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ARTIFICIAL INTELLIGENCE AND INCLUSION: RETHINKING TEACHER EDUCATION

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ABSTRACT

This theoretical article examines how artificial intelligence (AI) can contribute to teacher education in Francophone Africa in support of inclusive education. Drawing on a critical synthesis of academic literature and institutional frameworks, it analyses AI's potential to support differentiated instruction, the transformation of teachers' professional roles, and the ethical, linguistic and infrastructural challenges associated with its adoption. It proposes a four-dimensional teacher-education model comprising technological, pedagogical, ethical and contextual dimensions. AI can support the personalization of learning, provided that teachers retain professional responsibility and that inequalities of access, local languages and educational realities are taken into account. The proposed model offers a conceptual framework for critical and context-sensitive integration of AI and requires empirical validation.

Keywords: Artificial intelligence; Inclusive education; Teacher education; Digital competencies; Francophone Africa.

1 INTRODUCTION

Artificial intelligence (AI) is transforming social and educational practices. This development is taking place while African education systems continue to face the challenge of improving access, equity and the quality of learning. Sustainable Development Goal 4 calls for inclusive, equitable and quality education for all (UNESCO, 2015). AI offers opportunities to personalise learning and create educational resources, but it may also widen inequalities if these tools remain accessible primarily to well-equipped institutions and more advantaged learners (UNESCO, 2023, 2025).

The importance of this discussion lies in the fact that technological innovation does not, by itself, produce desirable pedagogical change. An application may facilitate the preparation of teaching materials or provide explanations quickly, but its usefulness depends on how it is selected, contextualised and integrated into a teaching sequence. The issue,

therefore, is not to introduce AI into every situation, but to determine the conditions under which it helps remove barriers to learning rather than creating new ones. This distinction is essential to inclusive education, whose ambition is to transform the school environment so that learner diversity does not become a reason for exclusion.

This issue is particularly important in Francophone African education systems, where teaching conditions vary considerably across territories, institutions and available resources. Teachers may face large classes, unreliable access to electricity and the Internet, shortages of teaching materials, or classrooms in which learners speak several different languages. A solution designed for a well-equipped institution cannot therefore be transferred without adaptation. Teacher education must enable practitioners to assess an AI tool's needs, costs, risks and actual benefits, and also to refrain from using it when conditions do not allow for reliable and equitable implementation.

Inclusive education requires schools to adapt their practices to learner diversity, whether related to disability, learning difficulties, language, socioeconomic circumstances or crisis situations. However, large classes, a lack of accessible materials and insufficient teacher preparation make differentiated instruction difficult in several African contexts (Plaisance et al., 2007; Bationo et al., 2022). AI tools could help produce adapted resources, simplify texts, generate differentiated exercises and provide rapid feedback. These possibilities nevertheless depend on the quality and accessibility of the tools and on teachers' ability to verify their outputs.

The central question is therefore: how can teachers be trained to use AI in support of inclusive education in contexts characterised by infrastructural constraints and digital inequalities? Three related questions arise: which theoretical frameworks connect AI, inclusion and teacher education; how does AI transform teachers' roles and competencies; and which ethical, technical and pedagogical challenges must be considered in Francophone Africa?

The overall objective is to propose a conceptual framework for rethinking initial and continuing teacher education in the age of AI. Four propositions guide the analysis: AI promotes inclusion only when it supports differentiated pedagogy; it reinforces the teacher's role as mediator and designer; teacher education must combine technical, pedagogical, ethical and contextual competencies; and constraints in African contexts can stimulate locally developed, resource-efficient solutions.

The study adopts a theoretical and conceptual approach. It draws on a critical synthesis of scientific studies, institutional reports and competency frameworks, particularly those of UNESCO and DigCompEdu. The analysis examines the concepts of inclusion, differentiation and educational AI, the professional competencies expected of teachers, and the conditions for context-sensitive integration. It does not rely on original empirical data; the proposed model must therefore be tested in the field.

