]. As the core subjects of higher education teaching, university teachers' teaching ability and professional standards profoundly affect the effectiveness of talent cultivation, and are also key elements in implementing the digital reform of education. In this regard, the national level has issued multiple policies to provide guidance. The National Education Development Plan for 2024-2035 clearly proposes to promote artificial intelligence to assist educational transformation and to build a high-quality, specialized teaching workforce. The "AI-Empowered Education Action" launched by the Ministry of Education further refines the deployment [2]. Providing clear policy guidance and practical follow-up for the digital development of university teachers. Under the background of digital higher education, artificial intelligence provides important support for college teaching reform and teachers ' professional development. At present, there are still some problems in the construction of AI-enabled teachers, such as uneven digital literacy, unbalanced technical cognition, insufficient human-computer integration, prominent data and academic ethical risks, and limited effectiveness of empowerment. Based on relevant educational theories, this paper analyzes the realistic dilemma and constructs an optimized development path, in order to enrich the theory of digital teacher development and provide reference for improving the quality and efficiency of AI-enabled teachers in colleges and universities.

2. AI-Enabled Teacher Development: Theoretical Basis for Teaching and Professional Growth

2.1. Educational Digitalization Theory

The digital transformation of education refers to the process of promoting educational reform and innovation in the 5G environment, with the Internet and the Internet of Things as the carrier, data resources as the key elements, and the deep integration of digital technology and educational elements [3]. Digital technology is not only a tool for education and teaching, but also the core driving force to promote education reform. It can break the time and space constraints of traditional education and realize the personalized, precise and efficient development of education. The theory of educational digitization provides the core guidance for AI to empower the development of university teachers. On the one hand, it clarifies that AI technology, as the core carrier of educational digitization, can break the time and space constraints of traditional teacher development, optimize the mode of teacher training and teaching practice, and promote the deep integration of teacher development and educational digitization. On the other hand, it emphasizes student-centered, empowers teachers through AI technology, improves teachers' teaching ability and professional quality, and then improves the quality of talent training. At the same time, the theory requires colleges and universities to build a digital teacher development system, improve digital infrastructure, optimize the application environment of AI technology, and provide guarantee for AI-enabled teacher development.

2.2. The Theory of Teacher Professional Development Stage

The theory of teachers' professional development stage is put forward by American scholars Fuller, Berliner and so on. The theory holds that teachers' professional development is a process of continuous evolution. According to teachers' teaching experience, teaching ability, professional quality and other factors, it can be divided into novice stage, skilled novice stage, competent stage, proficient stage and expert stage. Teachers at different stages have significant differences in teaching ability, professional needs and development priorities. This theory provides important support for AI to empower the development of university teachers, and clarifies that AI technology should accurately match training resources and development paths according to different development stages of teachers, realize phased and personalized empowerment, and help teachers gradually improve their professional quality and move towards a higher development stage. For example, for novice teachers, AI technology can provide basic teaching tool training and teaching case push; for expert teachers, AI technology can provide scientific research assistance and frontier theory push to meet the differentiated needs of teachers at different stages.

2.3. TPACK Theory

The TPACK theory proposed by Mishra and Koehler emphasizes that teachers should have subject content knowledge (CK), pedagogical knowledge (PK) and technical knowledge (TK), and realize the organic integration of the three. [4] AI technology is autonomous and can generate content, analyze data, and conduct dialogues. To this end, the academic community proposes extended models such as AI-TPACK and Intelligent-TPACK, adds the dimensions of "AI as content" and "AI supports professional development" in the traditional framework, and embeds the five-stage literacy progression path of "cognition - use - evaluation - ethics - creation". The TPACK theory provides important guidance for AI to empower college teachers to improve their teaching ability. It is

clear that the core of AI empowerment is not to simply improve teachers' AI technology application ability, but to promote teachers to organically combine AI technology with subject teaching content and teaching methods, improve the pertinence and effectiveness of technology application, and avoid the disconnection between technology and teaching.

