From Sage to Architect: A Framework for Reconstructing Teacher Education in the AI Era

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Abstract

The rapid development of artificial intelligence has led to changes in human production and lifestyle, and artificial intelligence has evolved from an auxiliary tool to the foundation of education, presenting unprecedented challenges to the traditional global education system. Therefore, enabling teachers to master and utilize this intelligent ecosystem has become an urgent priority for policymakers and educators. However, current teacher education programs exhibit a critical lag, often reducing AI integration to a mere technical add-on rather than a catalyst for paradigm shifts. To bridge this gap, this paper critiques the multifaceted impact of AI across macro, meso, and micro levels and proposes the TELA model—an integrative competency framework encompassing Technological Pedagogical Fluency, Ethical Stewardship, Learning Experience Architecture, and Affective Engagement. By redefining the teacher's role from a "Knowledge Sage" to a "Learning Architect," this study provides actionable pathways for reforming curriculum and practicum, offering a blueprint for cultivating future-ready educators in an intelligent age.

1. Introduction

With breakthrough advancements in big data, machine learning, and generative AI, artificial intelligence is reshaping human production, lifestyles, and governance structures at an unprecedented pace(Luckin, 2018). As a crucial component of the social system, the field of education is confronting a profound, technology-driven revolution(Zawacki-Richter et al., 2019). This evolution marks a significant departure from previous IT reforms, where technology primarily served as an "aid" or "efficiency booster." Today, AI is emerging as a foundational educational infrastructure, deeply integrated into core processes like instruction, assessment, and administrative decision-making(Case et al., 2025; Upadhyay & Rastogi, 2025; Yan et al., 2025). Consequently, teacher education—the "engine room" of the educational system—confronts unprecedented external pressures and internal tensions in preparing educators for this new reality. On one hand, societal demands for future talent have fundamentally changed; the traditional knowledge-memorization model is ill-suited for an intelligent society where critical thinking, creativity, human-machine collaboration, and socio-emotional skills have become core competencies. On the other hand, the internal logic of education is being redefined by algorithms and data, with new practices like personalized learning paths and data-driven instructional decisions challenging the standardized, one-size-fits-all paradigm of the industrial age.

However, while much of the current discourse focuses on applying specific AI tools in the classroom or discussing AI's general impact on learning, a holistic, systemic framework for reforming teacher education itself—the very engine of the educational workforce—remains critically underdeveloped. Existing programs often treat AI as a mere technical add-on rather than a catalyst for fundamental pedagogical and ethical re-evaluation. This transformation demands a proactive and systemic response from teacher education. To systematically navigate this complex terrain and move beyond fragmented discussions, this paper seeks to answer the following core research questions:

1. How does the rise of generative AI fundamentally reconstruct the educational ecosystem, thereby necessitating a transformation of the teacher's professional role?

2. What are the core competencies required for teachers to thrive in this new ecosystem, and how can they be structured into a coherent theoretical framework?

3. Based on this framework, what strategic pathways can teacher education institutions adopt to systematically reform their programs?

2.The AI-Driven Reconstruction of the Educational Ecosystem: A New Context for Teacher Education

The impact of artificial intelligence on education is not a localized adjustment but a systemic, structural reconstruction of the entire educational ecosystem. This reconstruction unfolds across three interconnected levels —macro (policy and curriculum), meso (school organization and management), and micro (classroom teaching and learning). Together, these shifts constitute the new reality, the fundamental context in which teacher education must now operate and reform.

2.1. The Macro Level: A Paradigm Shift in Knowledge and Assessment

At the macro level, generative AI has fundamentally destabilized the traditional epistemology of education. In the previous paradigm, knowledge was often viewed as a static, objective, and transmittable entity, with curricula and textbooks serving as its authoritative vessels. The teacher's core function was to "transmit" this established body of knowledge. Generative AI shatters this foundation. The production, organization, and acquisition of knowledge have been radically altered; students can now generate, validate, and recombine information in real-time, making knowledge boundaries fluid, dynamic, and open-ended(Chiu, 2024). This compels a shift in educational goals from "mastering the known" to "navigating the unknown," and a corresponding pedagogical transition from "knowledge transmission" to "inquiry-based exploration."

