

Ubuntu-Èkò framework: A four-pillared critical-cultural-contextual-communal model for cultivating, educating and enhancing an AI-ready African workforce

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ABSTRACT

The rapid advancement of Artificial Intelligence (AI) presents a profound colonial paradox for the African continent. While offering transformative potential for education, the uncritical adoption of AI systems built on Western, individualistic definitions of intelligence risks perpetuating digital colonialism and enabling deep epistemological capture. This conceptual and theoretical manuscript argues that preparing Africa for an AI-driven future requires a fundamental paradigm shift: from the reactive pursuit of “workforce readiness” to the proactive establishment of **Digital Sovereignty**. We deconstruct the dominant, functionalist definitions of AI and propose a new, decolonized conceptualization: **AI as Augmented Collective Wisdom (ACW)**. This reconceptualization, grounded in select African epistemologies, reframes AI as a socio-technical vehicle, encapsulated by the Yoruba proverb “*òwè lẹ́sìn ọ̀rọ̀*” (a proverb is the horse of words), designed to carry, clarify, and enhance a community’s collective wisdom and ethical fabric.

To operationalize this, we introduce a novel theoretical lens: the **Ubuntu-Èkò Framework for AI Workforce Readiness**. This model synthesizes the communal, relational ethics of Southern African Ubuntu (“I am because we are”) with the West African Yoruba educational philosophy of Èkò (Education), which redefines the goal of education as the cultivation of the Ọmọlúàbí – an individual of impeccable character, ethical grounding, and communal responsibility. Built on four interconnected pillars: *Critical Consciousness*, *Cultural Grounding*, *Contextual Responsiveness*, and *Communal Capability Enhancement*, the framework critically assesses the African educational ecosystem across K–12, Technical and Vocational Education and Training (TVET), and Higher Education sectors.

A key novel contribution is the Èkò-Ọmọlúàbí Procedural Framework, a three-layered procedural template that systematically translates Yoruba moral and educational philosophy into a structured architecture for ethical AI governance, establishing *Ìwà Rere* (good character) as the foundational design constraint, the Èkò holistic learning cycle (*Ìmò-Ọ̀yẹ-Ọ̀gbọ̀n*) as the implementation process, and Ọmọlúàbí as the terminal goal for both AI systems and their users. Drawing primarily on a structured synthesis of extant literature, policy documents, and philosophical analysis, the manuscript proposes a holistic competency model that prioritizes ethical character, critical agency, and collaborative problem-solving over purely technical skills.

This paper offers actionable recommendations for policymakers, educators, and researchers to build an equitable, sovereign, and sustainable AI future. Its central contribution is a fundamental re-theorization of AI through indigenous philosophies, offering a blueprint for aligning technological innovation with communal values. The model further lays the groundwork for novel, culturally grounded assessment paradigms, such as

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gbígbo èjọ (Yoruba restorative justice) scenario analysis, that prioritize collective accountability and communal well-being over individual performance metrics. As a conceptual framework, the Ubuntu-Èkọ Framework is presented as a foundational and guiding model whose effectiveness warrants future empirical validation across diverse African contexts.

1. Introduction: from AI readiness to digital sovereignty

1.1. The Colonial Paradox of Artificial Intelligence in Africa

Artificial Intelligence (AI), particularly generative models such as ChatGPT, is globally reshaping economies, labor markets, and human interactions, marking a significant inflection point with profound consequences [1–3]. For the African continent, this technological wave is not merely a force of transformation but a critical juncture that presents what we term the colonial paradox of AI. The “colonial paradox of AI” implies a tool that is positioned as one for development, inclusion, and global utility, yet its underlying infrastructure (compute, chips, cloud platforms) and governance (standards, platform policies, and control of key models) are concentrated within a few developed nations and resourced corporations. On one hand, AI offers significant potential to “enhance educational equity” [4] for developing universally contextualized learning experiences for all by implementing education for sustainable development-related activities, maximizing the opportunities and reducing the associated challenges relating to these experiences and their implementations, a key component of Sustainable Development Goal 4 (SDG 4) - Quality Education [5–8], personalize instruction, and create novel solutions to deeply entrenched challenges in agriculture, health, and governance [9–11]. On the other hand, this potential is constrained by the very structures it promises to overcome: significant infrastructural deficits including limited connectivity and energy access [12], which might create a persistent digital divide [3] that may threaten to undermine progress on SDG 10 (Reduced Inequalities) [5, 13] by ensuring that access to these new tools remains “highly inequitable” [8]. Furthermore, inherent challenges within AI, including factual accuracy concerns (hallucinations), bias embedded in training data, and the inherent opacity (“Black Box Conundrum”) of its reasoning processes, pose significant risks when deployed without critical oversight [3,7].

This duality of challenge and the potential in Africa, its youthful demographic [14] and its proven capacity for “leapfrogging” [15], creates an illusion. A narrow focus on overcoming technical deficits to adopt foreign-built AI systems, often pushed as a universal solution, merely accelerates a new form of digital colonialism [16], reflecting the dangers of applying “one-size-fits-all” development frameworks to diverse local contexts [17]. The rapid evolution of AI from passive tools towards proactive, agentic systems capable of autonomous planning and execution may magnify this risk globally [3]. For Africa, passively adopting these increasingly autonomous systems means importing tools embedded with alien ideologies, philosophies, and worldviews, leading to a profound epistemological capture rather than genuine technological empowerment. The true “point of no return” is not just economic marginalization [18], it is becoming a consumer of AI shaped by external values, further leading to dependency.

We argue for a fundamental shift in the discourse: *from AI readiness to Digital Sovereignty*. This imperative is critical because education (SDG 4) is not just an isolated goal but a fundamental enabler for achieving nearly all other SDGs ([8,19,20]). Achieving digital sovereignty requires more than policy; it mandates a technical and pedagogical overhaul in computing and engineering education, and a careful and thoughtful integration with indigenous knowledge systems of the society. This will enable Africans to locally design, deploy, govern, and audit her own AI systems that manages her own data and future, deliberately crafted based on her own unique intellectual traditions, data structures and algorithms which are deeply entrenched within the fabrics of her

culture, soundness of her ethics and logics of her way of thinking, ultimately ensuring an “Ethical-Technical Co-evolution” [3] where innovations and inventions align with local values.

This process necessitates integrating Indigenous Knowledge Systems (IKS) into curriculum design as a methodology for decentralized, context-aware innovation, moving beyond mere documentation [21–23], a role that Higher Education Institutions are uniquely positioned to lead [24] in communal-cultural-ethical synergy with other relevant community stakeholders.

1.2. The Colonial Gaze: Deconstructing Western vs. African Conceptualizations of AI

This paper argues that the very definition of artificial intelligence, as commonly understood, is decontextualized and antithetical to African philosophies. Therefore, any attempt to prepare for “AI workforce readiness” without first deconstructing this colonial gaze and re-grounding the entire endeavor in African epistemologies risks propagating misaligned philosophies to African culture, values, ethics, and communality. Such an approach will only perpetuate the colonial paradox by training a technically proficient workforce that serves a foreign paradigm.

The dominant Euro-American conceptualization of AI is functionalist and individualistic, defining intelligence by a system’s ability to perceive, reason, and act to “maximize its chance of successfully achieving its goals” [25]. The ethical frameworks developed to constrain this model, while crucial, are often reactive and similarly rooted in Western liberal traditions. When this definition is uncritically adopted within the African context, it risks imposing a “one-size-fits-all” framework that ignores diverse local realities [17], producing a workforce trained to build and serve systems reflecting foreign priorities rather than local needs.

This is a critical risk, as dominant AI models predominantly trained on Western data can “perpetuate discrimination, stereotypes and bias” [26], threatening “cultural and linguistic diversity” and leading to “cultural homogenization” and “epistemic exclusion” ([26]. This approach ultimately undermines progress on key SDGs, particularly SDG 4 and SDG 10 [8,13,24,27], running counter to the vision of “The Africa We Want” outlined in Agenda 2063 [28].

What is missing in existing AI workforce readiness frameworks, and why are dominant models insufficient for African contexts? Existing frameworks, including the AI Talent Readiness Index for Africa [29], the UNESCO AI Competency Framework [30], and micro-level technology adoption models such as Unified Theory of Acceptance and Use of Technology (UTAUT) [31], provide useful structural and diagnostic tools for understanding AI adoption. However, they share three critical deficiencies when applied to African contexts. *First*, they are *epistemologically monocultural*: their definitions of “intelligence,” “competence,” and “readiness” are rooted in Western, individualistic paradigms that privilege task-oriented rationality and market-driven human capital, systematically excluding communal, relational, and character-based conceptions of knowledge including ones central to African philosophies [23,32]. *Second*, they are *contextually agnostic*: they assume universally available infrastructure, institutional capacity, and data ecosystems, failing to account for the continent’s diverse socio-economic realities, multilingual landscapes, and the persistent digital divide [8,12]. *Third*, they are *ethically reactive*: their ethical components are typically appended as constraints on pre-existing technical systems rather than being generatively embedded as foundational

design principles drawn from local value systems [23,33]. Together, these deficiencies mean that dominant frameworks risk producing technically skilled but philosophically unmoored graduates who serve foreign paradigms rather than African communities.

This manuscript challenges the dominant functionalist definition as insufficient and philosophically misaligned. Drawing from the continent's rich epistemological foundations, we propose a new conceptualization: **AI as Augmented Collective Wisdom (ACW)**. This framework reframes AI not as an artificial general intelligence to be built, but as an intelligent socio-cultural-technical system designed to enhance and sustain the collective wisdom, cultural integrity, and ethical fabric of a community. This aligns with the global call for a "human-centered approach" to AI ([26,27]) that protects "human agency" and "indigenous knowledge and cultures" [26]. Its implementation in African classrooms, the key sites for workforce preparation and the fulcrum for achieving SDG 4 ([8,19]), must explicitly counter the allocative harms and inequitable access caused by Western context-agnostic models [34, 35]. This requires drawing on students' lived experiences and the indigenous epistemologies established earlier to foster collaborative problem-solving and digital innovation, ensuring AI contributes to "inclusion and equity" [27] and empowering the continent's youthful population to actively participate in shaping its future [35].

This perspective is articulated through the Yoruba proverb, "òwè leşin ọrọ, ọrọ leşin òwè" (a proverb is the horse of words, and words are the horse of proverbs) [36]. A Western-centric view might see AI as the source of words itself, an oracle generating truth *ex nihilo*. The African-centric view of AI as ACW, informed by this proverb, frames AI as the *ẹşin* (the horse or vehicle). Its primary purpose is not only to be intelligent, but critically, to carry, clarify, and contextualize human wisdom, ethics, and cultural nuance. As the proverb further connotes, "tí ọrọ bá sọnu, òwè lá fí nwa" (when words are lost, we use proverbs to find them), suggesting AI's role should be to restore meaning within a specific cultural context, rather than imposing a universalist and often biased worldview. This reconceptualization is a necessary act of decolonization.

1.3. Beyond Skills: Re-envisioning Workforce Readiness as the Cultivation of *Ọmọlúàbí*

The reconceptualization of AI as ACW necessitates a radical re-envisioning of "AI workforce readiness." The dominant paradigm, reflected in metrics like the AI Talent Readiness Index for Africa [29], conceptualizes readiness through a human capital lens: "develop, retain, and deploy AI talent" based on digital skills and infrastructure. While this may be a useful diagnostic for competing within the current global system [37], it fails to measure what truly matters for a sovereign and just African future, often ignoring the human-centered, ethical, and sustainable dimensions required for development ([24,26,27]).

The true goal of AI education in Africa is not only the production of skilled graduates but ultimately the cultivation of *Ọmọlúàbí*, a person of impeccable character and communal responsibility. As articulated in Yoruba philosophy, *Ẹkọ* (Education) is not merely the acquisition of knowledge (*ìmọ*), wisdom (*ọgbón*), or understanding (*oyé*), but their manifest embodiment in a person of impeccable character and communal responsibility [38–44]. As explained in Odejobi [45], *Ẹkọ* is a derivative of two syllables: "È" and "kọ". The first syllable serves as a qualifier to the second, which can mean either 'teach', 'build', or 'to hang on a hook'. Education is thus conceived as "subsuming the building of human character and tending it to hang properly to work in harmony with societal needs and norms". The *Ọmọlúàbí* is the epitome of sterling elegance and good taste, the ultimate aim of education for every individual within the societal ecosystem.

Therefore, an AI-ready individual is not one who can merely code or prompt an AI. An AI-ready individual is an *Ọmọlúàbí* who:

1. Possesses the **agency to deconstruct** the power dynamics and biases embedded in AI systems, moving beyond technical skills to master AI ethics and values [26,27].
2. Is **grounded in their own epistemologies** such that they can build and steward AI in a way that affirms indigenous knowledge and protects cultural and linguistic diversity [26].
3. Is **able to apply AI to solve pressing local problems** rather than implementing inappropriate "one-size-fits-all" solutions [17].
4. **Dedicates their skills for the well-being of the collective** [24], recognizing education as a key enabler for all other Sustainable Development Goals [20].

This redefines readiness from a state of passive consumption to one of active, ethical, and creative agency [46], ensuring human agency [26] and autonomy [33] are enhanced, not supplanted, by technology. This radical re-envisioning mandates an overhaul of educational assessment methodologies, shifting focus from standardized individual performance metrics to measuring a student's ethical acumen [27] and demonstrable contribution to communal problem-solving [38,39,47].

1.4. Intended Audience and Scope

This manuscript is primarily intended for scholars, policymakers, curriculum designers, and educators working at the intersection of AI, education, and sustainable development in Africa and the Global South. It is also directed toward international development practitioners, EdTech innovators, and researchers in decolonial studies, philosophy of education, and science and technology studies (STS) who seek culturally grounded alternatives to dominant AI adoption paradigms. The scope encompasses conceptual and theoretical analysis; empirical validation of the proposed framework is delineated as a critical direction for future research.

1.5. Positionality Statement

The authors of this paper include graduate students, postdoctoral research associates, and professors currently working mostly within U.S. institutions. One of the co-authors currently resides on the African continent. All authors have experienced educational systems in both African and Western contexts and are aware of the differing, as well as overlapping, educational philosophies and cultural contexts that influence and shape learning in these environments. As a team of AI researchers, machine learning experts, and culturally grounded pedagogical frameworks specialists originally from West Africa, we draw on educational experiences in both Africa and the United States. To ensure that our perspectives reflect broader African educational experiences, we validated our stance through engagement with participants representing all regions of Africa. Our combined expertise in engineering, education, artificial intelligence, pedagogy, and the philosophy of education informs our understanding and conceptual framing throughout this work.

