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Some Challenges and Future Prospects for Teachers in The Context of Artificial Intelligence

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Abstract: This study explores teacher professional development in the AI era by conducting an in-depth analysis of global educational policy frameworks, resource allocation, teaching competencies, and ethical considerations. Its key findings highlight five critical challenges faced by educators:1)The pressure to update knowledge and integrate interdisciplinary insights;2)The shift from traditional teaching methods to innovative approaches;3)The need to balance role definition with career advancement;4)The handling of ethical dilemmas and academic integrity issues;5)he ensuring of data privacy and security compliance.To tackle these challenges, future development strategies should focus on three dimensions: role evolution, human-machine collaboration, and continuous learning. Theoretically, this research delineates the scope of challenges in AI-enhanced teacher development, identifies their interconnections, and clarifies the components and relationships of future career trajectories. These findings lay a theoretical foundation and provide a research framework for exploring the interaction mechanisms between AI and teachers in education.From a practical standpoint, teachers should proactively embrace the pressures of knowledge renewal and interdisciplinary integration. They need to enhance their teaching competencies, adapt their instructional methods, clarify their professional roles, cultivate a mindset for continuous learning, and prioritize educational ethics and data privacy security. For policymakers, it is essential to formulate reasonable educational policy frameworks based on national educational realities, provide sufficient resource support, establish robust teacher training systems, and facilitate the role evolution and human-machine collaboration of educators. This will enable better adaptation to AI-driven educational environments and promote high-quality development in the education sector.
Key words: artificial intelligence; teachers; challenges; prospects

1. Introduction

Artificial intelligence, a key driver of the new technological and industrial revolution, has been widely adopted across various sectors, bringing about significant progress. In education, it has transformed traditional teaching models, reshaped the educational ecosystem, and promoted the development of high-quality learning environments. In this context, it is crucial for countries to draw on international best practices and research findings during the digital transformation of higher education.

Using Elsevier Science Direct as the data source, we systematically reviewed recent domestic and international studies. We selected "Research Articles" and used the keywords "Artificial Intelligence & Teacher Education" for the search, retrieving 232 relevant papers. When searching with "ChatGPT & Teacher Education", 64 related papers (published between July 2023 and July 2025, with the literature search conducted in July 2025) were obtained. By publication year, there were 39 papers in 2024 and 19 in 2025. In terms of journal coverage, journals with at least 3 published papers included Computers and Education: Artificial Intelligence (18 papers), Thinking Skills and Creativity (3 papers), Procedia Computer Science (3 papers), and System (3 papers).

Teachers form the cornerstone of educational development, and enhancing teacher education has become a pivotal initiative for global organizations and nations to tackle new-era challenges. Against the backdrop of artificial intelligence, this study explores the current challenges in teachers' future development by analyzing national education policies, measures, and academic research in the field.

At the national level:

United States: In April 2025, the Trump administration signed the executive order Promoting the Development of Artificial Intelligence Education for American Youth, which mandates the integration of AI into teacher training systems. Leveraging federal funding, it supports teachers in mastering instructional strategies for generative AI tools and established the "White House Task Force on Artificial Intelligence Education" to coordinate cross-departmental resources. Additionally, the AI Educator Development Act was enacted, allocating $5 billion in federal funding over the next decade to enhance AI capabilities among university faculty. The "AI + Higher Education Alliance," initiated by Harvard University and Stanford University, regularly holds teacher workshops to share AI teaching case libraries and ethical guidelines, currently covering over 50 U.S. universities.

