

Probing Faculty Cognitions: A Systematic Review of AI Integration, Perceived Benefits, and Ethical Challenges in Chinese Primary Teacher Education

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Abstract: *The integration of Artificial Intelligence (AI) into teacher education has emerged as a pivotal yet contested domain within Chinese higher education. This systematic literature review examines the multifaceted perceptions of AI integration among primary education faculty, with particular emphasis on the tripartite dimensions of teacher cognition, perceived benefits, and implementation challenges. Drawing upon empirical studies published between 2020 and 2024, this review synthesizes evidence regarding educators' cognitive appraisals encompassing perceived usefulness, ease of use, ethical acceptability, and emotional responses toward AI-assisted instruction. While findings reveal substantial perceived benefits including enhanced teaching efficiency, personalized learning facilitation, improved feedback mechanisms, and professional innovation identity significant challenges persist regarding algorithmic transparency, data privacy concerns, academic integrity risks, and potential threats to professional identity. The analysis highlights that teachers' cognitive frameworks serve as critical mediators, wherein positive perceptions catalyse technology adoption while ethical ambivalence and techno-stress may impede integration depth. This review contributes to the theoretical advancement of AI-mediated pedagogy in teacher education and provides evidence-based implications for curriculum reform, institutional policy development, and preservice teacher preparation in the Chinese context.*

Keywords: AI Integration; Teacher Education; Faculty Cognition; Perceived Benefits; Systematic Review; Sustainable Development Goal 4 (SDG 4)

1. Introduction

This paper focuses on the integrated application of artificial intelligence (AI) in China's primary school teacher education. Through a systematic review, it explores teachers' cognition of AI technology, perceived benefits, and ethical challenges, directly addressing the core principles of the United Nations Sustainable Development Goal 4 (SDG 4: Quality Education). SDG 4 aims to ensure inclusive and equitable quality education, enabling lifelong learning opportunities for all. Specifically, Goal 4 emphasizes "a substantial increase in the number of qualified teachers," while Goal 4 calls for enhancing learners' skills needed for employment and innovation. Goal 4 focuses on promoting sustainable development through education (Arranz-García, O., Romero García, M. del C., & Alonso-Secades, V., 2025).

The rapid proliferation of Generative Artificial Intelligence (GenAI) tools has precipitated a paradigmatic shift in higher education, fundamentally altering the landscape of teaching and

learning (Wainaina & Sun, 2025). Within the specific context of Chinese primary teacher education, the integration of AI technologies presents both unprecedented opportunities for pedagogical innovation and profound challenges to traditional educational paradigms. As AI systems increasingly assume functions ranging from administrative automation to personalized learning facilitation, university faculty members find themselves navigating a complex terrain where technological potential intersects with pedagogical responsibility (Dwivedi et al., 2023).

The emergence of sophisticated AI language models, such as Chat GPT, has sparked significant global attention regarding their potential to transform the education industry (Al-Mughairi & Bhaskar, 2024). In higher education contexts, these technologies have demonstrated capacity to enhance instructional support through automated grading, adaptive learning systems, and intelligent tutoring platforms (Zekaj, 2023). Consequently, teacher education institutions face mounting pressure to prepare pre-service educators for AI-rich classrooms while simultaneously grappling with the implications of these technologies for their own pedagogical practices (Rutti-Joy et al., 2024).

Despite the transformative potential of AI in enhancing instructional support, significant gaps persist in understanding how primary education faculty perceive, negotiate, and integrate these technologies into their professional practice (Arranz-García, O., Romero García, M. del C., & Alonso-Secades, V., 2025). While existing literature has extensively catalogued the technical affordances of AI in education, less attention has been devoted to the "cognitive mediation processes" through which educators interpret and implement these tools (Wainaina & Sun, 2025). Teachers' cognitions encompassing their beliefs about utility, emotional responses, ethical considerations, and self-efficacy serve as critical determinants of adoption depth, yet these dimensions remain under-theorized in the context of Chinese teacher preparation programs.

