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AI-ENHANCED METHODOLOGICAL TRAINING FOR FUTURE TEACHERS

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Abstract: Artificial intelligence (AI) is transforming education, but its integration into teacher preparation remains underdeveloped. This article reviews current approaches to AI in teacher training and proposes a structured framework for embedding AI technologies into pre-service and in-service teacher education. We outline a staged methodology – from foundational AI literacy to immersive practice and reflective assessment – aligned with emerging competency frameworks. The model leverages adaptive learning systems, AI tutors, chatbots, and simulations to personalize and enrich methodological training. Benefits include individualized instruction and increased efficiency, while challenges involve equity, privacy, and ethical use of AI. We discuss implications for pedagogy (e.g. data-driven teaching), curriculum design (incorporating AI literacy and AI-enabled tools), and teacher competencies (drawing on UNESCO's five AI dimensions). Finally, we highlight the need for ongoing research and policy support to realize an AI-augmented future for teacher preparation.

Keywords: Equity of access, Bias and Ethics, Teacher attitudes, technical limitations, Curriculum integration, Limitations and Challenges, AI pedagogy.

Introduction

Rapid advances in artificial intelligence (AI) offer unprecedented opportunities in education. AI-driven platforms can analyze learning data, adapt content, and provide real-time feedback, fundamentally changing how instruction and training occur. To leverage these tools, future teachers must be prepared to use and understand AI in teaching. Yet research indicates a gap: only about 35% of studies on AI in education address teacher professional development, with most focusing on student learning. Likewise, UNESCO notes few countries have defined AI competencies for educators. This growing consensus suggests a need for systematic AI integration into teacher education. In response, we review existing approaches – from adaptive learning systems to AI tutors – and propose a comprehensive methodological framework for AI-enhanced teacher training. We then examine the benefits, limitations, and challenges of AI-based teacher education, and discuss implications for pedagogy, curriculum design, and teacher competency frameworks.

LITERATURE REVIEW.

Recent practice and research reveal several ways AI is already entering teacher education.[1] On the technology side, adaptive learning systems (e.g. Knewton, Squirrel AI) and AI tutors (e.g. Carnegie Learning, DreamBox) provide models of personalized instruction that teachers can study and emulate. Chatbots and language models like ChatGPT are used informally by educators for tasks such as lesson planning or answering content questions. Some teacher-training programs have begun introducing AI literacy courses or modules, following international guidelines (for example, the UNESCO AI competency framework). Innovative field experiences use AI-based simulations: e.g. mixed-reality classroom simulators (such as TeachLivE) let trainee teachers practice managing virtual students as in a "flight simulator" for teaching .

On the professional development side, models are emerging that blend AI tools with teacher learning. Tammets and Ley (2023) propose teacher-centered design: teachers co-design and interact with AI tools that support classroom decision-making, noticing student needs and adapting instruction.[2] In-service programs increasingly use AI analytics for reflection – for instance, recording a lesson and using AI to analyze teaching moves. However, reports indicate that teacher preparation programs often treat AI as an add-on rather than integrated content, and few curricula systematically address AI's pedagogical use. Notably, global surveys (e.g. UNESCO 2024) call for restructuring teacher training around AI competency, emphasizing ethical, human-centered use.

Overall, current approaches are piecemeal. Many educators recognize AI's future importance – a Walton Family Foundation survey found 71% of U.S. teachers agree AI tools will be essential for student success – but training lags behind. To address this, we outline below a structured methodology that systematically embeds AI into teacher education.

METHODOLOGY.

We propose a multi-phase framework for "AI-augmented teacher education" that aligns with emerging competency standards. This approach ensures teachers **acquire** AI knowledge, **deepen** practical skills, and eventually **create** AI-informed teaching innovations. The framework has four main stages:

1.Foundational AI Literacy (Acquire): Pre-service teachers begin with the basics of AI – what AI is, how it works, and its ethical implications. Coursework covers AI concepts (e.g. machine learning, chatbots), data literacy, and AI ethics, reflecting UNESCO's dimensions of *human-centered mindset* and *ethics of AI*. Role-playing and case studies can illustrate real-world scenarios (e.g. bias in algorithms, privacy issues) to develop critical perspectives.