1.6. Objectives of this Manuscript

Grounded in this philosophical re-envisioning, the objectives of this paper are:

Objective 1: Deconstruct Dominant AI Paradigms (addressed primarily in Sections 1.6 and 3): To deconstruct the dominant, Euro-American conceptualizations of AI and "workforce readiness," identifying forms of digital colonialism within its conceptualization that are epistemologically misaligned with African contexts.

Objective 2: Propose the Ubuntu-Ẹkọ Framework (addressed primarily in Sections 2 and 3): To propose a new theoretical lens, the Ubuntu-Ẹkọ Framework for AI Workforce Readiness, which redefines AI as Augmented Collective Wisdom (ACW) and re-centers the goal

of education on the cultivation of *Ọmọlúàbí*, thereby establishing culturally resonant metrics for assessing competence in AI ethics and communal contribution.

Objective 3: Operationalize Through Critical Analysis (addressed primarily in Sections 5, 6, and 7): To operationalize this framework by critically analyzing the current African educational landscape and educator preparedness, identifying gaps and opportunities as measured against its four pillars.

Objective 4: Prescribe Actionable Strategies (addressed primarily in Sections 8, 9, and 10): To prescribe actionable, culturally-grounded strategies for policy, pedagogy, and research that can build a just, sovereign, and sustainable AI future for the continent, including the fundamental integration of Ubuntu and *Èkọ* principles into core computing and engineering education curricula and capstone project assessments. This structural integration is crucial for ensuring epistemic justice by transforming curricula from conduits of foreign knowledge into platforms for co-creation rooted in African philosophical traditions [35,48].

1.7. Distinguishing the Manuscript's Layers of Contribution

To enhance clarity regarding the nature and scope of this manuscript's contributions, we explicitly distinguish among three interconnected but analytically separable layers:

- (a) **Normative Commitments:** The manuscript is grounded in explicit normative commitments to digital sovereignty, epistemic decolonization, and the ethical primacy of communal well-being. These commitments are not presented as neutral observations but as principled positions from which we critically engage with dominant AI paradigms. We assert that AI systems deployed in African contexts must be accountable to African values, and that education must cultivate ethical character (*Ọmọlúàbí*) alongside technical competence.
- (b) **Theoretical Contributions:** The manuscript advances theory in three principal ways.

First, it introduces the novel reconceptualization of AI as Augmented Collective Wisdom, grounding intelligence in communal rather than individualistic terms. This reconceptualization is not merely philosophical but educationally and technologically consequential, as it redefines the design principles, governance structures, and assessment criteria for AI systems.

Second, the Ubuntu-Èkọ Framework itself constitutes a new

theoretical model that synthesizes Ubuntu philosophy, Yoruba educational philosophy (*Èkọ*), situated cognition theory, community cultural wealth theory, and critical consciousness theory into an integrated, four-pillared framework for workforce readiness.

Additionally, the manuscript's theoretical architecture rests on two original contributions: (1) the Pan-African Philosophical Foundation (Fig. 1), which establishes the isomorphic convergence between Ubuntu communal personhood and Yoruba collective strength as the ontological common ground for ethical AI; and (2) the *Èkọ-Ọmọlúàbí* Procedural Framework (Section 3.2.4, Fig. 2), which provides a three-layered procedural template for translating this philosophical foundation into implementable AI system design and governance.

Third, the manuscript refines existing technology adoption models (e.g., UTAUT) by asserting that cultural philosophies, power dynamics, and epistemic justice are primary, not peripheral, factors influencing AI adoption.

- (c) **Analytical Contributions:** The manuscript provides a structured critical analysis of the African educational ecosystem, spanning K–12, TVET, and higher education, through the lens of the four framework pillars. This analysis identifies specific gaps (e.g., the absence of localized AI curricula, educator readiness deficits, infrastructure inequities) and opportunities (e.g., the potential for IKS integration, community-based innovation ecosystems, project-based learning) that are obscured by universalist diagnostic tools. The analysis also extends to educator readiness and multi-stakeholder policy recommendations.

2. Methodological Positioning and Approach

Before presenting the theoretical foundations of the Ubuntu-Èkọ Framework, it is important to articulate the methodological orientation that underpins this work. This transparency is essential for enabling readers to assess the analytic basis of our claims and the boundaries of our framework.

2.1. Nature of the Inquiry

This manuscript is **conceptual and theoretical in nature**. Thus, it does not report empirical data, statistical analyses, sampling procedures, or quantitative outcomes. Instead, it advances a novel theoretical framework through structured philosophical argumentation, critical

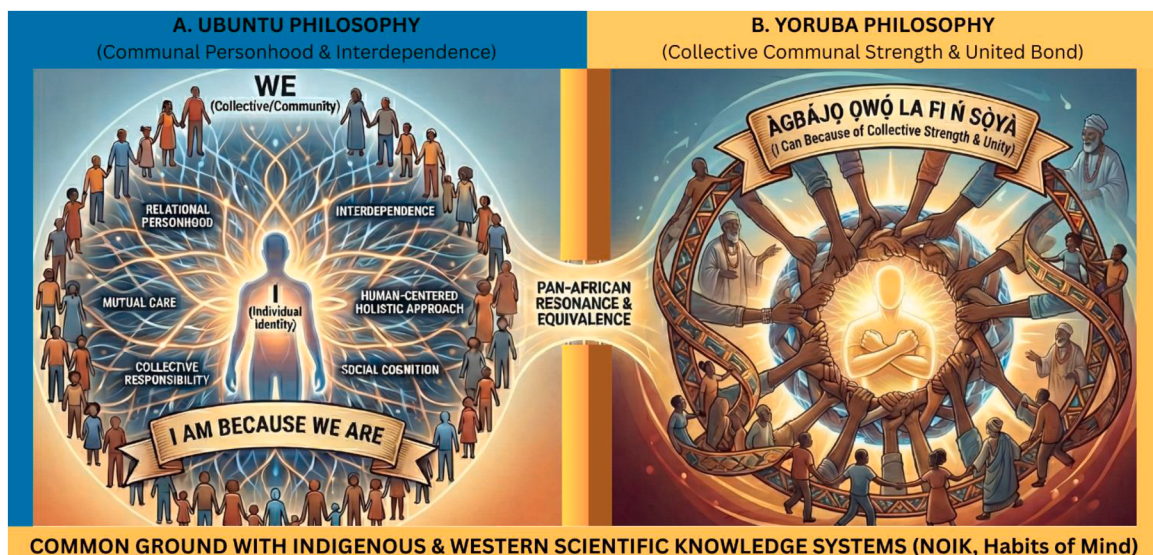


Fig. 1. Pan-African Philosophical Foundations: Ubuntu Philosophy as Communal Being and Yoruba Philosophy as Communal Agency.

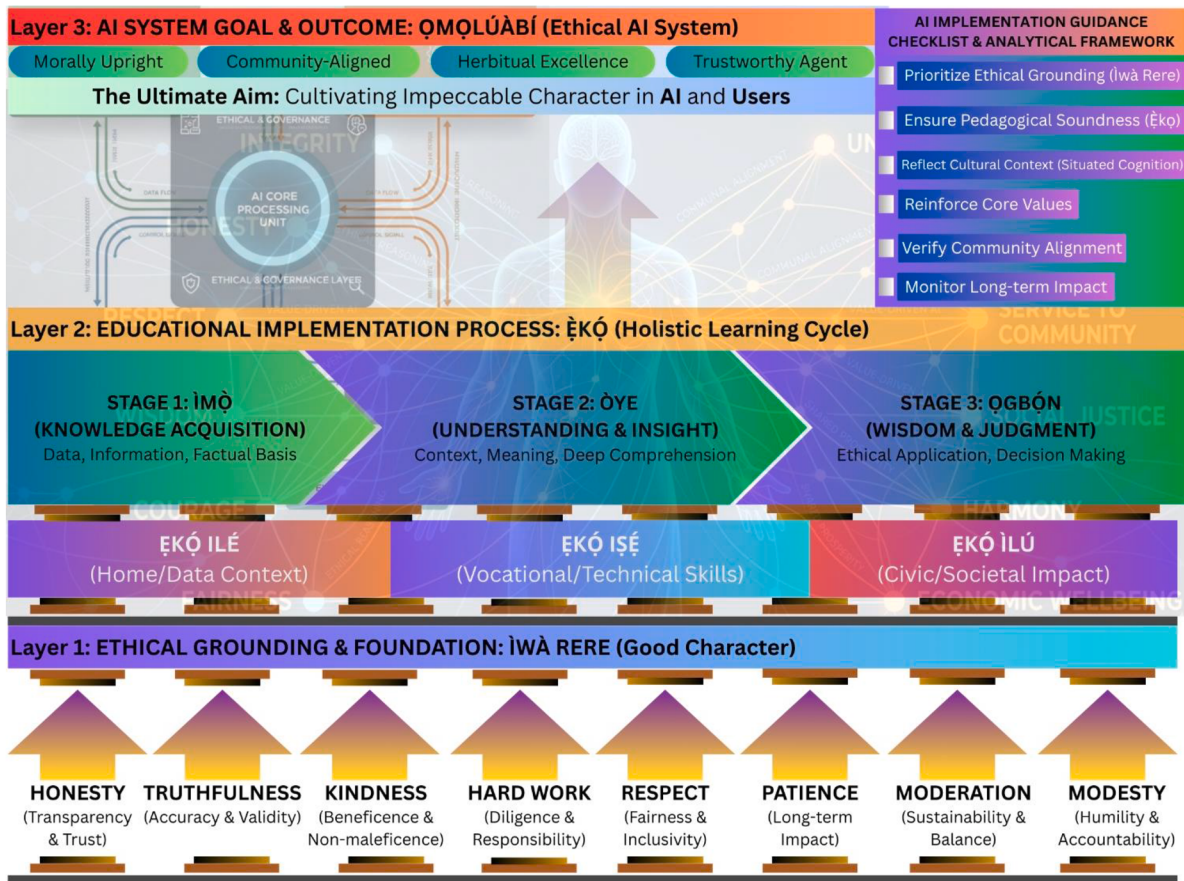


Fig. 2. The Yoruba philosophical concept of Ẹkọ (Education) and its ultimate goal - Ọmọlúàbí fused together to produce the Ẹkọ-Ọmọlúàbí Procedural Framework for Ethical AI in Education: grounding, guidance, and implementation.

synthesis of extant literature, and integrative theoretical analysis. Conceptual manuscripts of this nature serve a distinct and vital function in the scholarly ecosystem: they provide the foundational models, definitions, and analytical categories that subsequent empirical research operationalizes and tests [49]. The Ubuntu-Ẹkọ Framework is therefore presented as a *foundational and guiding model*, a theoretically robust starting point whose practical effectiveness warrants systematic empirical validation in future studies.

2.2. Analytic Basis and Sources of Evidence

The claims advanced in this manuscript are derived from three complementary analytic strategies:

- (i) **Structured Literature Synthesis:** We conducted a comprehensive review of peer-reviewed scholarship, policy documents, and institutional reports spanning AI ethics, African philosophy, decolonial theory, situated cognition, culturally relevant education, community cultural wealth theory, and critical consciousness studies. This synthesis identified both the strengths and the critical gaps in existing AI workforce readiness frameworks when applied to African contexts.
- (ii) **Policy Analysis:** We systematically examined continental and national AI strategies (e.g., the African Union's Continental AI Strategy, UNESCO's AI Competency Frameworks, national digital literacy initiatives) to assess their alignment with, or deviation from, the epistemological and ethical commitments of African philosophical traditions.
- (iii) **Philosophical and Theoretical Integration:** Drawing on established traditions in African philosophy (Ubuntu, Ẹkọ, and

the Ọmọlúàbí ideal), we engaged in integrative theoretical work to synthesize these indigenous epistemologies with global frameworks in situated cognition [50,51], critical consciousness [52,53], community cultural wealth [54], and the capability approach [55]. This synthesis produced the four-pillared Ubuntu-Ẹkọ Framework as an original theoretical contribution.

2.3. Relationship to Existing Methodological Traditions

This work draws on the tradition of *conceptual analysis* in education and philosophy [49], which involves the careful explication of concepts, the identification of logical relationships among them, and the construction of integrative frameworks that advance understanding. It also aligns with the tradition of *decolonizing methodologies* [56], which foregrounds indigenous epistemologies and challenges the hegemony of Western research paradigms. By grounding our analysis in African philosophical traditions and validating our perspectives through casual engagement and interaction with individuals across all regions of Africa within a few of the authors network, we seek to enact, not merely advocate for, epistemic justice in the research process itself.

3. Forging an African-centric Theoretical Lens for Artificial Intelligence

Having established the methodological basis for our inquiry, this section now turns to the substantive theoretical work of constructing an African-centric lens for AI. We first examine why existing global frameworks, while valuable, are insufficient for African contexts, and then develop the philosophical foundations, Ubuntu and Ẹkọ, upon which the Ubuntu-Ẹkọ Framework is built.

3.1. The Universalist Trap: Necessary but Insufficient Global Frameworks

To advance this new paradigm, we must first engage with existing global models, recognizing them as necessary but insufficient. Conceptual frameworks like the UNESCO AI Competency Frameworks are vital, providing a comprehensive structure for skills and ethics ([9,11,27,30]). Similarly, micro-level models like the Unified Theory of Acceptance and Use of Technology UTAUT [31] offer insights into adoption dynamics, highlighting factors like performance expectancy and facilitating conditions [37]. However, these frameworks present a “universalist trap,” often ignoring the critical role of context in cognition and learning [51, 57].

Their inherent flaw is exemplified by concepts like “Human-Centric AI,” which, despite its positive intent, often fails to address the critical question of which humans are centered in the design process, thereby perpetuating the exclusion of underrepresented groups [58,59]. Their implementation in Africa requires more than mere “adaptation” [14]; it requires a fundamental decolonization and re-grounding. Situated cognition theory posits that “all knowledge is, to some degree, situated” within specific activities, contexts, and cultures [51], and that cognition is deeply social, “distributed across the environment and other people” [60]. This means the “facilitating conditions” of UTAUT in Africa are not just about institutional support; they are deeply intertwined with systemic infrastructural barriers [12], economic inequality, and, most importantly, *epistemological alignment* [4]. A tool may be “easy to use” but simultaneously perpetuate a worldview that is culturally dissonant, thereby failing a more profound test of “facilitating” and ignoring the importance of “cultural fluency” in meaning-making [61].