Australia: On September 10, 2024, the House of Representatives Standing Committee on Employment, Education and Training released the report Learning Partners or Influencers, which investigates AI applications in Australian education systems. The report puts forward 25 recommendations, with a key focus on integrating generative AI into

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the national curriculum.
European Union: On August 27, 2024, the European Agency for Safety and Health at Work (EU-OSHA) published the report Artificial Intelligence and Education —— Teacher-Centered Safety and Health Approaches. It highlights that in the past, learners were the primary focus in the integration of digital technologies into education. Although teachers were acknowledged, they were initially regarded as mediators who mainly used digital tools. However, with the introduction of AI technology into schools, teachers have received greater attention as they now take charge of deploying these technologies and addressing associated challenges.
South Korea: The Ministry of Education has launched three key initiatives: "Supporting Teachers in Leading Classroom Revolution through Autonomous Teaching Reform," "Enhancing Digital Education Reform Capabilities for Teachers," and "Digital Infrastructure Improvement Plan for K-12 Schools." These measures aim to improve teachers' digital literacy, create digital learning environments, and establish specialized technical support teams to facilitate digital teaching reforms in the era of digital textbooks.
International Organizations and China: UNESCO's Teacher AI Competency Framework emphasizes human-centered values, AI ethics, foundational applications, integration with education, and AI-assisted professional development. China's State Council, in its New Generation Artificial Intelligence Development Plan, explicitly calls for accelerating talent cultivation models and teaching method reforms through intelligent technologies. The Ministry of Education's Higher Education AI Innovation Action Plan and Digital Empowerment for Teacher Development Initiative outline a three-to-five-year framework of "Intelligent Literacy Standards + Tiered Training + Dynamic Assessment." For example, the "National Training Program" provides specialized AI training, establishes digital literacy profiles for teachers, and incorporates digital competencies into teacher certification exams.
Academic Level:
"AI in STEM Education: Teacher Perceptions and ChatGPT Usage" explores how STEM teachers in German secondary schools assess the benefits and risks of ChatGPT, and its implications for the future application of AI in educational settings[1].
"Exploring Generative Artificial Intelligence in Teacher Education" studies 52 pre-service teachers and 21 teacher educators at Pacific Northwest University in the U.S., putting forward practical methods to enhance key competencies and better prepare both current and future educators [2].
"In search of artificial intelligence (AI) literacy in teacher education: A scoping review" deepens the comprehensive understanding of AI literacy in teaching, contributes to more robust AI literacy education in technical fields, and lays the groundwork for future research on teacher expertise [3].
In terms of global educational policy developments, governments worldwide are establishing frameworks, setting skill standards, providing educational resources, and raising awareness of ethical issues to support teacher development in the AI era. While academic research focuses on improving teachers' AI literacy through innovations in AI-assisted teaching, a critical challenge persists: identifying specific approaches to enhance educators' professional competencies and meet the demands of the digital age. These pressing issues now require in-depth exploration to formulate actionable strategies.

2.literature review

2.1 Conceptual definition of artificial intelligence

Artificial Intelligence (AI) is a branch of computer science that explores how computers can simulate human intelligence. Professor John A. Nelson from Stanford University's Artificial Intelligence Research Center defined AI as: "The discipline of knowledge —the science of how to represent, acquire, and apply knowledge." [4] Professor Winston from MIT further explained: "AI focuses on enabling computers to perform tasks previously reserved for humans." [5] NASA adheres to the definition in Executive Order 13960, which cites Section 238(g) of the National Defense Authorization Act of 2019. An artificial system designed to act rationally, including intelligent software agents or embodied robots that achieve objectives through perception, planning, reasoning, learning, communication, decision-making, and action[6]. These definitions collectively outline the core principles and fundamental content of the AI discipline. That is, artificial intelligence is to study the law of human intelligent activities, construct artificial systems with certain intelligence, and study how to make computers complete the work that used to require human intelligence.

2.2 The application status of artificial intelligence in education

The study of artificial intelligence is highly technical and specialized, with each subfield being deeply integrated yet distinct, thus covering an extremely broad scope. Currently, AI has been widely applied across various fields such as healthcare, biotechnology, agriculture, manufacturing, and education, driving rapid development in all sectors. Particularly in the field of education, AI is revolutionizing traditional teaching models, methods, and resources, bringing significant impacts to the educational sector. The core of global competition today lies in talent competition, with education being the key factor. Countries are implementing various educational policies and measures to leverage AI technology for educational transformation and upgrading, aiming to build strong educational nations. The current widespread application of AI in education is mainly reflected in the following aspects:
First, in student development, AI transforms students' traditional learning methods from mechanical learning to autonomous learning. For example, Adaptive Learning Platforms (ALPs) are electronic learning platforms that dynamically adjust teaching content using adaptive technology to meet individual learning needs[7]. Through

