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Policy, Pedagogy, and Technological Disruption: Teacher Agency in AI-Integrated Educational Ecosystems

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Abstract: The rapid development of artificial intelligence (AI) technology is reshaping the education ecosystem, driving the transformation of teachers' roles from traditional knowledge transmitters to learning facilitators and ethical supervisors. Through a systematic literature review, this study explores the driving factors of teachers' role transformation in the AI era and its impact on teaching strategies, while analyzing the practical challenges faced by teachers. The findings reveal that technological drivers, policy requirements, and societal demands synergistically reshape teachers' functions. However, this transformation faces multi-level challenges, including skill gaps, ethical dilemmas, and psychological conflicts. To address these issues, this paper proposes a "human-AI collaboration" teaching model, emphasizing the need to enhance teachers' decision-making authority in AI tool design. It further suggests optimizing policies, teacher training, and ethical frameworks to balance technological empowerment with educational values. The study provides theoretical and practical insights for educators to adapt to the AI era, advocating for the integration of technology, policy, and humanistic principles to restore education's core mission of nurturing holistic individuals.

Keywords: teacher role transformation; artificial intelligence; teaching strategies

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1. Introduction

The evolution of Artificial Intelligence (AI) has gone through a leapfrog development from symbolism to deep learning: in the 1950s, the concept of AI sprouted from Turing's question of whether a machine can think; in the 1970s, the Mycin system was the first to apply AI to vertical fields such as medical diagnosis [1,2]. At the beginning of the 21st century, machine learning promoted the popularity of data-driven decision-making; after 2010, deep learning achieved breakthroughs in image recognition, natural language processing, and other fields [3,4]. Technological innovation has recently pushed the traditional education model to intelligent transformation. AI tools represented by generative artificial intelligence have expanded from assisting in generating teaching resources to personalized learning design, automated assessment, and other fields [5]. The global education trend is shifting from "knowledge-based" to "core literacy-based", and the OECD reported in 2018 that 70% of teachers' work in the future would need to focus on areas that are difficult to replace by AI, such as creative ability and emotional communication [6]. AI tools can scale the supply of resources and precise teaching interventions. Hence, teachers need to be transformed into teaching organizers to ensure the operation's effectiveness, which is a key path to cracking the equity of education and ensuring the quality

of education [7]. In addition, the application of AI tools in education faces many risks, including the need for teachers to guide students in regulating the use of AI to avoid causing an academic integrity crisis and the over-reliance of students on AI-generated answers [8]. This paper provides educators with the theoretical basis and practical path to adapt to the AI era. It reveals the direction of the innovation of the education model under the empowerment of technology and proposes coping strategies to solve the problems of academic integrity and data privacy.

2. Literature Review

To date, there has been much research on the grounded theory of teacher role change. In traditional education, the core function of teachers is knowledge transfer [9]. As AI technologies are increasingly used in teaching, teachers are empowered with new responsibilities, shifting from one-way teaching to interactive learning and becoming competence guides focusing on higher-order literacies such as critical thinking and collaborative skills [6,10]. In addition, teachers have become ethical watchdogs in response to academic integrity and data privacy triggered by AI tools [11]. Currently, the application scenarios of AI in education are increasingly affluent, such as adaptive learning systems (Knewton), has been able to design personalized learning paths [12]. In recent years, generative AI tools have matured, and automated content generation and feedback mechanisms have made the application of AI in teaching more convenient [13]. In curriculum design, AI assists in lesson plan generation and interdisciplinary resource integration; in teaching assessment, AI drives homework assessment and learning situation analysis to optimize teaching feedback [14,15]. Smart classroom focuses on enhancing teachers' ability to apply information technology [16]. With the increasing development of AI technology, teachers focus on the guidance of emotions and values, which promotes the improvement of the model of human-computer writing collaboration [17]. For example, the AI Mentor Program in Australia has enabled teachers to shift 55% of their working time to teamwork and creativity development by co-directing student projects with AI [18]. However, insufficient digital literacy among teachers can lead to ineffective use of technology, which poses a significant challenge to teachers' adaptability [19]. A study of 1,200 teachers showed that only 29.5% of teachers could effectively integrate generative AI into their teaching [20]. On the other hand, the use of AI in teaching is still controversial. Some researchers believe that over-reliance on AI may undermine teacher autonomy; others point out that AI may exacerbate the unequal distribution of educational resources, thereby increasing educational inequity [21,22].