Therefore, implementing global frameworks without addressing underlying epistemological dissonance risks rendering the technology itself unfit to the local context, leading to limited adoption and sustained dependency on foreign paradigms ([16,26,48]). These global frameworks provide the “*what*,” but they lack the “*why*” and “*how*” that are deeply rooted in the continent’s own intellectual traditions [27]. A fundamental requirement, especially in technical fields, is developing culturally relevant education that links engineering principles to students’ lived experiences and local contexts [62].

3.2. The Ubuntu-Èkò Foundation: Anchoring AI in African Epistemologies

True digital sovereignty must be anchored in the continent’s rich and diverse epistemological traditions. This is not only an act of cultural preservation but a strategic imperative for epistemic justice, cultural relevance, ethical alignment, and co-constructed and shared communal intelligence embedded within artificial intelligence. Our framework is built upon the synthesis of two strong philosophical foundations, Ubuntu and Èkò, and the integration of Indigenous Knowledge Systems as a living logic for innovation.

The pan-African philosophical convergence between these traditions consolidates the Ubuntu principle of communal personhood (“I Am Because We Are”) with the Yoruba philosophical equivalence of communal agency “*àgbáj’òwó la fi ñ sọyà*” (“I Can Because of Collective Strength & Unity”).

3.2.1. Indigenous Knowledge Systems (IKS) as a Living Logic for AI

The integration of IKS with AI moves beyond using AI to merely document at-risk oral traditions [9,11]. This move is rooted in the principle of situated cognition, which holds that knowledge and learning are fundamentally inseparable from their specific cultural and social context [50,51]. It involves embedding IKS as a *living logic* for AI problem-solving. By incorporating indigenous scientific concepts [21, 22] and valuable knowledge bases [63] into AI design, we create systems that are context-aware, culturally coherent, and epistemologically pluralistic, directly countering the “allocative harms” [34,35] and algorithmic bias that results in “cultural homogenization” [26].

Furthermore, computing and engineering education curricula within

the continent must integrate IKS methodologies not just as content, but as alternative algorithms for decentralization and resilience, challenging conventional Western computational paradigms. This integration is crucial because it activates the students’ “cultural frames” for meaning-making, directly supporting the efficacy of Culturally Relevant Engineering Education (CREE) [62]. This commitment is crucial for making the curriculum culturally appropriate [63] and for enhancing student engagement and academic performance [64]. Engaging African youth as co-developers of this synthesis ensures the cultivation of a workforce equipped with both technological fluency and cultural intelligence. For example, studies have provided evidence that the integration of IKS directly into curriculum improves academic performance in technical subjects like Physics [64] and fosters critical thinking [64], underscoring the pragmatic, not merely symbolic, value of this integration.

3.2.2. Pan-African Philosophical Convergence: Integrating Ubuntu and Yoruba Epistemologies for Ethical AI

The first philosophical pillar of our framework is the Southern African Bantu’s philosophy of Ubuntu. Often summarized as “*I am because we are*” [32], Ubuntu provides the foundational communal-ethical imperative for the framework. It is a “philosophy of being” that moves beyond individualistic paradigms, locating identity and meaning-making within a collective approach [32]. This perspective aligns with psychological theories suggesting that human cognition is socially situated, emphasizing the emergent outcome of dynamic interaction between an agent and the environment, which is always social [60,65].

Ubuntu emphasizes a “human-centered and holistic approach” [32] built on human connections, interdependency, mutual care, community well-being, and collective responsibility. The core belief aligns closely with the Nature of Indigenous Knowledge (NOIK), which emphasizes the holistic and functional aspects of knowledge rooted in a community’s cultural matrix [66–68]. Ubuntu values like perseverance and respect overlap with the “Habits of Mind” recognized as common ground between Indigenous and Western scientific knowledge systems [66]. A “holistic Ubuntu AI ethics approach” [23] therefore serves as a “paradigmatic alternative” to purely market-driven or mechanistic models [32].

Fig. 1 consolidate the visualization of Ubuntu and Yoruba communal philosophies for ethical AI. This figure integrates the Ubuntu principle of relational personhood (“*I Am Because We Are*” Panel A) and its Yoruba equivalent emphasizing collective strength and unity (“*àgbáj’òwó la fi ñ sọyà*”, Panel B). It illustrates how these distinct, but resonating traditions provide a unified, holistic foundation for ethically grounded AI that prioritizes social harmony, collective capacity, and cultural specificity, moving beyond individualistic models.

This integrated figure presents the dual philosophical pillars underpinning the Ubuntu-Èkò Framework. **Panel A** depicts the Ubuntu philosophy of communal personhood and interdependence, centered on the foundational axiom “*I Am Because We Are*” [32]. Six constitutive dimensions radiate from the individual embedded within the collective: *Relational Personhood* (identity constituted through communal bonds), *Interdependence* (mutual reliance as an ontological condition), *Human-Centered Holistic Approach* (technology in service of human flourishing), *Social Cognition* (knowledge as socially situated and collectively constructed [60,65]), *Collective Responsibility* (shared accountability for communal outcomes), and *Mutual Care* (reciprocal obligation as the basis of ethical life). **Panel B** presents the Yoruba philosophical equivalence through the proverb “*àgbáj’òwó la fi ñ sọyà*”, literally translated as “*the conglomeration of hands brought and joined together in solidarity enables one to beat the chest with confidence to accomplish any task*”. We establish the literal translation of this proverb as the translated equivalent philosophical axiom “*I Can Because of Collective Strength & Unity*”, the Yoruba counterpart to Ubuntu’s “*I Am Because We are*.”

Panel B depicts the collective strength and united bond that emerges when communal action is guided by shared ethical purpose, by the

collective, often unwritten, communal-cultural-ethical traditional mandate and rules passed down through generations by sage members of the society who commit their willing and unrestrained support to uphold these traditions and rules for the growth and development of the individual for the collective good of the society. The *Pan-African Resonance & Equivalence* bridge connecting both panels demonstrates the philosophical convergence between Southern and West African epistemologies, showing that Ubuntu's philosophy of communal personhood and Yoruba's philosophy of communal collective solidarity are not merely parallel but isomorphic philosophical traditions. The *Common Ground* foundation identifies the intersection with Indigenous and Western scientific knowledge systems through the Nature of Indigenous Knowledge (NOIK) and the "Habits of Mind" recognized as shared epistemic values [66,67].

Furthermore, this consolidated visualization (Fig. 1) serves a critical analytical function by making explicit the pan-African philosophical convergence that undergirds the Ubuntu-Èkò Framework. By juxtaposing Ubuntu's "I Am Because We Are" (Panel A) with the Yoruba's axiom "I Can Because of Collective Strength & Unity" (Panel B), the figure demonstrates and emphasizes that these are not merely parallel but isomorphic philosophical traditions: both locate human identity, ethical obligation, and the production of knowledge within the collective rather than the individual. Where Ubuntu establishes communal *being*, the ontological claim that personhood is relationally constituted, the Yoruba proverb establishes communal *agency*, the pragmatic claim that individual capability and confidence are products of collective solidarity.

Together, they form a complete individual-community philosophical architecture: one cannot *be* without the community (Ubuntu), and one cannot *do* without the community (Yoruba proverb). The six Ubuntu dimensions depicted in Panel A: Relational Personhood, Interdependence, Human-Centered Holistic Approach, Social Cognition, Collective Responsibility, and Mutual Care, find their operational expression in the Yoruba proverb that anchors Panel B, where "àgbájò ọwọ" (literally translated *the conglomeration of hands*) signifies not merely cooperation but the ontological unity from which individual agency derives its meaning and legitimacy. Critically, this communal collective solidarity is sustained by an intergenerational communal-cultural-ethical mandate, the often-unwritten traditional rules, values and principles passed down and upheld by sage community members for the growth, guidance and development of the individual members of the community and for the collective good and overall benefit of the society. The *Common Ground* foundation further demonstrates that these African epistemologies share substantive epistemic values, particularly through the Nature of Indigenous Knowledge (NOIK) and the "Habits of Mind" framework, with Western scientific knowledge systems [66,67], providing the philosophical warrant for the framework's claim that African epistemologies can serve as the foundational architecture, not merely supplementary perspectives, for ethical AI governance in education.

The Ubuntu ethic mandates that technological advancement must demonstrably contribute to social harmony and collective capacity, ensuring that AI systems are judged not by their efficiency or individual utility, but by their contribution to social harmony, human dignity, and equity ([27,32]). This ideology is substantiated by Turing [69] who rightly noted, "The isolated man does not develop any intellectual power."

3.2.3. Èkò and Ọmọlúàbí: the Philosophy of Character and Wisdom

The second philosophical pillar operationalizes the framework at the level of the individual through the West African Yoruba philosophy of Èkò. This concept embodies knowledge (*ìmò*), wisdom (*ọgbón*), and understanding (*òye*), as fused with core ethical values like character, honesty, and modesty [40–43].

Fig. 2 provides a procedural template for grounding AI in education within the ethical foundation of *Ìwà rere*, guiding its implementation through the Èkò holistic learning stages, and defining its ultimate goal as the cultivation of the Ọmọlúàbí ethical standard in both systems and

users.

This analytical diagram (Fig. 2) provides a three-layered procedural template for grounding AI in education within the ethical foundation of *Ìwà rere*. The foundational layer (bottom) establishes eight core ethical values: Honesty, Truthfulness, Kindness, Hard Work, Respect, Patience, Moderation, and Modesty; each mapped to corresponding AI ethics principles (e.g., Transparency & Trust, Fairness & Inclusivity, Sustainability & Balance). The structural layer (middle) operationalizes the Èkò holistic learning cycle through three progressive stages: *Ìmò* (Knowledge Acquisition), *Òye* (Understanding & Insight), and *Ọgbón* (Wisdom & Judgment); supported by three traditional educational domains (*Èkò Ilé*, *Èkò Iṣẹ*, àti *Èkò Ilú*) within the Yoruba holistic educational philosophy. The analytical layer (top) defines the AI system goal as the cultivation of Ọmọlúàbí, an ethical AI system that is morally upright, community-aligned, exhibits habitual excellence, and operates as a trustworthy agent. The accompanying Implementation Guidance Checklist (right panel) provides a structured analytical tool for ensuring ethical alignment across all phases of AI deployment in education [35].

The ultimate aim of this educational tradition is to cultivate Ọmọlúàbí, a person of impeccable character [38,70]. Etymologically, Ọmọlúàbí is a fusion of Ọmọ-olú-ìwà-bí, meaning 'a child begotten by the chief of character' (*ọlú iwà*) or the 'possessor of character' (*ontíwà*) [71]. This concept signifies a morally upright person, nurtured through both parental guidance and active community involvement [71]. The concept transcends social class, focusing instead on *ìwà rere* (good character) as its bedrock [70,71]. Ọmọlúàbí traits: honesty, truthfulness, kindness, hard work, respect, patience, moderation, and modesty, are ideally internalized through training until they become habitual [70,71]. Traditional Yoruba education, comprising *èkò ilé* (home training), *èkò iṣẹ* (vocational training), and *èkò ilú* (civic training) [70], aims explicitly at this cultivation.

An authentic approach to AI education within this context must prioritize the application of AI in a manner that reflects sound Èkò and reinforces these core ethical values in cultivating the Ọmọlúàbí, aligning with the call for "ethically grounded, pedagogically sound implementation strategies" [35]. This aligns with Situated Cognition theory, which posits that learning is inseparable from its cultural context and is inherently a process of becoming a member of a community of practice [50,51].

3.2.4. The Èkò-Ọmọlúàbí Procedural Framework: A Novel Template for Ethical AI in Education

To advance from philosophical articulation to implementable design, we introduce the Èkò-Ọmọlúàbí Procedural Framework (Fig. 2) as a novel, three-layered procedural template that systematically translates the Yoruba educational philosophy elaborated above into a structured architecture for the ethical grounding, pedagogical implementation, and evaluative governance of AI systems in education. This framework constitutes an original contribution to the discourse on ethical AI by demonstrating that the conceptual resources necessary for responsible AI governance, far from being the exclusive province of Western technophilosophical traditions, are already richly present within African moral and educational philosophy. The three layers of the framework: Ethical Grounding, Educational Implementation, and System Goal, operate as analytically distinct but functionally interdependent tiers, each essential to the integrity of the whole.

Layer 1: Ethical Grounding and Foundation – *Ìwà Rere* (Good Character). The foundational layer of the framework establishes *Ìwà rere* (good character) as the non-negotiable ethical bedrock upon which all AI systems in education must be constructed [70,71]. This layer operationalizes the concept by disaggregating it into eight core ethical values, each functioning simultaneously as a structural pillar of the framework and as a bridge to contemporary AI ethics discourse:

- (i) **Honesty ↔ Transparency & Trust:** AI systems must operate with radical openness, ensuring that their decision-making processes,

data sources, and limitations are transparently communicated to users and communities.

- (ii) **Truthfulness ↔ Accuracy & Validity:** The outputs and recommendations of AI systems must be rigorously validated against empirical evidence, cultural knowledge, and community-verified standards of truth.
- (iii) **Kindness ↔ Beneficence & Non-maleficence:** AI must be designed to actively promote well-being while systematically mitigating potential harms, particularly to vulnerable populations, echoing the bioethical principle of “*first, do no harm.*”
- (iv) **Hard Work ↔ Diligence & Responsibility:** AI development demands rigorous, sustained commitment to quality, iterative testing, and responsible maintenance, rejecting shortcuts that compromise system integrity or user safety.
- (v) **Respect ↔ Fairness & Inclusivity:** AI systems must embody respect for all persons by ensuring equitable treatment across demographic groups, actively counteracting algorithmic bias, and centering the voices of historically marginalized communities.
- (vi) **Patience ↔ Long-term Impact:** AI deployment in education must be guided by a longitudinal orientation, prioritizing sustainable developmental outcomes over short-term efficiency gains and attending to the cumulative effects of technological interventions on learners and communities.
- (vii) **Moderation ↔ Sustainability & Balance:** AI integration must be proportionate, avoiding the technological solutionism that displaces proven pedagogical practices, and maintaining equilibrium between digital and human-mediated learning.
- (viii) **Modesty ↔ Humility & Accountability:** AI systems and their developers must operate with epistemic humility, acknowledging the limits of computational intelligence, remaining accountable to the communities they serve, and resisting the hubris of technological determinism.