personalized teaching, each learner can access content tailored to their unique characteristics, thereby maximizing learning effectiveness [8]. The ThoTh Lab virtual lab system adopted by cybersecurity students at Arizona State University has not only enhanced classroom engagement through intelligent course content tailored to learning styles, but also improved academic performance for 65% of students [9].The paper "Idiographic Artificial Intelligence Explaining Student Self-Regulation: Toward Precision Education" demonstrates how explainable and understandable AI models can identify variables explaining students 'self-regulated learning and guide data-driven decision-making[10]. While AI technology fulfills personalized learning needs and enhances comprehension in student development, its potential as a driving force in the new educational revolution remains vast. Additionally, MIT Media Lab's 2025 research revealed the double-edged sword effect of AI tools on cognitive processes. EEG monitoring of 54 college students showed: 1. Cognitive costs of over-reliance on AI: Students using ChatGPT for writing tasks exhibited significantly reduced α-waves (relaxation regulation) and β-waves (logical thinking), with neural connections decreasing by 27%-55% and memory retrieval accuracy dropping by 34%. When asked to rewrite their papers without AI assistance, 41% of students could not recall the content completely, with their language organization skills regressing to the level seen when they first used AI. 2. The critical role of tool usage: Passive reliance (directly copying AI outputs): showed the lowest brain activity, with creativity scores 42% lower than those in the self-writing group; Active integration (combining AI suggestions with personal knowledge): enhanced Theta waves (deep memory) and Gamma waves (innovative thinking), resulting in 29% improved paper quality and a 58% increase in content ownership satisfaction. The application of technology in education is like a double-edged sword—it drives rapid development while also generating negative effects.

Second, in educational pedagogy, there's a shift from knowledge transmission to knowledge exploration. A prime example is the ADDIE instructional design model – short for Analysis, Design, Development, Implementation, and Evaluation. This framework systematically breaks down teaching design into five core phases: analysis, design, development, implementation, and evaluation. It not only visualizes abstract instructional theories but also ensures efficient curriculum design and execution. Moreover, AI has become teachers' super assistants. Platforms like Turnitin offer plagiarism detection alongside Gradescope's programming and handwriting correction tools, while WriteLab and Grammarly (educational edition) provide real-time feedback on writing grammar, style, and structure[11]. While AI-powered teaching enhances educators' efficiency, it also carries risks. MIT Media Lab's "AI Education Impact" research reveals that while AI reduces lesson preparation time by 40%, over-reliance may lead to "creative burnout in teaching." For instance, as reported by Time magazine on June 18,2025, a new study from MIT Media Lab revealed that over-reliance on ChatGPT could impair critical thinking abilities, sparking concerns about generative AI's impact on brain development. While AI enhances teachers' professional competencies and improves instructional efficiency, it may lead educators to become overly dependent on AI technology. This dependency risks stifling the cultivation of innovative teaching approaches, hindering the development of critical thinking in education, and diminishing initiative in educational activities.

Third, in terms of teaching resources, the Mobile Integrated and Individualized Course (MIIC) developed by the Bilton team serves as an alternative to MOOCs. Through intelligent customization of learning paths and step-by-step instructional design, this approach has increased student engagement by 72% compared to traditional one-size-fits-all models. These courses may help reduce dropout rates (Bilton et al., 2015)[12]. This study reviewed literature to present a table showing the adoption of AI-assisted teaching by educators across different countries:

Table 1: Survey data on Teachers' Use of AI Teaching Tools in European and American Countries (2024-2025)