2.4. Human-Machine Collaboration Theory

The theory of human-machine collaboration emphasizes that there is a complementary relationship between human and intelligent machines. Through reasonable division of labor and efficient collaboration, knowledge production, classroom organization and formulation of teaching programs are deeply integrated. [5] Achieve the synergistic effect of "1+1>2". The theory of human-machine collaboration believes that intelligent machines have the advantages of high efficiency, precision and insatiability, and are suitable for repetitive, transactional and regular work. Human beings have the advantages of emotion, creativity, critical thinking and so on, which are suitable for undertaking innovative, decision-making and humanistic work. The cooperation between the two can optimize the workflow and improve the efficiency and quality of work. The theory of human-machine collaboration provides a clear logic for AI to empower the development of university teachers: AI technology undertakes repetitive and transactional work in teaching, such as homework correction, learning statistics, resource collation, classroom Q & A, etc., to liberate teachers' time and energy; teachers focus on the core work of teaching design, thinking guidance, personalized counseling, humanistic care and scientific research innovation, highlighting the dominant position of teachers.

3. Current State of AI in Higher Education

3.1. The Application of AI Technology in the Development of University Teachers Is Gradually Popularized

From April 2024 to October 2025, the education section announced 80 typical cases of "artificial intelligence+higher education" application scenarios in three batches, involving 53 universities, covering the core links of "teaching, learning, research, management and evaluation". [6] This shows that the application of artificial intelligence in the field of higher education is gradually achieving a comprehensive and systematic deep integration. In the aspect of teaching assistance, most colleges and universities introduce AI intelligent teaching assistant system to realize the automatic processing of repetitive work such as homework correction, classroom answering and learning statistics, and reduce the workload of teachers. For example, the "Tongji Xiaoyou" intelligent teaching assistant system developed by Tongji University provides students with 24/7 real-time Q&A and personalized learning support. In terms of training improvement, colleges and universities have built intelligent training platforms, relying on big data to analyze teachers' teaching behavior data, accurately identify weak links in teaching, and push customized training resources and training courses. For example, Shanxi Datong University and Central China Normal University have developed an AI-assisted teacher training system to provide teachers with training in AI technology foundation, integration of AI and subject teaching, and improve teachers' AI literacy. In terms of scientific research innovation, various AI research aids have been widely used in colleges and universities to help teachers complete literature retrieval, data modeling analysis, scientific research paper writing, etc., and significantly improve the efficiency of scientific research output and the level of academic innovation.

3.2. Growing AI Awareness and Rising Participation Among Teachers

With the gradual popularization of the application of AI technology in the development of college teachers, most college teachers have realized the importance of AI technology to teaching and professional development, and actively tried to use AI tools to optimize the teaching process and improve the efficiency of research and training. A study based on a national survey of university teachers published in 2025 shows that more than half of university teachers have used generative artificial intelligence (GAI) with high frequency and significant group heterogeneity. The high-frequency use of GAI not only effectively stimulates the interaction and innovation of teachers in teaching methods, but also significantly enhances the frequency and quality of teacher-student interaction outside the classroom field, and significantly promotes scientific research innovation [7].

From a policy perspective, the transformation of teachers' AI perceptions has also received institutional impetus. In 2025, the Department of Higher Education of the Ministry of Education launched the "Series of Teacher Training on AI-Empowered Higher Education Talent Cultivation", organizing subject-specific training on AI teaching competence for university teachers according to different disciplines. As of May 2026, the cumulative number of teachers trained in AI literacy on the National Smart Education Platform has exceeded 30 million person-times. The UNESCO-released "AI Competency Framework for Teachers" provides international reference standards for teacher competency development across five dimensions: "human-centered mindset", "AI ethics", "AI foundations and applications", "AI pedagogy", and "AI for professional development". At the same time, while enjoying the quality and efficiency improvements brought by AI technology, teachers remain highly attentive to technological ethical risks. According to survey data from 86,000 teachers nationwide in the "China Teacher Generative AI Application

Report (2026)" released by the Resource Center of the Ministry of Education in 2026, 96% of teachers are willing to actively learn to use generative AI; meanwhile, 86% of teachers are deeply concerned that excessive student reliance on AI will reduce their independent thinking abilities [8].