This systematic dual-coding, indigenous ethical value paired with its AI ethics counterpart, is a substantive intellectual move. It demonstrates the isomorphic relationship between Yoruba moral philosophy and the emergent global discourse on responsible AI, thereby challenging the prevailing assumption that AI ethics must be imported from Western philosophical traditions. Each pillar functions as both a design constraint (what the AI system must embody in its architecture) and an evaluative criterion (what the AI system must be assessed against in deployment), providing a culturally grounded alternative to the predominantly utilitarian or deontological frameworks that currently dominate AI ethics.

Layer 2: Educational Implementation Process – Èkó (Holistic Learning Cycle). The structural middle layer translates the ethical foundation into an educational implementation process through the Èkó holistic learning cycle. This cycle progresses through three epistemologically distinct and hierarchically ordered stages:

- (i) **Stage 1: Ìmò (Knowledge Acquisition)** – concerned with data, information, and the establishment of a factual basis. In the AI context, this stage encompasses foundational AI literacy, data fluency, and the acquisition of technical knowledge necessary for engaging with AI systems.
- (ii) **Stage 2: Òye (Understanding & Insight)** – concerned with context, meaning, and deep comprehension: part of which includes systematically breaking down the mathematical concepts underlying AI systems, carefully revealing the processes involved in the integration of these concepts into AI systems design and development, and deliberately teaching the technical know-how surrounding the design, development and deployment of AI systems. Crucially, this stage must further disintegrate and contextualize these concepts and processes into indigenous knowledge pathways for rapid local adoption, redesign, development and

deployment. This stage moves beyond surface-level knowledge to develop the learner’s deep capacity and fluid intelligence to contextualize AI within their socio-cultural environment, strategically discerning the implications of AI-mediated knowledge.

- (iii) **Stage 3: Ọgbón (Wisdom & Judgment)** – concerned with ethical application and decision-making. This terminal stage cultivates the capacity for wise, ethically informed judgment, the ability to discern not merely what AI can do, but what it should do in service of communal well-being.

This tripartite staging is pedagogically consequential: it resists the reductive tendency in contemporary AI education to conflate knowledge acquisition with competence, insisting instead that genuine AI literacy requires progressive epistemic development from data fluency (*Ìmò*), through contextual understanding (*Òye*), to ethical wisdom and judgment (*Ọgbón*). Crucially, the learning cycle is supported by three traditional Yoruba educational domains that anchor each stage within the learner’s social ecology: *Èkó Ilé* (Home/Data Context), which grounds learning in the familiar and the familial; *Èkó Isẹ* (Vocational/Technical Skills), which connects learning to productive practice and economic contribution; and *Èkó Ìlú* (Civic/Societal Impact), which orients learning toward civic responsibility and societal transformation. Together, these domains ensure that AI education is not confined to the classroom but permeates the full spectrum of the learner’s lived experience, a direct operationalization of the Situated Cognition principle that knowledge is inseparable from its social and cultural context [50,51].

Layer 3: AI System Goal and Outcome – Ọmọlúàbí (Ethical AI System). The terminal analytical layer defines the ultimate goal of the entire framework: the cultivation of Ọmọlúàbí in both the AI system and its users. An AI system that achieves this standard must exhibit four defining attributes: it must be (1) *morally upright*, operating in consistent alignment with the ethical principles of *Ìwà rere*; (2) *community-aligned*, serving the collective interests and cultural values of the communities it operates within; (3) *characterized by habitual excellence*, demonstrating reliable, high-quality performance that reflects the internalization of ethical standards rather than mere compliance with external rules; and (4) *a trustworthy agent*, earning and maintaining the trust of users and communities through demonstrated accountability, transparency, and fidelity to communal values. This layer re-defines the success criterion for AI in education: the measure of an AI system is not its technical sophistication or market value, but its capacity to cultivate impeccable character, Ọmọlúàbí, in both itself and its users. The ultimate aim, as the framework articulates, is the cultivation of impeccable character in AI and users alike, positioning the Ọmọlúàbí ideal as both a human developmental goal and an AI design standard.

Implementation Guidance Checklist and Analytical Framework. Accompanying the three-layered architecture is a practical Implementation Guidance Checklist (Fig. 2, right panel) that provides practitioners, policymakers, and researchers with a structured analytical tool for evaluating the ethical alignment and pedagogical soundness of AI interventions in education. The checklist mandates six sequential verification steps: (1) *Prioritize Ethical Grounding (Ìwà Rere)*, ensuring the intervention is built upon a clearly articulated ethical foundation; (2) *Ensure Pedagogical Soundness (Èkó)*, verifying the intervention follows sound educational principles aligned with the holistic learning cycle; (3) *Reflect Cultural Context (Situated Cognition)*, confirming the intervention is responsive to the specific socio-cultural environment; (4) *Reinforce Core Values*, checking that the intervention actively strengthens rather than erodes the community’s ethical fabric; (5) *Verify Community Alignment*, ensuring the intervention has been developed with meaningful community participation; and (6) *Monitor Long-term Impact* [27], committing to sustained evaluation of the intervention’s cumulative effects on learners, educators, and communities over time. This checklist transforms the abstract philosophical principles of the framework into a concrete, actionable protocol for ethical AI governance in African educational contexts.

3.3. Conceptualizing and Defining Artificial Intelligence for the African Context

The dominant Western paradigms define AI in functional terms, focusing on a system's ability to perceive its environment and take actions that maximize its chance of achieving its goals [72,73]. However, such a functionalist definition proves insufficient when viewed through the epistemological lenses of African philosophies, which emphasize collective goals, holistic knowledge (IKS), and the mitigation of social and economic inequality (SDG 10) ([8,20,24,74]). To conceptualize AI for the African context requires a radical shift from *what AI does* to *what AI sustains* within the human community.

Drawing from the Ubuntu philosophy and the Yoruba concept of Èkó, AI must transcend the mere replication of cognitive tasks. Instead, it must be framed as an intelligent relational partner whose value is measured by its contribution to social harmony, collective well-being, and the cultivation of Qmólúàbí [38,39,62].

Therefore, we propose conceptualizing AI not as artificial general intelligence, but as **Augmented Collective Wisdom (ACW)**. This framework defines AI as a *socio-cultural-technical system designed to harness, enhance, and sustain the collective wisdom, cultural integrity, and ethical fabric of a community*. An ACW system must be grounded in relational ethics like Ubuntu, prioritize communal benefit, and support the holistic development of character (Qmólúàbí) (Fig. 3).

This conceptualization is operationalized through the Yoruba proverb, “òwe leşin òrò, òrò leşin òwe, tí òrò bá sònù, òwe la fi ñwa” (A proverb is the horse of words, and words are the horse of proverbs; when words are lost, we use proverbs to find them) [36]. This proverb establishes AI as the *ẹşin* (horse or vehicle) for African knowledge, demanding that it be architected for maximal transparency and interpretability rather than operating as a “black box” oracle [75]. The proverb bifurcates into two distinct paradigm concepts that guide ACW design:

1. **Function** (òwe leşin òrò, òrò leşin òwe): This paradigm operationalizes ACW's primary function as a vehicle for conveying and clarifying concepts, meanings, and contexts in alignment with Ubuntu's communal values and Èkó's goal of cultivating Qmólúàbí. The converse implies that the concepts conveyed by AI are the vehicles that convey our understanding of how AI functions within African contexts. This mandates that ACW systems be created, developed, and trained exclusively on African data, and maintained by Africans.
2. **Goal/Utility** (tí òrò bá sònù, òwe la fi ñwa): This paradigm operationalizes ACW's ultimate goal as a pragmatic utility for finding and restoring meanings to words and concepts that reflect local values and contexts, ensuring IKS preservation and propagation. This mandate also implies that ACW systems must be auditable, clarified, and contextualized by the community itself.

The Yoruba emphasis on collective strength, encapsulated in the proverb “àgbájọ ọwọ la fi ñ sọyà”, whose equivalent philosophical axiom we establish as “*I Can Because of Collective Strength & Unity*”, reinforces the pan-African philosophy of Ubuntu (Fig. 1, Panel B). However, the framework also recognizes the continent's diversity through the counter-proverb “Báyí lánşẹ nílẹwá èwọbòmí” (our local customs may be another's taboo), underscoring the necessity of culturally specific pedagogical strategies rather than a “one-size-fits-all” model [17]. Together, Ubuntu provides the communal ethic, while Èkó provides the holistic educational philosophy for cultivating the virtuous individual (Qmólúàbí) who acts within that community. For AI education to be effective, this commitment requires the deep integration of African languages into computing and engineering education. Nuanced concepts, like the greeting “*E kú ilé oo*” or Yoruba temporal markers, lack direct English equivalents, highlighting that failure to incorporate this linguistic richness into ACW systems would sever the technology from the epistemological and ethical foundations it is meant to serve. This necessitates new computational models and data structures capable of

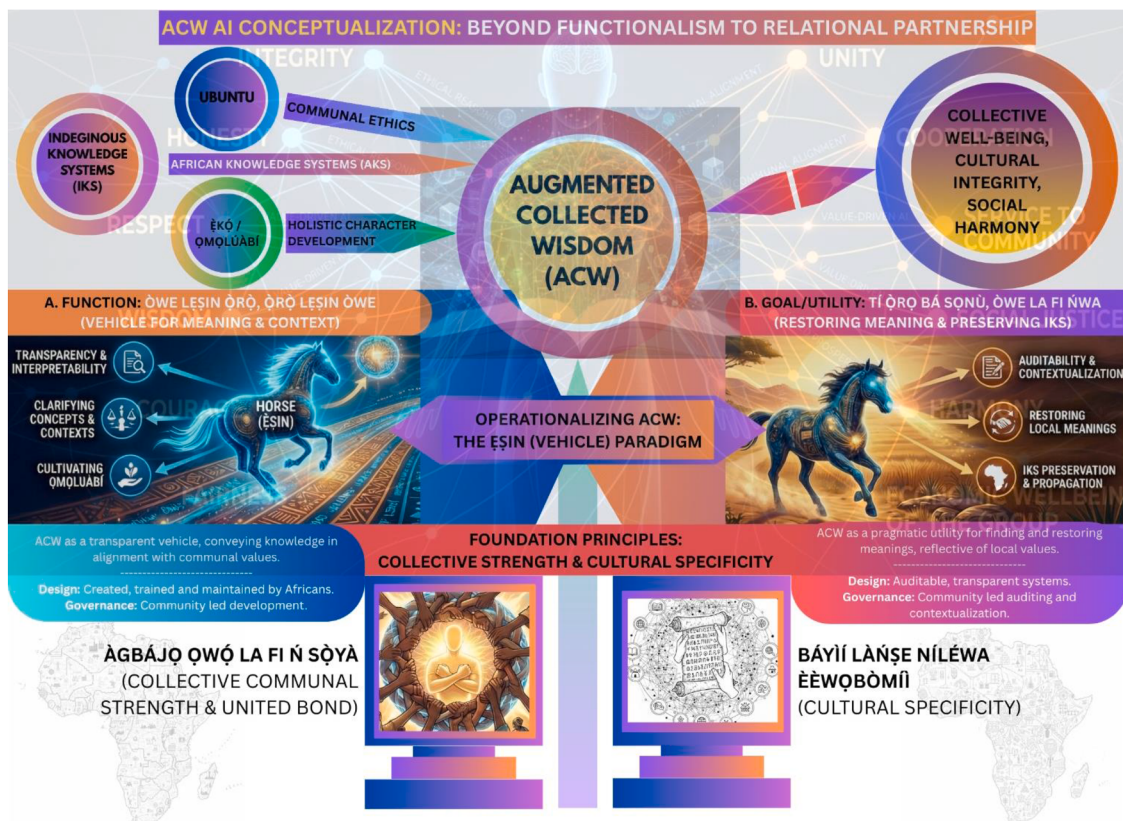


Fig. 3. Conceptualizing Artificial Intelligence as Augmented Collective Wisdom (ACW) for Africa.

processing and preserving these complex epistemological markers, forming a critical area for engineering innovation [21,22].

4. The Ubuntu-Èkò Framework: A New Model for AI Workforce Readiness in Africa

Building on the philosophical foundations established in the preceding section, we now present the Ubuntu-Èkò Framework itself, the manuscript's central theoretical contribution. This section defines each of the four pillars, articulates their theoretical grounding, and provides illustrative examples of how each pillar might be operationalized across educational contexts.

The reconceptualization of AI as ACW, grounded in African epistemologies, necessitates a corresponding paradigm shift in how we approach workforce readiness. Traditional models, often predicated on filling technical skills gaps, are insufficient for a context that prioritizes communal well-being and ethical character. Therefore, we propose a new theoretical lens: The **Ubuntu-Èkò Framework for AI Workforce Readiness**. This model advances theory by operationalizing the principles of Ubuntu and Yoruba Èkò to build a workforce that can not only use AI but also shape it ethically and direct it toward sustainable, culturally-affirming goals. The framework is built upon four interconnected and mutually reinforcing pillars (Fig. 4), rooted in the theory of Situated Cognition (SC), which holds that learning and competence are intrinsically inseparable from the social and cultural context in which they occur.

Critically, the philosophical foundation upon which these four pillars rest is the pan-African convergence between Ubuntu communal personhood and Yoruba collective strength and unity (Fig. 1), while their ethical operationalization is formalized in the Èkò-Òmọlúàbí Procedural Framework (Fig. 2, Section 3.2.4), which establishes *ìwà rere* (good character) as the non-negotiable ethical bedrock and the Èkò holistic learning cycle, progressing from *Ìmò* (Knowledge Acquisition) through *Òye* (Understanding & Insight) to *Ogbòn* (Wisdom & Judgment),

as the implementation pathway through which the four pillars are operationalized in educational practice.

Fig. 4 presents a framework that advances a decolonizing, justice-oriented approach to AI workforce readiness, embedding technical skills within philosophy of collective well-being and cultural integrity, operationalized through the Ubuntu-Èkò and Èkò-Òmọlúàbí Procedural Framework.