Country/region	Core indicators	Specific data
America	Tool usage	Sixty percent of K-12 teachers have used AI tools, with 38 percent using them frequently on a weekly basis
	Core application scenarios	49% for test item generation, 48% for cross-grade teaching content adaptation, and 51% for personalized content customization
	Efficiency gains	Teachers who use AI on a regular basis save an average of 5.9 hours per week
	digital gap	The coverage rate of AI courses in rural schools was 56%, only 61.5% of that in urban super middle schools (91%)
Europe	Regional/educational type differences	Private schools have 78 per cent of AI mentors, compared with 15 per cent in public schools; 23 per cent of UK teachers use them
	Teacher competency gap	Seventy-five percent of teachers lack AI training and only 31 percent have a computer science background

	Ethical risks	The AI scoring system showed a 7 percent bias against black students; virtual teaching assistants showed significant differences in response between boys and girls

Table 2: Survey data on Teachers' Use of AI Teaching Tools in Asian Countries (2024-2025)

country	Core policy/projects	implementation effect
China	New Generation AI Development Plan	Beijing and Shanghai have piloted the "AI + subject" curriculum system; Baidu's Wenxin Yiyang education edition has increased the coverage of AI courses in county schools by 23 percentage points
Singapore	Future Schools Project (15 pilot schools)	Chonghui Primary School's "virtual world" supports autonomous learning across time and space; Kangpei Primary school's 4D laboratory improves student participation by more than 30%
Japan	Pilot of AI teaching (52 schools)	The AI English Conversation Practice at The Forest of Learning School improved oral fluency by 27 percent; the AI Debate at Longqi High School enhanced logical depth
Korea	AI textbook promotion	The penetration rate in the spring semester of 2025 is 33%, lower than expected

The data reveals that while AI technology has driven educational advancement across nations and enhanced teaching quality, it also highlights a significant gap: Western countries have achieved broader adoption of AI-assisted education compared to Asian counterparts. This underscores the substantial potential for expanding AI applications in Asian education systems. Ultimately, the key driver of educational progress lies with teachers. Only by improving educators' digital literacy can we elevate national educational standards and strengthen global competitiveness.

3. The role of artificial intelligence in education

In the field of education, artificial intelligence plays a vital role in advancing educational modernization. Educational modernization refers to the dynamic process where the education system undergoes systematic transformations through updated concepts, institutional reforms, technological integration, and content optimization, transitioning from traditional educational models to new forms that meet modern societal demands. For instance, in terms of educational philosophy, AI empowers and restructures scenarios, driving educational concepts from the conventional "knowledge infusion" standardized training model toward modern directions such as "learner-centered approaches,""personalized development,""core competency cultivation,""lifelong learning," and "educational equity." This transforms abstract ideas into practical educational frameworks. Regarding institutional reform, AI reshapes core educational processes (such as teaching, evaluation, management, and resource allocation) by forcing educational systems to transition from traditional "standardized, closed, hierarchical" models to "flexible, open, personalized"ones. This transformation is not direct technological replacement but rather systemic adjustments in institutional rules, responsibility divisions, and operational mechanisms by altering the fundamental logic of educational practices. In terms of technology-integrated education, AI, as a core technology leading educational transformation, deeply promotes the upgrade of educational technology from "simple application" to "integrated innovation" through breaking down technical tool isolation, enhancing adaptability between technology and teaching processes, and building collaborative technological ecosystems.

Teachers serve as the cornerstone of education, playing a vital role that extends beyond knowledge transmission to shape students' holistic development. Research indicates artificial intelligence (AI) exerts particularly profound impacts on educators. Firstly, AI takes over repetitive and standardized tasks, freeing teachers from routine duties to focus on core educational values. Secondly, through technological empowerment and role transformation, AI drives educators to transition from traditional multimedia-assisted teaching to human-machine collaborative development, evolving from mere knowledge transmitters into innovators and leaders in educational ecosystems. Finally, teachers must remain vigilant against over-reliance on AI and address ethical concerns in education.