3.3. Initial Positive Outcomes of AI Empowerment, Improving Teacher Development Quality

The deep integration of artificial intelligence is driving a comprehensive transformation of university teacher development models from the traditional experience-led type to a data-driven intelligent type. This is mainly reflected in the following three aspects. First, teaching efficiency has significantly improved. From the perspective of educational digitalization theory, AI technology, as the core carrier of educational digitalization, can break the spatiotemporal constraints of traditional teacher development and optimize teacher training and teaching practice models. At the practical level, AI intelligent assistants have played a significant burden-reducing role in areas such as course design, assignment grading, and learning analytics, helping teachers free themselves from repetitive labor and allowing them more time to focus on instructional design innovation and student development. The "AI+Education Action Plan" jointly issued by the Ministry of Education and four other departments explicitly calls for strengthening the application of intelligent teaching systems throughout the entire teaching process of pre-class, in-class, and post-class activities to reduce teacher burdens and increase efficiency [9]. Second, the teaching quality is systematically optimized. The "teacher-student-AI-environment-culture" five-element education model proposed by Jiang Lan, President of Beijing Institute of Technology, points out that AI is no longer a simple technical tool, but a collaborative interaction with students, teachers, environment and culture. The synergy between AI and teachers is reflected in intelligence enhancement and professional complementarity. Through data analysis, personalized recommendation, intelligent evaluation and other functions, teachers' teaching ability and decision-making level are enhanced. [10] AI technology can carry out multi-dimensional analysis of the whole process of classroom teaching, covering key indicators such as the degree of realization of teaching objectives, the quality of classroom teacher-student interaction, and the effect of explanation of key and difficult points. Through intelligent diagnosis, it can accurately excavate teaching pain points and weak links, and provide scientific reference for teachers to improve teaching and improve teaching level. Thirdly, the professional quality of teachers has been improved as a whole. The intervention of AI technology makes it possible to carry out hierarchical and personalized training, and AI undertakes transactional work such as literature retrieval and data analysis, so that teachers can focus on higher-order thinking and innovation output. For example, Xihua University has built a "four future" teacher development system, deployed more than 50 intelligent tools, integrated 3338 curriculum knowledge maps, and realized the transformation from experience-driven to data intelligence-driven.

4. Key Issues in University Teachers' Digital Literacy

4.1. Coexistence of "Technophilia" and "Technophobia"

Although the application of AI technology in university teacher development has achieved initial results, teachers' AI cognition has not presented a balanced or rational state. On the one hand, some young teachers excessively rely on generative AI in lesson plan writing, courseware development, paper writing, and even research project design. This blind admiration of technology reflects some teachers' misunderstanding of AI instrumentalism-they often remain at the operational level of "being able to use it", while neglecting the irreplaceable aspects of the educational process: emotional connection, value guidance, and critical thinking training. The unlimited amplification of technological power causes teachers to gradually lose their independent thinking and innovative abilities, fall into the trap of instrumental rationality, and deviate from the original intention of technology serving educational goals. On the other hand, middle-aged and older teachers generally face the problem of "technophobia". Teachers' technological anxiety is mainly manifested as anxiety about their own ability to apply intelligent technologies, resistance to educational AI technology, and maladaptation to the "AI+education" environment. After ChatGPT-like generative AI technologies rapidly embedded themselves into university teaching contexts, this anxiety further evolved into technological substitution anxiety and technological trust anxiety. Many middle-aged and older teachers worry about being replaced by AI and fear that their accumulated teaching experience will lose value, thus adopting an attitude of rejection or wait-and-see toward new technologies, lacking the willingness to actively learn and experiment. This identity crisis has been summarized as "the expansion of instrumental rationality obscuring the original value of education", leading teachers into a triple predicament of weakened knowledge authority, a crisis of value confirmation, and shrinking professional autonomy [11].

