



Artificial Intelligence for Humanizing Access to Education in Africa: Overcoming the Burden of Distance

AMETEFE, Faith Gameli^{2*}, IBELEGBU, Ngozi, DOE, Gilbert Tory AMETEFE³, Alice Adamu, Abalis¹,

AMETEFE,⁴ George Dzorgbenya

¹Business Education Department,

Faculty of Vocation and Technical Education,

College of Education, Zing, Taraba State, Nigeria

²Department of Vocational and Technology Education,

Faculty of Education, Taraba State University,

Jalingo, Taraba State. Nigeria

³Department of Curriculum and Instruction,

College of Education, Zing, Taraba State, Nigeria.

⁴Department of Biotechnology, College of Science,

Engineering and Technology,

Osun State University, Osogbo. Nigeria.

G. D. Ametefe (ametefegorgeel@gmail.com)

ametefegorgeel@gmail.com

Publication Date: 2025/11/28

Abstract

Aim/Purpose

This perspective article explores how artificial intelligence (AI) can address the persistent barrier of geographical distance in African education, where rural learners travel long distances to under-resourced schools and urban learners face congestion and economic segregation. It argues that AI can transform distance from a structural disadvantage into an opportunity for equitable inclusion.

Background

Distance is a major determinant of access in Africa, intersecting with socioeconomic inequalities and infrastructural deficits. While AI-enabled learning tools are expanding globally, their role in mitigating Africa's distance-related inequities, especially in rural and peri-urban settings, remains underexplored.

Methodology

The article adopts a perspective approach, drawing on African case studies, policy insights, and emerging data to synthesize how AI interventions—adaptive tutoring, predictive analytics, and immersive classrooms—relate to equity.

Contribution

It positions AI not merely as a technological tool but as a culturally embedded strategy for social justice. The article introduces an Africanized framework combining opportunity cost, digital equity, and Ubuntu pedagogy to evaluate AI's potential to humanize learning.

Findings

Examples from Kenya, South Africa, and Uganda show that AI can reclaim time lost to travel, reduce fatigue, and expand access to resources. However, gaps in connectivity, affordability, and digital literacy risk reinforcing inequalities if adoption is not inclusive.

Recommendations for Practitioners

Educational policymakers and practitioners should design AI initiatives that are low-bandwidth, multilingual, and culturally relevant, ensuring accessibility for rural and peri-urban learners. Investments in infrastructure, digital literacy, and equity-focused policies are essential for sustainable adoption.

Recommendations for Researchers

Future research should emphasize Africa-specific longitudinal studies, localized AI design, and cross-disciplinary collaborations.

Impact on Society

Harnessing AI to overcome distance can advance educational equity, reduce dropout rates, and foster inclusive human development across Africa.

Future Research	Further inquiry should address ethical safeguards, Ubuntu-informed pedagogy, and the scalability of inclusive AI solutions.
Keywords	Artificial intelligence in education, Africa, educational equity, distance and access, digital divide, humanized pedagogy.

Introduction

The challenge of distance in education remains particularly acute in Africa, where geographical and infrastructural barriers continue to shape access to learning opportunities (Gunter, 2025). Across many countries in sub-Saharan Africa, students in rural communities often walk several kilometres daily to reach schools, while urban learners face long commutes through congested and unreliable transport systems (Chilewa, 2019). UNESCO reports that nearly 34% of African children live more than 30 minutes away from a primary school, a proportion far higher than the global average, and in countries such as Nigeria, Tanzania, and Ethiopia, travel times frequently exceed one hour each way (Nwoke et al., 2024a). These spatial barriers intersect with structural inequalities: rural schools are more likely to be under-resourced, while urban schools remain stratified by economic segregation, perpetuating cycles of unequal opportunity (Nwoke et al., 2024b).

Artificial intelligence (AI) is increasingly presented as a transformative tool that can mediate these challenges by decoupling learning from geography (Rakuasa, 2023). AI-driven adaptive learning platforms, such as Eneza Education in Kenya, have reached

millions of learners in remote areas via simple mobile phones, offering personalized lessons that reduce dependence on physical proximity to schools (Oberdieck, 2021). Similarly, AI-powered early warning systems are being piloted in South Africa to identify at-risk students based on attendance and performance data, enabling timely interventions even when students face irregular school access due to distance (Embarak & Hawarna, 2024). These innovations illustrate how AI has the potential to reframe educational access: not merely as a matter of infrastructure and transport, but as a question of intelligent, equitable design (Ahmed, 2024).

Yet the promise of AI in Africa cannot be detached from the realities of the continent's digital divide (Kitsara, 2022). Internet penetration across Africa remains at approximately 36%, compared to a global average of 66%, and disparities in bandwidth, device ownership, and digital literacy risk reproducing the very inequalities AI is meant to solve (Anicet Kiemde & Dooguy Kora, 2020). While AI can mitigate the disadvantages of distance, poorly designed or narrowly implemented systems may reinforce exclusion by privileging urban, affluent learners with better digital access (Li, 2023). Furthermore, questions of cultural relevance and decolonization in education demand that AI

applications be adapted to local languages, pedagogical traditions, and community needs, rather than imported wholesale from global EdTech models (Nemorin, 2024).