Recent evidence indicates that faculty perceptions regarding AI integration are characterized by a complex "cognition gap," wherein technological capabilities substantially outpace educators' psychological readiness and ethical confidence (Ofosu-Ampong, 2024). While 84% of lecturers may demonstrate willingness to accept AI for their students, significant concerns persist regarding algorithmic transparency, data privacy risks, and potential threats to academic integrity (Ofosu-Ampong, 2024; Dayagbil et al., 2025). Moreover, the phenomenon of "algorithmic anxiety"—manifesting as fears of job displacement, loss of pedagogical control, and concerns regarding assessment authenticity—creates substantial barriers to meaningful integration (Huang & Zhao, 2025; Çifçi et al., 2024).

In the Chinese context specifically, this cognition gap is exacerbated by unique sociocultural tensions between state-mandated digital transformation initiatives and deeply rooted pedagogical traditions emphasizing examination preparation and human-centered instruction (Mamo et al., 2024). Faculty must reconcile external pressures for technological adoption with internalized beliefs about the irreplaceable human elements of teaching, particularly regarding moral cultivation and developmental assessment practices that resist algorithmic quantification (Dayagbil et al., 2025).

This systematic literature review addresses the identified cognition gap through three specific objectives:

- i. To synthesize faculty cognitions toward AI integration, encompassing perceived utility, ethical concerns, and affective responses. This objective examines how educators' beliefs regarding usefulness, ease of use, and technological self-efficacy mediate their willingness

to adopt AI tools in primary teacher education contexts (Wainaina & Sun, 2025; Goli-Cruz, 2024).

- ii. To map perceived benefits of AI integration across three dimensions: administrative efficiency and workload reduction, personalized learning facilitation, and professional innovation identity development. This objective synthesizes evidence regarding how AI enhances teaching productivity, supports adaptive learning, and fosters educator professional growth (Zekaj, 2023; Alnasib, 2023; Al-Mughairi & Bhaskar, 2024).
- iii. To identify implementation challenges relating to algorithmic transparency, data privacy vulnerabilities, and professional identity threats. This objective examines the ethical risks, reliability concerns, and psychosocial barriers that impede effective AI integration in teacher education programs (Dayagbil et al., 2025; Ofosu-Ampong, 2024).

This review contributes to significant theoretical and practical implications for AI-mediated pedagogy, particularly within developing educational contexts characterized by rapid technological adoption and evolving regulatory frameworks. By foregrounding "faculty cognition" as the critical mediating variable between technological availability and pedagogical implementation, this study challenges technocentric approaches that privilege infrastructure development over educator psychological readiness (Wainaina & Sun, 2025).

For the Chinese primary teacher education context specifically, this synthesis illuminates the dialectical tension between national imperatives for educational digitalization and the ethical complexities inherent in algorithmic decision-making. The findings inform curriculum redesign initiatives that must balance AI literacy development with critical ethical reasoning, ensuring that pre-service teachers develop both technical competencies and the moral discernment necessary for responsible AI integration (Dayagbil et al., 2025; Ofosu-Ampong, 2024).

Furthermore, by examining the socio-cultural contextual factors that shape faculty attitudes including institutional policies, collegial norms, and cultural expectations regarding teaching excellence this review provides a transferable framework applicable to other developing contexts navigating similar transformations (Mamo et al., 2024; Ofosu-Ampong, 2024). The identification of specific cognitive barriers and facilitators offers actionable insights for professional development program design, emphasizing that sustainable AI integration requires addressing educators' ethical anxieties and self-efficacy deficits alongside technical training provision (Goli-Cruz, 2024; Al-Adwan et al., 2024).

2.Theoretical Framework

2.1 Technology Acceptance Model (TAM) and Extensions

This review draws upon the Technology Acceptance Model (TAM) as its foundational theoretical architecture, positing that perceived usefulness (PU) and perceived ease of use (PEOU) constitute primary determinants of technology adoption (Al-Adwan et al., 2024). However, recognizing the limitations of TAM in explaining affective and ethical dimensions of AI integration, this review incorporates extensions that account for technostress, ethical reasoning, and pedagogical beliefs as moderating variables (Ofosu-Ampong, 2024).