The root cause of the above cognitive divergence lies in the fact that teachers have not yet established a positive and rational understanding of AI. On the one hand, some teachers regard AI as a technological myth, blindly exaggerating the functional boundaries of the technology while overlooking its potential limitations and ethical risks. On the other hand, some teachers, due to a sense of unfamiliarity with the technology, develop an instinctive rejection, viewing AI as an invader threatening their professional status. These two extreme cognitions are essentially deviations in understanding the human-

machine relationship-failing to recognize both the auxiliary rather than substitutive nature of AI and the irreplaceable humanistic value of teachers in a "human-machine symbiosis" pattern. In order to break through this cognitive dilemma, the key for college teachers is to cultivate positive and rational digital consciousness, to enhance the ability of "man-machine dialogue" as the core, and to seek a balance between technological empowerment and humanistic persistence. This understanding also echoes the core requirements of UNESCO's "Teacher Artificial Intelligence Capability Framework" on "people-oriented values" and "safe and responsible use of AI", that is, teachers should always grasp the direction of technology application while fully understanding the boundary of AI technology ability.

4.2. Disconnect Between Professional Growth and Technological Innovation

The iteration speed of AI technology is much faster than the update cycle of teachers' professional development, and there is a significant difference between the two. Some scholars have pointed out that only 4.1% of teachers in colleges and universities can use smart classrooms skillfully, and up to 63.2% of teachers can not use smart classroom technology skillfully, which affects the expected effect of smart environment. The traditional teaching mode of "blackboard, chalk, PPT cramming" is still in the mainstream, and more than 60% of teachers do not know how to realize classroom transformation [12]. This data reveals a deep problem: the rapid deployment of technology does not automatically translate into the improvement of teachers' ability, but exposes the lag of teachers' professional growth system.

The reasons for this disconnect are manifold. First, the current teacher training is mostly a short-cycle model. After completing the training organized by the school, teachers lack continuous learning support and advanced path, resulting in their digital literacy staying at the entry level, and it is difficult to keep up with the version iteration and function update of AI tools. Secondly, there is a general lack of specialized technical service departments in colleges and universities to provide timely and professional response. Teachers often have no way to help when they encounter technical obstacles, and give up deep use over time. Thirdly, the evaluation system of teachers' professional development has not yet incorporated AI literacy into the normalized and lifelong assessment framework, and lacks institutional incentives and constraints, which makes teachers lack the motivation of continuous learning. The deeper problem is that teachers' learning of AI technology often stays at the level of operational skills, while ignoring the integration of teaching methods and the transformation of thinking. Many teachers can learn to use an AI tool, but do not know how to integrate it into their own subject teaching logic, let alone reconstruct teaching design and innovate teaching mode through AI. This dilemma of "using but not using" is essentially a rupture between technical training and professional development. What teachers need is not an isolated tool operation manual, but a transformative ability to deeply integrate AI with their own subject teaching. This is exactly the pedagogical content knowledge of integrating technology emphasized by the TPACK framework. To solve this dilemma, it is necessary to promote teachers to shift from passive training to active approach to technology, and integrate AI learning into the track of lifelong professional development. Colleges and universities should build a hierarchical, progressive and continuous AI ability training system, and set up a special technical support and teaching consulting service team to help teachers realize the internalization and migration of technology in real teaching scenarios.

4.3. Emerging Digital Security and Ethical Risks

The more developed the digital technology is, the more abundant the application of digital scene is, and the more prominent the digital security problem is [13]. After artificial intelligence is deeply integrated into the whole process of teaching management, classroom teaching and scientific research creation in colleges and universities, teachers have derived multiple risks such as data privacy leakage, intellectual property infringement and academic integrity anomie in the process of normalized use of various intelligent teaching platforms, generative AI tools and online teaching and research systems, which has become a realistic problem that needs to be solved urgently in the construction of digital literacy of college teachers.