2 THEORETICAL FOUNDATIONS: INCLUSION, DIFFERENTIATION AND AI

2.1 Inclusive education and differentiated instruction

Inclusive education, affirmed notably by the Salamanca Statement (UNESCO, 1994) and the Convention on the Rights of Persons with Disabilities (United Nations, 2006), goes beyond simply placing learners with different needs in mainstream classrooms. It seeks to transform institutions and practices so that everyone can participate in learning. Its underlying principle is that schools must adapt to learners, rather than expecting learners to adapt to schools (Plaisance et al., 2007). Learner diversity must therefore be considered in content, activities, resources and assessment methods.

Inclusion is not limited to enrolling a learner in a mainstream class. It requires institutions to examine the barriers that restrict participation, learning and a sense of belonging. This approach shifts the focus: rather than attributing all difficulties to the learner, it encourages educators to question teaching methods, resources, pace, assessment and classroom organisation. It concerns learners with disabilities, but also those experiencing temporary difficulties, those learning in a language different from the language of instruction, and those whose social or geographical circumstances limit access to educational resources.

Inclusion is consequently an institutional process as much as a classroom practice. It requires support policies, accessible resources, cooperation among teachers, families and specialist staff, and training that enables educators to identify needs without confining learners to fixed categories. AI cannot solve organisational or funding problems on its own. It may, however, help produce different versions of a document, provide clearer instructions or facilitate access to certain content, provided that outputs are checked and individual needs are considered carefully.

Differentiated instruction translates this principle into classroom practice. It involves adjusting content, learning processes, expected outputs and the learning environment according to learners' readiness, interests and needs (Tomlinson, 2004). Implementation is demanding: large classes, limited time and resources, and insufficient training

make it difficult to prepare activities adapted to different learners (Onyishi & Sefotho, 2020; Sitabkhan et al., 2022). AI can reduce some design-related tasks, but it cannot replace observation of learners or pedagogical judgement.

2.2 Educational uses of artificial intelligence

AI in education encompasses systems that analyse data, support learning, assist assessment or help teachers prepare instruction (Miao et al., 2021; Zawacki-Richter et al., 2019). Six broad categories of use can be distinguished: intelligent tutoring systems; adaptive learning environments; automated assessment; virtual assistants; predictive tools for identifying learning difficulties or risks of dropout; and generative tools that produce texts, images or other resources. Their usefulness depends on context, data quality and human validation.

These uses do not involve identical technologies or levels of risk. Some adaptive systems use responses or activity traces to adjust exercise difficulty. Other tools support literature searches, translation, transcription or resource creation. Generative systems produce texts, images, exercises or explanations in response to user instructions. Their outputs may be useful, but they can also contain errors, oversimplify concepts or present uncertain information as established fact. Training must therefore distinguish between tool functions and their specific limitations.

Responsible use begins with defining a pedagogical objective. For example, a teacher may ask an AI tool to suggest several examples of the same concept, then select those that match the curriculum, learners' level and local realities. The teacher may also request a simpler version of a difficult text, but must check that the new version preserves the essential concepts and does not distort the meaning. For learners with specific needs, AI may help adjust text length, explain vocabulary or prepare graded questions. These possibilities guarantee neither accuracy nor genuine accessibility: human review remains essential.

For teachers, AI tools may speed up lesson preparation, generate several levels of the same exercise, suggest examples, adapt texts, support translation or produce audio formats. For learners, they may facilitate access to content, provide rapid feedback and support differentiated working pace (Roll & Wylie, 2016; Miao & Holmes, 2023). These functions do not automatically guarantee better learning: outcomes depend on the pedagogical choices surrounding the technology, the quality of the resources and the support available to learners.

2.3 Personalized learning and the pedagogical triangle

AI may contribute to inclusion by adapting the presentation of content, offering additional practice, supporting different learning speeds and providing feedback. However, personalization should not be confused with fully automated instruction. A system can adjust exercises or suggest resources, but it cannot fully understand the social, emotional and cultural dimensions of a learning situation. Its recommendations must be interpreted in light of teachers' knowledge of learners and of the educational context.

