

PREPARING FUTURE EDUCATORS IN THE ERA OF ARTIFICIAL INTELLIGENCE: A FRAMEWORK FOR AI FLUENCY IN NIGERIAN EDUCATION

EMMANUEL TYOLUMUN TERHILE, ABUBAKAR SALIHU
& FARUK BUBA

Department of Educational Psychology and Counselling,
Federal University Dutsin-ma, Katsina State
tyolumunemmanuel@gmail.com; salihun2000@gmail.com
Faroukbuba20@gmail.com

Abstract

The rapid proliferation of artificial intelligence (AI) across social, economic, and educational sectors presents both opportunities and challenges for teacher education. This paper argues that teacher education programmes must systematically integrate AI fluency as a core professional competency, and proposes a five-domain Drawing on literature in educational technology, teacher professional development, and AI ethics, the Artificial Intelligence Fluency Framework for Teacher Education (AFFTE) comprises five domains: (1) foundational AI literacy, (2) pedagogical AI integration, (3) critical and ethical AI reasoning, (4) data and assessment intelligence, and (5) adaptive professional identity. The paper reviews the emerging landscape of AI in education, identifies gaps in teacher preparation, and offers policy and programmatic recommendations for institutions and policymakers. Specifically, the paper recommends that Nigerian teacher education programmes adopt the AFFTE as a structural guide for integrating AI fluency across pre-service and in-service training, supported by national policy frameworks and targeted faculty development. The central argument is that developing AI-fluent educators is essential for ensuring equitable and responsible educational practice in AI-mediated learning environments.

Keywords: Artificial Intelligence, Teacher Education, AI Fluency, Educational Technology, AI Ethics.

Introduction

Artificial intelligence has rapidly entered everyday educational practice. Tools such as generative AI systems, intelligent tutoring platforms, and automated feedback applications are transforming how students learn and how teachers design instruction (Luckin et al., 2022; UNESCO, 2023). Despite this transformation, teacher education programmes have been slow to integrate AI-related competencies into their curricula.

The failure to keep pace with AI developments carries serious professional and pedagogical consequences. Teachers who lack AI literacy may either adopt technologies uncritically or reject them entirely, limiting their potential educational value. Effective teaching in AI-rich environments requires educators who can critically evaluate AI tools, integrate them pedagogically, and guide students in responsible engagement with digital systems (Holmes et al., 2023; Zawacki-Richter et al., 2019).

This paper proposes the Artificial Intelligence Fluency Framework for Teacher Education (AFFTE) as a conceptual model for preparing teachers to work effectively in AI-mediated educational environments. The paper first reviews the current landscape of AI in education, then examines gaps in teacher preparation, before presenting the five domains of AI fluency and discussing implications for teacher education policy and practice.

Methodological Approach

This study adopts a conceptual synthesis approach. Rather than reporting original empirical data, the paper integrates insights from contemporary scholarship on artificial intelligence in education, teacher professional development, and educational technology ethics. Conceptual synthesis as a methodological orientation draws on systematic engagement with existing literature to construct theoretical frameworks and derive practical implications (Torraco, 2005; Grant & Booth, 2009).

Relevant literature published between 2019 and 2024 was examined through academic databases including Scopus, ERIC, and Web of Science using keywords such as AI in education, AI literacy, teacher professional development, and educational data analytics. Themes emerging across the literature were synthesised to identify competencies necessary for teachers operating in AI-mediated educational environments.

The AI Landscape in Education

Artificial intelligence is increasingly embedded in educational systems, with generative AI, machine learning platforms, and intelligent tutoring tools being used to generate learning materials, provide personalised instruction, and analyse student performance data (Zawacki-Richter et al., 2019). While these tools can support brainstorming, formative feedback, and concept explanation, they also raise concerns about academic integrity, student dependency, and the authority of machine-generated knowledge (Kasneci et al., 2023).

Global policy organisations such as UNESCO (2023) and the OECD (2023) identify AI competencies as essential for future citizenship and employment, yet most national curricula and teacher education programmes have not systematically incorporated these competencies. In developing regions especially, AI adoption raises additional concerns related to digital inequality, algorithmic bias, and data governance (Amara et al., 2023), underscoring the urgent need for teacher education frameworks that prepare educators to engage with AI critically and ethically.