At the level of data security, some teachers lack systematic data desensitization awareness and privacy protection norms. When using AI to carry out academic analysis, homework correction and teaching seminars, they often directly upload sensitive content including student identity information, academic files, and classroom behavior data without information stripping. Most of the third-party AI platforms have operating mechanisms such as background data collection and model training feeding. If there is a lack of strict encrypted storage and authority control, it is easy to cause personal information of teachers and students, teaching raw data leakage, and even illegal circulation and commercial use. At the same time, many teachers introduce unpublished scientific research manuscripts, first-hand data of research, and exclusive teaching resources of courses into the general AI model for processing, which is easy to cause the hidden loss of original achievements and the hidden danger of intellectual property infringement. At the level of application norms and ethics, although AI can enable the subject to accept more information, it will also produce the problem of content homogenization while referring to the subject's preference, causing the information island effect. [14] However, some teachers rely too much on AI to complete thesis writing, project reports, lesson plans, etc., lack independent thinking and original argumentation,

weaken the rigor and innovation of academic research, and violate academic norms and the original intention of scientific research. The reason lies in the lack of teachers' own digital security literacy and AI ethical cognition, and the failure to clarify the use boundary and responsibility bottom line of intelligent tools. It is also due to the fact that colleges and universities have not yet issued perfect AI application management rules, data hierarchical protection system and intelligently generated content citation labeling standards, and lack of normalized ethical constraints and supervision mechanisms. Therefore, it is urgent to incorporate data security, AI ethics and academic integrity into the normal training system of teachers, and to clarify the boundary of AI application: which data can be shared, which content must be marked with AI participation, and how to balance efficiency and integrity, so as to promote teachers to adhere to the bottom line of data security and academic integrity while enjoying technical empowerment reasonably.

5. Pathways of AI-Enabled Teacher Development

5.1. The Dimension of Technology Application: Promoting the Deep Transformation from " General Tool " to "discipline Adaptation"

5.1.1. Construct a Discipline-adapted AI Tool Matrix

Colleges and universities should abandon the "one-size-fits-all" technology introduction strategy and build a differentiated AI tool matrix according to the characteristics of disciplines. Specifically, for liberal arts teachers, AI text analysis, literature review assistance, paper duplication checking and polishing tools are deployed to help them quickly extract key information from massive literature and improve the efficiency of academic writing. For science and engineering teachers, virtual simulation experiments, data modeling, code generation and optimization tools are configured to support complex scientific computing and experimental simulation. For medical teachers, pathological image analysis and virtual diagnosis and treatment simulation system are provided to assist clinical teaching and case discussion. For art teachers, AI creative design assistance, work style analysis and evaluation tools are introduced to expand the creative boundary. In addition, colleges and universities can establish an AI tool recommendation library, regularly update and organize trial evaluations to ensure that teachers can easily obtain technical resources that are most suitable for their own subject needs.

5.1.2. Building an Integrated Intelligent Teaching Support Service Platform

Colleges and universities should build a cloud-integrated intelligent teaching platform, break through the data barriers between smart classrooms, online learning platforms and educational management systems, and realize the seamless connection between physics teaching space and network teaching space. The platform should deploy a sufficient number of data observation points, covering the whole process of pre-class preparation, in-class interaction, after-class homework and counseling, so as to realize the accompanying collection of teaching data. Through the establishment of a unified data center, the integration of multi-source heterogeneous data, for each teacher to generate personalized learning portraits, including students' knowledge mastery, classroom participation, learning habits and other dimensions. The platform should also provide intelligent early warning function. When students have learning difficulties or abnormal behaviors, it will automatically push reminders to teachers, and attach targeted teaching intervention suggestions, so as to support teachers to carry out accurate and differentiated teaching decisions.

5.2. The Dimension of Training System: Building a Hierarchical, Progressive and Integrated AI Ability Training System

5.2.1. Establish a Hierarchical Training Mechanism Based on the Development Stage

According to the theory of teachers' professional development stage, a three-layer progressive training system of "novice-backbone-expert" is constructed. For novice teachers, the training content is based on the basic operation of AI tools, the introduction of intelligent teaching design, and AI-assisted lesson preparation. Workshops and practical exercises are used to help them quickly establish confidence in use. For key teachers, the training focuses on the deep integration of AI and subject teaching, data-driven precision teaching, and mixed teaching mode innovation, and introduces in-depth training methods such as case study and heterogeneous classes; for expert teachers, we focus on cutting-edge issues such as AI-assisted scientific research innovation, interdisciplinary AI application, AI ethics and humanistic reflection, support them to carry out action research, and form exemplary teaching cases that can be promoted. The training should abandon the one-time model, establish a closed-loop mechanism of "training - practice - feedback -advanced", and organize advanced assessment every semester to ensure the continuous improvement of teachers ' ability.