This perspective article explores the relationship of geographical distance, educational equity, and AI in Africa. It argues that distance should not be understood only in physical terms but also in digital and cultural dimensions that shape learning access. By situating AI within Africa's diverse educational landscapes, the discussion highlights both its potential to humanize pedagogy and its risks of deepening inequity if deployed without sensitivity to local contexts. Through a synthesis of emerging African case studies, quantitative data, and theoretical insights, the article calls for policy frameworks and research agendas that critically evaluate AI's role in overcoming distance-related barriers and ensure its contributions align with the continent's broader goals of inclusive, equitable, and decolonized education.

Theoretical framework

Understanding the impact of distance on student academic performance in Africa requires a theoretical foundation that integrates geography, technology, and equity. In contexts where long commutes and infrastructural deficits continue to disadvantage learners, AI emerges as both a potential equalizer and a site of risk. Three interconnected theoretical lenses—educational access and opportunity cost, digital equity and the digital divide, and humanizing pedagogy within the Ubuntu tradition provide a framework for analysing how AI can transform distance-related challenges into opportunities for inclusion.

Educational Access and Opportunity Cost in African Schooling

Access to education in Africa has historically been shaped by spatial inequalities. Rural learners in countries such as Tanzania, Ethiopia, and Nigeria often face commutes of over an hour each way, with significant opportunity costs in terms of time for rest, study, and household responsibilities. Opportunity cost theory, traditionally applied to economic trade-offs, illuminates the stark choices faced by African families: long travel distances may force children to forego extracurricular learning, contribute to family labour, or even drop out entirely. AI reframes this trade-off by offering adaptive learning resources through mobile devices, enabling students to reclaim learning time otherwise lost to distance. For instance, mobile-based AI tutoring platforms in East Africa allow learners to study after returning

from farms or long journeys, converting distance into flexible digital opportunity.

Digital Equity and the African Digital Divide

While AI holds promise in extending access, its effectiveness is constrained by the continent's digital divide. Theories of digital equity emphasize that access is multidimensional, involving not only devices and connectivity but also digital literacy, affordability, and cultural relevance. Across Africa, disparities in broadband access and device ownership mean that AI-enhanced learning can deepen inequities if not accompanied by inclusive infrastructure development. The framework of digital justice—which links technology use to broader issues of fairness and equity—is especially salient in Africa. Without careful policy design, AI adoption may benefit urban elite schools while leaving rural communities further behind. Conversely, when embedded in inclusive strategies, such as the low-bandwidth AI-supported SMS systems in Kenya, AI can become a tool for democratizing access to quality learning regardless of geography.

Humanizing Pedagogy and the Ubuntu Philosophy

A uniquely African contribution to rethinking AI in education is found in the Ubuntu philosophy, which emphasizes relationality, community, and shared humanity: "I am because we are."

Applied to pedagogy, Ubuntu challenges technocentric models of AI by insisting on culturally relevant, community-centred approaches to learning. Humanizing pedagogy within this framework requires that AI applications not only deliver individualized content but also reflect local languages, cultural narratives, and collaborative modes of knowledge-building. For example, AI-assisted translation tools can support instruction in indigenous African languages, making distance learning more inclusive for learners in multilingual and rural contexts. By embedding Ubuntu into AI adoption, education can resist the risk of depersonalization and instead affirm collective values, ensuring that technology humanizes rather than alienates learning.

Toward a Contextualized AI Framework for Africa

By integrating opportunity cost theory, digital equity, and Ubuntu pedagogy, this framework highlights both the potential and the pitfalls of AI in addressing distance-related challenges in Africa. It underscores that the question is not merely whether AI can overcome geographical barriers, but how it can do so without reproducing new forms of digital exclusion. A

contextualized theoretical foundation recognizes that African learners experience distance in physical, economic, and digital forms simultaneously, and that AI must be harnessed to address all three dimensions. This holistic perspective provides a basis for analysing empirical findings and guiding future policy interventions to ensure that AI contributes meaningfully to educational equity and social justice in Africa.

Mechanisms Linking Distance to Academic Performance in Africa through AI

The impact of distance on student academic performance in Africa can be explained through several interrelated mechanisms encompassing, time allocation, physical and mental fatigue, and access to resources (Okpunukpang et al., 2024). These mechanisms highlight how geographical separation from schools continues to disadvantage African learners. However, AI introduces new opportunities to mitigate these barriers by extending access to personalized, context-sensitive learning (Rasheed et al., 2025).