Houssaye's pedagogical triangle conceptualises the relationships among teacher, learner and knowledge. The introduction of AI changes these relationships without eliminating any of the three poles. Between teacher and knowledge, AI can assist with searching for, organising and adapting content. Between learner and knowledge, it may offer alternative explanations, exercises and feedback. Between teacher and learner, it may provide information that helps the teacher identify learning needs, while also raising concerns about data protection and the risk of reducing learners to measurable indicators.

AI should therefore be understood as a mediating resource rather than an independent educational actor with responsibility for decisions. The teacher remains accountable for the learning environment, the choice of content, the interpretation of results and the quality of the relationship with learners. The central challenge is to use technological assistance without weakening human interaction, critical thinking or learner autonomy.

3 CHANGES IN TEACHERS' PROFESSIONAL ROLES AND COMPETENCIES

3.1 The changing role of the teacher in the age of AI

The integration of AI is reshaping lesson planning, resource design, assessment and the consideration of individual learning needs (Celik et al., 2022; Tan et al., 2025). It strengthens a shift from the teacher as a sole transmitter of knowledge towards a professional who designs learning environments, guides inquiry, interprets information and supports learners' development. This shift does not occur automatically, and it should not be presented as a simple replacement of traditional teaching by technology.

The teacher's role increasingly involves selecting reliable resources, formulating meaningful learning tasks, helping learners assess the credibility of information and encouraging them to explain their reasoning. When AI generates an

answer, learners need opportunities to compare it with other sources, identify errors and justify their conclusions. Teachers must also ensure that activities remain aligned with curriculum objectives and do not turn into exercises in merely accepting machine-generated responses.

This transformation requires professional judgement as well as technical familiarity. Teachers need to decide when AI adds value, when a non-digital approach is preferable and when a tool's limitations make its use inappropriate. Their professional agency must be protected: AI recommendations should inform, not dictate, pedagogical decisions. The relationship between teacher and learner remains fundamental, particularly for motivation, emotional support, classroom mediation and the development of social skills.

3.2 UNESCO's AI competency framework for teachers

UNESCO's AI competency framework for teachers provides an international reference for organising professional learning. It highlights the need to understand AI, use it in pedagogically meaningful ways, preserve human agency and develop the ability to assess the ethical implications of its use (Miao & Cukurova, 2024, 2025). Such a framework can help teacher-training institutions design learning outcomes and progression pathways.

For initial and continuing teacher education, the framework should not be treated as a checklist of applications to master. It should guide the development of a critical understanding of AI, the ability to evaluate tools and outputs, and the capacity to design learning situations that serve educational objectives. Teachers should be able to identify when generated information requires verification, when a tool may reproduce bias, and how to explain the limits of AI to learners and colleagues.

International competency frameworks need contextual adaptation. In Francophone African settings, training must address the realities of connectivity, equipment, languages of instruction, local curricula and teacher workloads. The objective is not to lower expectations, but to make them attainable and relevant. Training institutions can support this process by creating locally meaningful examples and resources, facilitating peer learning and documenting practices that work under different conditions.

3.3 DigCompEdu and teachers' digital competencies

Beyond AI-specific skills, teachers need professional digital competencies that enable them to use technologies critically and appropriately. The European Digital Competence Framework for Educators, DigCompEdu, provides a structured reference with 22 competencies across six areas: professional engagement; digital resources; teaching and learning; assessment; empowering learners; and facilitating learners' digital competence (Redecker, 2017). These areas include professional collaboration, resource selection and creation, organisation of learning activities, digital assessment, interpretation of learning data, inclusion and personalization.

DigCompEdu can complement AI-specific frameworks by ensuring that AI is not taught in isolation from wider digital pedagogy. For example, teachers who create AI-assisted resources must also understand copyright, accessibility, digital communication, formative assessment and learner empowerment. Competency development should progress from basic use to critical integration and, where appropriate, collaborative creation of resources and practices.

The combination of UNESCO's AI framework and DigCompEdu offers a useful basis for designing teacher education. However, both frameworks must be interpreted in relation to local needs. Training should focus on pedagogical problems and learning outcomes rather than technology adoption for its own sake.

