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Beyond the Device: Reforming Higher Education and Teacher Education Curricula from ICT Literacy to AI Pedagogical Readiness in East Africa

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The rapid advancement of artificial intelligence (AI) is transforming teaching, learning, assessment, and educational practice, requiring education systems to rethink how future educators are prepared for AI-enabled teaching and learning. The Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024) highlights the need for education systems to strengthen AI capacity, ethical adoption and human-centred innovation. However, despite significant investments in digital infrastructure and ICT literacy across East African higher education institutions, many teacher education curricula remain focused on basic digital skills and technology operation rather than the advanced competencies required for AI-enabled teaching and learning. This creates a growing mismatch between existing teacher preparation approaches and the knowledge, pedagogical skills, and ethical awareness required for responsible AI integration. By adopting a qualitative conceptual research design supported by systematic document analysis published from (2020-2026) of contemporary scholarship and key policy frameworks, including UNESCO's *AI Competency Framework for Teachers*, the OECD *Digital Education Outlook*, and the African Union *AI Strategy*, this conceptual paper aimed to examine how higher education and teacher education curricula can transition from ICT literacy to AI pedagogical readiness. The paper argues that AI readiness requires more than technological proficiency; it requires educators who can critically understand, ethically evaluate, and pedagogically apply AI in teaching, learning, assessment, research, and professional practice. It proposes curriculum reform that positions AI pedagogical readiness as a core graduate attribute within teacher education. The paper concludes that coordinated curriculum reform, institutional support, and responsible AI governance are essential for preparing AI-ready educators capable of advancing equitable, innovative, and sustainable education in East Africa.

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INTRODUCTION

Artificial intelligence (AI) is one of the most transformative technologies shaping the future of education, with significant implications for curriculum development, teaching practices, assessment systems, educational leadership, and lifelong learning (UNESCO, 2023). Globally, universities are increasingly reconsidering how graduates are prepared for AI-enabled societies where intelligent technologies complement human expertise rather than simply automate routine activities. This transformation has created new expectations for teacher education, requiring educators to possess not only digital competencies but also the pedagogical knowledge, ethical reasoning, and critical capabilities needed to integrate AI meaningfully into learning environments. As Zawacki-Richter et al. (2020) observe, AI applications in higher education are expanding rapidly, yet effective adoption depends greatly on educators' ability to understand and shape their educational use.

Across East Africa, governments have invested substantially in digital transformation initiatives aimed at improving educational access and technology integration. Kenya's Digital Literacy Programme and broader education transformation agenda, Uganda's Digital Transformation Roadmap, Rwanda's Smart Education Policy Framework, and Tanzania's ICT policy and digital learning initiatives demonstrate growing national commitments towards technology-supported education (Ministry of Education,

Kenya, 2023; Ministry of ICT and National Guidance, Uganda, 2021; Rwanda Ministry of Education, 2023; Tanzania Ministry of Education, Science and Technology, 2023). These initiatives have contributed to expanding digital infrastructure and institutional connectivity; however, infrastructure investment alone has not always translated into pedagogical transformation (World Bank, 2023). In many contexts, teacher preparation continues to emphasise basic ICT operations and digital tool usage rather than the higher-order competencies required to design, evaluate, and implement AI-supported learning experiences. Consequently, a gap is emerging between technological advancement and the capacity of educators to use emerging technologies effectively.

The rapid emergence of generative AI has intensified this challenge. UNESCO (2023) highlights that technologies such as large language models, intelligent tutoring systems, adaptive learning platforms, and automated feedback systems are reshaping educational processes, including lesson planning, assessment, research, and learner support. Similarly, Kasneci et al. (2023) argue that generative AI presents significant opportunities for enhancing learning but also introduces challenges related to accuracy, academic integrity, bias, and responsible use. Therefore, universities preparing future teachers can no longer treat AI as an external technological innovation; rather, it has become a pedagogical reality requiring deliberate curriculum transformation.

The Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024) provides an important regional policy response to these developments. The Declaration emphasises strengthening AI capacity, promoting ethical and inclusive AI adoption, developing educator competencies, and ensuring that emerging technologies contribute to equitable educational transformation. Its significance lies in shifting attention from technology acquisition towards human capacity development and institutional preparedness. However, translating this regional commitment into practice requires higher education institutions and teacher education providers to reconsider whether existing curricula adequately prepare educators for AI-enabled teaching and learning environments.

Although ICT literacy remains an essential foundation for educational technology integration, AI requires a broader and more sophisticated range of competencies. Long and Magerko (2020) argue that AI literacy involves understanding AI concepts, recognising its capabilities and limitations, critically evaluating AI outputs, and making informed decisions about its use. For educators, these competencies must be combined with pedagogical knowledge, ethical awareness, and professional judgment. Holmes et al. (2022) further emphasise that teachers require abilities in AI-supported instructional design, algorithmic awareness, data-informed decision-making, learner privacy protection, and responsible human oversight of intelligent systems. These expectations extend beyond knowing how to operate digital devices; they require educators to determine when, why, and under what conditions AI can enhance learning.

This paper therefore argues that East African universities should shift teacher education curricula from ICT literacy towards AI pedagogical readiness. AI pedagogical readiness is conceptualised as the integrated capacity of educators to understand AI technologies, critically evaluate their educational value, apply them ethically within teaching and assessment, protect

learner rights, and continuously adapt professional practice in response to technological change. This transition represents not merely a technological upgrade but a fundamental curriculum reform agenda aimed at preparing teachers who can guide responsible AI integration and contribute to inclusive, innovative, and sustainable educational transformation in East Africa.

Problem Statement

The rapid emergence of artificial intelligence (AI) is transforming educational practices globally and creating new expectations for teacher competencies. Although East African higher education institutions have made significant progress in promoting ICT literacy through digital infrastructure and technology integration initiatives, many teacher education curricula remain focused on operational digital skills rather than the advanced competencies required for AI-enabled teaching and learning. This creates a growing mismatch between existing teacher preparation approaches and the knowledge, pedagogical skills, and ethical awareness needed to integrate AI effectively in education.

The Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024) highlights the need for strengthened AI capacity, responsible innovation, and curriculum transformation within education systems. However, limited attention has been given to how higher education and teacher education curricula should evolve from ICT literacy towards AI pedagogical readiness. Without deliberate reform, future educators may remain users of digital technologies rather than professionals capable of critically evaluating, ethically applying, and pedagogically integrating AI. This paper addresses this gap by examining the curriculum reforms required to prepare AI-ready educators in East Africa.

Research Questions

- What curriculum reforms are required to transform higher education and teacher education curricula from ICT literacy to AI pedagogical readiness in East Africa?
- How can higher education institutions and teacher education providers in East Africa prepare future educators to integrate artificial intelligence ethically, critically, and pedagogically into teaching, learning, assessment, and professional practice?

Purpose of the Paper

The purpose of this paper is to examine why and how higher education and teacher education curricula in East Africa should be reformed from a focus on ICT literacy towards AI pedagogical readiness. Drawing upon contemporary scholarship and international and regional policy frameworks, the paper develops a conceptual argument for curriculum transformation that equips future educators with the knowledge, pedagogical competencies, ethical reasoning, and professional capabilities required to integrate artificial intelligence responsibly and effectively into teaching, learning, assessment, curriculum development, and educational research.