Gaps in Teacher Education

Lack of AI Curriculum

Most teacher preparation programmes still treat technology integration primarily as digital literacy training rather than AI-specific competency development. This is evidenced in curriculum structures that focus on the use of productivity tools, internet navigation, and basic instructional software, rather than equipping teachers with knowledge of how AI systems are designed, how they generate outputs, and how they influence learning environments. As a result, many teachers enter the profession without understanding how AI systems function or how they influence learning processes (Celik, 2023).

Limited Faculty Expertise

Teacher educators themselves often lack experience with AI technologies, reflecting the rapid emergence of these tools and limited professional development opportunities (Luckin et al., 2022).

Neglect of Ethical Dimensions

Existing technology training frequently emphasises tool usage rather than critical examination of ethical issues such as algorithmic bias, data privacy, and corporate influence on educational infrastructure (Akgun & Greenhow, 2022; Holmes et al., 2023).

Policy–Practice Disconnect

Policy documents increasingly call for AI-ready education systems, yet teacher education programmes often lack the resources and structural support required to implement these goals

(OECD 2022) cited as
than op

AI Fluency Framework for Teacher Education (AFFTE)

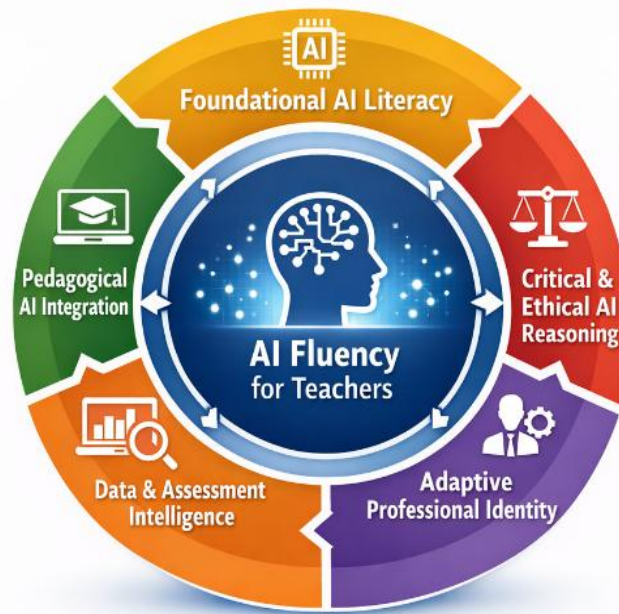


Figure 1. AI Fluency Framework for Teacher Education (AFFTE)

Theoretical Foundations

TPACK Framework

According to Mishra and Koehler (2006) The Technological Pedagogical Content Knowledge (TPACK) model emphasises the integration of technological, pedagogical, and disciplinary knowledge for effective teaching. AI fluency extends this model by incorporating knowledge of algorithmic systems and data-driven technologies. Specifically, teachers must understand not only how to use AI tools within subject-specific pedagogy, but also how these tools generate recommendations, process learner data, and interact with curriculum design. This extension of TPACK positions AI as a unique epistemic layer that requires distinct forms of knowledge beyond conventional digital tool use.

Transformative Learning

Mezirow's (1991) Transformative learning theory, emphasises critical reflection and shifts in professional perspectives. Developing AI fluency requires teachers to reconsider traditional assumptions about knowledge, assessment, and creativity. For instance, when an AI system generates a student essay or solves a mathematical problem, teachers must interrogate what these outputs reveal about learning, and what forms of student thinking they may obscure. Transformative engagement with AI tools thus demands not merely technical skill, but a willingness to critically re-examine long-held educational beliefs and professional identities.

Critical Pedagogy

Critical pedagogical traditions emphasise social justice, power relations, and ethical responsibility in educational practice (Freire, 1970). These perspectives are essential for analysing the social implications of AI technologies in education. Critical pedagogy compels educators to ask whose

interests are served by particular AI systems, whose data they are trained on, and which student populations stand to benefit or be marginalised. In the Nigerian context, where educational inequities along lines of gender, geography, and socioeconomic status remain pronounced, a critically grounded AI fluency ensures that technology adoption serves inclusion rather than reproducing existing disparities.