Consequently, assessment systems face a fundamental re-evaluation. Traditional standardized tests, which primarily measure the recall and reproduction of established facts, are becoming obsolete in an era where such tasks can be performed instantly by AI (Cheng & Wang, 2023). The new imperative is to measure what AI cannot easily replicate: higher-order thinking, complex problem-solving, creativity, and human-AI collaborative competence. Future assessments will increasingly focus on students' ability to solve problems in authentic or simulated contexts using AI tools, the quality of their critical thinking, and the originality of their creative outputs (Shah, 2023). This paradigm shift presents a fundamental mandate for teacher education: it must pivot from training evaluators of knowledge reproduction to cultivating architects of performance-based assessments. This requires equipping future teachers not only with the "how" of new assessment tools but, more importantly, the "why" of a new assessment philosophy that values process, collaboration, and creative application over simple recall.

2.2. The Meso Level: Data-Driven Governance and Inclusive Support

At the school organization level, AI offers the technical foundation for achieving true personalization and inclusive education(Mao et al., 2024). By integrating multimodal data (e.g., learning behaviors, interaction logs, emotional feedback, academic performance), AI systems can construct detailed digital learner profiles. For students with learning difficulties, special needs, or exceptional talents, AI can act as a "personalized auxiliary tutor," providing customized learning paths and instant feedback through adaptive learning systems, intelligent coaching tools, and virtual reality simulations. Simultaneously, AI is transforming school management from a practice based on experience and intuition to one driven by data intelligence. Administrators can leverage AI to monitor student progress and well-being, enabling early warnings for potential risks such as academic failure, mental health crises, or dropout tendencies.

This transition from experience-based intuition to data-informed practice places "data literacy" at the core of teacher professional competency. The demand on teachers is no longer just to use data, but to interpret it meaningfully and act on it ethically(Upadhyay & Rastogi, 2025). Teacher education, therefore, is tasked with the critical mission of developing educators who are not just passive consumers of data dashboards, but critical interpreters of educational data and ethical stewards of student information, capable of leveraging data to support every learner while rigorously protecting their privacy.

2.3. The Micro Level: The New Normal of Human-AI Collaboration in Learning

In the micro-level learning environment, AI tools like ChatGPT have become a "second brain" for students, fundamentally reconfiguring the learning process(Kim et al., 2022). The accessibility of information and the simplification of basic research tasks have become ubiquitous. However, this convenience is a double-edged

sword. It can lead to an over-reliance on algorithmically generated answers, potentially diminishing students' motivation for deep thinking and fostering cognitive inertia due to a lack of engagement with the underlying logic of knowledge.

The core challenge at this level, therefore, is to redefine the very essence of "learning." It is no longer a one-way reception of knowledge but a collaborative process of knowledge construction between humans and AI. Students must learn how to effectively dialogue with AI (prompt engineering), critically evaluate the credibility of AI-generated content, and creatively synthesize AI outputs into novel solutions.

This new learning paradigm necessitates that teacher education radically redefines its focus. The primary goal is no longer to teach teacher candidates 'how to use AI,' but to cultivate their capacity to design learning experiences where students learn 'how to think with AI.' This involves equipping teachers with the skills to architect human-AI collaborative learning activities and foster students' metacognitive abilities—such as planning, monitoring, and reflecting—within this new and complex cognitive ecosystem, as shown in Figure 2.1.
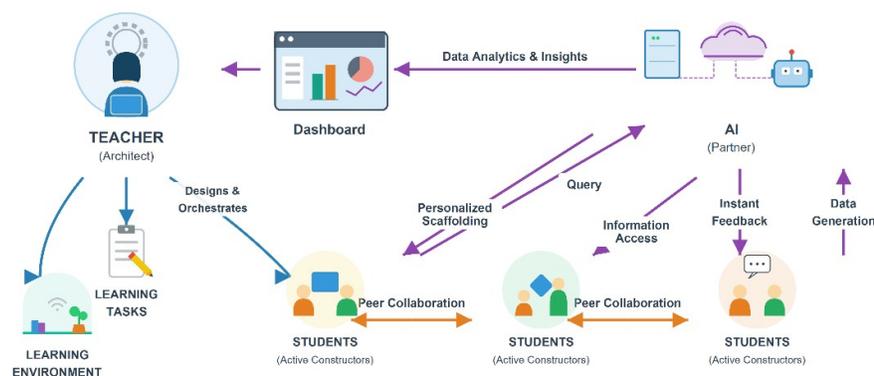