METHODOLOGY

This paper adopted a qualitative conceptual research design supported by systematic document analysis to examine how higher education and teacher education curricula in East Africa can transition from ICT literacy towards AI pedagogical readiness. Conceptual research is appropriate for exploring emerging educational issues by critically synthesising existing knowledge, theories, and policy perspectives rather than collecting primary empirical data (Creswell & Creswell, 2023). The analysis drew upon contemporary literature published between 2020 and 2026, including peer-reviewed journal articles, key policy frameworks, including Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern

Africa (2024), which is the regional policy framework, UNESCO's AI Competency Framework for Teachers, the African Union Artificial Intelligence Strategy, and the Organisation for Economic Co-operation and Development (OECD) Digital Education Outlook; together with institutional reports from UNESCO, the World Bank, African Union, the Inter-University Council for East Africa (IUCEA), and national education agencies.

The selected literature and policy documents were analysed thematically following the approach proposed by Braun and Clarke (2022). The analysis focused on four interconnected themes: AI competencies for educators, curriculum transformation, responsible AI integration, and institutional readiness. The paper integrated international evidence with African educational priorities and developed a contextually relevant argument for preparing AI-ready educators in East Africa.

FINDINGS

From ICT Literacy to AI Pedagogical Readiness: A Conceptual Shift

Effective digital transformation in education requires more than access to technological devices; it requires educators who possess the competencies to use technologies meaningfully to improve teaching and learning (UNESCO, 2021). In East Africa, ICT literacy has provided an important foundation for educational technology integration by equipping teachers with basic competencies in computer operation, digital communication, internet use, and educational applications. However, the emergence of artificial intelligence (AI) has revealed the limitations of technology competence models that focus mainly on operational skills. As Redecker (2020) argues, contemporary educators require broader digital capabilities involving critical evaluation, creativity, ethical awareness, and the ability to integrate technologies within appropriate pedagogical contexts. Therefore, the challenge is not to replace ICT literacy but to transform it into

a more advanced professional competence responsive to AI-enabled education.

The movement from ICT literacy to AI pedagogical readiness represents a fundamental shift in how teacher competence is understood. The European Commission (2022) notes that digital competence increasingly involves innovation, critical thinking, collaboration, and responsible technology use rather than simply operating digital tools. AI introduces additional complexity because intelligent systems generate content, support decision-making, personalise learning, and influence educational processes. Consequently, teachers require competencies that include understanding AI capabilities and limitations, evaluating AI-generated information, recognising algorithmic bias, protecting learner data, and making informed decisions about appropriate AI use in classrooms. Without these capabilities, educators risk becoming passive consumers of AI technologies rather than professionals capable of guiding their responsible educational application (Holmes et al., 2022).

The concept of AI pedagogical readiness developed in this paper refers to the capacity of educators to critically understand, ethically evaluate, and pedagogically integrate artificial intelligence technologies into teaching, learning, assessment, curriculum design, and professional practice while maintaining human agency and educational values. This concept extends beyond AI literacy, which primarily concerns awareness and understanding of AI systems, by emphasising the ability to apply AI within authentic educational contexts. According to UNESCO (2024), teachers require competencies that combine AI knowledge, pedagogical application, ethical reasoning, and the capacity to support inclusive learning environments. Similarly, Long and Magerko (2020) argue that AI literacy requires individuals to understand AI systems, evaluate their outputs, and make informed decisions regarding their use. For teachers, these competencies must be integrated with pedagogical knowledge and professional judgment.

AI pedagogical readiness therefore involves several interconnected dimensions. The first is AI knowledge and critical understanding, enabling educators to comprehend AI concepts, opportunities, and limitations. The second is AI-enhanced pedagogy, which involves using AI to support instructional design, personalised learning, learner engagement, and feedback. The third is ethical and responsible AI practice, addressing concerns related to privacy, transparency, bias, equity, and academic integrity. The fourth is AI-informed assessment competence, which prepares teachers to redesign assessment approaches in response to generative AI. As OECD (2023) highlights, future-ready educators must not only use emerging technologies but also understand their broader implications for learning, society, and professional practice.