4. The challenge of artificial intelligence to teachers

4.1 Pressure of knowledge update and interdisciplinary knowledge integration

With the rapid development of artificial intelligence technology, the speed of knowledge renewal is unprecedented. As teachers, they not only need to deal with the pressure of rapid knowledge renewal, but also face the dilemma of

cross-disciplinary knowledge integration, which brings great challenges to their teaching and teaching research work. In the age of artificial intelligence, the knowledge renewal cycle has been dramatically shortened. Take the AI field as an example: new algorithms, models, and applications keep emerging. The Transformer architecture in deep learning, proposed since 2017, has sparked revolutionary changes across natural language processing, computer vision, and other domains. The GPT series of large language models based on this architecture have even ignited a global craze. These emerging technologies and knowledge require educators to continuously update their expertise to keep pace with the times. However, for many teachers, it's no easy task to stay updated with rapidly evolving knowledge while juggling busy teaching and research duties. For instance, when applying AI technology in classroom design, the fundamental principle of AI is "outputting according to instructions," whereas prompts are about "translating human needs into AI-understandable language." This requires clearly defining what the AI should do, how it should do it, and what outcomes should be achieved. By adhering to principles of clarity, specificity, and constraints, adjusting elements according to scenarios, and optimizing through iterative processes, we can transform AI from a tool into an efficient collaborative partner. If teachers lag in this area, it not only affects their teaching quality but also hinders their professional development.

The advancement of artificial intelligence has catalyzed interdisciplinary integration, making cross-disciplinary teaching and research a defining trend in future education. This demands educators to master the art of knowledge synthesis, skillfully weaving together insights from diverse fields into their instructional practices and academic endeavors. Yet in practice, teachers often encounter numerous challenges that hinder this transformation.Taking "AI + Chinese Language" classroom teaching as an example, Chinese language teachers typically possess relatively limited knowledge structures and restricted understanding of artificial intelligence. Integrating these two domains in instruction may negatively impact students' comprehension of course content. Moreover, the integration of interdisciplinary knowledge presents significant challenges, requiring teachers to demonstrate strong knowledge synthesis skills and innovative thinking. Given the substantial differences in disciplinary knowledge systems, research methodologies, and cognitive frameworks across subjects, how to organically combine these elements into a logically coherent and content-rich instructional framework remains a major challenge for educators.

4.2 Challenges in Improving Teaching Competence and Transforming Teaching Methods

The widespread application of artificial intelligence (AI) technology has introduced new demands on teachers 'instructional capabilities and methods. Educators need to master digital teaching skills to transition from traditional lecture-based instruction to interactive pedagogy, adapting to students' learning needs in the modern era. However, many teachers face significant challenges in practical implementation. A study titled "Most Teachers Are Not Using AI. Here's Why" published on Education Week revealed that two-thirds of educators surveyed had never used AI-powered tools in their classrooms. Key barriers include teachers' busy schedules leaving no time for training, lack of knowledge and support for effective application, and concerns about cheating through tool usage that might undermine critical thinking development. The article "A Review of Artificial Intelligence in K-12 Education" provides a comprehensive overview of AI applications in K-12 education from 2010 to 2023. While highlighting potential benefits like personalized learning, it emphasizes challenges including teacher resistance, high implementation costs, ethical considerations, and extensive teacher training requirements—factors that limit the widespread adoption of intelligent teaching tools in classrooms[13].

Furthermore, digital teaching tools and intelligent educational systems, along with online learning platforms like Yu Classroom and Chaoxing, have been widely adopted in the era of artificial intelligence. While these tools bring convenience and innovation to education, they also pose challenges to teachers 'digital pedagogical capabilities. Some educators demonstrate noticeable limitations when utilizing these smart tools. Many teachers possess only basic operational knowledge of intelligent teaching tools, failing to fully leverage their potential. The research titled "Digital Literacy for Future Teachers in the AI Era: An Investigation by Liaoning Normal University's 'Future Teacher Digital Literacy Survey Research' Project" reveals that although most prospective teachers can skillfully operate foundational digital tools such as online office software and smart whiteboards, and perform basic tasks like digital image editing and video production, they still need improvement in advanced application skills for digital tools and self-development/adjustment capabilities for smart devices. For instance, 31.4% of future teachers reported lacking proficiency in big data analysis tools, while 56% indicated insufficient mastery of theoretical frameworks for designing smart teaching activities and blended learning programs. Over 70% of prospective teachers have not utilized smart classrooms or other digital environments for personalized instruction in daily teaching practices, highlighting limitations in their understanding and application of intelligent teaching tools[14].