Existing research focuses on a single area, such as AI technology or the role of teachers, and lacks a systematic analysis of the dynamic relationship between teachers, AI, and teaching strategies. In addition, there is still a lack of empirical research on the ethical risks of AI tools, especially the long-term impact of algorithmic bias on student development has not been fully explored. Therefore, this paper will fill this theoretical gap by revealing the interaction mechanism between teacher role change and AI tool suitability through literature analysis. Specifically, the research will focus on two core questions: first, how do technology drivers, policy requirements and societal needs synergise to drive teacher role change? Second, what are the practical challenges faced by teachers in the process of role transformation? The study will deeply analyse teachers' cascading difficulties and digital literacy deficits at the skill, ethical, and psychological levels, barriers to the operation of AI tools, regulation of academic integrity, responsibility for data privacy protection, and professional identity crisis. Through these analyses, this paper aims to provide theoretical support for teachers' adaptation in the AI era and to inform related training and practice.

3. Methodology

This paper adopts a systematic literature analysis approach to explore the drivers and practical challenges of teacher role change through a multi-stage literature screening process. Specifically, we searched multiple databases and official policy documents with the core themes of "teacher role transformation" and "artificial intelligence education", and then read the full text of the searched literature and assessed its quality.

By integrating multiple data, the systematic literature analysis not only reveals the cross-cultural common patterns and geographical differences of teacher role transformation, but also provides an opportunity to understand how this transformation has taken place globally. It also provides important references for understanding the trends of this transition on a global scale. For example, differences in the application of educational technology and teachers' professional development in different countries and regions directly affect the speed and manner of teachers' role transformation. However, the limitations of over-reliance on secondary data should not be overlooked, which may undermine in-depth interpretation of psychological dimensions, such as the emotional complexity of career anxiety. Future research could incorporate mixed research methods, such as teacher focus group interviews and questionnaires, to make up for the shortcomings of the literature analysis. Through the combination of multiple research methods, a more comprehensive and in-depth understanding of the complexity of teachers' role change can be achieved, providing more targeted recommendations for educational practice and policy development.

This study strictly followed the ethical quasi-tests of literature analysis. All cited documents are fully labelled with sources and APA 7th edition citation format is used to avoid the risk of plagiarism and copyright infringement. In secondary analysis of data literature from published authors, such as teacher interviews, identifiable information was removed to protect the privacy of the interviewees. The research is independent of any education technology companies, and literature screening is not influenced by commercial interests to ensure the objectivity and impartiality of the research. When dealing with non-English literature, back-translation is used to ensure terminological accuracy and avoid misunderstanding due to language transformation. At the same time, transitional generalization of the Chinese case was avoided, and the context-dependency of the findings was emphasized, taking into account the impact of different educational environments and cultural contexts on the transformation of teachers' roles.

4. Findings

Through systematic literature analysis, this study reveals the drivers of teacher role transformation in the age of AI and the multilevel challenges it triggers. It is found that the transformation of teachers' roles is a result of the synergistic effects of technology penetration, policy interventions and social demands, but this process faces complex barriers at the skill, ethical and psychological levels, and a systematic support framework needs to be constructed to cope with the double-edged sword effect of AI education. Technology, policy and social needs do not work in isolation. The technical feasibility of generative AI drives policymaking, and policy leads to changes in social perceptions, forming a positive feedback loop of "technology-policy-society".

4.1. Key factors driving teacher role change

First, the popularity of generative AI under technology-driven conditions can reconfigure teaching scenarios and force teachers to transform their functions. Studies have shown that the TPACK and TAM frameworks of video-generative AI enable K-12 teachers to enhance teaching strategies and improve student engagement [23]. The most significant impact of technology penetration is the shift in the focus of teaching: after AI takes over knowledge transfer (e.g., automated problem solving), teachers need to shift to higher-

order competency development [24]. For example, in the pilot of Beijing's "Smart Education Demonstration Zone", intelligent teaching collects students' pre-school data, homework grades and other data, generates a visual report on chemistry, helps teachers accurately grasp the academic situation, pushes teaching resources for teachers, and helps teachers improve the efficiency of lesson preparation through precise annotation, intelligent recommendation, and teaching resource search [25]. Generative AI accelerates the realisation of policy goals by reducing the cost of instructional design, while amplifying the social expectation of innovation capability.