Time Allocation and AI-Supported Flexibility

Long commutes significantly reduce the time students in Africa can dedicate to study and rest. Rural learners in northern Nigeria, for instance, often spend more than an hour traveling each way to reach school, while urban learners in cities like Lagos or Nairobi lose substantial hours in traffic congestion (Wachira et al., 2022). This lost time translates into fewer hours for homework, reading, and cognitive recovery. AI-enabled learning platforms, particularly those accessible through low-bandwidth mobile applications, provide flexibility for learners to engage in study outside rigid school hours (Alam & Mohanty, 2023). Eneza Education in Kenya and M-Shule in Uganda exemplify how AI-powered adaptive learning modules can deliver personalized exercises via SMS or lightweight apps, allowing learners to convert fragmented time at home or during travel into meaningful study opportunities (Yadav et al., 1 C.E.) , (Kyambade et al., 2025). In this way, AI helps offset the opportunity costs imposed by distance (Uddin, 2024).

Physical and Mental Fatigue: AI as a Mediator of Cognitive Load

Physical fatigue from long walks and mental exhaustion from navigating poor transport systems remain defining features of African students' daily lives, especially in rural areas. Fatigue diminishes focus, memory retention, and classroom participation (Chen & Qin, 2024). AI applications can help mediate these effects by optimizing learning processes and reducing

cognitive overload (Twabu, 2025) . Intelligent tutoring systems, for example, adjust the pace and complexity of material to match the learner's energy and attention levels, ensuring that students who arrive at school tired are not doubly disadvantaged (*Integrating Intelligent Tutoring Systems for Differentiated Learning in Inclusive Classrooms*, 2024) . Furthermore, emerging AI-driven emotional recognition tools, though still in their infancy in Africa, can detect signs of disengagement or fatigue and prompt supportive interventions from teachers (Helwig, 2025) . By integrating these adaptive systems, schools can better accommodate the realities of students who endure taxing commutes.

Access to Resources: Expanding Reach through AI-Powered Platforms

Distance often restricts African learners' access to libraries, laboratories, and extracurricular activities (Loots et al., 2023) . In rural Malawi, for instance, schools lack adequate textbooks, while in many peri-urban South African contexts, participation in after-school clubs is curtailed by travel constraints (Altinyelken & Hoeksma, 2021) . AI-driven digital platforms have begun to bridge these gaps. Virtual libraries powered by natural language processing tools can provide reading materials in local languages, while AI-based simulation software offers science experiments virtually, reducing reliance on physical labs (Murali et al., 2024) . Moreover, AI-supported peer learning platforms allow collaboration across distances, enabling students in remote villages to join study groups with peers in urban centres (Tripathi et al., 2025) . Such systems reconfigure access to resources from being place-bound to being digitally mediated, provided infrastructure gaps are addressed (Myronchuk et al., 2025) .

Distance, AI, and Educational Equity in Africa

Taken together, these mechanisms demonstrate that while distance continues to create significant barriers to academic success in Africa, AI technologies can be harnessed to mitigate its effects (Ebelechukwu Okonkwo et al., 2024) . Importantly, these interventions must be designed with inclusivity in mind: without careful attention to affordability, infrastructure, and cultural fit, AI could reinforce rather than resolve inequalities (Sarkar, 2025) . A holistic approach requires not just the deployment of AI tools, but their integration into equitable policies and practices that recognize the lived realities of African learners (Pedro et al., 2019) .

Geographical Variations and Contextual Factors in Africa

The impact of distance on student academic performance in Africa is highly differentiated across urban, peri-urban, and rural settings (Lembani et al., 2020) . Each geographical context presents unique challenges shaped by infrastructural, socioeconomic, and cultural factors. AI has the potential to mitigate these disparities, but its effectiveness depends on context-sensitive application and the narrowing of digital divides (Božić, 2023) .

Urban Africa: Congestion, Inequality, and AI for Adaptive Access

In African megacities such as Lagos, Cairo, and Nairobi, physical proximity to schools does not necessarily translate into easy access (Mboup, 2019) . Students frequently spend long hours navigating traffic congestion, unsafe transport routes, and economic segregation (Mboup, 2019) . Urban schools are often better resourced, yet stark inequalities persist between affluent private institutions and underfunded public schools in informal settlements (*Education Policies, Systems, and Progress in Africa and Asia A Comparative Analysis of 12 Cities in Six Countries*, 2020) . AI offers pathways to level this disparity through adaptive digital learning platforms. In South Africa, for instance, AI-powered early warning systems are being piloted to identify at-risk learners across diverse school districts, helping teachers intervene despite structural inequalities in school quality (Babu et al., 2024) . Similarly, AI-enhanced timetabling and transport optimization systems can potentially reduce travel inefficiencies in dense cities, freeing more time for learning (Vetri Selvi et al., 1 C.E.) .

Peri-Urban and Township Contexts: Infrastructure Gaps and AI Mediation

Peri-urban areas and townships, such as those surrounding Johannesburg or Accra, occupy an intermediate position where students may live closer to schools than rural learners but face significant infrastructural deficits, including irregular electricity, limited public transport, and uneven digital connectivity (Andoh, 2024) . Many families rely on private vehicles or shared informal transport, which is unaffordable for low-income households. In these contexts, AI-mediated mobile platforms provide flexible alternatives. Low-bandwidth SMS-based AI tutoring systems, like M-Shule in Kenya, enable peri-urban learners to access personalized lessons without needing full-scale broadband or expensive devices (Jordan et al., 2025) . These platforms transform learning into a more accessible, home-centred activity, thereby

offsetting infrastructural gaps. AI chatbots and voice-based systems in local languages are also emerging, enabling learners with low literacy or limited internet to engage in educational support (Soledad et al., 2025).