For East Africa, developing AI pedagogical readiness is particularly important because educational transformation must move beyond providing devices and connectivity. National digital education policies in East Africa have created important foundations for technology integration; however, these frameworks have largely focused on expanding connectivity, digital access, and ICT competencies rather than developing advanced AI-related pedagogical capabilities among educators (Ministry of Education, Kenya, 2023; Ministry of ICT and National Guidance, Uganda, 2021; Rwanda Ministry of Education, 2023). The next phase of educational transformation therefore requires moving beyond technology access towards developing educators capable of critically and ethically integrating AI into teaching and learning. The World Bank (2023) argues that successful digital transformation depends primarily on institutional capacity, teacher competence, and supportive policy environments rather than technology access alone. This challenge is also reflected in higher education globally, where AI adoption has often developed faster than institutional frameworks for supporting educators and ensuring responsible implementation (Zawacki-Richter et al., 2020).

Therefore, East African universities must reform teacher education curricula to develop educators who can shape AI adoption according to regional educational priorities, ethical principles, and contextual realities.

The Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024) provides a critical foundation for this transformation by emphasising capacity development, responsible innovation, and inclusive AI adoption. Moving from ICT literacy to AI pedagogical readiness is therefore not simply a technological transition but a necessary curriculum transformation that prepares teachers to lead education in an AI-driven future.

Reforming Higher Education and Teacher Education Curricula in East Africa: Building AI-Ready Educators

Preparing educators for artificial intelligence requires a fundamental transformation of teacher education systems rather than the simple introduction of technological tools into existing programmes (UNESCO, 2024). In East Africa, this requires a shift from an ICT-centered approach, where technology is often treated primarily as a technical skill, towards a curriculum model that positions AI competence as an essential component of professional teacher preparation. Although countries such as Kenya, Uganda, Rwanda, and Tanzania have expanded digital education initiatives, including curriculum reforms and technology integration programmes, many teacher education programmes remain focused on foundational digital competencies rather than AI-enabled pedagogical practices (Tanzania Ministry of Education, Science and Technology, 2023). This creates a gap between technological advancement and educator preparedness.

A key priority is the integration of AI competencies across teacher education curricula rather than treating AI as an isolated subject. The UNESCO AI Competency Framework for Teachers (2024) identifies AI knowledge,

pedagogical application, ethical awareness, and professional development as essential components of teacher readiness. For East African universities, this requires embedding AI competencies within educational technology, curriculum studies, assessment, research methods, and subject-specific teaching methodologies. Existing curriculum frameworks, such as Kenya's competency-based curriculum approach developed through the Kenya Institute of Curriculum Development (2017), provide an opportunity to incorporate AI-related competencies that promote creativity, problem-solving, critical thinking, and responsible technology use.

Curriculum reform must also ensure that teacher education curricula develop AI competencies that integrate pedagogical innovation, ethical reasoning, and professional judgment rather than merely technological proficiency (UNESCO, 2024). This perspective builds on earlier technology integration models, such as the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006), which demonstrates that effective technology integration depends on the interaction of technological, pedagogical, and disciplinary knowledge. Building on this foundation, AI-enabled education requires teachers not only to understand how AI tools function but also to evaluate their educational value, recognise their limitations, and apply them responsibly within diverse learning contexts. Accordingly, the UNESCO AI Competency Framework for Teachers (2024) positions educators as critical decision-makers who evaluate, adapt, and ethically integrate AI to enhance teaching, learning, assessment, and professional practice. Teacher education institutions should therefore promote experiential learning through AI-supported lesson design, critical evaluation of AI-generated content, reflective practice, collaborative inquiry, and problem-based learning. Such approaches prepare future teachers to become designers of AI-enhanced learning experiences rather than passive users of emerging technologies.

Assessment reform is another essential component of AI-ready teacher preparation. Generative AI has challenged traditional assessment approaches that emphasise reproduction of information and individual written outputs. Kasneci et al. (2023) and Bearman and Ajjawi (2023) argue that universities must rethink assessment practices by emphasising creativity, critical thinking, authentic performance, and application of knowledge. Within East African teacher education, this requires preparing future teachers to design assessments that promote deeper learning, evaluate AI-supported work responsibly, and maintain academic integrity in increasingly AI-enabled learning environments.