5.2.2. Strengthening AI Ethics and Data Security Education

The construction of educational intelligence must anchor itself in the establishment of AI ethical norms. First, it is necessary to adhere to the human-centered ethical principles, identify potential AI risks throughout the entire chain of data collection, algorithm design, model building, and practical appli-

cation, clarify the value logic of AI for good and human-oriented development, and establish the development concept of human-machine symbiosis and inclusive, shared "AI for All" [15]. Second, it is essential to balance the intrinsic relationship between instrumental rationality and value rationality, improve the network security protection system, strictly control data security, algorithm compliance, and ethical risks, and uphold the bottom lines of academic integrity and professional ethics. Regular general education on AI ethics and information security should be carried out, making AI ethics a compulsory module in teacher training, strengthening teachers' humanistic literacy and value judgment capabilities, and regulating AI practical application from the four dimensions of reliability, transparency, fairness, and accountability, so as to promote the orderly development of intelligent education within a compliant and secure ethical framework. Universities should also develop a "Teacher AI Ethical Use Manual", clearly prohibiting improper behaviors such as uploading student privacy data to public AI platforms, while recommending best practices, and establish an ethics consultation window to provide real-time guidance for teachers.

5.3. Build a Systematic and Sustainable Enabling Ecology

5.3.1. Reconstruct the Incentive and Evaluation System

The outcomes of AI technology application should be incorporated into the teacher performance assessment and professional title evaluation systems, with special awards established for "AI+teaching innovation". Specific evaluation indicators may include: the frequency and effectiveness of AI tool use in instructional design, such as the number of times AI-assisted lesson preparation is used and student feedback; cases of teaching improvement based on data analysis, such as evidence of student performance improvement after adjusting teaching strategies using learning portraits; and AI-empowered teaching research outcomes, such as published papers on AI teaching applications or developed intelligent teaching resources. At the same time, an AI training credit recognition mechanism should be established. Teachers who participate in university-level or national AI training, complete online AI courses, or engage in AI teaching innovation projects may earn continuing education credits, which should be linked to annual evaluations. Universities should hold an "AI Teaching Innovation Achievement Exhibition" once per semester, recognizing and promoting outstanding cases, thereby creating a demonstrative and leading effect.

5.3.2. Strengthening Digital Infrastructure and Resource Supply

Increase investment in digital infrastructure such as smart classrooms, high-speed networks, and cloud computing resources to ensure the stable operation of AI tools and efficient data processing. Establish a high-quality digital and intelligent education resource sharing pool, and strive to improve the scene and efficiency of AI technology application. Through self-construction, procurement, cooperation and other ways, the resources such as discipline-adapted AI tools, high-quality data sets, and typical teaching case libraries are gathered. Colleges and universities should take the initiative to establish in-depth cooperation with head technology enterprises and scientific research institutes, build joint laboratories or industry-education integration communities, introduce external high-quality computing power, algorithms and data resources, and reduce the cost of self-research in schools. At the same time, a support team composed of educational technology professionals, data analysts and IT operation and maintenance engineers was formed to provide 7 ×24-hour technical response services, and an AI application help desk was established. Through online Q&A, hotline calls, on-site services and other forms, teachers can find people and solve problems quickly when using AI tools. The application effect of AI technology is included in the evaluation system of teacher performance appraisal, professional title evaluation, evaluation and evaluation, and the special reward of "AI + teaching innovation" is set up. Specific indicators can include: the application frequency and effect of AI tools in teaching design, teaching improvement cases based on data analysis, AI-enabled teaching research results, AI-related curriculum development and resource construction contributions, etc. At the same time, establish an AI training credit recognition mechanism, incorporate AI training and training activities that teachers participate in into the credit management of continuing education, and promote teachers to achieve normal learning.