Traditional lecture-based teaching methods, which are teacher-centered and emphasize knowledge transmission, place students in a passive learning position. In the age of artificial intelligence, interactive teaching approaches can better stimulate students 'interest and initiative, while cultivating innovative thinking and practical skills. However, many teachers encounter significant challenges when transitioning from conventional to interactive teaching. Interactive instruction places higher demands on teachers' classroom management and adaptability. During interactions, students may raise various questions and viewpoints, requiring teachers to respond promptly and guide effectively to ensure smooth teaching activities. This poses considerable challenges for some educators.

4.3 Role positioning and career development dilemma

The advent of the era of artificial intelligence has brought about profound changes in the role positioning of teachers, from traditional knowledge transmitter to learning guide. This role change has exerted a profound impact on the professional development of teachers, but also brought a series of uncertainties.

In traditional teaching models, educators primarily serve as knowledge transmitters, with students acquiring information through lectures. However, in the AI era, learners can access abundant resources via smart devices and online platforms, transforming knowledge dissemination beyond teacher-centered instruction. Consequently, educators must evolve from mere knowledge dispensers to learning facilitators, guiding students to effectively utilize these resources while cultivating self-directed learning skills, innovative thinking, and critical analysis abilities. To meet the evolving demands of AI-driven education, countries worldwide have implemented digital literacy initiatives. For instance, UNESCO's 2024 "Teacher AI Competency Framework" outlines 15 requirements across five dimensions— "human-centered thinking," "AI ethics," and three developmental levels: "acquisition," "deepening," and "creation." China has also established its "Digital Literacy Standards for Teachers," developing a framework encompassing digital awareness, technical knowledge, and skills to enhance educators' digital competencies. The "Digital Equity Framework" was released on August 14,2024 by Digital Promise, comprising three components: "State Digital Equity and Opportunity Framework," "K-12 Digital Equity Framework," and "Higher Education Digital Equity Framework." The K-12 Digital Equity Framework consists of five interdependent areas: strategic guidance, system resource policy coordination, device and network access, digital literacy development, and learner-centered teaching models. It aims to close the digital teaching gap in schools, promote digital equity, and provide students with equitable academic, social, and economic outcomes.

The advancement of artificial intelligence has reshaped the career development landscape for higher education faculty, leaving educators uncertain about their professional trajectories. On one hand, as AI technology permeates teaching practices, repetitive and routine instructional tasks may be automated by smart learning systems, fueling concerns about their career prospects. On the other hand, teachers face growing confusion in navigating career planning within this AI-driven era.

4.4 Challenges to educational ethics and academic integrity

The development of artificial intelligence technology has brought convenience to education, while also triggering a series of issues related to educational ethics and academic integrity. Teachers need to actively address these problems in the process of teaching to maintain a sound educational order and academic environment. For example, AI Ethics in the Fields of Education and Research: A Systematic Literature Review points out that the key ethical aspects repeatedly examined in relevant studies include transparency and explainability, privacy and data protection, responsibility and accountability, as well as equity.Transparency and explainability are crucial to ensuring that AI systems in education operate in an understandable manner, which helps build trust between educators and students. Privacy and data protection emphasize the importance of handling personal data with extreme caution and complying with relevant regulations. Responsibility and accountability highlight the need for clear mechanisms to supervise the deployment of AI, while equity involves avoiding bias and discrimination[15].

With the continuous advancement of artificial intelligence technology, academic misconduct such as cheating and plagiarism through AI has become increasingly prevalent among students. Some learners employ AI tools like smartwatches and glasses to receive answers during exams. The article "Making AI Your Friend, Not Your Foe, in Literacy Education" highlights that while AI tools like ChatGPT pose challenges such as cheating concerns in education, teachers can guide students to utilize them as beneficial tools in literacy instruction. Educators should help students understand how to effectively use ChatGPT by addressing practical issues and experiences, teaching them to evaluate AI-generated content, and enabling AI to play a positive role in language and literacy development rather than outright prohibition. Teachers need to strengthen educational guidance for students, enhance their awareness of academic integrity, and implement effective measures to prevent and combat these academic misconduct behaviors[16].