Successful curriculum transformation also depends on strengthening the capacity of teacher educators and university lecturers. The World Bank (2023) highlights that technology investments have limited educational impact when educators lack the competencies required for meaningful integration. Similarly, regional higher education transformation requires institutions to strengthen staff capacity through professional development, collaborative research, and institutional partnerships (Inter-University Council for East Africa [IUCEA], 2023). Universities should therefore prioritise continuous AI professional learning that develops lecturer competence in AI literacy, AI-enhanced pedagogy, ethical AI practices, and discipline-specific applications.

Finally, AI curriculum reform requires supportive institutional governance and quality assurance frameworks. The African Union (2024) emphasises that Africa's approach to AI should promote inclusion, ethical innovation, and context-sensitive development. Higher education institutions should therefore establish responsible AI guidelines addressing data protection, algorithmic bias, academic integrity, accessibility, and equitable participation. The goal is not to prepare teachers who merely operate AI tools, but professionals who can critically evaluate AI, preserve human agency, and use technology to

improve educational quality and equity. As emphasised by the Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024), sustainable AI transformation depends on strengthening human capacity alongside technological development.

Policy Implications for Curriculum Reform towards AI-Ready Teacher Education in East Africa

The Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024) provides an important regional foundation for promoting ethical, inclusive, and contextually relevant AI adoption in education. However, translating this commitment into meaningful educational transformation requires policy reforms that move beyond expanding access to technology and instead prioritise curriculum redesign, teacher competence development, and institutional readiness. For East African higher education systems, curriculum reform for AI-ready teacher education should become a strategic priority within national education policies, university development plans, teacher education standards, and quality assurance frameworks. Such reforms should position AI pedagogical readiness as a core graduate outcome, ensuring that future teachers are equipped not only to use AI technologies but also to apply them critically, ethically, and pedagogically in diverse educational contexts.

A central policy priority should therefore be the revision of teacher education curriculum frameworks to incorporate AI pedagogical readiness as a core professional competency. UNESCO (2024) emphasises that educators require structured competency pathways integrating AI knowledge, pedagogical application, ethical reasoning, data literacy, and continuous professional learning. While many East African countries have made significant progress in digital education strategies, most curriculum policies continue to emphasise ICT infrastructure and digital literacy rather than AI-

enabled teaching competencies. Governments, curriculum agencies, universities, and higher education regulators should therefore review teacher education curricula and professional standards to embed AI competencies across educational technology, curriculum studies, assessment, research methods, and subject-specific pedagogy.

Universities and teacher education institutions also require stronger policy frameworks for responsible AI integration that directly inform curriculum development and implementation. According to the OECD (2023), effective AI adoption depends on institutional policies that promote transparency, accountability, ethical use, learner privacy, and data protection. These principles should not remain institutional guidelines alone but should be translated into explicit curriculum outcomes that prepare future teachers to evaluate AI critically, address algorithmic bias, uphold academic integrity, and make informed pedagogical decisions. Embedding responsible AI principles within teacher education curricula will ensure that technological innovation strengthens rather than diminishes professional judgment and educational values.

Quality assurance agencies and regional higher education bodies, including the Inter-University Council for East Africa (IUCEA, 2023), have a critical role in institutionalising curriculum reform for AI-ready teacher education. The African Union (2024) argues that Africa's AI development should be guided by human-centred innovation, equity, and sustainable development. Accordingly, accreditation and programme review frameworks should require universities to demonstrate how teacher education curricula explicitly develop AI pedagogical readiness through measurable learning outcomes, authentic assessment approaches, ethical AI competencies, and opportunities for practical application. Such policy alignment would promote greater consistency in the preparation of AI-ready educators across East Africa while respecting national educational priorities.