2.2 Technological Pedagogical Content Knowledge (TPACK)

The TPACK framework provides a critical lens for examining how primary education faculty navigate the intersection of AI technologies, pedagogical strategies, and content knowledge. Recent scholarship suggests that AI literacy constitutes an emerging dimension of teacher

professional knowledge, necessitating reconceptualization of traditional TPACK competencies (Al-Adwan et al., 2024).

2.3 Conceptualizing Faculty Cognition as Mediator

Central to this review is the conceptualization of faculty cognition as a multidimensional mediating variable comprising: (1) cognitive interpretations of utility and pedagogical value; (2) affective responses including enthusiasm and algorithmic anxiety; (3) technological self-efficacy; and (4) ethical reasoning frameworks (Huang & Zhao, 2025; Ofosu-Ampong, 2024). This mediated model suggests that institutional factors and AI characteristics influence integration outcomes primarily through their impact on these cognitive processes.

3. Methodology

3.1 Research Design

This study employed a systematic literature review methodology following the PRISMA 2020 guidelines. The review synthesizes empirical evidence regarding faculty perceptions of AI integration in primary teacher education contexts, with specific focus on studies conducted within or applicable to Chinese higher education settings.

3.1.1 PRISMA Protocol

A systematic review of the literature was conducted, and the reporting of this systematic review was guided by the standards of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA). In the PRISMA guidelines, PRISMA flow diagram is shown (Figure 1) that outlines essential elements for ensuring clarity in literature reviews (Page et al., 2021). This study was framed using the PRISMA analysis. A thorough data collection approach and meticulous and detailed procedures ensured that our approach adhered to high-quality literature review guidelines. A systematic approach is recognized due to its adherence to a defined protocol for data synthesis that incorporates relevant and reusable material used by previous researchers. This systematic review was conducted following the PRISMA guidelines. The completed PRISMA checklist is provided as a Supplementary Materials.

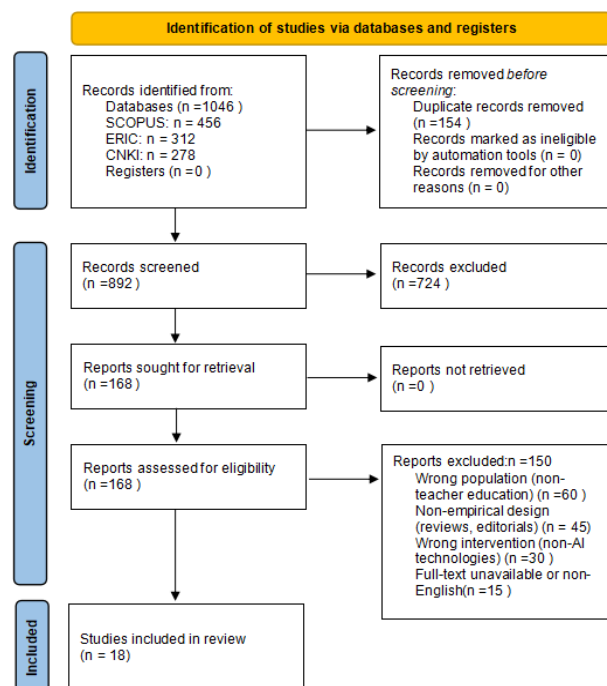


Figure 1: PRISMA flow diagram

3.2 Timeline

To document the accelerated proliferation of artificial intelligence in educational contexts during the post-pandemic recovery period, the analysis concentrated on the specific timeframe (2020–2024). This timeframe captures three critical inflection points: the COVID-19 pandemic in 2020 that necessitated emergency digital pedagogical transformation (MOE, 2020); the 2022–2024 National Education Digitalization Strategy implementation and the AI literacy universalization target for 2030 (MOE, 2024); and the ethical challenges posed by generative AI following ChatGPT's emergence in late 2022 (Wang et al., 2024; Zhou & Li, 2023). These phases align with this review's systematic examination of AI integration, perceived benefits, and ethical dilemmas.