2.Integration of AI Tools (Deepen): Trainees learn to use specific AI-enabled educational tools as part of their methodological training. For example, they might interact with adaptive learning systems or AI tutoring platforms to see how content can be tailored to individual students. Chatbots (e.g. GPT-driven conversational agents) can serve as practice partners – for instance, posing as a student asking subject questions, while the teacher practices responding. During pedagogy courses, AI tools are incorporated in lesson design exercises: teachers might use generative AI to draft lesson plans or get feedback on activity scripts. Throughout this phase, instructors model a *human-AI collaboration* approach, where the teacher guides and interprets AI outputs.

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[1] Najmiddinova G.N. "The Integration of Artificial Intelligence (AI) into education system".34-37 b. Tamaddun Nuri ,ISSN 2181-8258,12-son (63) Ilmiy, ijtimoiy-falsafiy, madaniy-ma'rifiy, adabiy-badiiy jurnal,12.12.2024. https://doi.org/10.69691/r1bx4f56

[2] Tammets, K., & Ley, T. (2023). Integrating AI tools in teacher professional learning: A conceptual model and illustrative case. Frontiers in Artificial Intelligence, 6, 1255089. https://doi.org/10.3389/frai.2023.1255089

3.Immersive Practice and Simulation (Deepen/Create): Building on AI tool experience, teachers engage in interactive simulations. Immersive environments (such as virtual/augmented reality classrooms) provide risk-free settings. For instance, using a virtual classroom simulator (like TeachLivE), a trainee can practice classroom management and receive AI-driven feedback on their prompts and responses. This stage emphasizes reflective practice: AI analytics from the simulation (e.g. a log of teacher questions, student engagement metrics) are used to help teachers refine strategies. Peer collaboration can be enhanced by AI co-facilitators or automated discussion moderators in group projects.

4.Reflective Evaluation and Continuous PD (Create): Finally, teachers use AI-driven analytics to assess their own learning and plan further growth. E-portfolios and video logs of teaching can be analyzed by AI for insights (e.g. frequency of student talk, use of inclusive language). This aligns with UNESCO's "AI for professional development" dimension. Teachers also learn to critically evaluate AI systems themselves – seeking "explainable, overridable" AI as recommended by education authorities. The framework encourages a feedback loop: trainers collect data on trainee performance and iterate the curriculum using design-based research methods, ensuring tools and content adapt to teacher needs.

This structured progression (Acquire–Deepen–Create) mirrors international AI competency frameworks and allows for assessment at each level (e.g. through AI-themed capstone projects or practicum evaluations). In sum, the methodology integrates AI not as a side topic but as a core element of methodological training: teachers learn *with* AI and *about* AI in parallel.

RESULTS AND DISCUSSION.

Benefits: AI-enhanced teacher training offers notable advantages. First, **personalization**: AI-driven platforms can adapt training content to each trainee's knowledge and pace, addressing individual strengths and gaps. Just as AI tutors tailor lessons to students, an AI-powered learning environment could provide extra practice on topics where a trainee is weak. Second, **efficiency**: repetitive tasks (e.g. auto-grading microteaching exercises, generating quizzes) can be offloaded to AI, freeing instructors to focus on higher-level mentoring. Pardos (EdWeek) notes AI can "save time and money… not by doing away with teaching roles but by cutting down on… instructional materials". Third, **enhanced feedback loops**: AI provides immediate formative feedback (e.g. on lesson plan drafts or practice teaching), allowing trainees to iterate quickly. For example, an AI tutor might score a mock lesson and highlight areas for improvement, much faster than a human observer. Fourth, **safe practice environments**: simulated classroom AI (avatars, VR) lets teachers rehearse challenging scenarios (e.g. handling disruptions) without risk to real students . Studies have shown that such simulations can improve teachers' skills and confidence. Collectively, these benefits point to more engaged, confident trainees who receive data-informed support throughout their preparation.

Limitations and Challenges: Despite promise, AI-based training faces obstacles. **Equity of access** is a major concern: high-end AI tools and infrastructure may be available only in well-funded programs. WEF warns that without deliberate policy, AI resources could widen gaps between schools, especially in under-resourced regions. ***Bias and Ethics*** are critical issues: AI systems trained on limited data may give skewed feedback, and their use in teaching must respect student privacy and fairness. The U.S. Department of Education cautions about "examples of discrimination from algorithmic bias," underscoring the need for oversight. This means teacher training must include safeguarding against biased AI and respecting data rights. **Teacher attitudes** are another challenge: some educators fear AI may replace their role. In practice, most experts reject this fear, emphasizing augmentation over replacement, but overcoming skepticism requires careful PD and evidence of AI's assistive role. ***Curriculum integration*** is nontrivial: deciding where and how to embed AI in already-crowded teacher

education programs demands strategic planning. As one AI researcher notes, heavy reliance on vendor platforms could risk ceding curriculum control to tech companies . Finally, there are **technical limitations**: not all teacher skills are easily measured or supported by AI (e.g. empathy, creativity), and current chatbots may generate inaccurate or superficial suggestions.