5.4. Human-machine Coordination Dimension: Reshape the Role of Teachers and Return to the Essence of Educational Humanities

5.4.1. Clarify the Boundary of Man-machine Division of Labor and Strengthen the Dominant Position of Teachers

According to the theory of human-machine collaboration, it is clear that AI undertakes repetitive and transactional work, while teachers focus on core education work such as teaching design innovation, high-level thinking guidance, emotional communication and value shaping. Teachers should take the initiative to establish a new teaching relationship of "teacher-AI-student" ternary interaction. In the specific implementation, the following collaborative process can be designed: before class, teachers and AI collaborative lesson preparation-AI recommends teaching strategies and resources based on historical data, and teachers combine their own experience to screen and adapt; in the class, AI participates in interactive discussions as a virtual learning partner, and generates Q & A and instant feedback in real time. Teachers are responsible for capturing classroom generative problems, guiding in-depth

questioning, and conducting value guidance and emotional response. After class, AI automatically generates an analysis report of classroom teaching behavior, and teachers combine the report to reflect on teaching and make improvement plans. In addition, colleges and universities should formulate implementation guidelines for human-machine collaborative teaching, clarify the specific boundaries of human-machine division of labor in different teaching scenarios (lesson preparation, teaching, homework, evaluation, counseling), and avoid technology abuse or over-reliance.

5.4.2. Reshaping the Role of Teachers and Strengthening the Guidance of Humanistic Value

In the era of AI, the role of teachers should shift from knowledge imparter to learning guide, thinking trainer and growth companion. Teachers should devote more energy to cultivating students' higher-order abilities such as critical thinking, innovation ability, interdisciplinary integration ability and humanistic quality, which are irreplaceable by AI. For example, in classroom discussions, teachers can design open questions, guide students to question and verify the views generated by AI, and cultivate their critical thinking; in project-based learning, teachers can use the data analysis support provided by AI to help students discover rules, but the final conclusions and creative solutions still need students to construct independently. In teaching evaluation, we should adhere to the dual-track evaluation model of "data+humanities"-AI is responsible for quantitative analysis, such as homework accuracy and knowledge point mastery, while teachers retain professional judgment on qualitative dimensions, such as learning attitude, cooperation spirit, innovation consciousness and ethical performance. Colleges and universities should guide teachers to establish correct AI application values, clarify that AI is a tool to serve the goal of educating people, rather than the purpose of education itself, and ensure that technical logic is subordinate to the logic of educating people. When the principle of "people-oriented and technology-oriented " is implemented in curriculum, evaluation and governance, technology can truly become the "second cognitive tool" of education and help realize the free and comprehensive development of human beings.

6. Conclusion

In the era of high-speed iteration of digital technology, artificial intelligence has become an important engine to drive the teaching innovation and professional growth of college teachers, and promote the new model of teacher development driven by traditional experience to data intelligence. At present, Chinese universities have accumulated many practical achievements in the field of AI-enabled teacher construction. The implementation of intelligent teaching platform, the popularization of AI teaching and research tools, and the normalization of digital training of teachers have effectively optimized the efficiency of teachers ' teaching and scientific research. However, due to the differences in teachers' cognition, the imperfect training system, the lack of supporting guarantee, and the lack of cognition of man-machine integration, problems such as the coexistence of technology worship and technology fear, the superficiality of man-machine application, ethical security risks, and the disconnection between technology and subject teaching still exist objectively. Based on the classical theories of education digitization, TPACK, and human-machine collaboration, this paper proposes an optimization path from four aspects: discipline adaptation technology construction, hierarchical progressive training, all-round system guarantee, and human-oriented human-machine collaboration. By customizing the AI tool matrix of chemistry, closed-loop hierarchical cultivation mechanism, multiple incentive evaluation system, and clarifying the division of human-machine education, we can break the shackles of the current development of teachers' digital literacy. In the future, as AI technologies continue to evolve and university digital ecosystems improve, institutions must persistently optimize hardware and software resources, routinely refine AI ethics supervision rules, guide teachers beyond extreme technological misconceptions, uphold the humanistic attributes of education, and achieve an organic unity between technological empowerment and the essence of education through complementary human-machine advantages. Subsequent research should conduct empirical studies across different types of universities and disciplines, refine targeted implementation strategies, and continuously improve the implementation system for AI-empowered teacher professional development.