3.3 Search Strategy

A comprehensive literature search was conducted across multiple databases including the Web of Science, Scopus, ERIC, and CNKI. Search terms combined descriptors for AI technologies ("artificial intelligence," "ChatGPT," "generative AI"), educational contexts ("primary teacher education," "elementary teacher preparation"), and perceptual dimensions ("faculty cognition," "teacher perception," "attitudes").

3.4 Inclusion Criteria

The articles needed to satisfy the following criteria:

- i. examined faculty perceptions regarding AI integration in teaching;
- ii. focused on higher education or teacher preparation contexts;
- iii. Studies published between the years 2020 and 2024;
- iv. employed empirical methodologies (quantitative, qualitative, or mixed methods);
- v. published in peer-reviewed English-language journals.

3.5 Exclusion Criteria

Exclusion criteria eliminated studies focusing exclusively on K-12 student populations or non-pedagogical AI applications.

3.6 Data Synthesis

Selected studies underwent thematic synthesis using a deductive coding framework aligned with the three-dimensional structure of faculty cognition, perceived benefits, and implementation challenges. Extracted data included study characteristics, methodological approaches, and key findings regarding faculty perceptions.

4. Result

4.1 Faculty Cognitions Toward AI Integration

4.1.1 Cognitive Interpretations of Utility and Pedagogical Value

Faculty cognitions regarding AI integration are fundamentally shaped by perceptions of pedagogical utility. Wainaina and Sun (2025) demonstrate that educators evaluate AI technologies through lenses of perceived usefulness, assessing whether these tools enhance teaching efficiency, feedback efficacy, student engagement, and assessment accuracy. When AI applications are perceived as aligned with instructional goals particularly in automating administrative burdens and facilitating differentiated instruction, faculty demonstrate greater willingness to adopt and innovate (Dwivedi et al., 2023).

Conversely, when AI is perceived as unreliable or pedagogically incongruent with developmental teaching objectives, faculty tend to restrict usage to administrative tasks or discontinue integration efforts (Dwivedi et al., 2023). This cognitive appraisal process is particularly salient in primary teacher education, where faculty must model developmentally appropriate practices for pre-service teachers.

4.1.2 Affective Dimensions: Enthusiasm, Anxiety, and Self-Efficacy

Affective responses constitute a critical yet frequently overlooked dimension of faculty cognition. Huang and Zhao (2025) identify a dualistic emotional landscape wherein educators simultaneously experience enthusiasm (innovation, excitement, curiosity) and anxiety (loss of control, data risks, concerns regarding assessment authenticity). Goli-Cruz (2024) further elucidates that emotional perception functions as a core mechanism regulating technology adoption, with positive affective states correlating with creative integration strategies while anxiety predicts resistance or superficial usage.

Self-efficacy beliefs substantially mediate these relationships. Faculty who possess confidence in their ability to navigate AI tools demonstrate greater creativity and frequency of technology integration (Mah et al., 2025). This is particularly pertinent for primary education faculty, who must simultaneously manage their own technological learning curves while preparing future educators to navigate AI-rich classrooms.

4.1.3 Ethical Reasoning and Pedagogical Beliefs

Faculty cognitions encompass sophisticated ethical reasoning regarding student data privacy, algorithmic bias, academic integrity, and the fairness of AI-generated decisions (Ofosu-Ampong, 2024). The degree to which educators trust AI ethics fundamentally determines whether integration is viewed as responsible practice or potentially harmful experimentation. In the Chinese context, where educational ethics emphasize both collective welfare and individual moral development, these concerns assume heightened significance (Mamo et al., 2024).