4.1. Pillar 1: Critical Consciousness (CC)

The CC pillar moves beyond a surface-level critique of algorithmic bias to foster a deep, decolonizing engagement with AI. It calls for an educational pedagogy [76] designed for marginalized populations [52] to question the very definition of "intelligence" embedded in AI systems and to challenge the power dynamics of digital colonialism [16]. This involves developing the two core components of critical consciousness (CC): (1) **Critical Reflection**, the capacity to critically analyze systemic social and political inequities [52,77], which is crucial for overcoming access inequity [8] and achieving SDG 10 (Reduced Inequalities) [78]; and (2) **Critical Action**, the participation in individual or collective efforts to change those perceived inequities [52,77];).

Cultivating this consciousness is viewed as learning through legitimate peripheral participation in a community focused on justice [51, 79]. It equips students with the agency to identify and dismantle systemic inequities [80] and serves as an "antidote" to the deleterious effects of structural oppression [76,77]. In practical terms, this pillar envisions computing and engineering programs implementing AI audit simulations, structured exercises in which students systematically examine AI systems for embedded biases, inequitable outcomes, and misaligned values; and ethical scenario-based assessments that measure a student's capacity to articulate and mitigate socio-technical harm. For example, a K-12 activity might involve students critically analyzing the outputs of a language translation AI when processing African proverbs, while a university course might require students to conduct a full ethical

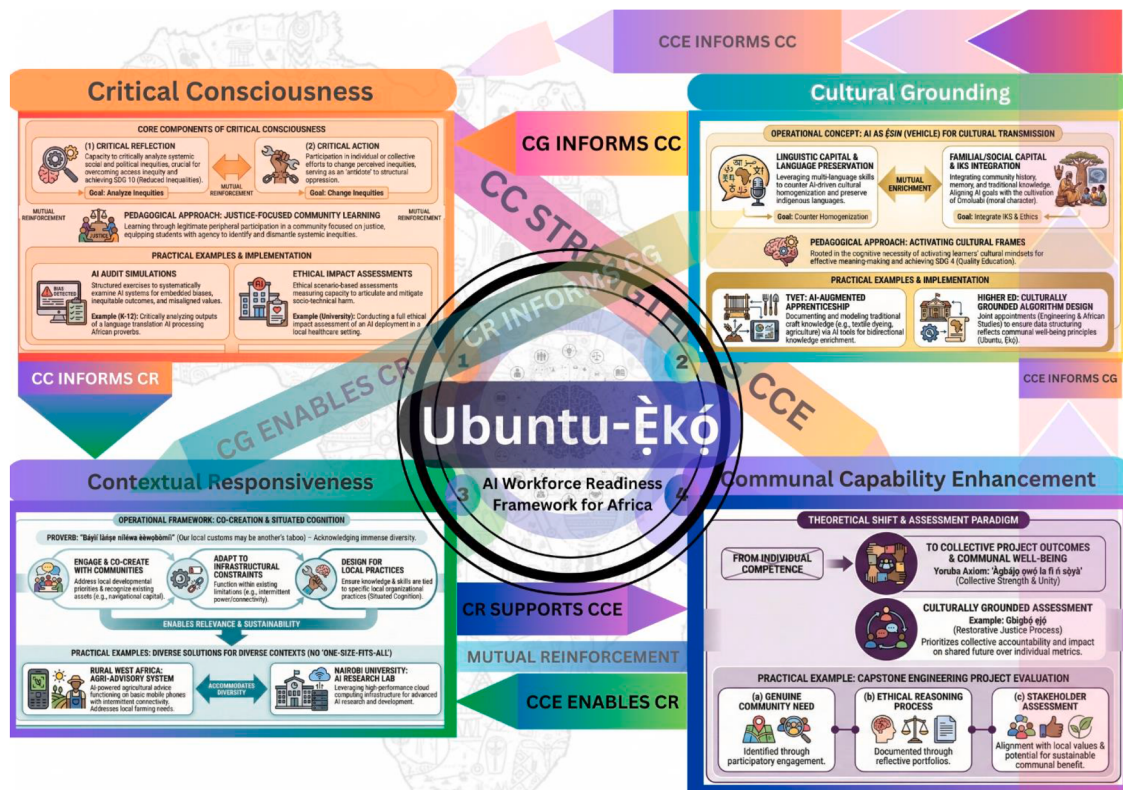


Fig. 4. Ubuntu-Èkò: AI Workforce Readiness Framework for Africa.

impact assessment of an AI deployment in a local healthcare setting.

4.2. Pillar 2: Cultural Grounding (CG)

The CG pillar insists that AI education must be fundamentally rooted in local cultures, languages, Indigenous Knowledge Systems (IKS), and philosophies. This pillar rejects the deficit-thinking models [54] that have often characterized Communities of Color as "lacking" the cultural capital required for success [54]. Instead, it centers the concept of "community cultural wealth" [54], an array of cultural knowledge, skills, and assets possessed by socially marginalized groups. This approach is rooted in the cognitive necessity of activating the learner's "cultural frames" or "cultural mindsets" for meaning-making [61,81].

Following this approach, we propose that designing curricula should leverage *linguistic capital* [54] – the intellectual and social skills learned through multi-language communication – to preserve and revitalize indigenous languages [9,11], countering the risk of AI-driven cultural homogenization [26]. It also involves the integrating IKS [21–23] by recognizing *familial capital*, the cultural knowledge, memory, and community history nurtured by kin [54] and explicitly aligning the goals of AI education with the cultivation of *Ọmọlúabí*. This dedication to culturally sensitive education is fundamental to SDG 4 (Quality Education) [20].

Illustratively, at the TVET level, this pillar might manifest as apprenticeship programs in which traditional craft knowledge (e.g., textile dyeing techniques, agricultural practices) is documented and modeled using AI tools, creating a bidirectional enrichment between indigenous and computational knowledge. At the higher education level, joint appointments between Engineering and African Studies departments would ensure that algorithm design and data structuring assignments fundamentally reflect the principles of communal well-being articulated in Ubuntu and Èkọ.

Crucially, this pillar asserts that AI infused into education should not only be rooted in local cultures to design curricula for the African people, but must also leverage "community cultural wealth" to design, develop, and deploy AI applications and systems *from the ground up*, enriched by the social, linguistic, and familial capital fabric of the community for strengthening, preserving, and enriching community cultural wealth.

4.3. Pillar 3: Contextual Responsiveness (CR)

Recognizing the continent's immense diversity, as captured in the proverb "*Báyìl láńṣe nílẹ́wá èwẹ̀wòbòmí*" (our local customs may be another's taboo), this pillar demands that all strategies be hyper-responsive to specific socio-economic and infrastructural realities. A one-size-fits-all model is not only ineffective but constitutes a form of epistemic violence [17]. This pillar operates as the organizational manifestation of Situated Cognition, ensuring that knowledge and skills are tied to specific local organizational practices [57].

Contextual responsiveness demands that AI solutions are co-created with the communities they are meant to serve, addressing local developmental priorities, functioning within existing technological constraints (e.g., intermittent power or connectivity), and recognizing existing assets, such as the *navigational capital* [54] communities already possess to maneuver institutional barriers. *Practically*, this means that an AI-powered agricultural advisory system in rural West Africa must function on basic mobile phones with intermittent connectivity, while a university-level AI research lab in Nairobi may leverage cloud computing infrastructure, the framework accommodates both without privileging one context over the other. This ensures that AI applications are relevant, sustainable, and genuinely beneficial across the continent's vast diversity of contexts.

4.4. Pillar 4: Communal Capability Enhancement (CCE)

The CCE pillar fundamentally reframes the goal of workforce readiness. Drawing from Amartya Sen's capability approach [55] but reorienting it through the communal lens of Ubuntu, the focus shifts from enhancing individual human capital to strengthening *communal capability*. This perspective is validated by the theory that cognition is socially mediated and "distributed across the environment and other people" [60]. The primary question is not "What can an individual do with AI?" but "*How does AI enhance our collective ability to live well together?*" This aligns directly with the Yoruba axiom "I Can Because of Collective Strength & Unity" ("*Agbájo ọwọ́ lá fí ñ sọyà*") (Fig. 1, Panel B).

This pillar demands that educational and workforce assessment strategies shift fundamentally, evolving from solely measuring individual competence to evaluating the success of collective project outcomes based on their demonstrable alignment with local ethical benchmarks and their capacity to strengthen the community's shared future. *Specifically*, institutions should integrate culturally grounded assessment paradigms, such as *gbígbo ejó* (Yoruba restorative justice process, where issues between parties are given fair hearing with the ultimate aim of amicable resolution) scenario analysis, which prioritize collective accountability and impact on communal well-being over individual technical performance metrics [82]. To illustrate this, a capstone engineering project assessed through this pillar would be evaluated not solely on technical sophistication but primarily on (a) the extent to which the project addresses a genuine community need identified through participatory engagement, (b) the project team's demonstrated ethical reasoning process (documented through reflective portfolios), and (c) community stakeholders' assessment of the project's alignment with local values and its potential for sustainable communal benefit.

5. The African AI Education Ecosystem: A Critical Ubuntu-Èkọ Assessment

Having established the theoretical architecture of the Ubuntu-Èkọ Framework, this section applies it as an analytical lens to critically assess the current landscape of AI integration within African education. This analysis draws on the structured literature synthesis and policy analysis described in Section 2, identifying gaps and opportunities across K-12, TVET, and Higher Education sectors as measured against the four pillars.

5.1. K-12 Education: the Unprepared Ground for Critical and Cultural AI Literacy

The integration of AI into African K-12 systems is nascent, revealing a foundational challenge to the Ubuntu-Èkọ vision. While the importance of AI literacy and computational thinking is acknowledged [83], the current approach often overlooks the imperative of fostering Critical Consciousness from an early age. The stark "curriculum divide," with virtually no government-endorsed K-12 AI curricula in Southern Africa as of 2022 [80], signifies more than a content gap; it represents a missed opportunity to ground learning in African epistemologies. Importing frameworks like the US-based AI4K12 initiative without deep, critical adaptation risks perpetuating digital colonialism, teaching students *what* to think about AI through a Western lens, rather than *how* to think critically from their own cultural standpoint [84]. This lack of Cultural Grounding is compounded by severe resource limitations: hardware, software, and connectivity, that form barriers to even basic digital education [12,85], posing a direct threat to achieving SDG 4 across the K-12 sector [20].

Beyond technical deficits, the pedagogical gap is stark: **students are rarely positioned as active producers of knowledge, and their voices, cultural perspectives, and digital fluency are underutilized.** AI literacy must be reframed beyond operational skills to include the capacity for critical engagement, ethical reasoning, and understanding

how AI exacerbates inequalities (SDG 10) [13,24]. Without educators equipped to facilitate these conversations, and curricula that reflect local values, the K-12 system cannot cultivate the foundational soil from which a generation capable of building ACW can grow.

5.2. TVET Sector: Bridging the Gap Between Individual Skills and Communal Needs

The TVET sector represents a critical nexus for translating AI potential into tangible societal benefits. AI tools like adaptive learning systems and virtual labs hold immense promise for enhancing practical skills and aligning training with industry needs [9,11,86]. From an Ubuntu-Èkò perspective, the goal is not merely to enhance individual employability but to bolster Communal Capability Enhancement by creating a workforce skilled in addressing local challenges. AI's potential to bridge the education-employment gap is significant, but it must be directed towards community-centric problems in agriculture, health, and sustainable industry, aligning TVET with SDG 4 (Quality Education) while simultaneously positioning it as a fundamental enabler for broader sustainable development [20].

However, the path is fraught with obstacles that reflect a lack of Contextual Responsiveness. Widespread technological literacy gaps among both students and educators, coupled with insufficient institutional support and a scarcity of AI tools [87], mean that the "facilitating conditions" for adoption are often absent [86]. This reality underscores that simply deploying technology is insufficient. A successful TVET strategy requires a holistic approach that builds educator capacity [88], ensures tools are relevant to the local industrial context, and frames skill development not as an individual pursuit, but as a contribution to the collective good. Assessment strategies within TVET must evolve from measuring isolated individual skills to evaluating project outcomes based on their measurable impact on community challenges and their alignment with local ethical benchmarks.

5.3. Higher Education: The Crucible for Forging Ethical and Indigenous AI Leadership

African Higher Education Institutions (HEIs) are the crucible where the continent's future AI innovators, researchers, and ethical leaders must be forged. While institutions like the University of Nairobi and Mohammed VI Polytechnic University are making strides in harnessing AI [89], global HE sector has often been "reactive rather than proactive" in the face of AI [90]. HEIs face profound challenges: the integration of AI is often fragmented and unevenly distributed, plagued by ethical concerns such as data privacy and cultural biases [4]. This critical lack of comprehensive, localized "big data" on African students' learning styles and cultural norms renders many personalized AI tools, like Intelligent Tutoring Systems, inaccurate and culturally dissonant [14].

This presents HEIs with a dual mandate framed by the Ubuntu-Èkò philosophy. *Firstly*, they must cultivate a specialized workforce capable of building and managing AI systems locally, asserting technological sovereignty [29]. *Secondly*, and more fundamentally, they must ensure all graduates embody the principles of Ọmọlúàbí, possessing not just technical skills but deep ethical acumen and Critical Consciousness. This requires a radical curriculum overhaul: integrating discussions of AI ethics, data sovereignty, and digital colonialism across all disciplines. Computing and engineering departments must partner explicitly with humanities and indigenous knowledge scholars to embed Ubuntu and Èkò principles directly into algorithm design, data structures, and capstone project assessment rubrics. HEIs must establish joint faculty appointments between Engineering and African Studies departments to sustain this critical philosophical oversight in the technical production pipeline [48,83].

5.4. Educator Readiness: The Human Fulcrum of the Ubuntu-Èkò Vision

Educators are the human fulcrum upon which the entire Ubuntu-Èkò vision rests, rightly recognized as the most critical factor in enabling equitable, high-quality, and inclusive learning [35]. Currently, significant gaps in AI literacy and pedagogical preparedness are evident across all tiers [30]. Studies show a "significant demand for support and training" [91], as many educators have "limited awareness" of AI's applications [92], creating a "persistent knowledge gap" [92]. The importance for professional development in developing AI literacy has also been highlighted [88]. The challenge is not merely technical; it is philosophical and cultural. Many educators grapple with fear of displacement, mistrust regarding AI's classroom use [14,93], and cultural or organizational barriers to adoption [92].