The AI Fluency Framework for Teacher Education (AFFTE)

Figure 1. AI Fluency Framework for Teacher Education (AFFTE) Core Domains:

Foundational AI Literacy

Pedagogical AI Integration

Critical and Ethical AI Reasoning

Data and Assessment Intelligence

Adaptive Professional Identity

1. Foundational AI Literacy

Teachers require a basic conceptual understanding of AI systems, including machine learning processes, generative AI models, and common applications in education. This knowledge enables educators to evaluate AI outputs critically and explain AI processes to students (Kasneci et al., 2023). Foundational AI literacy does not demand deep technical programming skills; rather, it requires teachers to comprehend how algorithms learn from data, how training datasets can encode bias, and how AI-generated content differs from human-authored knowledge. Without this foundation, teachers are ill-equipped to make informed decisions about when and how AI tools are appropriate in instructional contexts.

2. Pedagogical AI Integration

Teachers must be able to incorporate AI tools into teaching strategies while maintaining meaningful human interaction and pedagogical intention. This includes designing AI-supported learning activities and adapting assessment practices in AI-enabled environments (Romero et al., 2023). Pedagogical AI integration requires teachers to distinguish between AI tools that enhance student thinking and those that bypass it, ensuring that instructional design remains centred on learning outcomes rather than technological novelty. In Nigerian classrooms, where large class sizes and resource constraints are common, AI-supported differentiated instruction may offer particular promise when thoughtfully implemented.

3. Critical and Ethical AI Reasoning

Educators must critically evaluate AI technologies and their implications for equity, privacy, and accountability. Ethical AI reasoning includes recognising potential algorithmic bias and advocating for responsible technology use in education (Akgun & Greenhow, 2022). Teachers who develop this domain will be capable of questioning the provenance and representativeness of AI training data, protecting student information from corporate data collection, and modelling responsible digital citizenship for learners. In a context such as Nigeria, where regulatory frameworks for AI governance are still emerging, teachers occupying this critical stance serve as frontline ethical guardians of AI in the classroom.

4. Data and Assessment Intelligence

AI-enabled education generates extensive learner data. Teachers therefore require data literacy to interpret learning analytics, evaluate predictive models, and protect student data privacy (Zawacki-Richter et al., 2019). This domain encompasses the ability to read and interpret dashboards generated by adaptive learning platforms, identify when automated assessments may be unreliable or biased, and design assessment tasks that remain authentic in AI-rich environments. Data and assessment intelligence empowers teachers to make evidence-informed instructional decisions while maintaining

professional judgement over the interpretation of algorithmically generated insights.

5. Adaptive Professional Identity

The final domain concerns teachers’ capacity to maintain professional agency in technologically evolving environments. Adaptive professional identity involves openness to innovation while preserving core educational values (Selwyn, 2022). As AI continues to transform the teaching landscape, educators must develop the resilience and reflective capacity to evolve alongside these changes without losing sight of their fundamental commitment to human development, social justice, and student wellbeing. Teacher education programmes must therefore cultivate this adaptive disposition alongside technical and pedagogical competencies, ensuring that AI serves as a tool for professional empowerment rather than a threat to teacher relevance.