Fig2.1 The Micro-Ecosystem of Human-AI Collaborative Learning.

3. The Tripartite Role Transformation of the Teacher: Rebuilding Professional Identity in the Intelligent Age

The reconstruction of the educational ecosystem inevitably triggers a historic transformation in the role of the teacher. AI not only automates some of the teacher's routine tasks but, more profoundly, compels a professional identity shift from a singular "knowledge authority" to a multifaceted, composite role(Ouyang & Jiao, 2021). We conceptualize this as a tripartite transformation into three interconnected identities: the Learning Architect, the Emotional Mentor, and the Critical Technology Integrator.

3.1 From "Sage on the Stage" to Learning Architect

In an era of information scarcity, teachers held natural authority due to their privileged access to knowledge. However, in the intelligent age of information overload and instant access, any student connected to the internet can access a repository of information far exceeding that of a single teacher. The teacher's function as a "content deliverer" is being rapidly superseded by AI.

The teacher's core value is therefore shifting to that of a Learning Architect. Their professional focus pivots from delivering content to designing challenging, authentic learning tasks; scaffolding learning with integrated AI tools; and orchestrating interdisciplinary, project-based learning (PBL) and inquiry-based activities(Zhang, 2022). The teacher's primary role becomes guiding students from passive information reception to active knowledge construction, empowering them to maintain agency and criticality within a human-AI collaborative environment.

This shift demands a radical restructuring of teacher education curricula. The emphasis must move away from the transmission of declarative knowledge towards an in-depth focus on learning sciences, instructional design, and pedagogical frameworks like TPACK, updated to explicitly include strategies for orchestrating AI-integrated learning environments.

3.2 From "Instructional Implementer" to Emotional Mentor and Value Guide

While AI excels in cognitive computation, pattern recognition, and personalized recommendations, it remains profoundly deficient in emotional understanding, empathetic communication, moral judgment, and value formation(Aldrup et al., 2022). The global experience with remote learning during the pandemic highlighted that while technology can maintain instructional continuity, the face-to-face emotional connection, non-verbal communication, and sense of community are vital for students' socio-emotional development.

Thus, the teacher's unique value will be increasingly concentrated in the humanistic dimension of education. They must become facilitators of students' Socio-Emotional Learning (SEL), attending to their mental well-being and cultivating empathy, resilience, cooperation, and digital citizenship. In a digital world rife with misinformation and algorithmic filter bubbles, teachers must also act as ethical gatekeepers and value guides, helping students develop a critical consciousness, discern factual information from falsehoods, and form their own moral compass regarding technology use(Beyea et al., 2025).

Teacher education programs must significantly enhance their curriculum in areas such as developmental psychology, ethics, sociology, and digital citizenship education. The goal is to prepare teachers who are not just instructional experts, but also compassionate mentors capable of nurturing the whole child in a complex digital age.

3.3 From "Technology User" to Critical Technology Integrator

Faced with rapidly iterating AI educational tools, teachers must possess a growth mindset, proactively learning and experimenting with new technologies to explore their potential and limitations. However, this must be paired with a clear-eyed critical consciousness, avoiding the pitfalls of "technological determinism" or blind "techno-solutionism."

A Critical Technology Integrator is capable of evaluating the pedagogical suitability, potential risks, and ethical implications of a given AI tool and making rational integration decisions based on specific learning objectives and student needs. This capacity for critical integration is a hallmark of professional autonomy. Teachers must remain in the driver's seat, ensuring that technology serves the holistic development of the person, not the other way around.