Addressing this requires equipping educators to be facilitators of Critical Consciousness, guides who help students "examine AI tools carefully, assess their outputs, and understand their limitations along with associated ethical risks" [94,95], and innovators who implement Culturally Grounded teaching methods, with the centering of student voices being essential [35]. An educator ready for the Ubuntu-Èkò future is not only an AI expert, but crucially, an expert in facilitating learning and ethical reasoning with AI. By automating "repetitive tasks" [4], AI can free educators to "concentrate on higher-order instruction" [96,97], becoming the essential cultivators of critical thinkers and community-oriented leaders (Table 2).

6. Forging the Future: an Ubuntu-Èkò Blueprint for Cultivating AI-Ready Generations

This section translates the analytical findings of Section 5 into forward-looking strategies. It articulates how the Ubuntu-Èkò Framework can guide the redesign of competencies, curricula, technology development, and equity-oriented practices.

Building an AI-ready Africa requires a deliberate, philosophical, and multi-pronged strategy. Grounded in the Ubuntu-Èkò Framework, this blueprint moves beyond reactive skills training to proactively cultivate generations of ethical innovators and critical citizens who can shape AI to serve communal well-being.

6.1. From Skills to Ọmọlúàbí: Redefining Competencies for Communal Well-being

The AI era demands a radical rethinking of what constitutes a "competent" individual. An approach focused narrowly on technical skills is fragile, as today's programming languages and platforms may be obsolete tomorrow [83]. The Ubuntu-Èkò Framework calls for a shift from cultivating individual technical proficiency to nurturing the holistic capabilities that define Ọmọlúàbí.

The three progressive stages of the Èkò-Ọmọlúàbí Procedural Framework (Fig. 2), from *Ìmò* (Knowledge Acquisition) through *Òye* (Understanding & Insight) to *Ọgbọń* (Wisdom & Judgment), provide the pedagogical architecture for this shift. This ensures that competency development progresses from technical data fluency to contextual understanding and, ultimately, to the ethical wisdom that characterizes Ọmọlúàbí.

- **Critical Thinking & Ethical Acumen:** The ability to analyze AI-generated content, deconstruct embedded biases, and make decisions guided by an ethical compass rooted in communal values [14]. This is the modern manifestation of *ọgbọń* (wisdom).
- **Collaborative Problem-Solving:** Reflecting the Yoruba axiom "I Can Because of Collective Strength & Unity" ("*àgbájó ọwọ la fí n sọyà*"), this capability emphasizes working in diverse, AI-augmented teams to solve complex, real-world community problems.

- **Creativity & Contextual Innovation:** The ability not just to use AI, but to imagine and create novel, culturally-relevant applications that address local needs. It encompasses the ability to be a creator, not just a consumer.
- **Lifelong Adaptability:** The most critical meta-competency, the commitment to continuous learning and resilience, enabling individuals and communities to adapt and thrive amidst technological change [80].

6.2. The living curriculum: weaving AI into the fabric of African education

Curriculum transformation is the primary mechanism for embedding the Ubuntu-Èkò philosophy into educational practice. This is not about adding an "AI module" but about weaving AI concepts, applications, and ethical dilemmas into the entire fabric of learning across disciplines and levels.

The Implementation Guidance Checklist accompanying the Èkò-Qmòlúábí Procedural Framework (Fig. 2) provides curriculum designers with a structured analytical protocol for this integration, mandating that each curricular intervention is assessed against criteria of ethical grounding (*Ìwà rere*), pedagogical soundness (*Èkò*), cultural context (Situating Cognition), core values reinforcement, community alignment, and long-term impact monitoring. An interdisciplinary approach is non-negotiable, ensuring that artists, lawyers, and historians, not just engineers, develop the Critical Consciousness to grapple with AI's societal impact [80].

The development of a Pan-African Framework for AI in Education [29,83] presents a monumental opportunity. To be effective, this framework must be a living document, co-created with local educators and communities, prioritizing Cultural Grounding by adapting global "big ideas" to reflect African philosophies, histories, and languages. Methodologies like Project-Based Learning (PBL) are ideal, as they allow students to apply AI to solve tangible community problems, turning learning into a meaningful act of communal contribution [98]. Crucially, institutional policy reform must embrace performance-based and portfolio assessment methodologies, moving away from standardized testing to holistically measure the student's embodied ethical character (Qmòlúábí) and capacity for communal contribution. These assessment tools must incorporate criteria explicitly derived from local ethical benchmarks, such as the principles of fairness and accountability inherent in *gbígbò ejó* [82].

6.3. Building the Èsin: Culturally-Attuned AI for An Inclusive Digital Future

For AI to serve as a vehicle (*èsin*) for African knowledge, a new generation of learning tools is required. The current dominance of Anglophone, culturally-agnostic platforms represent a failure of Contextual Responsiveness [14]. Building an equitable AI future is therefore contingent on the development and deployment of tools that are:

- **Culturally Responsive & Multilingual:** Tools reflecting local cultures and languages, as demonstrated by projects producing children's books in Bambara and Meta's NLLB translation model [9,11,99]. This is an act of cognitive justice.
- **Mobile-First & Low-Bandwidth:** Solutions accessible via mobile devices, as exemplified by Kenya's SMS-based M-Shule platform [100,101], ensuring reach across infrastructure-constrained contexts.
- **Open-Source & Locally Developed:** Prioritizing open-source solutions fostering affordability, collaboration, and local adaptation, empowering African EdTech innovators to create tools that are truly fit-for-purpose [14].

6.4. Ubuntu in Action: Ensuring No Learner is Left Behind

The principle of Ubuntu demands an unwavering commitment to equity. AI technologies hold the potential to either bridge or widen existing educational divides. The Ubuntu-Èkò Framework insists on a proactive strategy to ensure AI promotes inclusion for all learners, especially those in rural areas, low-income households, girls and women, and students with disabilities [29,85]. This requires systemic interventions beyond device provision: investing in shared infrastructure like community tech hubs [12], deploying AI-enabled assistive technologies [9,11] and implementing policies addressing underlying socio-economic barriers. Equally important is orienting educators as scholars who critically engage with their students' diverse cultural expressions, ensuring no student is overlooked.

7. Cultivating the Cultivators: An Ubuntu-Èkò Approach to Educator Empowerment

The preceding sections have established the theoretical framework, assessed the current landscape, and articulated a blueprint for the future. This section addresses what is arguably the most critical enabler of this entire vision: the educators themselves. Without adequately prepared educators, even the most sophisticated framework remains aspirational.

The realization of an AI-ready Africa, capable of building and stewarding ACW, is fundamentally dependent on its educators. They are the cultivators of the next generation's mindset. Empowering them requires a strategy that transcends mere technical training, focusing instead on nurturing their capacity for critical pedagogy, ethical leadership, and communal practice, all grounded in the principles of the Ubuntu-Èkò Framework. Equally critical is positioning educators as scholars who deeply understand their students, the next generation. This scholarly orientation involves observation and critical reflection with the sole aim of continuously learning about students' cultural, social, and cognitive dimensions and the co-construction of knowledge within learning communities [35]. In this way, educators become not only transmitters of skills but also reflexive, informed guides capable of shaping culturally grounded, ethically oriented, and contextually responsive AI learning experiences.

7.1. Professional Development as Character Formation: Beyond Literacy to Wisdom

Effective professional development (PD) must be reconceptualized not only as a transfer of skills, but also as a process of character formation for educators. While global roadmaps like UNESCO's AI Competency Framework for Teachers offer an essential structure [80], their true power lies in their localization through an African philosophical lens. Tiered training programs are necessary to address varying levels of digital competency [102], but their ultimate goal must be to cultivate educators who can instill Critical Consciousness and facilitate Cultural Grounding. PD must be context-sensitive, equipping teachers to deconstruct the biases and colonial legacies embedded in AI systems and empower them to integrate Indigenous Knowledge Systems (IKS) into their pedagogy. This includes specific training on how to integrate and build upon students' linguistic capital and familial cultural wealth to generate contextually relevant AI curricula and case studies [35,54].

The model must shift from sporadic workshops to *continuous, community-based professional learning ecosystems*. These ecosystems embody the Ubuntu principle, fostering peer-to-peer support and transforming educators into active co-creators of African-centric AI pedagogy, rather than passive recipients of foreign training modules.

7.2. The Shift in Pedagogy: From Sage on the Stage to a Community of Learners

The integration of AI demands a profound pedagogical shift toward the cultivation of a learning environment that reflects a community of inquiry, reflection, and co-construction of knowledge – core tenets of both Ubuntu and the pursuit of *Èkò*. AI tools that automate routine tasks free educators to focus on what is uniquely human: fostering deep conceptual understanding, creativity, and the ethical character of *Qmólúàbí* [9,11]. This requires embracing student-centered methodologies like project-based and inquiry-based learning, where AI is used not as a dispenser of facts but as a tool for investigation and creation [98].

The pedagogical transformation is about fostering *student agency*. In an Ubuntu-*Èkò* classroom, AI is leveraged to empower students as active constructors of their own knowledge and critical contributors to the collective understanding of their community, fully prepared to engage with technology as discerning and responsible citizens.

7.3. Educators As Ethical Shepherds: Guiding the Path to *Qmólúàbí*

In an AI-suffused world, the educator's most critical role becomes that of a facilitator, guiding students through the moral complexities of technology. This necessitates training that moves beyond a checklist of rules about plagiarism [89] or data privacy. For STEM educators, this specialized training must include technical modules on data provenance, feature engineering, and bias auditing techniques, enabling them to deconstruct the technical mechanisms through which AI perpetuates allocative and representational harms. It requires equipping educators with the philosophical tools to foster ethical reasoning grounded in African values, facilitating nuanced discussions on algorithmic bias, fairness, and societal impact, ensuring technology is scrutinized for its alignment with human rights and cultural diversity [80].

The eight core ethical values articulated in the foundational layer of the *Èkò-Qmólúàbí* Procedural Framework (Fig. 2), from Honesty (Transparency & Trust) through Respect (Fairness & Inclusivity) to Modesty (Humility & Accountability), provide educators with a culturally grounded ethical vocabulary for facilitating these discussions, replacing the often abstract and culturally decontextualized principles of dominant AI ethics frameworks with concrete, locally resonant values that bridge indigenous moral philosophy and contemporary AI governance discourse.

Professional development in this domain should use case studies and ethical dilemmas to build educators' capacity to cultivate the moral science of *Qmólúàbí* in their students, preparing them to provide the enduring ethical compass needed for the unknown dilemmas of tomorrow.

7.4. Communities of Practice As Living Ubuntu: Sustaining Collective Growth

The long-term success of AI in African education hinges on building sustainable networks of support that are, in essence, a modern expression of Ubuntu. Communities of Practice (CoPs), both virtual and physical, become living embodiments of "I am because we are." They are crucial spaces for educators to share best practices, co-create culturally relevant resources, and collaboratively solve problems, thereby strengthening their Communal Capability. These networks reduce the isolation that often accompanies technological change and foster teacher-led innovation from the ground up. By linking these CoPs with researchers, EdTech developers, and community leaders, a virtuous cycle of feedback and improvement is created [102]. This bottom-up approach ensures that AI integration is not a top-down mandate but a collectively owned and driven process, guaranteeing its contextual relevance, cultural resonance, and long-term sustainability.

8. Building the Ecosystem: A Blueprint for a Sustainable and Equitable AI Future

The preceding sections have addressed what must be learned, how it should be taught, and who will teach it. This section broadens the lens to the systemic conditions: policy, infrastructure, partnerships, innovation, and governance, that must be in place for the Ubuntu-*Èkò* Framework to flourish at scale.

Creating an AI-ready Africa is an ecosystem-wide endeavor. It requires the deliberate construction of a supportive environment through coherent policies, just infrastructure, and authentic partnerships, all architected to support the Ubuntu-*Èkò* Framework and foster the growth of ACW.

8.1. Policy as Philosophy: Weaving Ubuntu-*Èkò* into National and Continental Strategy

Effective policy is not merely a set of regulations but the articulation of a guiding philosophy. National and continental AI strategies, such as the AU's Continental AI Strategy [46] and South Africa's national framework [103], must be explicitly woven with the ethical and communal threads conveyed by Ubuntu-*Èkò*. Their goal should not just be economic competitiveness but the creation of a trustworthy, equitable, and human-centric AI ecosystem. This requires robust and adaptive governance mechanisms, including harmonized data protection laws [29] and regulatory sandboxes that foster responsible innovation ([104,105]. Crucially, these policies must be living documents, shaped through continuous, participatory dialogue with all stakeholders, ensuring they remain Contextually Responsive and democratically legitimate. The AU and each country in Africa should work toward the contextualization of AI development and adoption within their locality using the Ubuntu-*Èkò* Framework.

It is important to note that these policy recommendations are presented as guiding directions informed by the framework's philosophical commitments. Their feasibility will necessarily depend on the specific political, economic, and institutional conditions of each national context, and their effectiveness must be assessed through future empirical and policy analysis.

8.2. Infrastructure as Justice: Bridging the Digital, Data, and Energy Divides

Infrastructure is the foundation upon which an equitable digital future is built. The digital, data, and energy divides are not just technical problems; they are matters of social justice that impede the realization of Communal Capability [106]. Strategic investment is paramount in:

- **Digital Connectivity:** Expanding affordable and reliable internet access to all communities.
- **Sustainable Energy:** Ensuring consistent power through renewable sources, aligning with the need for energy-efficient "small AI" and green computing.
- **Data Sovereignty:** Building local data centers and cloud resources to reduce reliance on foreign infrastructure and assert control over Africa's data assets [15].
- **Digital Public Infrastructure (DPI):** Creating foundational systems like digital identity to enable a wide range of AI-driven services [107–109].

Furthermore, AI systems themselves must be leveraged as accountability tools for infrastructural justice, employing predictive analytics to monitor equitable resource distribution, optimize energy efficiency across educational hubs, and proactively flag underserved communities.

8.3. Partnerships as Co-Creation: From Stakeholders to Community

To achieve communal-cultural-ethical synergy in collaborations

between HEIs (HEIs) and community stakeholders, the relationship must be inherently communal and strictly non-hierarchical. This mandates the complete absence of a "superiority complex" [110] from HEI representatives when engaging with community counterparts, regardless of the community members' formal educational attainment. Such an egalitarian approach is essential to cultivating a truly culturally grounded collaboration aligned with community ethical values.