3.4 Linking initial and continuing teacher education

AI changes rapidly, making one-off training insufficient. Initial teacher education should establish foundations in digital literacy, AI concepts, pedagogical integration, ethics and inclusive design. Continuing professional development should then support teachers as tools, regulations and classroom needs evolve. Effective professional learning is sustained, active and collaborative, and gives teachers opportunities to apply new knowledge to their own practice (Darling-Hammond et al., 2017).

A coherent continuum may combine face-to-face workshops, online modules, classroom-based experimentation, mentoring and professional learning communities. Trainees should analyse real teaching situations, design AI-assisted resources, test them against clear criteria and reflect on the results. This approach helps connect theoretical knowledge to practical judgement and avoids reducing training to demonstrations of software.

Teacher educators and pedagogical advisers need particular attention because they can support wider institutional change. They require time, equipment, professional development and opportunities to share experience. Training

initiatives should also recognize that some teachers may have limited connectivity or digital experience. Accessible materials, offline alternatives and differentiated training pathways are therefore essential.

4 CONTEXTUAL, ETHICAL AND PEDAGOGICAL CHALLENGES IN FRANCOPHONE AFRICA

4.1 Digital inequalities and infrastructural constraints

Unequal access to electricity, connectivity, devices and technical support can limit the educational use of AI. These differences exist between countries and regions, and also between urban and rural areas, schools and households. If AI-supported activities require continuous connectivity or personal devices, they may benefit learners who already have greater access to resources while excluding others. The result could be an expansion rather than a reduction of educational inequality.

Any adoption strategy should begin with a realistic assessment of infrastructure and costs. Institutions need to consider device availability, data prices, maintenance, technical support and the long-term sustainability of subscriptions. Low-bandwidth, offline or shared-device approaches may be more appropriate in some contexts. Technology choices should be driven by educational need and feasibility rather than by the novelty of a product.

Teacher education should also address contingency planning. Teachers need alternatives for power outages, network interruptions or platform failure. The lesson should remain pedagogically coherent even when an AI tool is unavailable. This principle protects continuity of learning and prevents dependence on a single commercial service.

4.2 Linguistic and cultural diversity

Language is central to inclusive education. In many Francophone African classrooms, learners use national or local languages at home while instruction takes place in French or another official language. AI tools may assist with translation, vocabulary explanation and the adaptation of texts, but their performance varies substantially across languages. Some languages are underrepresented in training data, which can lead to inaccurate, unnatural or culturally inappropriate outputs.

Cultural relevance is equally important. Educational examples and explanations generated by systems trained primarily on external data may reflect assumptions or experiences distant from learners' lives. Teachers should therefore examine whether generated materials represent local environments, knowledge systems and social realities appropriately. They may need to replace examples, add context, consult local sources or create resources collaboratively with colleagues and communities.

Local innovation is an important response to these limitations. Teacher-training institutions, universities, researchers and educational authorities can collaborate to develop verified multilingual resources and document culturally grounded teaching practices. Such work should respect communities' rights, obtain appropriate permissions and avoid treating local knowledge as freely extractable data. The goal is not to reject international tools, but to use them critically and strengthen local capacity.

4.3 Ethical issues: equity, transparency and data protection

AI use in education raises ethical questions that must be addressed through policy and teacher education. First, algorithmic bias may reproduce or amplify patterns of discrimination present in training data or system design. Outputs may differ according to language, gender, disability or socioeconomic background. Teachers should learn to identify such patterns, question apparently neutral recommendations and avoid using AI-generated classifications as definitive judgements about learners.

Second, transparency and explainability are important. Some systems provide limited information about how outputs are produced, making it difficult to understand why a recommendation was made. Teachers should maintain a critical stance, compare outputs with reliable sources and communicate uncertainty to learners. Professional responsibility cannot be transferred to a tool or its provider.

Third, the protection of personal data is essential. Student records, assessment results, images, disability-related information and personal conversations should not be uploaded to AI systems without a lawful basis, appropriate safeguards and clear institutional guidance. Teachers should minimise data sharing, use anonymised examples where possible and familiarize themselves with applicable rules. Institutions, in turn, must provide practical guidance rather than leaving individual teachers to manage complex risks alone.