Teacher education must cultivate teachers' critical thinking about technology itself. Programs should equip future educators with frameworks to analyze AI tools, understand their underlying data and algorithms, and make informed choices. The ultimate aim is to empower teachers to maintain professional agency in a human-AI collaborative setting, becoming masters of the technology, not its servants.

These three interconnected identities—the Learning Architect, the Emotional Mentor, and the Critical Technology Integrator—form the professional 'persona' of the future teacher. Cultivating this multifaceted persona is the ultimate goal of teacher education reform, and our proposed TELA framework, presented in Part V, is specifically designed to provide the systemic pathway to achieve this goal.

4. Ethical Dilemmas and Risks in AI-Driven Education

While AI offers immense potential to enhance education, its integration is fraught with significant ethical risks and societal controversies. If implemented without effective regulation and a workforce prepared to navigate these challenges, AI could undermine the core values of education, erode equity, and compromise the rights of students and teachers. We identify three critical areas of risk that teacher education must urgently address.

4.1 Algorithmic Bias and "Machine Hallucinations": Threats to Knowledge Integrity

The performance of AI systems is fundamentally dependent on the data used to train them(Holmes et al., 2022). If this data reflects historical or societal biases (e.g., related to gender, race, culture, or socioeconomic status), the AI's outputs—whether in the form of learning content, assessment feedback, or resource recommendations—will inevitably replicate and may even amplify these prejudices. This can lead to the perpetuation of stereotypes and inequitable educational pathways.

Furthermore, generative AI is prone to a phenomenon known as "hallucination"(Ji et al., 2023), where it produces plausible but factually incorrect or entirely fabricated information. For young learners with developing

critical thinking skills, this poses a significant cognitive risk, as they may internalize misleading knowledge as fact. The "black box" nature of many AI models makes it difficult even for educators to trace the source of an error, challenging the very notion of objective knowledge(Yan et al., 2025).

It is imperative that teacher education programs integrate "algorithmic literacy" and "media and information literacy" into their core curriculum. This integration must transcend mere technical skills training to equip future teachers with a conceptual understanding of how AI works, an awareness of its inherent limitations, and practical strategies for fact-checking, source criticism, and value judgment of AI-generated content. The goal is to prepare teachers to guide their students in the rational and critical use of AI.

4.2 Data Privacy, Surveillance, and the Erosion of Student Rights

AI-powered personalized learning relies on the continuous collection and analysis of sensitive student data, including learning behaviors, biometric information, and even emotional states. Without transparent policies, informed consent, and stringent governance, this process can lead to severe violations of student privacy. The school risks transforming into a "digital panopticon," a place of pervasive surveillance where students are constantly monitored and algorithmically judged(Buckingham Shum & Luckin, 2019).

While policy frameworks like the European Union's AI Act (Proposal for a regulation of the European Parliament And Of The Council laying down harmonised rules on artificial intelligence (artificial intelligence act) and amending certain union legislative acts, 2021) and Ethical Guidelines on the use of AI and data for educators (Ethical Guidelines on the Use of Artificial Intelligence and Data in Teaching and Learning for Educators | European Education Area, 2024) are emerging, global regulatory standards for AI in education remain nascent. Teachers, as the frontline implementers of data collection and use, are placed in a precarious position. They urgently require systematic education on data ethics to understand their responsibilities, behavioral boundaries, and strategies for compliant, secure, and ethical data handling.

Teacher education is tasked with the non-negotiable mission of providing robust data ethics training. This must empower teachers to act as ethical gatekeepers of student data. Programs should use case studies and ethical simulations to cultivate teachers' ability to navigate complex privacy issues and equip them with the knowledge to advocate for students' digital rights within their institutions.

4.3 The Deepening Digital Divide: A Structural Challenge to Educational Equity

AI technology has a "magnifying effect": it can empower individuals, but it can also exacerbate existing inequalities(Chan & Lee, 2023). While AI theoretically promises to democratize access to high-quality educational resources, the reality is often different. Disparities in hardware access, network quality, teacher AI literacy, and family socioeconomic backgrounds can transform this promise into a new form of digital divide.Students from advantaged backgrounds are more likely to leverage AI for enriched learning and creative exploration, gaining a significant competitive edge. In contrast, students from disadvantaged groups may be limited to basic AI functions, or worse, be further marginalized by digital exclusion. This creates a two-tiered system where technology, intended as an equalizer, becomes a driver of greater inequity.