The Ubuntu-Èkò Framework demands a shift from traditional Public-Private Partnership models to **Public-Private-Community Partnerships (PPCPs)**. This reframes the relationship from one of service delivery to one of co-creation [3]. Local communities, civil society, and educational institutions must be recognized as active partners, not passive beneficiaries, thereby promoting equitable partnerships. This principle of co-creation ensures that solutions are designed *with* and *by* the people they serve, mitigating the risks of vendor lock-in [107–109] and "digital colonialism" [16], ensuring partnerships build sustainable local capacity.

8.4. Indigenous Innovation as the Èsin: Creating Culturally-Grounded AI

A truly sustainable AI ecosystem must be fueled by a vibrant culture of indigenous innovation. This involves nurturing local talent and supporting startups that develop AI solutions for uniquely African challenges in agriculture, healthcare, and education [14,111]. A key focus must be on creating AI that speaks Africa's languages and understands its cultures, integrating IKS into its logic [23]. Africa's diverse datasets are a strategic asset that, if governed ethically, can power this innovation [46]. Fostering this local ecosystem is the most direct path to developing ACW that is authentic, relevant, and truly serves the continent's people.

8.5. Ethics as Foundation: Building Trust Through Ubuntu-Centric Governance

Robust ethical frameworks are the foundation of a trustworthy AI ecosystem. These frameworks must be proactively developed from African philosophies like Ubuntu, prioritizing communal well-being, dignity, and social harmony [34]. An "ethics by design" approach is essential, embedding these values into AI systems from inception [30].

The *Èkò-Òmòlúàbí* Procedural Framework (Section 3.2.4) provides the structured template for this "ethics by design" approach, operationalizing the principle that ethical grounding through *Ìwà rere* is not an afterthought or a regulatory add-on but the foundational architecture upon which all AI system design, pedagogy, and governance decisions and policies must be built. Its six-step Implementation Guidance Checklist offers regulatory bodies a culturally-grounded protocol for evaluating the ethical alignment of AI deployments in education.

National AI regulatory bodies must mandate and standardize Ethical Impact Assessment (EIA) protocols derived from Ubuntu ethics for all major public sector AI deployments, ensuring communal accountability before launch [75]. The goal is a culture of ethical vigilance among all stakeholders, ensuring AI development and deployment are fair, transparent, accountable, and serve to strengthen the social fabric.

9. New Lenses, New Paths: Advancing Research for an African-Centric AI in Education

To guide this transformative journey, research itself must be transformed. This section articulates the methodological innovations and theoretical contributions needed to support an AI integration process that is equitable, ethical, and authentically African.

9.1. Methodological Innovations: Decolonizing the Measurement of Impact

Evaluating AI interventions in Africa requires a decolonizing

approach to methodology. The vast diversity of the continent and limitations in data infrastructure demand innovation beyond traditional metrics [14].

- **Mixed and Multi-Methods Approaches:** We suggest combining quantitative data with rich qualitative and ethnographic insights to understand the nuanced, real-world interactions between learners, educators, and AI [21,22].
- **Longitudinal Studies:** A critical need for long-term studies that track not just job placement but the impact on Communal Capability, civic engagement, and overall well-being [112].
- **Culturally Grounded Assessments:** There is a need to develop and validate psychometric tools measuring competencies like ethical reasoning and collaborative problem-solving within specific cultural contexts, rather than importing foreign instruments. To maximize research impact and ensure validity across diverse African contexts, these novel assessment paradigms must undergo systematic validation studies and be openly shared among regional research networks for continuous collaborative improvement [35,82]. This implies cross-context validation, refinement, update and expansion (where necessary and applicable). Specifically, assessments must move toward collective performance evaluation, utilizing methodologies such as *gbígbo èjò* scenario analysis (Yoruba restorative justice process where issues that need to be resolved between two or more parties involved are given fair hearing with the ultimate aim of resolving the issue amicably between/among the parties) in ethical reasoning, where group solutions and accountability for shared data integrity are the core measurement criteria. The evaluation principles presented here mirror those of the widely recognized Empowerment Evaluation framework, emphasizing the participatory and empowering intent of the proposed assessment model [82].
- **Participatory M&E:** Research must be conducted *with* communities, not *on* them. Involving local stakeholders in the research process honors their knowledge and ensures findings are relevant and actionable [83].
- **Holistic Impact Assessments:** The success of an AI intervention must be measured against the pillars of the Ubuntu-Eko Framework. Does it foster Critical Consciousness? Does it enhance Cultural Grounding? Does it strengthen Communal Capability? These are the questions our research must answer.

9.2. Theoretical contribution: the ubuntu-eko framework for AI workforce readiness

This manuscript's primary theoretical contribution is the proposed Ubuntu-Èkò Framework for AI Workforce Readiness. This framework advances existing theory by offering a more robust, ethically sound, and contextually appropriate foundation for guiding AI's role in African development. It contributes in several key ways:

- **Refining Technology Adoption Models:** It enriches models like UTAUT [37] by asserting that cultural philosophies (Ubuntu, Èkò), power dynamics (colonial legacies), and epistemic justice are primary, not peripheral, factors influencing AI adoption and use.
- **Advancing Skill Development Theories:** It challenges individualistic human capital theory by shifting the focus from individual skills acquisition to the enhancement of Communal Capability. The goal is a workforce that strengthens the collective's ability to thrive.
- **Operationalizing Ethical AI Integration:** By grounding ethics in African philosophies [23], the framework provides a concrete pathway for developing governance and pedagogies that are authentically African and prioritize communal well-being.
- **Promoting Decolonizing Research:** The framework inherently calls for the decolonization of research itself [21,22] through a critical lens that centers African epistemologies, thereby

empowering African communities as creators of knowledge, not merely subjects of study.

- **Reconceptualizing AI as ACW:** The originality of reframing AI as Augmented Collective Wisdom is not merely philosophical but educationally and technologically consequential. It redefines the design principles, governance structures, assessment criteria, and pedagogical approaches for AI systems deployed in African contexts, offering a paradigmatic alternative to the dominant functionalist view.
- **Formalizing Ethical AI Governance through the Èkò-Òmọ̀lúàbí Procedural Framework:** The three-layered procedural template (Section 3.2.4, Fig. 2) constitutes a distinct theoretical contribution by demonstrating that the conceptual resources necessary for responsible AI governance are already richly present within African moral and educational philosophy. By systematically dual-coding Yoruba *Ìwà rere* ethical values to contemporary AI ethics principles and defining *Òmọ̀lúàbí* as both a human developmental goal and an AI design standard, this framework decolonizes the discourse on AI ethics and provides a replicable template for bridging philosophical abstraction to implementable system design.
- **Establishing the Pan-African Philosophical Foundation:** The consolidated visualization of Ubuntu communal personhood and Yoruba collective strength and unity (Fig. 1) constitutes a further contribution by making explicit the isomorphic convergence between Southern and West African epistemologies, demonstrating that these traditions provide not merely parallel but mutually reinforcing ontological foundations for ethical AI governance, a convergence further validated by their shared epistemic values with the Nature of Indigenous Knowledge (NOIK) and the “Habits of Mind” framework [66].

In essence, the Ubuntu-Èkò Framework shifts the theoretical lens from a techno-economic universalism to a perspective that is historically informed, culturally grounded, critically engaged, and justice-oriented, offering a more holistic way to theorize AI's role in Africa's future.

9.3. Positioning Within the AI-in-Education Literature

The Ubuntu-Èkò Framework makes a distinctive contribution to the rapidly growing global literature on AI in Education by advancing a philosophically grounded, context-sensitive approach to human-centered AI. While existing frameworks in this space, such as UNESCO's AI Competency Framework [30], the European Union's ethical guidelines for trustworthy AI, and various national AI-in-education strategies, have made important strides in articulating principles of fairness, transparency, and human oversight, they remain largely silent on the question of *whose* values, epistemologies, and conceptions of the good life should inform AI design and governance.

The Ubuntu-Èkò Framework addresses this gap by demonstrating that “human-centeredness” in AI is not a culturally neutral concept but one that must be specified through engagement with particular philosophical traditions. By grounding human-centeredness in Ubuntu's relational ontology and Èkò's character-based educational philosophy, the Ubuntu-Èkò framework provides a concrete example of how global AI-in-Education discourse can be enriched by non-Western intellectual traditions without abandoning the commitment to universal human rights and dignity. This positioning is consequential for international policy discussions, as it suggests that truly inclusive global frameworks for AI in education must accommodate, and actively invite, plural philosophical foundations rather than assuming a single, implicitly Western conception of ethical AI.

10. Conclusion: Towards an AI of Collective Wisdom and Shared Futures

10.1. Contributions and Strengths

Before synthesizing the argument, we explicitly foreground the manuscript's key contributions and strengths, distinguishing among its normative, theoretical, and analytical dimensions (as elaborated in Section 1.6):

- Normative Originality:** The manuscript provides a principled, philosophically grounded critique of dominant AI paradigms and articulates an alternative vision of digital sovereignty rooted in African values. It demonstrates that decolonization in AI is not merely a political stance but an epistemological and pedagogical necessity.
- Theoretical Innovation:** The Ubuntu-Èkò Framework is an original theoretical model that synthesizes Ubuntu philosophy, Yoruba educational philosophy (*Èkò/Òmọ̀lúàbí*), situated cognition, community cultural wealth, and critical consciousness into an integrated, four-pillared framework. The reconceptualization of AI as Augmented Collective Wisdom is a novel contribution that redefines intelligence in communal rather than individualistic terms, with consequential implications for AI design, governance, and assessment.
- The consolidated Pan-African Philosophical Foundation (Fig. 1) makes explicit the isomorphic convergence between Ubuntu communal personhood and Yoruba's communal collective strength and unity philosophy that undergirds the framework, while the *Èkò-Òmọ̀lúàbí* Procedural Framework (Fig. 2) translates this philosophical foundation into a structured, three-layered procedural template, from the ethical ground of *Ìwà rere* through the Èkò holistic learning cycle to the terminal *Òmọ̀lúàbí* standard, that transforms abstract philosophical commitments into concrete design constraints and evaluative criteria for AI systems in education.
- Analytical Depth:** The structured critical analysis of K-12, TVET, and higher education systems through the four-pillar lens reveals specific gaps and opportunities that are obscured by universalist diagnostic tools. The multi-stakeholder policy recommendations and competency framework provide actionable guidance informed by the theoretical model.
- Practical Relevance:** Despite its conceptual nature, the framework is designed for translational impact. The summary table mapping pillars to educational applications (Table 1), the competency framework (Table 3), and the multi-stakeholder recommendations (Table 4) provide concrete starting points for curriculum designers, policymakers, and educators seeking to operationalize the framework's principles.
- Interdisciplinary Integration:** The manuscript bridges philosophy, education, computer science, engineering, cultural studies, and development policy, a synthesis that is essential for addressing the multidimensional challenges of AI in African contexts but is rarely achieved in existing literature.
- Significance and Novel Contribution.** The *Èkò-Òmọ̀lúàbí* Procedural Framework advances the manuscript's contribution in three critical ways. *First*, it demonstrates that the ethical vocabulary required for responsible AI governance already exists within Yoruba moral philosophy, thereby decolonizing the discourse on AI ethics by centering African intellectual traditions as generative rather than derivative. *Second*, it provides a structured, replicable template that bridges the gap between philosophical abstraction and the practical demands of AI system design and educational implementation, a gap that has persistently limited the translational impact of decolonial scholarship. *Third*, by defining *Òmọ̀lúàbí* as the terminal goal of both AI

Table 1

Summary of the Ubuntu-Èkò Framework: Pillars, Theoretical Grounding, and Illustrative Applications Across Educational Tiers.

Pillar	Theoretical Grounding	K–12 Applications	TVET Applications	Higher Education Applications
Critical Consciousness (CC)	Critical consciousness theory [52,53]; Decolonial theory; Critical pedagogy [76]	Age-appropriate discussions of AI bias using local examples; media literacy projects examining AI-generated content	AI audit simulations in vocational contexts; analyzing how AI tools may disadvantage local industries	Algorithmic auditing courses; AI ethics seminars integrating African case studies; thesis projects examining digital colonialism
Cultural Grounding (CG)	Community cultural wealth [54]; Culturally relevant education [62]; IKS integration [63]	Storytelling and proverb-based AI literacy; IKS-integrated science curricula; multilingual digital content creation	Apprenticeship models integrating indigenous craft knowledge with AI tools; local language data collection projects	Joint Engineering-African Studies curriculum design; NLP research on African languages; IKS-based algorithm development
Contextual Responsiveness (CR)	Situated cognition [51,57]; Context-sensitive development [17]	Mobile-first, low-bandwidth learning tools; offline AI literacy resources; community-based tech hubs	Region-specific AI applications (e.g., AI for local agriculture, artisanal manufacturing); flexible delivery models	Community-engaged capstone projects; regulatory sandbox participation; infrastructure-aware research design
Communal Capability Enhancement (CCE)	Ubuntu philosophy [32]; Capability approach [55]; Social capital theory [54]	Collaborative AI projects solving school/community problems; peer mentoring programs	Community-impact assessments of vocational AI projects; cooperative enterprise development with AI tools	<i>Gbigbò ejò</i> -based assessment; community-impact thesis requirements; Public-Private-Community Partnerships (PPCPs)

Table 2

Proposed Ubuntu-Èkò Assessment of AI Integration and Workforce Readiness in Africa.

Educational Tier	AI Integration Level	Key Capabilities Targeted (or Lacking)	Major Challenges to Ubuntu-Èkò Pillars	Notable Initiatives	Readiness Output
K-12 Education	Low to Emerging	Foundational digital skills (lacking widely), AI awareness (limited).	Critical Consciousness/Cultural Grounding: Lack of localized AI curricula, teacher training deficits, infrastructure gaps.	AI Africa Project [83], national digital literacy drives.	Nascent: Lacking critical and cultural foundations.
TVET Sector	Low to Medium	Practical AI application, data analysis (often lacking).	Contextual Responsiveness/Communal Capability: Tech literacy gaps, insufficient tools, weak industry-community links.	Institutional efforts to integrate AI tools; need for organized policies.	Developing: Focus on individual skills over communal capability.
Higher Education	Medium in leading HEIs	Specialized AI skills, research capabilities, and ethical leadership (partially lacking).	CG/CC: Lack of local data, Western tool dominance, curriculum inertia, brain drain.	AU AI Strategy, AIMS, AMMI programmes	Fragmented: Specialists emerging, but holistic ethical grounding is weak.
Educators (All Tiers)	Generally Low	AI literacy, AI pedagogical skills, ethical guidance (all largely lacking).	All Pillars: Lack of training, fear of AI, resource constraints, unclear policies.	UNESCO AI Competency Framework [80], calls for localized frameworks.	Under-Prepared

Table 3

The Ubuntu-Èkò Competency Framework for African Students and Educators.