Rural Africa: Distance, Underfunding, and AI's Expansive Potential

Rural Africa presents the most severe educational challenges associated with distance. In Ethiopia, Malawi, and northern Nigeria, learners often walk several kilometres to reach schools that are underfunded and face teacher shortages (Härmä, 2021). Roads are frequently poorly maintained, and public transport is absent. These conditions severely limit learning opportunities and contribute to dropout rates, especially among girls, who may also face safety risks during long commutes (Mchunu et al., 2025). AI-enabled distance learning platforms, when coupled with basic mobile infrastructure, offer transformative potential. In Kenya, Eneza Education has reached over six million rural learners through SMS-based AI tutoring, delivering subject-specific content without requiring smartphones or high-speed internet (Otieno et al., 2023). Similarly, pilot projects in Rwanda have explored AI-assisted radio and voice-based platforms to provide instruction in rural communities, ensuring access even where schools are sparsely distributed (Sangwa & Mutabazi, 2025). By leveraging widely accessible technologies such as feature phones, AI can reconfigure the geography of education, extending learning beyond the physical classroom (Quevedo Piratova et al., 2025).

Cultural and Infrastructural Factors: AI Between Opportunity and Risk

Cultural perceptions of education in Africa also shape how distance interacts with academic performance (Banda et al., 2023). In some rural communities, families prioritize agricultural or domestic labour over formal schooling, making long commutes an additional deterrent. Here, AI-enabled flexible learning systems provide an opportunity for students to study during non-school hours, balancing community responsibilities with learning (Singh et al., 1 C.E.). At the same time, infrastructure remains a critical constraint. Without affordable electricity, broadband connectivity, and reliable devices, AI risks reinforcing urban privilege while rural learners fall further behind (Sharma et al., 2024). Bridging this gap requires investments in infrastructure alongside AI deployment. Equally important is ensuring cultural relevance: AI systems must support African languages, local curricula, and context-specific pedagogies. Otherwise, AI risks importing homogenized

learning models that alienate rather than empower African learners (Murungu, 2023).

Future Directions for Research in Africa

A deeper understanding of the relationship between distance and student academic performance in Africa requires moving beyond correlational insights toward research that critically engages with AI as both a tool and a context-dependent intervention (Mfikoyi et al., 2025). The continent's unique educational geography, marked by rural-urban disparities, infrastructural deficits, and cultural diversity, offers an urgent yet fertile ground for reimagining how AI can transform access and equity in education (Adewale et al., 2024). Several future directions are particularly salient.

Longitudinal and Empirical Studies on AI in African Education

Most evidence on AI in education remains short-term and pilot-focused, leaving critical gaps in understanding its sustained impact on African learners facing distance-related barriers (Niane, 2024). Longitudinal research is needed to track how AI interventions such as SMS-based tutoring, predictive analytics for at-risk students, and AI-assisted radio programs affect learning trajectories over years rather than months (Hamid, 2024). For example, following rural learners in Ethiopia or Malawi who engage with AI-enabled platforms could reveal whether these tools offset the cumulative disadvantages of distance in the long run (Talema, n.d.). Such studies would also clarify whether AI narrows or inadvertently widens gaps between rural and urban learners.

Localized and Multilingual AI Design

AI tools must be adapted to Africa's cultural and linguistic diversity. With over 2,000 languages spoken across the continent, AI systems designed exclusively for English or French instruction risk excluding vast numbers of learners (Gwagwa et al., 2020). Future research should therefore explore the development and evaluation of AI platforms that support indigenous African languages and localized curricula (Senekal & Brokensha, 2023). Natural language processing (NLP) tailored to African dialects is an emerging field, but its integration into educational platforms remains limited. Investigating how such tools can humanize distance learning by making it culturally and linguistically inclusive is an urgent priority.

Cross-Disciplinary Collaboration: AI, Education, and African Realities

Addressing the complex intersections of distance, equity, and AI requires collaboration between

educators, computer scientists, urban planners, and sociologists (Mac Fadden et al., 2024). For instance, urban planners and AI researchers can jointly use Geographic Information Systems (GIS) and machine learning to map “education deserts” in African cities, informing where AI-enabled digital hubs should be established (Macharia et al., 2023). Sociologists and educational psychologists can explore how AI-mediated learning interacts with cultural values such as Ubuntu, which emphasizes community and collective well-being, ensuring that AI enhances rather than erodes social cohesion in African classrooms (Suliman et al., 2024).