Teacher education must actively cultivate a commitment to "digital equity." It is not enough for teachers to be aware of the digital divide; they must be trained as agents of equity. This involves equipping them with pedagogical strategies to design inclusive, AI-enhanced learning environments, to leverage AI tools specifically to support marginalized students, and to critically identify and actively mitigate technology-induced inequalities within their classrooms and schools.

5. Strategic Framework: Constructing the Future-Oriented "TELA" Model for Teacher Education

The disruptive impact of artificial intelligence not only deconstructs the traditional educational landscape but also places unprecedented demands on the professional identity and core competencies of teachers. As previously argued, the role of the teacher is undergoing a profound transformation from the "Sage on the Stage" to the "Architect of Learning." This paradigm shift necessitates that teacher education systems move beyond a fragmented "skill-add-on" approach toward a systemic "competency-reconstruction" model.

To address this challenge and provide a clear, actionable blueprint for reform, this paper proposes an integrative framework for reconstructing teacher education based on the foregoing analysis of the AI-driven educational ecosystem, evolving teacher roles, and attendant ethical risks. We term this the TELA model.

The TELA model is not a mere concatenation of four independent modules but a dynamic, integrated ecosystem. It represents four interrelated and spiraling core competency dimensions essential for exemplary teachers in the era of AI, as shown in Figure 5.1:

- T - Technological Pedagogical Fluency
- E - Ethical & Critical Stewardship
- L - Learning Experience Architecture
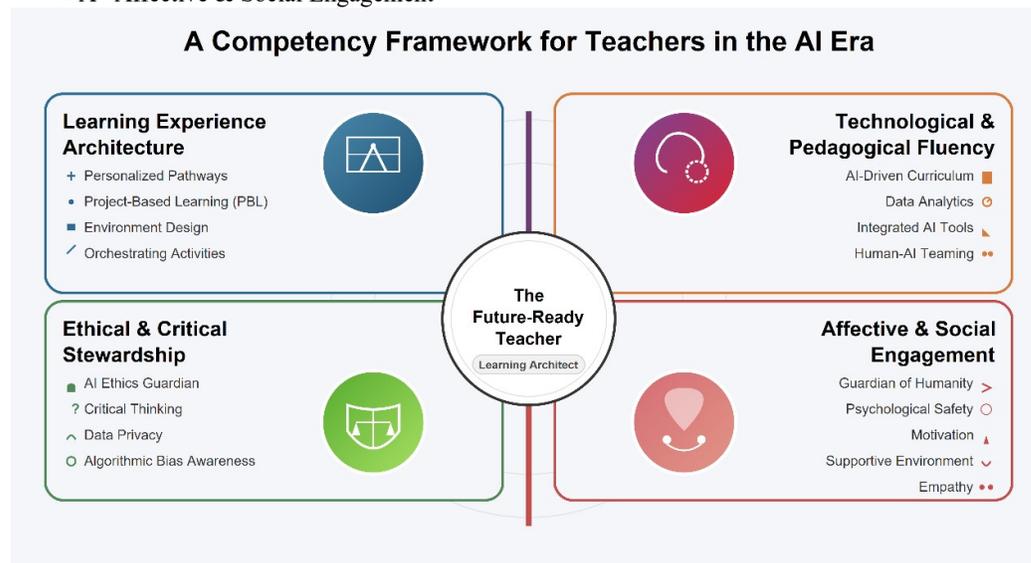- A - Affective & Social Engagement

Fig5.1 the Future-Oriented "TELA" Model for Teacher Education

5.1. T - Technological Pedagogical Fluency

This dimension transcends the traditional scope of "ICT integration in curriculum," emphasizing that teachers must not only know how to "use" AI tools but achieve a state of "fluency." It comprises three progressive levels:

1. AI Literacy & Application: Comprehending the fundamental principles, functional boundaries, and educational applications of mainstream AI technologies (e.g., Large Language Models, adaptive learning systems). This includes the ability to skillfully utilize AI tools to assist in lesson planning, generate instructional resources, and conduct preliminary learning analytics.
2. Pedagogical Integration: The core of this level is to treat AI as a pedagogical approach, not merely a tool. Teachers must be able to discern in which teaching objectives and learning contexts the introduction of AI is most effective, such as using AI to create personalized learning pathways or to design problem-solving projects based on human-computer collaboration.
3. Critical Innovation: This involves the capacity to critically evaluate the efficacy, reliability, and potential biases of various AI-in-education products. Furthermore, teachers should be equipped to "co-create" novel pedagogical models with AI, positioning themselves as proactive participants in educational innovation rather than passive adopters.
- Implementation Pathways:
  - Curriculum Development: Introduce mandatory or elective courses such as Introduction to AI in Education, AI-Driven Curriculum Design, and Educational Data Analytics and Visualization.
  - Practical Projects: Establish "Smart Classroom Workshops" where pre-service teachers are required to design and implement a complete lesson that deeply integrates AI.
  - Platform Support: Develop a dedicated experimental platform for educational AI tools within teacher education institutions, encouraging students to trial, evaluate, and even contribute to the development of these tools.

5.2. E - Ethical & Critical Stewardship

The more powerful the technology, the more critical the ethical reins become. As guides for students' intellectual

and moral development, teachers must act as steadfast guardians of AI ethics and cultivators of critical thinking.

1. Awareness & Risk Identification: Teachers must be highly sensitive to the ethical issues that AI can precipitate in education, including data privacy, algorithmic bias, technological dependency, the exacerbation of the digital divide, and the potential for diminished student autonomy.

2. Value Judgment & Decision-making: In complex educational scenarios where efficiency may conflict with equity or personalization with privacy, teachers must be able to make responsible professional judgments grounded in sound pedagogical and ethical principles.

3. Implementation of Ethics Education: Teachers must possess the competence to integrate discussions of AI ethics into their daily instruction, guiding students to become responsible and critical digital citizens rather than unwitting consumers of technology.

• Implementation Pathways:

• Mandatory Modules: Mandate a module on Ethics in Educational Technology for all pre-service teachers, employing case studies, debates, and scenario-based learning.

• Code of Conduct: Facilitate workshops for pre-service teachers to collaboratively develop an Ethical Code of Conduct for AI Use by Future Teachers.

• Interdisciplinary Dialogues: Organize forums with students from law, sociology, and computer science to foster a broader, cross-disciplinary understanding of AI's societal impacts.

5.3. L - Learning Experience Architecture

This represents the core value proposition of teachers in the AI era and the most fundamental aspect of their role transformation. The focus of their work shifts decisively from "transmitting knowledge" to "designing learning."

1. Reconstruction of Learning Goals: In an environment where factual knowledge is readily available via AI, teachers must pivot learning objectives toward cultivating higher-order thinking skills, collaborative competence, creativity, and the ability to solve complex problems.

2. Design of Learning Pathways: Teachers architect personalized, contextualized, and project-based learning journeys by masterfully blending online/offline, synchronous/asynchronous, and human-human/human-computer interactions. This includes sequencing learning resources, orchestrating activities, and embedding assessment points.

3. Creation of Learning Environment: They are responsible for cultivating a learning environment that is motivating, supportive, and psychologically safe. Such an environment encourages exploration, tolerates failure, and promotes deep engagement, positioning AI as a learning partner rather than a surveillance tool.

• Implementation Pathways:

• Core Curriculum Reform: Upgrade courses like Principles of Instructional Design to Learning Experience Design, incorporating methodologies from Design Thinking and Service Design.

• PBL/DBL Projects: Strongly promote Project-Based Learning (PBL) and Design-Based Learning (DBL), allowing pre-service teachers to learn by doing through the complete process of architecting a learning experience.