Competency Domain	Specific Capabilities	Pillar (s)	Relevance
1. Critical & Ethical Consciousness (<i>Ìmò, Oye</i>)	AI concepts, societal impact, ethics (fairness, accountability), data sovereignty, and bias identification.	CC, CG	Informed citizenship, ethical leadership, and risk mitigation.
2. Contextual Problem-Solving & Innovation	AI tools for complex problem-solving, prompt engineering, local adaptation, and creative expression.	CR, CCE	Local innovation, entrepreneurship, and community solutions.
3. Data Wisdom & Stewardship	Data collection, analysis, interpretation, privacy, and responsible management.	CC, CR	Data-driven decisions, protecting community data.
4. Collaborative Intelligence	AI-augmented teamwork, interdisciplinary collaboration, and AI communication.	CCE	Teamwork, social cohesion, modern workplaces.
5. Lifelong Adaptability	Continuous learning, adapting to new tools, resilience.	All	Individual and community resilience.
6. Ubuntu-Grounded Pedagogy (Educators)	Culturally relevant AI-integrated lessons, ethical discussions, supporting diverse learners.	All	Engine for cultivating all student competencies.
7. Professional Growth (Educators)	Personal AI learning, peer networking, sharing best practices.	CCE	Supportive ecosystem for continuous improvement.

systems and their users, the framework offers a paradigm in which ethical grounding is not an afterthought or a regulatory add-on but the foundational architecture upon which all subsequent design, pedagogy, and governance decisions are built. This stands in marked contrast to dominant approaches in which ethical review is typically applied *ex post facto* to systems already optimized for commercial or technical objectives.

10.2. Synthesis of Key Arguments

The path to AI readiness in Africa is a transformative societal project, not a mere technological upgrade. This manuscript has argued for a fundamental paradigm shift away from a narrow focus on technical skills and towards a holistic approach grounded in African philosophies, epistemologies and aspirations. The central thesis is that to avoid the pitfalls of digital colonialism and truly harness AI for inclusive development, Africa must define AI on its own terms as an epistemological tool for Augmented Collective Wisdom. The proposed Ubuntu-Èkò Framework, with its four pillars of Critical Consciousness, Cultural Grounding, Contextual Responsiveness, and Communal Capability Enhancement, provides a theoretical and practical compass for this journey.

Together, the Pan-African Philosophical Foundation (Fig. 1) and the *Èkò-Òmólúábí* Procedural Framework (Fig. 2) constitute the manuscript's original contributions to this compass: the former establishes the ontological convergence between Ubuntu communal personhood and Yoruba's communal collective strength and unity, while the latter translates this foundation into structured design constraints, evaluative criteria, and a practical implementation checklist for ethical AI governance in education. This demonstrates that African philosophies and

Table 4

Multi-Stakeholder Policy and Strategic Recommendations for Enhancing AI Workforce Readiness in Africa.

Stakeholder	Action Area	Recommendations	Desired Outcome
Governments	Policy & Governance	Develop National AI Strategies aligned with AU frameworks; establish clear data governance & ethics guidelines; create regulatory sandboxes	Coherent, adaptive AI ecosystem; trustworthy AI
	Infrastructure	Prioritize nationwide broadband & energy access; Invest in DPI & local data centers	Equitable access; reduced digital divide.
Educational Institutions	Curriculum	Integrate AI literacy & ethics across all levels/ disciplines; develop localized, culturally relevant AI content; adopt project-based learning.	Students with foundational & specialized AI skills
	Teacher Training	Comprehensive, continuous PD on AI literacy, pedagogy & ethics; support communities of practice (CoPs)	Confident, competent educators
Industry	Talent & Ethics	Collaborate on curriculum design; offer internships, apprenticeships & AI skills training; adhere to ethical AI principles	Industry-relevant skills; ethical AI products / services
Civil Society	Advocacy & IKS	Advocate for equitable AI; participate in co-creating culturally relevant AI content & integrating IKS	Inclusive policies; AI reflecting local values
AU / Regional Bodies	Coordination	Drive implementation of Continental AI Strategy; facilitate policy harmonization & knowledge sharing	Coordinated African approach
International Partners	Support	Provide expertise for policy development; offer funding; support ethical AI standards.	Accelerated readiness; responsible AI development

epistemologies possess the conceptual richness to serve as self-sufficient, generative architectures for responsible AI, not merely supplementary perspectives to Western frameworks. It champions an approach that empowers Africa not just to participate in the AI revolution, but to lead it in a more humanistic, ethical, and communally-oriented direction.

10.3. Actionable Recommendations for an Ubuntu-Èkò Future

The analysis culminates in a call for concerted, collaborative action, with recommendations (as detailed in Table 4) aimed at weaving the Ubuntu-Èkò philosophy into the fabric of policy and practice.

- **For Policymakers:** Build policies and infrastructure that serve as foundations for digital justice and communal well-being, including harmonized data governance, regulatory sandboxes, and investment in Digital Public Infrastructure.
- **For Educational Institutions:** Reform curricula and invest in educators to cultivate generations of critical, ethical, and culturally-grounded citizens, embracing performance-based and portfolio assessment methodologies aligned with Qmólúábí values.
- **For Educators:** Embrace your role as ethical shepherds and facilitators of a learning community, guiding students toward becoming

creators of a better future through culturally grounded, inquiry-based pedagogy.

- **For Industry:** Engage as true partners in co-creation through PPCPs, investing in local innovation and aligning business practices with communal values.
- **For Researchers:** Adopt decolonizing methodologies to conduct research that empowers communities and genuinely advances an African-centric understanding of AI, prioritizing mixed-methods, longitudinal, and participatory approaches.

These recommendations are offered as guiding directions informed by the framework's theoretical commitments. Their implementation will necessarily require adaptation to specific national, institutional, and community contexts, and their effectiveness should be assessed through rigorous future research.

10.4. Envisioning the Future: Digital Sovereignty Through Ubuntu and the Cultivation of Qmólúábí in Every Individual

Africa's AI journey is only just beginning, and its path will be defined by the choices made today. Sustaining momentum requires more than policy and investment; it demands an unwavering, long-term commitment to the core philosophies of the Ubuntu-Èkò Framework. The path forward will be marked by emerging challenges, the increasing sophistication of generative AI, its complex implications for academic integrity and misinformation, evolving job displacement patterns, and the intricate geopolitics of data, all of which demand continuous, critical dialogue and adaptive governance.

The ultimate vision is the realization of Digital Sovereignty: the fundamental capacity for African nations to leverage AI on their own terms, for their own priorities, and in full alignment with their own values [46]. This sovereignty is not merely technological independence; it is a profound expression of the core values of Ubuntu, which insists "*I am because we are*" and provides the ethical imperative for building ACW. It reframes the goal of AI from individual gain or state power to the strengthening of Communal Capability, social harmony, and collective well-being.

This communal vision, however, is built upon the foundation of the individual. The cultivation of Qmólúábí in every individual becomes the continent's most vital and strategic objective. An individual who embodies Qmólúábí possesses the Critical Consciousness to deconstruct bias, the ethical wisdom to navigate moral complexity, and an innate orientation toward using their skills for the collective good. Africa's youthful population, its burgeoning spirit of innovation, and its proven capacity for technological leapfrogging [15] provide a powerful foundation for this ambitious vision. By building indigenous capacity, governing African data, and developing ethical norms rooted in its own humanistic traditions [23], the continent can achieve true digital self-determination. The journey ahead is a profound project of cultivating a generation of Qmólúábí who will build a society that leverages AI as an *eshin* (vehicle) for enhancing human dignity and realizing the collective promise of Ubuntu.

11. Limitations

Transparency about the boundaries and limitations of this work is essential for situating its contributions appropriately and guiding future research. We identify the following key limitations:

1. **Conceptual and Theoretical Nature:** This manuscript is a conceptual and theoretical contribution. It does not include empirical validation of the proposed Ubuntu-Èkò Framework. While the framework is grounded in established philosophical traditions and supported by extant literature, its practical effectiveness, including whether and how the four pillars translate into measurable educational and workforce outcomes, remains to be demonstrated through

future empirical studies. The framework should therefore be understood as a *foundational and guiding model* whose operational value must be tested through systematic, context-sensitive research.

2. **Scope of the Critical Assessment:** The analysis of K–12, TVET, and higher education systems in Africa draws primarily on a structured synthesis of published literature, policy documents, and philosophical analysis rather than on original primary data collection (e.g., field surveys, interviews, or classroom observations). While this approach is appropriate for a conceptual manuscript, it means that the assessment reflects the state of the published evidence base and may not capture all on-the-ground realities, particularly in contexts where documentation is limited.
3. **Practical Implementation Challenges:** The manuscript acknowledges that it does not examine in depth the significant practical challenges that would attend any attempt to implement the framework at scale. These include, but are not limited to: (a) policy constraints and political will, including competing priorities in resource-constrained governance environments; (b) educator capacity, including the strategic substantial professional development investments required to equip educators with the philosophical, pedagogical, and technical competencies the framework envisions; (c) infrastructure limitations, including persistent digital, energy, and connectivity divides that constrain the deployment of AI-based educational tools; and (d) institutional inertia, including resistance to the radical curricular reforms and cross-departmental collaborations the framework demands. Future work should systematically examine these implementation barriers and develop phased, context-sensitive strategies for addressing them.
4. **Philosophical Scope:** While the framework draws on Ubuntu (Southern African) and *Èkò/Omolúàbí* (Yoruba, West African) philosophies, the African continent encompasses an extraordinary diversity of philosophical traditions, languages, and educational cultures. The selection of these two traditions is justified by their established scholarly foundations and their complementary emphases (communal ethics and individual character formation, respectively), but we do not claim that they are exhaustive representatives of all African epistemologies. Future work should explore how the framework resonates with, or requires adaptation for, other African philosophical traditions (e.g., Maat in Kemetic philosophy, Ujamaa in East African thought, or the diverse philosophical systems of North and Central Africa).
5. **Scalability and Generalizability:** Some claims regarding the immediate or large-scale applicability of the framework should be interpreted with caution. The framework is presented as a foundational and guiding model that must be adapted to specific local contexts. Its generalizability across the continent's 54 nations, with their diverse political systems, economic conditions, linguistic landscapes, and educational traditions, cannot be assumed but must be empirically established through comparative, multi-site research.
6. **Assessment Paradigm Development:** While the manuscript proposes novel assessment approaches (e.g., *gbígbò ejò* scenario analysis, collective performance evaluation), these are presented as illustrative and aspirational rather than as validated instruments. Developing, piloting, and validating these assessment paradigms across diverse African educational contexts constitutes a substantial and necessary program of future research.

These limitations do not diminish the framework's contribution as a conceptual and theoretical advance. Rather, they delineate the boundary conditions within which the framework's claims should be interpreted and identify the empirical work needed to extend its scholarly and practical utility.

12. Connecting the Ubuntu-Èkò Framework to Sustainable AI Adoption in African Education

This section directly addresses the emphasis on practical pathways from theory to implementation, connecting the Ubuntu-Èkò Framework to questions of sustainable, equitable, and scalable AI adoption under real-world constraints.

The Ubuntu-Èkò Framework is not only a philosophical and theoretical contribution; it is also designed to inform practical questions of sustainable AI adoption in African education systems. We briefly articulate how the framework connects to three critical dimensions of sustainability:

12.1. Policy and Institutional Decision-Making Under Infrastructural Constraints

The framework's Contextual Responsiveness pillar directly informs policy and institutional decision-making in resource-constrained environments. Rather than prescribing technology-intensive solutions that presuppose Western-level infrastructure, the framework encourages tiered adoption strategies that match AI interventions to available resources. For example, in contexts with limited connectivity, the framework supports offline-capable, mobile-first AI literacy tools and SMS-based adaptive learning platforms (e.g., Kenya's M-Shule). In contexts with greater infrastructure, it supports more advanced implementations such as AI-augmented research labs and virtual learning environments. The key principle is that *the absence of advanced infrastructure should never be a barrier to meaningful AI education*; rather, the framework provides criteria for designing AI interventions that are contextually appropriate at any level of infrastructural development.

12.2. Equity in Multilingual and Resource-Diverse Contexts

The Cultural Grounding pillar provides specific guidance for addressing equity in multilingual and resource-diverse contexts. It mandates that AI tools and curricula be developed in, and for, African languages, leveraging linguistic capital as a pedagogical asset rather than treating non-English proficiency as a deficit. The framework supports: (a) the development of multilingual NLP models trained on African language corpora; (b) curriculum materials that integrate indigenous proverbs, oral traditions, and local case studies as legitimate knowledge resources; and (c) assessment approaches that accommodate diverse linguistic and cultural expressions of competence. These strategies directly address the risk that AI-driven education could exacerbate existing linguistic and cultural marginalization.

12.3. Low-Cost, Scalable, and Socially Accountable AI Education Strategies

The Communal Capability Enhancement pillar, combined with the framework's emphasis on open-source tools, community tech hubs, and Public-Private-Community Partnerships, provides a blueprint for low-cost, scalable, and socially accountable AI education. By centering community ownership, the framework ensures that scalability does not come at the cost of cultural relevance or communal accountability. The emphasis on Communities of Practice among educators provides a sustainable, low-cost mechanism for professional development that does not depend on external training providers. Similarly, the framework's assessment approaches, which prioritize collective project outcomes and community impact over individual standardized metrics, can be implemented without expensive testing infrastructure, relying instead on portfolio-based, participatory evaluation methods.

CRedit authorship contribution statement

Taiwo R. Feyijimi: Writing – review & editing, Writing – original

draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Viyon Dansu:** Writing – review & editing, Writing – original draft, Validation, Investigation. **Ibukun O. Osunbunmi:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Isaac O. Elesemoyo:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Moses Olayemi:** Writing – review & editing, Writing – original draft, Supervision, Resources, Investigation, Conceptualization. **Olukayode E. Apata:** Writing – review & editing, Validation, Investigation, Data curation. **Daniel O. Oyeniran:** Writing – review & editing, Validation, Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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