In summary, AI-based teacher training can greatly enrich learning, but must be implemented with attention to digital divides, ethical safeguards, and alignment with educators' goals.

Implications for Pedagogy, Curriculum, and Competencies

Integrating AI into teacher preparation will have ripple effects on pedagogy and program design. Pedagogically, educators must model a *human-AI collaboration* mindset: teachers' roles shift toward mentoring, interpreting AI feedback, and focusing on social-emotional support while routine tasks are automated. Classrooms are likely to become more data-driven; teachers learn to use learning analytics to inform instruction (for example, spotting trends in student engagement) which requires new analytic and reflective skills.[3] Therefore, teacher educators should emphasize 21st-century pedagogies (inquiry, project-based learning) that complement AI tools, rather than traditional lecture-only methods.

Curriculum design in teacher education should embed AI literacy throughout. Instead of a single workshop, AI concepts can be threaded into methods courses, technology courses, and clinical experiences. For example, a mathematics methods class might include sessions on AI-driven math tutors and have trainees compare AI-generated problems with their own. Institutes might partner with edtech providers to give students access to adaptive learning platforms. Assessment of trainees should likewise evolve: in addition to observation by human supervisors, AI analytics (such as evaluation of lesson plans by an AI rubric) could become part of proficiency checks.

Key teacher competencies must expand. UNESCO's framework identifies five AI-related areas. We can summarize these as follows:[4]

- **Human-centered mindset:** Teachers should value human agency and be prepared to make final decisions in teaching, with AI as a support. They must advocate for equity and inclusivity when using AI.

- **Ethics of AI:** Educators need competence in ethical principles, such as understanding privacy, consent, and avoiding bias. Teacher training must build this ethical orientation.

- **AI foundations and applications:** Teachers require basic AI knowledge (how algorithms work) and awareness of current tools. This technical foundation allows them to critically evaluate new technologies.

- **AI pedagogy:** This is the skill of using AI as a teaching resource. It includes designing lessons that effectively integrate AI-driven activities (e.g. personalized learning modules) and interpreting AI-provided insights about student learning.

- **AI for professional learning:** Finally, teachers need to leverage AI for their own growth – for instance, using AI-curated resources for self-study or analyzing peer teaching videos with AI tools.

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[3] Najmiddinova M.N., Najmiddinova G.N. "Pedagogical mechanisms for improving student knowledge with the help of Artificial Intelligence". International journal of scientific researchers". www.wordlyknowledge.uz. Volume: 2, Issue: 1, 2023.

[4] UNESCO. (2024). AI competency framework for teachers: Guiding teachers on artificial intelligence use and misuse in education (F. Miao & M. Cukurova, Eds.). United Nations Educational, Scientific and Cultural Organization.

Table 1 (below) aligns these competencies with training activities in our methodology. This competence-based approach ensures that AI training supports teachers' professional growth, not just tool usage.

Table 1: AI-Related Teacher Competencies and Training Activities (Example Framework)

- Human-Centered Mindset & Ethics: Classroom debates on AI equity; reflective journals on AI scenarios.
- AI Foundations & Applications: Intro AI modules; hands-on with a coding-free AI tool.
- AI Pedagogy: Lesson plan assignments using AI tutors; observation of AI-enhanced teaching.[5]
- AI for PD: Using AI-driven feedback on teaching demonstrations; AI-curated professional resources.

In summary, teacher education programs must be reoriented around these competencies. In doing so, curriculum developers and policymakers should engage educators in co-design (as recommended by Tammets & Ley) to ensure that AI integration supports real teaching needs.

Conclusion

AI holds great promise for transforming teacher preparation, but realizing this requires a comprehensive, thoughtful approach. We have outlined a structured methodology that starts with foundational AI understanding, integrates cutting-edge tools into practice, and uses analytics for continuous improvement. This approach is grounded in emerging frameworks and empirical insights, and it emphasizes teacher agency and ethics. Benefits of AI-based training include personalized learning for trainees and greater efficiency, while challenges like equity, bias, and curricular alignment must be proactively managed.