Attitudes reflecting general evaluative tendencies toward AI serve as moderating variables. (Ofosu-Ampong, 2024) establishes that positive attitudes correlate with higher adoption rates and enhanced teaching efficacy perceptions, whereas negative attitudes inhibit integration depth even when institutional resources are abundant.

4.2 Perceived Benefits of AI Integration

4.2.1 Enhancement of Teaching Efficiency and Productivity

The most frequently cited benefit involves AI's capacity to automate administrative routines including grading, feedback generation, attendance analysis, and content recommendation (Rutti-Joy et al., 2024). These efficiencies reduce cognitive and temporal burdens, theoretically liberating faculty to engage in student interaction, curriculum design, and reflective practice (Al-Adwan et al., 2024). When faculty observe quantifiable time savings, efficiency gains create positive feedback loops that enhance motivation for deeper AI integration (Al-Adwan et al., 2024).

4.2.2 Support for Personalized and Adaptive Learning

AI systems' capacity to analyze learner data, identify learning gaps, and dynamically adjust content difficulty represents a significant perceived benefit (Zekaj, 2023). Faculty report that adaptive learning tools effectively enhance differentiated instruction, particularly in large university classrooms where individual attention is constrained (Alnasib, 2023). This

personalization capability is especially valued in primary teacher education, where modeling adaptive pedagogies for pre-service teachers is essential.

4.2.3 Improved Feedback Quality and Assessment Precision

AI-driven assessment tools facilitate rapid feedback cycles through automated writing evaluation, formative quizzing, and sentiment analysis (Rutti-Joy et al., 2024). Faculty perceive AI feedback as consistent and data-driven, enhancing their confidence in instructional effectiveness (Bond et al., 2024). The immediacy of AI-generated feedback is viewed as particularly beneficial for developing pre-service teachers' reflective practices.

4.2.4 Student Engagement and Professional Innovation Identity

Generative AI, chatbots, and interactive learning platforms foster student engagement through conversational scaffolding and gamified tasks (Al-Mughairi & Bhaskar, 2024). Faculty who successfully implement AI report enhanced professional confidence, increased innovation consciousness, and heightened motivation to refine pedagogical methods (Zekaj, 2023). In teacher education specifically, faculty recognize that exposing pre-service teachers to AI is essential for developing competencies required in contemporary classrooms (Ma & Li, 2023).

4.3 Perceived Challenges and Implementation Risks

4.3.1 Algorithmic Opacity and Reliability Concerns

Faculty frequently express skepticism regarding AI decision-making processes, particularly concerning how algorithms generate recommendations, detect errors, or evaluate student work (Dayagbil et al., 2025). The lack of transparency erodes trust and exacerbates fears of misjudgment, particularly in high-stakes assessment contexts. When AI outputs exhibit bias, inconsistency, or contextual inappropriateness, educators question the reliability of AI-supported instructional decisions (Dayagbil et al., 2025).

4.3.2 Ethical Risks: Privacy, Bias, and Academic Integrity

Ethical concerns represent the most significant barrier to AI adoption. Faculty apprehensions center on student data collection, surveillance risks, algorithmic bias, and the potential for AI-generated content to compromise academic integrity (Dayagbil et al., 2025; Ofosu-Ampong, 2024). These concerns are particularly acute in the Chinese context, where compliance expectations and regulatory scrutiny intensify ethical responsibilities. Many educators fear that irresponsible AI adoption may foster plagiarism, rote learning, or declines in critical thinking capacities outcomes antithetical to teacher education core values (Wainaina & Sun, 2025).

4.3.3 Professional Identity and Role Displacement

AI-driven automation generates apprehensions regarding teacher obsolescence or diminished pedagogical authority. Çifçi et al. (2024) note that faculty worry AI may replace certain instructional elements, potentially devaluing the professional worth of human educators. Even when role displacement remains unlikely, perceptions of role erosion may generate emotional distress and reduce willingness to integrate AI into higher-order pedagogical processes such as mentoring and reflective dialogue.