Policy and Infrastructure: AI for Equity, Not Exclusion

AI in African education cannot succeed in isolation from infrastructural and policy reform (Kolog et al., 2022). Reliable electricity, affordable mobile internet, and device accessibility remain prerequisites for any AI intervention. Future research should therefore examine not just AI tools, but also the policy frameworks that determine their equitable deployment. For example, studies could analyse how national broadband policies in Kenya, Nigeria, or South Africa intersect with AI adoption in schools, and whether they reduce or reinforce inequalities in access (Adegoke et al., 2025). Equally, research into financing models, including public-private partnerships, community-based digital hubs, or open-source AI platforms can provide evidence-based pathways for sustainable AI integration in African education (Olusegun Aderibigbe et al., 2023).

Ethics, Equity, and the Risk of Digital Colonialism

Finally, critical research must interrogate the ethical dimensions of AI in African education (Gbadebo, 2024). Without careful design, AI platforms imported from global EdTech companies risk reproducing “digital colonialism,” where African learners are subjected to pedagogical models detached from their cultural realities (Salami, 2024). Future studies should therefore foreground equity, decolonization, and inclusivity in evaluating AI adoption. This includes examining how African-led AI innovation can resist dependency on foreign platforms and instead build context-sensitive systems that reflect the continent’s aspirations for self-determined educational development (Arakpogun et al., 2021).

Conclusion

The relationship between distance and academic performance in Africa underscores the profound

impact of geography and infrastructure on educational opportunity. For decades, African learners, particularly those in rural and peri-urban areas have shouldered the burdens of long commutes, resource scarcity, and fatigue, all of which restrict academic engagement and widen equity gaps. This perspective has argued that AI offers a unique opportunity to transform these distance-related disadvantages into pathways for inclusion. AI-powered platforms such as adaptive tutoring systems, predictive analytics, and low-bandwidth mobile learning applications already demonstrate how technology can reconfigure access by reaching students beyond the physical classroom. In Kenya and Uganda, SMS-based AI systems have allowed learners in remote communities to engage with curricula despite infrastructural limitations. In South Africa, AI-enhanced early warning systems are being deployed to identify at-risk learners irrespective of geographical location. These cases illustrate how AI can humanize access to education by reducing dependence on proximity and enabling learning opportunities that are flexible, personalized, and scalable.

Yet the promise of AI in Africa is inseparable from the continent’s structural realities. Without inclusive infrastructure policies, involving reliable electricity, affordable connectivity, and equitable device distribution, AI risks reinforcing existing inequalities, privileging urban elites while leaving rural learners further behind. Equally, without attention to cultural relevance and linguistic diversity, AI could impose external pedagogical models that alienate African learners rather than empowering them. This raises urgent questions about digital equity, decolonization, and the ethics of AI in education. For Africa, the challenge is therefore twofold: to harness AI as a powerful tool for bridging educational distance, and to ensure its deployment aligns with principles of social justice, Ubuntu, and cultural sustainability. Achieving this balance requires coordinated efforts among policymakers, educators, technologists, and communities to design AI systems that reflect African contexts and values. Future research must prioritize Africa-led innovations that address the continent’s unique challenges, while contributing critical insights to global debates on equity and AI in education. Ultimately, overcoming distance in African education is not solely a logistical or technological issue but a matter of justice and inclusion. AI can play a decisive role in creating an educational landscape where no learner’s potential is limited by where they live. By embedding AI within strategies that foreground equity, cultural relevance, and human dignity, Africa can chart a path toward an inclusive

educational future—one that not only bridges the gap of distance but also redefines the meaning of access and opportunity in the age of AI.

Conflict of Interest: The authors have no conflict of interest to declare

Funding: This study has no funding option.

References

Adegoke, D., Ismail, O., Joshua, T., & Solaja, O. (2025). Exploring Digital, Artificial Intelligence and Emerging Technology Inequality in Nigeria and Sub-Saharan Africa. *The Palgrave Handbook of Global Social Problems*, 1–21. https://doi.org/10.1007/978-3-030-68127-2_606-1

Adewale, M. D., Azeta, A., Abayomi-Alli, A., & Sambo-Magaji, A. (2024). Empirical Investigation of Multilayered Framework for Predicting Academic Performance in Open and Distance Learning. *Electronics 2024, Vol. 13, Page 2808, 13(14), 2808*. <https://doi.org/10.3390/ELECTRONICS13142808>

Ahmed, F. (2024). The Digital Divide and AI in Education: Addressing Equity and Accessibility. *AI EDIFY Journal*, 1(2), 12–23. <https://researchcorridor.org/index.php/aiej/article/view/259>

Alam, A., & Mohanty, A. (2023). Educational technology: Exploring the convergence of technology and pedagogy through mobility, interactivity, AI, and learning tools. *Cogent Engineering*, 10(2). <https://doi.org/10.1080/23311916.2023.2283282>; JOURNAL:JOURNAL:OAEN20;WGROU:STRING:PUBLICATION

Altinyelken, H. K., & Hoeksma, M. (2021). Improving educational quality through active learning: Perspectives from secondary school teachers in Malawi. *Research in Comparative and International Education*, 16(2), 117–139. https://doi.org/10.1177/1745499921992904/ASSET/00B66F24-50BD-4E0B-968A-416414CDF816/ASSETS/IMAGES/LARGE/10.1177_1745499921992904-FIG1.JPG