4.5 Responsibility for data privacy and security

In the age of artificial intelligence, the collection and utilization of educational data have become increasingly frequent and widespread. During teaching processes, educators gather students' learning data and personal information, where privacy protection and security safeguards are paramount. Any leakage or misuse of such data could harm student rights. The article "Unveiling the Shadows: Beyond the Hype of AI in Education" highlights that AI applications in education involve massive data collection and analysis, raising concerns about privacy breaches, security vulnerabilities, and sensitive information abuse. The complexity and opacity of AI algorithms also make decision-making processes difficult to comprehend, leading to accountability and fairness issues[17]. Additionally, the OECD Digital Education Outlook 2023: Towards an Effective Digital Education Ecosystem document notes that AI applications in education have sparked worries about personal privacy, security, and usage practices among teachers and learners. Data protection policies must ensure the effective and equitable delivery of education while safeguarding the privacy of students and teachers. Education authorities should provide schools and educators with clear data protection guidelines, establish well-defined ethical standards, and evaluate the security, effectiveness, and potential biases of digital tools before implementation[18]. The China Education Association released the "Guidelines for Primary and Secondary School Students 'Use of Generative Artificial Intelligence (2025 Edition)", which specifies that teachers should supervise and guide students' AI applications. This includes recommending reliable generative AI tools, fostering students 'understanding of AI technology, application skills, innovation capabilities, and information discernment abilities, as well as enhancing critical thinking, data security awareness, and technical ethics. Therefore, when collecting and using student data, teachers must strictly comply with relevant laws, regulations, and ethical guidelines, implement effective technical measures and management protocols to protect students' data privacy and security.

5. Teachers' outlook for the future

5.1 Evolution of Teacher Role

In the context of AI's deep integration into education, teachers are transitioning from being "sole knowledge carriers" to becoming "core architects of educational ecosystems." This transformation transcends mere functional replacement, leveraging AI's technological strengths (such as efficient knowledge delivery, data-driven analysis, and personalized recommendations) to refocus on education's unique human value——core domains where AI struggles to substitute, including emotional connection, cognitive guidance, and value shaping. This professional evolution can be achieved through the following progressive approaches.

Phase/Classification	Specific operation content	Target results
Basic Evolution: Build AI collaboration awareness	1.Classroom practice:A new"AI teaching effect prediction"section has been added,, 2.Role extension:15 minutes of"AI Tool Transparency Classroom"will be held every week to demonstrate the process of AI content modification	Role extension:15 minutes of "AI Tool Transparency Classroom" will be held every week to demonstrate the process of AI content modification
Mid-level Evolution:Upgrading Educational Designers	1.Interdisciplinary project design: Collaborate with teachers from multiple disciplines and technical personnel to develop integrated courses. 2. Rule formulation: Take the lead in formulating the "Classroom Human-Machine Collaborative Learning Convention", clarify the fields where AI is irreplaceable, and revise it regularly.	Take the lead in human-machine collaboration rules and become a "project architect"and "co-creator of educational rules"
High-Level Evolution:Ethics Arbitrator	1.School-based practice: Establish an"AI Teaching Ethics Case Bank"and analyze controversial scenarios. 2.Industry influence: Participate in the regional "AI Education Ethics Committee" and transform cases into industry recommendations.	Lead industry standards,evolving from a"classroom practitioner"to an"industry standard contributor"

5.2 Human-machine collaborative development

In the context of artificial intelligence, human-machine collaboration standards refer to a set of guidelines and frameworks that regulate the division of labor and complementary advantages between teachers and AI systems in educational scenarios, aiming to achieve educational goals such as promoting students 'all-round development and improving teaching quality. The core principle is to clarify "who does what, how to collaborate, and what principles to follow" to realize the educational effect of "1+1>2". AI serves as an "instrumental assistant", while teachers remain the "educational leaders". AI outputs must undergo teacher review (such as personalized learning plans and evaluation results), and teachers need to compensate for AI's limitations (such as algorithmic bias and emotional detachment). Notably, the human-machine collaboration process must also adhere to educational ethics and technological ethics to prevent technology from deviating from the essence of education. Specific solutions can be implemented to achieve coordinated human-machine development.