Finally, successful curriculum reform will depend on sustained investment in the professional development of teacher educators and university lecturers. The World Bank (2023) emphasises that educational technology reforms achieve meaningful impact only when supported by competent educators and enabling institutional systems. Governments and universities should therefore invest in continuous AI-focused professional learning, collaborative curriculum innovation, regional research partnerships, and communities of practice that enable teacher educators to continually review, implement, and refine AI-responsive curricula. Strengthening educator capacity will be essential for ensuring that curriculum reform remains responsive to the rapid evolution of AI technologies and emerging pedagogical practices.

Ultimately, the transition from ICT literacy to AI pedagogical readiness requires coordinated curriculum policy reform connecting governments, universities, quality assurance agencies, curriculum developers, and regional organisations. The success of the Nairobi Declaration will depend not only on expanding access to AI technologies but also on transforming teacher education curricula to prepare educators capable of leading the ethical, critical, and pedagogically sound use of artificial intelligence across East African education systems.

Recommendations for Advancing Curriculum Reform towards AI-Ready Teacher Education in East Africa

Drawing on the preceding analysis, the following strategic recommendations are proposed to support the transition from ICT literacy to AI pedagogical readiness within higher education and teacher education in East Africa.

- **Undertake comprehensive curriculum review and reform.** Governments, higher education regulators, and universities should initiate systematic reviews of teacher education curricula to ensure that AI pedagogical readiness becomes a compulsory

graduate competency. Curriculum reform should move beyond digital literacy by embedding AI knowledge, ethical reasoning, data literacy, and AI-supported pedagogical practice across teacher preparation programmes.

- **Integrate AI competencies across teacher education programmes.** Universities should mainstream AI pedagogical readiness throughout educational technology, curriculum studies, assessment, research methods, and subject-specific teaching methodologies rather than confining AI to standalone technology courses. This integrated approach will better prepare future teachers to critically evaluate, responsibly apply, and pedagogically integrate AI across diverse learning contexts.
- **Strengthen professional capacity for curriculum implementation.** Universities and teacher education institutions should invest in continuous professional development for teacher educators and university lecturers to enable effective implementation of AI-responsive curricula. Professional learning should include AI literacy, ethical AI practices, AI-enhanced pedagogy, curriculum innovation, and authentic assessment in AI-enabled learning environments.
- **Embed responsible AI governance within curriculum implementation.** Higher education institutions should operationalise responsible AI policies by integrating principles of academic integrity, learner privacy, data protection, transparency, algorithmic fairness, and ethical decision-making into curriculum design, assessment practices, research supervision, and institutional quality assurance processes. This will ensure that AI enhances educational quality while safeguarding human agency and learner rights.
- **Promote regional collaboration for AI curriculum innovation.** East African governments, universities, and regional organisations such as the Inter-University Council for East Africa (IUCEA) should

establish collaborative platforms for AI curriculum innovation, joint research, professional learning, and the exchange of best practices. Regional cooperation will accelerate curriculum reform, promote harmonisation of AI competencies, and strengthen the preparation of AI-ready teachers capable of responding to shared educational priorities across East Africa.

CONCLUSION

Artificial intelligence is redefining the competencies required of teachers, making curriculum reform an urgent priority for higher education and teacher education in East Africa. This paper argues that preparing future educators can no longer rely on ICT literacy alone but must prioritise AI pedagogical readiness: the capacity to critically, ethically, and pedagogically integrate AI into teaching, learning, assessment, research, and professional practice. Achieving this transformation requires coordinated curriculum reform supported by enabling policies, institutional leadership, continuous professional development, and responsible AI governance. While the Nairobi Declaration on Artificial Intelligence and Emerging Technologies in Education for Eastern Africa (2024) provides a strong regional policy foundation, its success will depend on translating these commitments into meaningful curriculum reform. Moving beyond the device is therefore a curriculum transformation imperative for preparing AI-ready educators capable of advancing quality, equitable, and innovative education across East Africa.

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