Andoh, N.-Y. (2024). *Informal Settlements: The Intersection of Social Networks, Livelihoods, and the Built Environment in Johannesburg, Nairobi, and Accra*. <https://doi.org/10.7302/22922>

Anicet Kiemde, S. M., & Dooguy Kora, A. (2020). The Challenges Facing the Development of AI in Africa. *Proceedings of IEEE International Conference on Advent Trends in Multidisciplinary Research and Innovation, ICATMRI 2020*. <https://doi.org/10.1109/ICATMRI51801.2020.9398454>

Ikpogun, E. O., Elsahn, Z., Olan, F., & Elsahn, F. (2021). Artificial Intelligence in Africa: Challenges and Opportunities. *Studies in Computational Intelligence*, 935, 375–388. https://doi.org/10.1007/978-3-030-62796-6_22

bu, M., Virgin, A., Rs Edwin, M., Priya, G., & Ravichandran, K. (2024). Identifying Learning Difficulties at an Early Stage in Education with the Help of Artificial Intelligence Models and Predictive Analytics. *International Research Journal of Multidisciplinary Scope (IRJMS)*, 5(4), 1455–1461. <https://doi.org/10.47857/irjms.2024.v05i04.01821>

nda, L. O. L., Liu, J., Banda, J. T., & Zhou, W. (2023). Impact of ethnic identity and geographical home location on student academic performance. *Helion*, 9(6), e16767. <https://doi.org/10.1016/J.HELION.2023.E16767/ASSET/7FEB4FDA-7E3D-462F-A471-B912B78F32F1/MAIN.ASSETS/GR2.JPG>

Božić, V. (2023). Artificial Intelligence as the Reason and the Solution of Digital Divide. *Language Education and Technology*, 3(2), 96–109. <https://langedutech.com/letjournal/index.php/let/article/view/53>

Chen, Y., & Qin, X. (2024). Student fatigue and its impact on teaching effectiveness based on online teaching. *Education and Information Technologies*, 29(8), 10177–10200. <https://doi.org/10.1007/S10639-023-12197-3/METRICS>

Chilewa, A. (2019). *Assessment of the Effect of Transport on School Girls Academic Performance in the City of Dar es Salaam: A Case of Ilala Municipal*.

Ebelechukwu Okonkwo, B., Unoma Ndu-Anunobi, G., & Chris Umeokafor, C. (2024). HARNESSING ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT: A PATHWAY TO ACHIEVING SUSTAINABLE DEVELOPMENT GOALS IN AFRICA USING NIGERIA AS A STUDY. *INTERNATIONAL JOURNAL OF PUBLIC ADMINISTRATION AND DEVELOPMENT STUDIES*, 1(2), 37–58. <https://ijpads.com/index.php/ijpads/article/view/16>

Education Policies, Systems, and Progress in Africa and Asia A comparative analysis of 12 cities in six countries. (2020).

Embarak, O. H., & Hawarna, S. (2024). Automated AI-driven System for Early Detection of At-risk Students. *Procedia Computer Science*, 231, 151–160. <https://doi.org/10.1016/J.PROCS.2023.12.187>

Gbadebo, A. D. (2024). UTILIZING ARTIFICIAL INTELLIGENCE FOR ETHICAL RESEARCH: IMPLICATIONS FOR THE ATTAINMENT OF SDGS ON EDUCATION

IN AFRICA. *International Journal of Social and Educational Innovation (IJSEIro)*, 11(21), 142–155.

Gunter, A. (2025). The geography of distance education: spatial disparities, accessibility, and impact across place. *South African Geographical Journal*. <https://doi.org/10.1080/03736245.2025.2472653>; JOURNAL:JOURNAL:RSAG20;WGROU:ST RING:PUBLICATION

Gwagwa, A., Kraemer-Mbula, E., Rizk, N., Rutenberg, I., & de Beer, J. (2020). Artificial Intelligence (AI) Deployments in Africa: Benefits, Challenges and Policy Dimensions. *The African Journal of Information and Communication*, 26(26), 1–28. <https://doi.org/10.23962/10539/30361>

Hamid, O. H. (2024). Impact of Artificial Intelligence (AI) in Addressing Students at-Risk Challenges in Higher Education (HE). *The Evolution of Artificial Intelligence in Higher Education*, 183–194. <https://doi.org/10.1108/978-1-83549-486-820241011>

Härmä, J. (2021). Low-fee Private Schooling and Poverty in Developing Countries. *Low-Fee Private Schooling and Poverty in Developing Countries*, 1–264. <https://doi.org/10.5040/9781350088276>

Helwig, N. (2025). *Teachers Collaborating with AI to Increase Student Engagement and Improve Student-Teacher Relationships: Action Research in an Upstate NY Middle School*.