Finally, reliance on externally controlled platforms raises questions of educational sovereignty, continuity and cost. Public institutions should assess data governance, contractual conditions, security and the possibility of changing providers. Ethical integration requires not only responsible individual behaviour but also institutional policies, procurement standards and accountability mechanisms.

4.4 The risk of dehumanization and the preservation of pedagogical relationships

Inclusive education depends on relationships, recognition and participation. Excessive reliance on automated systems may reduce opportunities for dialogue, observation and mutual understanding. A learner's difficulty cannot always be inferred from performance data; it may be connected to family circumstances, language, confidence, peer relationships or events outside school. These factors require attentive human interaction.

AI should therefore support, rather than displace, the teacher's relational work. Automated feedback may help learners practise independently, but it should be complemented by discussion, encouragement and teacher guidance. Teachers must also help learners develop autonomy and critical judgement instead of encouraging them to accept every generated answer. The educational objective is not maximum automation, but improved learning and participation.

The human-centred approach is especially important for learners who need individual support. AI-generated recommendations should not replace dialogue with learners, families or specialist staff. Inclusion requires listening to learners' experiences and giving them a role in decisions that affect their learning. Technology is valuable only when it contributes to these aims.

4.5 Risks of overdependence, misinformation and weakened critical thinking

Generative AI can produce convincing but inaccurate information, fabricated references or explanations that omit important qualifications. Learners who lack sufficient subject knowledge may find these errors difficult to detect. Teachers must therefore model verification practices, including checking claims against authoritative sources, comparing explanations and distinguishing evidence from speculation.

Overdependence can also weaken the development of writing, problem-solving and independent reasoning if learners delegate core cognitive tasks to AI. Rather than banning every use or accepting unrestricted use, educational institutions should establish clear expectations. Learners should disclose significant AI assistance where required, retain responsibility for their work and be able to explain the reasoning behind their answers. Assessment practices may include oral explanation, drafts, reflection on process and authentic tasks that reveal learning.

Teacher education should address these issues through concrete cases, not only general warnings. Trainees can compare AI-generated and verified content, identify fabricated citations, examine biased outputs and design activities that require learners to justify decisions. Such experiences can foster critical AI literacy and support responsible classroom practices.

5 A FOUR-DIMENSIONAL MODEL FOR TEACHER EDUCATION

5.1 Guiding principles

The proposed model rests on six principles: a systemic approach combining technical, pedagogical, ethical and contextual competencies; adaptation to infrastructure, languages and educational cultures; priority for inclusion and equity; active learning based on professional situations; continuity between initial and continuing education; and collaboration among peers and co-construction of resources. These principles align with research on effective professional development, which highlights active learning, cooperation and sustained support (Darling-Hammond et al., 2017).

The first principle is an inclusive purpose: each use should respond to an identified barrier to learners' participation or learning. The second is human responsibility: teachers remain decision-makers and should be able to explain their choices. The third is proportionality: the chosen tool must fit the task and should not collect more data than necessary. The fourth is contextualization: resources must reflect curricula, languages, cultural realities and available material resources. The fifth is gradual implementation: uses should be tested, discussed and evaluated before being scaled up. The sixth is collaboration: teachers, trainers, institutional leaders, families and learners should be able to contribute to rules and the improvement of practice.

5.2 The model's four dimensions

The technological and instrumental dimension concerns understanding the basic principles of AI, using generative and adaptive tools judiciously, working with platforms and recognizing their limitations. The aim is not to train technicians alone, but to prepare professionals who can select tools according to educational objectives.

Technologically, teachers should be able to understand in broad terms how tools work, distinguish major system types and identify their limitations. They should learn to write clear instructions, provide useful context without sharing sensitive information, compare outputs and document important checks. Competence should not be measured by the number of applications mastered, but by the ability to select an appropriate tool, understand what it can and cannot do, and use it judiciously. Basic training should also cover digital security and dependence on platforms.

The pedagogical and didactic dimension concerns the design of differentiated lessons, creation of accessible materials, formative assessment, use of feedback and interpretation of information to adapt teaching. It requires tools to be aligned with learning objectives and learners' actual needs.