Implementing the AFFTE

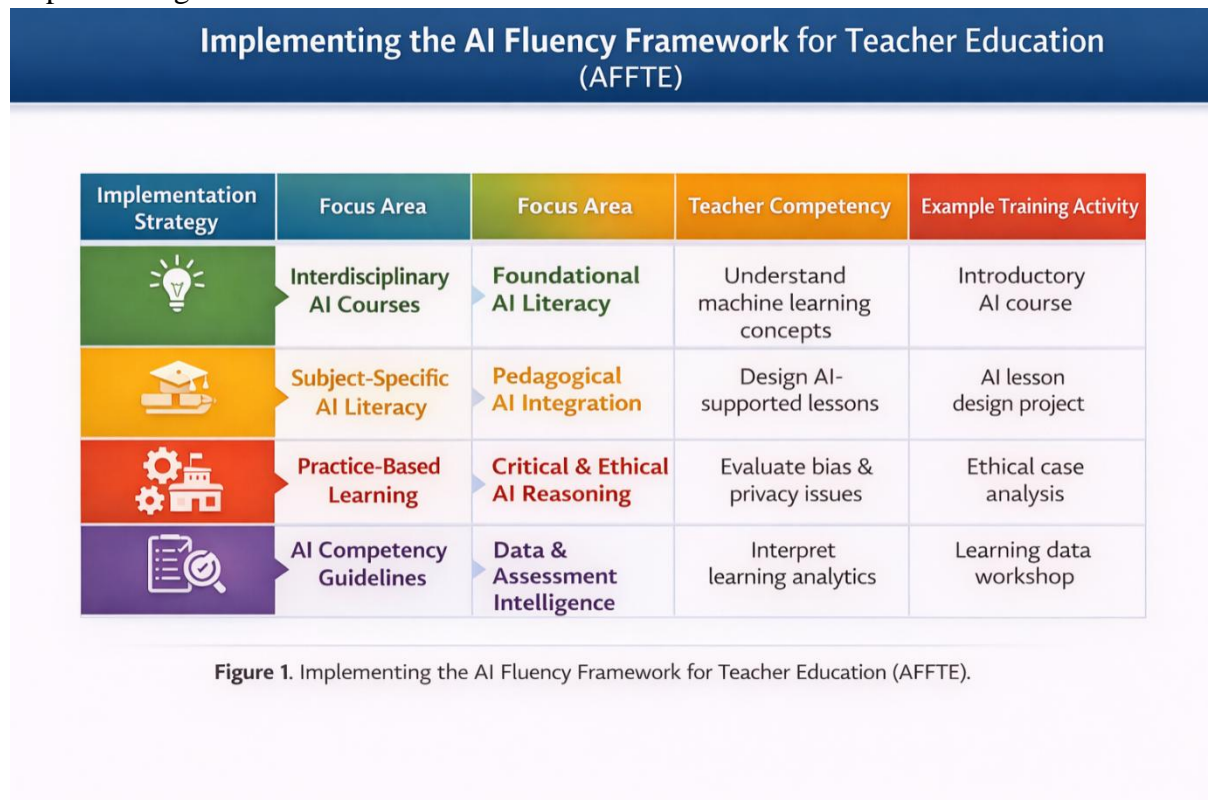


Figure 1. Implementing the AI Fluency Framework for Teacher Education (AFFTE).

Institutional, Programmatic, and Policy Strategies

Institutions should conduct curriculum audits to identify gaps in AI-related competencies and integrate AI fluency across courses rather than treating it as a standalone module. Faculty development programmes are also essential to build educator capacity. Teacher education programmes may introduce interdisciplinary courses such as Artificial Intelligence and Pedagogy to develop foundational AI literacy and critical evaluation skills (Romero et al., 2023; Celik, 2023). AI literacy activities can also be embedded within subject-specific methods courses, enabling students to design lessons that integrate AI tools while maintaining clear pedagogical objectives (Mishra & Koehler, 2006). Practice-based learning environments, including AI-supported teaching laboratories and school partnerships, provide opportunities for pre-service teachers to experiment with AI-enhanced instructional strategies under mentorship (Darling-Hammond et al., 2017). Education ministries should establish national AI competency standards for teacher preparation and provide resources for curriculum development and faculty training (OECD, 2023; UNESCO, 2023). Professional associations should support continuous AI professional development and promote ethical guidelines for AI use in teaching.

Conclusion

Artificial intelligence is reshaping educational practice, creating new opportunities and responsibilities for teachers. Preparing educators for AI-mediated classrooms requires more than technical training; it demands comprehensive professional preparation encompassing pedagogical, ethical, and data-related competencies.