• Practicum Reform: Shift the evaluation criteria for teaching practicums from "how well a single lesson was delivered" to "how scientifically, effectively, and engagingly a complete learning unit was designed."

5.4. A - Affective & Social Engagement

As AI's cognitive capabilities advance, the intrinsic value of human warmth and social connection becomes increasingly pronounced. This dimension is the final and most robust line of defense for ensuring a human-centric education, as technology cannot replicate the affective bond between teacher and student or the power of social learning among peers.

1. Insight into & Support for Individual Affect: Teachers must develop and apply skills in observation and dialogue to sensitively perceive students' emotional states, motivations, and frustrations during the learning process, providing timely psychological support and humanistic care.

2. Building & Maintaining Learning Communities: They must be adept at designing and facilitating collaborative learning activities that cultivate students' communication skills, empathy, and teamwork. The teacher acts as a community facilitator, fostering a sense of belonging and shared purpose.

• Implementation Pathways:

• Interpersonal & Counseling Skills Training: Strengthen training in Educational Psychology, Teacher-Student Communication Skills, and basic counseling techniques to equip teachers to address students' affective

needs.

- Community-Building Practicums: Design practicum experiences that specifically require pre-service teachers to build and manage a positive and collaborative classroom or online learning community.

- Reflective Practice: Encourage reflective journaling and peer coaching focused on analyzing and improving the quality of interpersonal and social dynamics within the learning environment.

6. Conclusion and Future Outlook

In an era where artificial intelligence is reshaping the educational ecosystem with unprecedented depth and breadth, the systemic reconstruction of teacher education has become an urgent imperative. This paper has sought to address this need by deconstructing the systemic impact of AI on education and the fundamental reshaping of the teacher's role. In response, we have constructed and proposed an integrative competency framework for cultivating future-ready teachers: the TELA model.

The primary contributions of this paper are twofold:

First, at the theoretical level, this study transcends the conventional perspective of viewing AI as a mere tool or a skill to be added on. Instead, it situates teacher education reform within the broader context of a systemic ecosystem reconstruction. The proposed TELA model—integrating Technological Pedagogical Fluency, Ethical & Critical Stewardship, Learning Experience Architecture, and Affective & Social Engagement—offers a new, more holistic theoretical lens for understanding and defining teacher professionalism in the intelligent age. It underscores the intrinsic unity of technology, ethics, pedagogy, and humanistic care, arguing that the teacher of the future must be both an efficient "architect of learning" and a steadfast "guardian of humanity."

Second, at the practical level, the TELA model provides a concrete and actionable blueprint for policymakers, administrators of teacher education institutions, and frontline teacher educators. It not only delineates the normative direction for teacher competency development but also offers specific reference points for curriculum design, pedagogical innovation, practicum reform, and the reconstruction of evaluation standards by suggesting implementation pathways for each dimension. Consequently, it translates a grand vision for change into executable strategies.

Naturally, as a conceptual framework, this study has its limitations. The efficacy of the proposed TELA model and its associated reform pathways must be validated through extensive empirical research across diverse cultural and institutional contexts. Future research should focus on several key areas: 1) Instrument Development: Creating reliable and valid assessment instruments based on the TELA model to diagnose and evaluate teachers' competency levels across the four dimensions. 2) Empirical Validation: Conducting longitudinal case studies or quasi-experimental research on teacher education programs that adopt the TELA framework to assess its real-world impact on pre-service teachers' development and, ultimately, on student outcomes. 3) Contextualized Application: Investigating the strategies and possibilities for the localized adaptation and application of the TELA model within different national and regional educational systems to enhance its universality and effectiveness.

Despite these limitations, one truth remains clear: the future of education will be a symbiosis of human and machine intelligence. In this new ecosystem, the teacher, as the architect of learning, the guide of values, and the guardian of humanity, will not only remain indispensable but will become more important than ever. Future research should focus on the empirical validation of the proposed TELA model across diverse cultural and institutional contexts to assess its applicability and effectiveness. Additionally, longitudinal studies are needed to track how preservice teachers trained under this framework translate these competencies into actual classroom practices over time, thereby refining the model for sustainable teacher development.

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