The ethical and critical dimension focuses on identifying bias, verifying content, protecting data, preserving professional autonomy and preventing excessive dependence. It encourages teachers to question the purpose of using AI rather than assuming that every innovation is beneficial by definition.

The contextual dimension concerns adaptation to limited resources, weak or intermittent connectivity, national languages and local cultures. It encourages the production of African educational resources, community participation and the search for resource-efficient solutions. The four dimensions are interdependent and should be assessed together. Their effectiveness in improving inclusive practices remains to be established empirically.

5.3 Implementation strategies

Implementation may combine face-to-face workshops, distance-learning modules, blended training, action research and communities of practice. Workshops allow participants to test tools and discuss outputs; online courses provide flexibility but require a minimum level of connectivity; action research enables teachers to test uses in their classrooms, document results and adjust their practices. Communities of practice support resource sharing and collective analysis of difficulties.

A training sequence could begin with a real teaching situation: a difficult text, a class with varied learning levels or a learner who cannot access a particular resource. Participants first define the objective and the needs, then use an AI tool to generate several possible resources. They check accuracy, linguistic appropriateness, accessibility and potential risks before testing the resource or simulating its use. Finally, they document necessary adjustments and discuss the results. This approach places the pedagogical problem before the technology and makes verification a mandatory step.

Priority should be given to training teacher educators and pedagogical advisers, who can then support teachers. Institutions should provide sustained support, clear rules for use and regular opportunities for exchange. Evaluation should measure not only ease of use, but also the contribution of tools to learning, participation and equity.

5.4 Recommendations for education policy

Seven policy directions can be identified:

- Revise initial teacher-education curricula to include modules on AI in education.
- Offer certified continuing professional development compatible with teachers' professional constraints.
- Prioritize equipment for teacher-training colleges and centers, including offline solutions.
- Train teacher educators before scaling up programs.
- Adopt rules governing ethical use, data protection and accountability.
- Fund research on AI's effects on learning, inclusion and equity, and support local innovation.
- Strengthen cooperation among Francophone African countries to share resources and experience.

These recommendations should be implemented through a gradual roadmap. First, authorities and institutions can assess equipment, connectivity, available competencies and priority needs. Second, training modules and pilot initiatives can be conducted in volunteer institutions, with evaluation criteria defined from the outset. Third, lessons from these pilots can inform curricula, rules for use and equipment needs. Finally, large-scale implementation should depend on observed outcomes, recurring costs and the capacity to ensure equitable access.

The feasibility of these recommendations must be assessed in light of available resources, institutional capacity and national priorities. Rapid generalization without appropriate support could widen the gaps that AI is intended to reduce.

6 CONCLUSION

This theoretical analysis shows that AI can support inclusive education by facilitating differentiated instruction, improving access to resources and providing feedback. These possibilities do not materialize automatically: they require sound teacher education, human validation of content and policies that address inequalities of access. The teaching profession is evolving towards the design of learning environments, critical interpretation of data, relational support and ethical oversight.

The four propositions outlined in the introduction receive conceptual support, but not definitive empirical validation. AI appears to be a potential means of differentiation when integrated into learner-centred pedagogy. It changes some aspects of the teacher's role without making professional expertise redundant. The most relevant training combines technological, pedagogical, ethical and contextual dimensions rather than reducing learning to tool proficiency. Finally, constraints in African contexts call for resource-conscious choices, cooperation and local innovation rather than uniform adoption of solutions designed elsewhere.

The proposed model brings together four complementary dimensions: technological, pedagogical, ethical and contextual. It calls for international frameworks to be adapted to African realities, particularly connectivity constraints, linguistic diversity and the need to preserve local knowledge. Education policies should invest in initial and continuing teacher education, equipment, data protection, research and regional cooperation.

The main limitation of this work is its exclusively theoretical nature: the propositions and model have not been validated through original empirical data. Case studies, participatory action research and comparative evaluations are therefore needed to measure their effects on teaching practices and learning. The aim is not to replace teachers with AI, but to make AI a critical and context-sensitive tool in support of learner autonomy and more inclusive education.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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The authors declare no conflicts of interest regarding this manuscript.

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