Second, the literacy-oriented curriculum reform under the curriculum standard policy of each country directly promotes the transformation of teachers' roles. In the era of information explosion, the cycle of knowledge updating has become shorter than in the past, and the knowledge learnt in schools can no longer meet the needs of future social growth. In this environment, improving students' ability to learn independently has become the focus of education reform, forcing teachers to shift from "teaching" to "educating" [26]. Studies have shown that in the 1950s, 75 per cent of the knowledge gained at university could be used until retirement. This figure has now dropped to 2 per cent. If people stop acquiring new information and skills, they will be lost to more advanced industries [26]. Many countries have incorporated programming into their national curricula as part of a recent wave of reforms to primary and secondary school curriculum standards. Finland, for example, was the first EU member state to include AI technology development as a national-level objective. The national core curriculum syllabus was rolled out nationwide in August 2016, emphasizing the need for educational innovation to meet the country's demand for AI talent [27]. In contrast, China's Ministry of Education has seen an increase in the number of AI textbooks written at all levels of basic education since 2018. However, these textbooks lack a coherent structure due to differences in their perspectives and compilation techniques [26].

Finally, society needs the ability to innovate to create more economic value. The pervasive technology of generative AI provides instrumental support for policy goals, and society's need for innovative talent further strengthens this link. Employers' and parents' demand for "irreplaceable AI capabilities" reshapes educational goals. More and more parents realize that critical thinking is more important than subject knowledge, and societal expectations are forcing teachers to adjust their strategies. For example, after the introduction of AI tools in the electrical engineering programme, teachers led interdisciplinary innovation projects, which significantly improved the learning outcomes of students with electrical engineering backgrounds and effectively achieved the teaching objectives, proving the effectiveness of their curriculum development [28].

4.2. Practical Challenges of Changing Teacher Roles

Firstly, an important crisis facing teachers is the lack of digital literacy. In March 2019, UNESCO released the report Artificial Intelligence in Education: challenges and opportunities for sustainable development, which clearly states that AI technologies will be widely used in future classrooms and that teachers need to be AI literate [28]. There is a significant divide between teachers' digital literacy and the complexity of AI tools. Data from a survey study of 489 maths teachers in China showed that increased AI literacy and trust were directly correlated with increased AI dependency and a decline in skills such as self-confidence, problem solving, critical thinking, creative thinking and collaboration [28].

Secondly, the ethical dilemmas and professional identity crisis brought about by generative AI cannot be ignored. the misuse of AI tools exacerbates the academic integrity crisis. Knowledge gap about ethical assessment of AI tools. Teachers must not only master the technical aspects of these tools, but also be familiar with the ethical dimensions that influence their application in the classroom setting [26]. University teachers, in particular,

must engage in a process of critical evaluation and informed decision-making when integrating AI tools into their teaching practices, yet students use ChatGPT to directly generate essays and teachers lack effective means of detection. In addition, role transition triggers self-perception dissonance among teachers. A questionnaire survey of 1192 teachers revealed that current AI anxiety among primary and secondary school teachers (especially those over 50 years of age) is high, and they generally believe that the widespread use of AI in education will threaten their jobs [28]. Such resistant technological perceptions will not help teachers to use AI to help them free themselves from the mechanical and repetitive labour of education, and will also lead to students' rejection of the new technology through exposure to it [28].

5. Discussion

This study reveals the multidimensional driving mechanism and complex temporal challenges of the transformation of teachers' perceptions in the age of artificial intelligence through systematic literature analysis. The study finds that the reconfiguration of teachers' perceptions is not only an inevitable product of technological iteration, but also an adaptive choice of the education system to cope with social change. However, this process is not a simple technological replacement, but a deep game of designing power relations, cultural traditions and ethical values. In the following, we will discuss the theoretical dialogue and practical insights in the light of literature and research findings, and reflect on the limitations and future directions of this study.