Integrating intelligent tutoring systems for differentiated learning in inclusive classrooms. (2024). <https://doi.org/10.25403/UPRESEARCHDATA.28323272>

Jordan, K., Myers, C., Damani, K., Khagame, P., Mumbi, A., & Njuguna, L. (2025). Supporting equitable access to learning via SMS in Kenya: Impact on engagement and learning outcomes. *British Journal of Educational Technology*, 56(4), 1530–1552. <https://doi.org/10.1111/BJET.13533>;PAGE:STR ING:ARTICLE/CHAPTER

Kitsara, I. (2022). *Artificial Intelligence and the Digital Divide: From an Innovation Perspective*. 245–265. https://doi.org/10.1007/978-3-030-90192-9_12

Kolog, E. A., Odoi Devine, S. N., Egala, S. B., Amponsah, R., Budu, J., & Farinloye, T. (2022). *Rethinking the Implementation of Artificial Intelligence for a Sustainable Education in Africa: Challenges and Solutions*. 27–46. <https://doi.org/10.1108/S1877-636120220000029003>

Kyambade, M., Namatovu, A., & Male Ssentumbwe, A. (2025). Exploring the evolution of artificial intelligence in education: from AI-guided learning to learner-personalized paradigms. *Cogent Education*, 12(1). <https://doi.org/10.1080/2331186X.2025.2505297>

nbani, R., Gunter, A., Breines, M., & Dalu, M. T. B. (2020). The same course, different access: the digital divide between urban and rural distance education students in South Africa. *Journal of Geography in Higher Education*, 44(1), 70–84. <https://doi.org/10.1080/03098265.2019.1694876>

H. (2023). AI in Education: Bridging the Divide or Widening the Gap? Exploring Equity, Opportunities, and Challenges in the Digital Age. *Advances in Education, Humanities and Social Science Research*, 8(1), 355–355. <https://doi.org/10.56028/AEHSSR.8.1.355.2023>

ots, S., Strydom, F., & Posthumus, H. (2023). Learning from students: Factors that support student engagement in blended learning environments within and beyond classrooms. *Journal of Student Affairs in Africa*, 11(2), 73–88. <https://doi.org/10.24085/jsaa.v11i2.4897>

c Fadden, I., García-Alonso, E. M., & López Meneses, E. (2024). Science Mapping of AI as an Educational Tool Exploring Digital Inequalities: A Sociological Perspective. *Multimodal Technologies and Interaction 2024*, Vol. 8, Page 106, 8(12), 106. <https://doi.org/10.3390/MTI8120106>

charia, P. M., Moturi, A. K., Mumo, E., Giorgi, E., Okiro, E. A., Snow, R. W., & Ray, N. (2023). Modelling geographic access and school catchment areas across public primary schools to support subnational planning in Kenya. *Children's Geographies*, 21(5), 832–848. <https://doi.org/10.1080/14733285.2022.2137388>; JOURNAL:JOURNAL:CCHG20;WGROU:ST RING:PUBLICATION

Mboup, G. (2019). Smart Urban Accessibility and Mobility for Smart Economy in Africa. *Advances in 21st Century Human Settlements*, 251–295. https://doi.org/10.1007/978-981-13-3471-9_8

Mchunu, G. G., Kuupiel, D., Ncama, B. P., Isike, C., Kistan, M., Pillay, J. D., & Duma, S. E. (2025). Public transport systems and safety of female commuters in low-and-middle-income countries: a systematic scoping review. *BMC Women's Health*, 25(1), 1–15. <https://doi.org/10.1186/S12905-025-03821-0/TABLES/4>

Mfikoyi, T., Mfikoyi, T., & Rabotapi, T. (2025). Students' Perspectives on Contextualizing AI Tools for Engaged Learning: An... *Society for Information Technology & Teacher Education International Conference*, 2025(1), 241–261. <https://www.learntechlib.org/p/224101>

Murali, R., Ravi, N., & Surendran, A. (2024). Augmenting Virtual Labs with Artificial Intelligence for Hybrid Learning. *IEEE Global Engineering Education Conference, EDUCON*.

<https://doi.org/10.1109/EDUCON60312.2024.10578649>

Murungu, R. (2023). *Reimagining Education in Africa: The Transformative Potential of Prompt Engineering*. <https://papers.ssrn.com/abstract=4809504>

Myronchuk, N., Antonova, O., Piddubna, O., Pavlenko, V., Basiuk, N., & Zalibovska-Ilnitska, Z. (2025). Navigating The Digital Landscape: How Online Resources Are Transforming Education. *International Journal of Basic and Applied Sciences*, 14(Special Issue 1), 239–250. <https://doi.org/10.14419/ZDK1JX69>

Nemorin, S. (2024). Towards decolonising the ethics of AI in education. *Globalisation, Societies and Education*. <https://doi.org/10.1080/14767724.2024.2333821>; CTYPER:STRING:JOURNAL

Niane, H. M. (2024). *PERCEIVED LEARNING BARRIERS USING REMOTE LEARNING IN RURAL SCHOOLS: A NARRATIVE INQUIRY*.