The AFFTE proposed in this paper offers a principled, adaptable architecture for that response, grounding AI fluency in five interconnected domains that span technical understanding, pedagogical application, ethical reasoning, data intelligence, and professional identity. These domains reflect the conviction that teacher education must move beyond surface-level technology training toward a holistic preparation that equips educators to exercise critical professional judgement in AI-mediated learning environments.

For Nigeria specifically, where teacher education faces compounding pressures from resource constraints, digital inequality, and rapidly evolving labour market demands, the AFFTE represents a contextually grounded tool for reform. Its adoption, however, requires genuine institutional will, enabling policy environments, and sustained investment in faculty development. The position of this paper is clear: AI-fluent teachers are not a luxury they are a prerequisite for educational systems that aspire to be equitable, responsive, and fit for the twenty-first century. Nigerian teacher education institutions, in partnership with government and professional bodies, must act now to make that aspiration a reality.

Recommendations

The following recommendations, grounded in the AFFTE, are directed at Nigerian teacher education institutions and policymakers;

1. Nigerian teacher education institutions should formally adopt the AFFTE as a structural guide for curriculum reform, mapping each of its five domains to specific course outcomes across pre-service teacher training programmes.
2. The Federal Ministry of Education and the National Universities Commission (NUC) should develop a national policy framework mandating AI literacy competencies in teacher education curricula. Without regulatory backing, institutional uptake will remain uneven.
3. Universities should establish AI professional learning communities for academic staff and create incentives for participation in AI-focused training, since teacher educators who are not AI-fluent cannot effectively model or teach these competencies.
4. The AFFTE should be piloted across institutions in Nigeria's six geopolitical zones, with adaptations to reflect local infrastructure and learner contexts; evaluation findings should feed back into iterative framework refinement.

References

- Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K–12 settings. *AI and Ethics*, 2(3), 431–440. <https://doi.org/10.1007/s43681-021-00096-7>
- Amara, B., Chatti, M. A., & Schroeder, U. (2023). Artificial intelligence in education: Challenges and opportunities for developing countries. *Education and Information Technologies*, 28(5), 5113–5132. <https://doi.org/10.1007/s10639-022-11255-8>
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.
- Freire, P. (1970). *Pedagogy of the oppressed*. Continuum.
- Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., Santos, O.

- C., Rodrigo, M. M. T., Cukurova, M., Bittencourt, I. I., & Koedinger, K. R. (2023). Ethics of AI in education: Towards a community-wide framework. *International Journal of Artificial Intelligence in Education*, 33, 504–526. <https://doi.org/10.1007/s40593-021-00239-1>
- Kasneji, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Müller, M., Nöth, E., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., ... Kasneji, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274. <https://doi.org/10.1016/j.lindif.2023.102274>
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. (2022). *Intelligence unleashed: An argument for AI in education*. Pearson.
- Mezirow, J. (1991). *Transformative dimensions of adult learning*. Jossey-Bass.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism*. New York University Press.
- OECD. (2023). *Artificial intelligence and the future of education: Policy perspectives*. Organisation for Economic Co-operation and Development.
- Romero, M., Bruguera, C., Quintero, L., Sanagustín-Fons, V., Martínez-Morales, I., & Lepage, A. (2023). Co-designing AI literacy education for pre-service teachers: A competency-based approach. *Education Sciences*, 13(4), 415. <https://doi.org/10.3390/educsci13040415>
- Selwyn, N. (2022). The future of AI and education: Some cautionary notes. *European Journal of Education*, 57(4), 620–631. <https://doi.org/10.1111/ejed.12532>
- UNESCO. (2023). *Guidance for generative AI in education and research*. United Nations Educational, Scientific and Cultural Organization.
- Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology*, 45(3), 223–235. <https://doi.org/10.1080/17439884.2020.1798995>
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education*, 16(39). <https://doi.org/10.1186/s41239-019-0171-0>
- Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, 26(2), 91–108. <https://doi.org/10.1111/j.1471-1842.2009.00848.x>
- Torraco, R. J. (2005). Writing integrative literature reviews: Guidelines and examples. *Human Resource Development Review*, 4(3), 356–367. <https://doi.org/10.1177/1534484305278283>