Abbreviations

AI	Artificial Intelligence
TPACK	Technological Pedagogical Content Knowledge
CK	Content Knowledge
PK	Pedagogical Knowledge
TK	Technical Knowledge
GAI	Generative Artificial Intelligence
UNESCO	United Nations Educational, Scientific and Cultural Organization

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Luna Sun: Conceptualization, Funding acquisition, Writing – original draft

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Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Zhang, L. (2024). The Construction of Chinese Paradigm for AI-Empowered Higher Education Teaching Reform. China Higher Education, (24), 9-13. (in Chinese).

[2] The CPC Central Committee and the State Council. (2025, January 20). National Education Development Plan for 2024-2035. People's Daily. https://doi.org/10.28655/n.cnki.nrmrb.2025.000833 (in Chinese).

[3] Hao, X. (2025). The Practical Dilemmas and Implementation Pathways of Curriculum Ideological and Political Education in Less Commonly Taught Language Courses in Higher Education with in the Context of Educational Digital Transformation. Journal of Northeast Normal University (Philosophy and Social Sciences Edition), (2), 86-91. https://doi.org/10.16164/j.cnki.22-1062/c.2025.02.010 (in Chinese).

[4] Wang, X. (2025). Strategies for Enhancing University English Teachers' Ability to Integrate Ideological and Political Education into Courses through Digital Empowerment. Overseas English, (22), 141-143+168. (in Chinese).

[5] Li, S., & Feng, S. (2026). Four Roles of Teachers and Five Realms of Education: Challenges and Reshaping of Pedagogy in an Era of Intelligent Education. Modern Distance Education Research,1-8. https://link.cnki.net/urlid/51.1580.G4.20240327.1424.004 (in Chinese).

[6] Ministry of Education. (2025). Typical application scenarios of "AI+Higher Education"(Batches 1-3) [EB/OL]. (2025-10-15) [2026-06-06]. https://higher.smartedu.cn

[7] Bao, W., & Wan, Y. (2025). The Complex Tensions of Digital and Intelligent Empowerment: The Impact of Generative Artificial Intelligence on the Professional Ecology of Faculty in China's Universities. China Educational Technology, (12), 98-107. (in Chinese).

[8] Teaching Research and Evaluation Center, Qufu Normal University. (2026, May 16). China Teacher Generative AI Application Report (2026). https://pgzx.qfnu.edu.cn/info/1057/2640.htm (in Chinese).

[9] Zhu, X. (2026). The"AI + Education" Action Plan Jointly Issued by the Ministry of Education and Four Other Departments. Science and Education Literature, (10), 1. (in Chinese).

[10] Jiang, L. (2025). Exploration of Constructing a "Teacher-Student-AI-Environment-Culture" Five-Element Educational Model in the Intelligent Era. China Higher Education Research, (10), 1-8. (in Chinese).

[11] Yang, G., & Cai, Q. (2025). The Manifestation and Resolution of Teachers' Professional Identity Crisis in the Era of Digital Intelligence. Educational Research, 46(12), 139-150. (in Chinese).

[12] Ge, F., & Liu, Q. (2025). Practical Patterns and Optimization Pathways for Classroom Application of the National Smart Education Platform for Primary and Secondary Schools. China Educational Technology, (10), 46-54. (in Chinese).

[13] Li, J. (2025). Research on Pathways to Enhance University Teachers' Digital Literacy through AI Applications. China Higher Education, (Z3), 48-51. (in Chinese).

[14] Huang, J. (2025). The Value Mechanism and Countermeasures of Generative AI Empowering Higher Education Governance. China Higher Education, (Z3), 62-65. (in Chinese).

[15] Wu, F., Li, Y., Chen, J., et al. (2024). Red Book on University Students' AI Literacy (2024 Edition). Journal of Science and Technology Development Research, 4(2), 71-96. https://doi.org/10.20105/j.cnki.jstes.2024.02.006 (in Chinese).