The implications are broad: teacher educators and institutions will need to update curricula, invest in technology infrastructure, and develop new assessment strategies. Policymakers should support these shifts through funding and standards (for example, by promoting UNESCO's AI competency framework as a guideline). Future research should evaluate pilot implementations of this methodology, measuring outcomes such as teacher competence and student learning gains. By embracing AI as a partner in teacher training, the educational community can prepare a workforce ready to harness AI for better learning outcomes while upholding human values.

References

1. Buffalo State University. (n.d.). TeachLivE: Mixed-reality classroom simulation. Retrieved from https://exceptionaleducation.buffalostate.edu/teachlive

2. Lee, D., & Towne, J. (2025, January 9). How AI and human teachers can collaborate to transform education. World Economic Forum. Retrieved from https://www.weforum.org/stories/2025/01/how-ai-and-human-teachers-can-collaborate-to-transform-education

3. Najmiddinova G.N. "The role of artificial intelligence in society and education". Til va liyatrat.uz Scientific-methodical electronic journal. - Tashkent. 2025 year. -B. 239-242. https://oak.uz/pages/4802.

[5] Schultz, B. (2025, February 14). The new teachers' aides: AI tutors. Education Week. Retrieved from https://www.edweek.org/technology/the-new-teachers-aides-ai-tutors/2025/02

4. Najmiddinova N.G. "Perspective usage of artistic intellect in the educational sphere". Innovative Development in Educational Activities ISSN: 2181-3523. -B. 30-33. openidea.uz.

5. Najmiddinova G.N. "Introduction of Artificial Intelligence (AI) in Secondary Education School System". Scientific-theoretical, methodical magazine of science, No. 1. 2025 year. -B.144-147.

6. Najmiddinova M.N., Najmiddinova G.N. "Pedagogical mechanisms for improving student knowledge with the help of Artificial Intelligence". International journal of scientific researchers". www.wordlyknowledge.uz. Volume: 2, Issue: 1, 2023.

7. Najmiddinova M.N., Najmiddinova S.N. "Ways to organize the activities of teachers in the process of distance Education" . Asian Journal of Multidimensional Research, ISSN: 2278-4853 Vol. 11, Issue 5, May 2022.

8. Najmiddinova M.N. "Practical basis of the problem of teaching foreign languages in higher education system". International Conference on Sustainable Development and Economics. June 24-25.

9. Najmiddinova G.N. "The role of artificial intelligence technologies in the development of society and education". International scientific and practical conference on "Modern trends in teaching in the environment of innovation and digital technologies in higher education: prospects, problems and solutions", November, 29, 2024. https://doi.org/10.5281/zenodo.14305115.

10. Najmiddinova G.N. "Artificial Intelligence Technologies and How to Use Them Properly in Education." Mejdunarodnoy ochno-ochnoy nauchno-prakticheskoy conference. Aktualnye problemy sovremennoy Tatarsky filologii, Ufa, November 22, 2024. 201-204 str.

11. Najmiddinova G.N. "The Integration of Artificial Intelligence (AI) into education system". 34-37 p. Tamaddun Nuri, ISSN 2181-8258, issue 12 (63) Scientific, social-philosophical, cultural-educational, literary-artistic journal, 12.12.2024. https://doi.org/10.69691/r1bx4f56

12. Tan, H., Cheng, G., & Ling, M. H. (2025). Artificial intelligence in teaching and teacher professional development: A systematic review. Computers and Education: Artificial Intelligence, 8, 100355. https://doi.org/10.1016/j.caeai.2024.100355

13. Tammets, K., & Ley, T. (2023). Integrating AI tools in teacher professional learning: A conceptual model and illustrative case. Frontiers in Artificial Intelligence, 6, 1255089. https://doi.org/10.3389/frai.2023.1255089

14. UNESCO. (2024). AI competency framework for teachers: Guiding teachers on artificial intelligence use and misuse in education (F. Miao & M. Cukurova, Eds.). United Nations Educational, Scientific and Cultural Organization.

15. U.S. Department of Education, Office of Educational Technology. (2023). Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations. Washington, DC: U.S. Dept. Ed. Retrieved from https://tech.ed.gov/ai

16. Schultz, B. (2025, February 14). The new teachers' aides: AI tutors. Education Week. Retrieved from https://www.edweek.org/technology/the-new-teachers-aides-ai-tutors/2025/02