5. Discussion

5.1 The Cognition-Benefit Nexus

The findings reveal a complex dialectic wherein faculty cognitions function as the primary mediator between technological potential and pedagogical practice. Positive cognitive appraisals characterized by high perceived utility, strong self-efficacy, and ethical confidence

catalyze deep integration strategies wherein AI augments rather than replaces human pedagogical expertise (Wainaina & Sun, 2025; Alnasib, 2023). This suggests that professional development initiatives must prioritize cognitive reframing over mere technical training, addressing underlying beliefs about AI's pedagogical role.

The perception of benefits operates as a positive moderator; when faculty perceive AI as enhancing rather than diminishing their professional capabilities, institutional resources translate more effectively into meaningful integration (Zekaj, 2023). However, this relationship is non-linear, with perceived benefits interacting dynamically with risk perceptions to shape adoption trajectories.

5.2 The Cognition-Risk Dialectic

The synthesis reveals that ethical ambivalence and technostress constitute significant impediments to AI adoption. Faculty navigate a "cautious optimism" paradigm wherein enthusiasm for technological potential is tempered by concerns regarding algorithmic opacity, data sovereignty, and pedagogical integrity (Huang & Zhao, 2025; Dayagbil et al., 2025). This ambivalence is not merely a barrier but a professional safeguard, reflecting educators' commitment to ethical stewardship of their students' learning.

In the Chinese primary teacher education context specifically, the tension between national directives for educational digitalization and institutional cultures emphasizing examination preparation and pedagogical stability creates unique cognitive dissonance (Mamo et al., 2024). Faculty must reconcile external pressures for AI adoption with internalized beliefs about the irreplaceable human elements of teaching.

5.3 Theoretical Implications

This review extends the Technology Acceptance Model by demonstrating that in high-stakes educational contexts, ethical reasoning and professional identity concerns moderate the relationship between perceived usefulness and adoption intention (Ofosu-Ampong, 2024). The findings suggest that AI integration models must incorporate socio-cultural contextuality and ethical risk assessment as core variables, moving beyond utilitarian frameworks that privilege efficiency over educational values.

6. Conclusion

This study examines how AI technology reshapes teachers' professional development pathways, exploring mechanisms to enhance teachers' digital literacy and teaching efficacy, thereby directly serving the cornerstone of educational equity improving teacher quality. It fully demonstrates the academic value and practical significance of this research within the framework of SDG 4.

This systematic review synthesizes evidence that primary education faculty navigate AI integration through complex cognitive frameworks that simultaneously weigh efficiency gains against ethical risks. While perceived benefits including enhanced productivity, personalized learning support, and professional innovation drive adoption enthusiasm, significant challenges regarding algorithmic transparency, data privacy, academic integrity, and professional identity threaten to constrain integration depth. Faculty cognition serves as the critical mediating mechanism determining whether AI adoption remains superficial or achieves transformative pedagogical impact.

For teacher education institutions, these findings suggest the necessity of:

- a) Curriculum Redesign: Integrating AI literacy and ethical reasoning into pre-service teacher preparation, modeling responsible AI use for future educators (Dayagbil et al., 2025);
- b) Policy Development: Establishing clear institutional guidelines regarding data privacy, algorithmic transparency, and academic integrity in AI-mediated instruction (Ofosu-Ampong, 2024);
- c) Professional Development: Moving beyond technical training to address affective dimensions of AI adoption, including anxiety management and ethical confidence building (Goli-Cruz, 2024).

7. Limitations

This review is constrained by the nascent stage of Generative AI in education, with most studies representing cross-sectional, early adoption snapshots (2020–2024) that preclude longitudinal analysis of evolving faculty cognitions. Furthermore, the rapid evolution of AI technologies since late 2023 renders current findings necessarily transient, requiring continuous reassessment as tools mature and institutional policies stabilize.

8. Future Research

Future research should employ longitudinal designs to examine cognitive shifts as AI technologies mature and institutional policies stabilize. Additionally, intervention studies examining strategies to mitigate ethical concerns while maximizing pedagogical benefits would provide valuable practical guidance.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this study.

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