Collaboration phase	**Core functions of AI**	**The core function of teachers**	**Collaborative logic**
Basic synergy (corresponding to the base layer of role evolution)	Implement standardized tasks:generate teaching materials,simulate teaching effect data,automatically correct objective questions,and generate basic exercises.	Calibration and decision making:analyze AI data bias,modify AI content,and lead classroom interactions.	AI assisted execution,teacher led judgment

Deep collaboration (corresponding to the middle layer of role evolution)	Processing professional tasks: cross-disciplinary data integration, generation of personalized learning paths, implementation of basic rules monitoring.	Design and guidance: design interdisciplinary projects, formulate human-machine collaboration rules, and guide critical interpretation of AI results.	Teachers lead the design, and AI supports professional tasks
Dominant synergy (corresponding to role evolution at the top)	Support systematic tasks: ethical risk warning, integrate multi-scenario data to generate industry reports.	Arbitration and guidance: establish an ethical case database, formulate industry standards, and promote the implementation of cross-regional collaborative norms.	Teachers lead ecological rules, and AI assisted systems optimize

The implementation plan reveals three key developments: 1. Collaborative Evolution: Progressing from "AI-assisted support" to "human-machine collaboration" and ultimately to "teacher-led rule-making", demonstrating progressively deepening synergy as educators evolve their roles. 2. Functional Differentiation: While AI remains focused on "data processing and standardized tasks", teachers transition to higher-order functions including "value assessment, rule creation, and ethical guidance", highlighting the irreplaceable humanistic dimension of education. 3. Contextual Continuity: The three-phase scenario examples form a closed loop (from single-subject teaching to interdisciplinary integration and industry standards), illustrating the dynamic adaptation process of human-machine collaboration throughout teachers' complete evolution from "classroom implementers" to "educational leaders".

5.3 Continuous learning state

In the age of artificial intelligence, teachers as "educational leaders" serve as the core safeguard for enhancing educational quality to meet technological transformation demands. Beyond traditional subject knowledge updates, educators must expand their expertise into technical literacy, pedagogical concepts, collaborative skills, and other multidimensional dimensions. This requires teachers to maintain a continuous learning mindset that evolves with the times. The essence of sustained teacher learning lies in "taking ownership and applying knowledge": embracing new tools that boost teaching efficiency without fear, while avoiding blind conformity to tech trends. Anchored by the fundamental nature of education, teachers recognize that technology is easily accessible but educational values remain profound. Through the cyclical process of "learning-practice-reflection", they achieve the leap from "adapting to technology" to "mastering technology", ultimately becoming "educational designers in the AI era". To implement continuous learning, educators should: 1. Keep up with evolving content through iterative updates to enhance creative impact; 2. Upgrade learning formats by building immersive networks to deepen understanding and broaden global perspectives; 3. Transform learning outcomes into practical applications, shifting from "passive learning" to "proactive evolution" to maintain professional competitiveness.

6. Conclusions

This paper examines the challenges educators face in the age of artificial intelligence (AI). The research identifies five key dimensions: pressure to update knowledge and integrate interdisciplinary expertise; the need to enhance teaching capabilities and reform instructional methods; dilemmas in professional identity and career development; ethical concerns and academic integrity issues; and responsibilities for data privacy and security.In response to these challenges, three future directions for educators are proposed: evolving their roles, advancing human-machine collaboration, and sustaining continuous learning.

Looking ahead, the evolution of teachers in the AI era essentially reflects a dynamic interaction between educational practitioners and technological environments. Educators must undergo a transformative shift from "knowledge transmitters" to "architects of educational ecosystems" through the dialectical integration of "technological empowerment" and "humanistic commitment." This transformation requires both top-level policy design and personalized professional development, with the ultimate goal of realizing the ideal scenario where "technology serves humanity and education returns to its essence."

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