In traditional education theory, the role of the teacher is often framed within the binary structure of "knowledge authority" and "classroom controller" [10]. This study shows that the intervention of AI is creating a triadic interaction paradigm of "teacher-AI-student". This finding echoes the "double-loop collaboration model": AI frees up teachers' energy through data processing and resource scheduling, allowing them to focus on the humanistic needs of emotional support and values guidance [7]. The essence of the teacher's role transformation dilemma is the structural mismatch between technology, system, and personal competence. First, policymakers need to clarify the boundaries of AI applications in education, and all AI educational tools must be audited through algorithmic transparency [28]. In addition, this study suggests promoting the "AI + subject knowledge" model to help teachers integrate generative AI tools into subject-specific teaching contexts, and professional development should encourage teachers to explore different pedagogical tools [28]. Attention also needs to be paid to the unique needs of rural teachers-the resource platform of the Beijing Smart Education Demonstration Zone effectively promotes the balanced radiation of high-quality educational resources across regions. The resource platform now supports 301,957 people, including those in Xinjiang, Inner Mongolia, and so on [24]. Finally, the technical design of AI teaching tools should be based on a teacher-centered development logic, and the design tendency of AI educational tools to "replace teachers" should be avoided. Generative AI can introduce "teaching strategy control" to support teachers in setting the fittingness of the AI-generated lesson plans manually and using real-time correction of the content of the lesson plans. Without sufficient information, educators may have difficulty justifying AI tools, especially when early warning notifications from the AI are inconsistent with pedagogical needs [28].

There are three limitations to this study. First, the literature analysis method is limited by the coverage of existing studies, and the lack of cases in some countries may affect the generalisability of the findings. Second, teachers' professional identity needs to be deepened through qualitative research methods such as interviews, while this study relies on the literature analysis method with insufficient subjective dimensions. Finally, generative AI is developing rapidly, and the existing literature has not yet fully reflected its impact. Future research needs to construct a multi-level. Inclusive analytical framework to systematically advance the in-depth exploration of teaching role transformation. First,

cross-national tracking surveys can be conducted to compare the paths of teacher transformation under different policy frameworks. For example, by tracking the five-year implementation data of China's "Smart Education Demonstration Zones" and the European Union's "Digital Education Action Plan", we can analyse the differences in the impact of the policies on teachers' adaptability, so as to distil the universal laws and geographical differences of technology-enabled education. On this basis, we will further explore the collaborative decision-making model of "teachers and AI" and develop quantifiable assessment tools for human-computer interaction. At the same time, it is important to pay attention to the adaptation of marginalized groups in the expansion of technology, so as to narrow the gap of educational equity. The organic combination of macro-policy comparison, meso-technology development and micro-group care will advance future research trends and achieve the sustainability of education transformation in the age of artificial intelligence.

6. Conclusion

This paper focuses on the impact of teachers' role transformation on teaching strategies in the context of artificial intelligence, and systematically analyses the reconfiguration of teachers' functions and the practical challenges they face under the synergy of technology, policy and social needs. The study finds that the popularity of generative AI has pushed teachers to shift from "knowledge transmitters" to "learning guides" and "ethical supervisors", and that this transformation has brought about technological faults, ethical dilemmas, and professional challenges while improving teaching efficiency. AI educational tools are a double-edged sword, and it is suggested to build a new teaching strategy of "human-machine collaboration". On the one hand, teachers need more targeted digital literacy training through "AI + subject pedagogy" to deal with algorithmic bias and data privacy risks. On the other hand, the technical design should strengthen the weight of teachers' decision-making, transparent AI algorithmic logic, as far as possible to break the contradiction of education differentiation caused by technology empowerment.

In the future, policymakers should establish an ethical framework for AI education, technology developers should optimize the design of tools with teachers in mind, and academic research needs to focus on the technological adaptability of marginalized groups. The synergy of technology, policy and humanities should be realized, so as to promote education to truly return to the essence of educating people in the AI era, and to cultivate world citizens with both innovative ability and humanistic spirit.

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