Nwoke, C., Oyiga, S., & Cochrane, L. (2024a). Assessing the phenomenon of out-of-school children in Nigeria: Issues, gaps and recommendations. *Review of Education*, 12(3), e70011. <https://doi.org/10.1002/REV3.70011>; WEBSITE:WEBSITE:BERA-JOURNALS;WGROUPE:STRING:PUBLICATI ON

Nwoke, C., Oyiga, S., & Cochrane, L. (2024b). Assessing the phenomenon of out-of-school children in Nigeria: Issues, gaps and recommendations. *Review of Education*, 12(3), e70011. <https://doi.org/10.1002/REV3.70011>; WEBSITE:WEBSITE:BERA-JOURNALS;WGROUPE:STRING:PUBLICATI ON

Oberdieck, R. (2021). *An implementation suggestion for Girl Move Academy in Mozambique*.

Okpunukpong, E. P., Ogunode, N. J., & Suleiman, K. (2024). *Impact of Long Distance Trekking on Students' Academic Performance in Tertiary Institutions, Nigeria*. <https://multijournals.org/index.php/synergy/article/view/2636/2896>

Olusegun Aderibigbe, A., Efosa Ohenhen, P., Kelvin Nwaobia, N., Osheyor Gidiagba, J., Chigozie Ani, E., & Author, C. (2023). ARTIFICIAL INTELLIGENCE IN DEVELOPING COUNTRIES: BRIDGING THE GAP BETWEEN POTENTIAL AND IMPLEMENTATION. *Computer Science & IT Research Journal*, 4(3), 185–199. <https://doi.org/10.51594/csitrj.v4i3.629>

Otieno, J., Kaye, T., & Mbugua, W. (2023). *The Use of Technology to Promote Equity and Inclusion in Education in North and Northeast Kenya*. <https://doi.org/10.53832/EDTECHHUB.0159>

Iro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: challenges and opportunities for sustainable development. *MINISTERIO DE EDUCACIÓN*. <https://repositorio.minedu.gob.pe/handle/20.500.12799/6533>

vedeo Piratova, D. A., Sánchez Duarte, M. M., Chiappe, A., & Sáez Delgado, F. M. (2025). Intelligent Classrooms: How AI and IoT Can Reshape Learning Spaces. *European Journal of Education*, 60(1), e70000. <https://doi.org/10.1111/EJED.70000>; PAGEGRO UP:STRING:PUBLICATION

kuasa, H. (2023). Integration of Artificial Intelligence in Geography Learning: Challenges and Opportunities. *Sinergi International Journal of Education*, 1(2), 75–83. <https://doi.org/10.61194/EDUCATION.V1I2.71>

sheed, T., Bashir, A., Hanif, S., & Gul, H. (2025). Leveraging AI to Mitigate Educational Inequality: Personalized Learning Resources, Accessibility, and Student Outcomes. *The Critical Review of Social Sciences Studies*, 3(1), 2399–2412. <https://doi.org/10.59075/J4959M50>

ami, A. O. (2024). Artificial intelligence, digital colonialism, and the implications for Africa's future development. *Data & Policy*, 6, e67. <https://doi.org/10.1017/DAP.2024.75>

igwa, S., & Mutabazi, P. (2025). Artificial Intelligence and Rwanda's Economic Transformation: A Strategic Policy Review of Sectoral Readiness, Challenges, and Opportunities. *SSRN Electronic Journal*. <https://doi.org/10.2139/SSRN.5275949>

Sarkar, A. (2025). *Bridging the Divide: A Systems Thinking Approach to Inclusivity in AI Development and Education*. <https://doi.org/10.2139/SSRN.5097669>

Senekal, B., & Brokensha, S. (2023). The potential of artificial intelligence (AI) for decolonising education in South Africa through the development of indigenous languages. *South African Journal of African Languages*, 43(3), 208–215. <https://doi.org/10.1080/02572117.2023.2294405>; CTYPER:STRING:JOURNAL

Sharma, P., Malhotra, R. K., Altybekova, D., & Singh, C. P. (2024). AI and Machine Learning as Catalysts for Educational Equity: Bridging the Urban–Rural Divide. *Lecture Notes in Networks and Systems*, 1074 LNNS, 41–55. https://doi.org/10.1007/978-981-97-6103-6_4

Singh, A., Lakhera, G., Ojha, M., Mishra, A. K., & Nain, A. (1 C.E.). Balancing Innovation With Responsibility: Ethical Dimensions of AI in Revolutionizing E-Learning. <Https://Services.Igi-Global.Com/Resolveddoi/Resolve.Aspx?Doi=10.4018/979-8-3693-4147-6.Ch020>, 467–500.

https://doi.org/10.4018/979-8-3693-4147-6.CH020

Soledad, M., Zúñiga, V., Ortiz Jimenez, M., & García, P. G. (2025). Artificial intelligence chatbots in language learning for disadvantaged populations (migrants and aboriginal). State of the art and challenge. *EDMETIC*, 14(2), 5–5. <https://doi.org/10.21071/EDMETIC.V14I2.17263>

Suliman, Z., Mohale, N. E., Maphoto, K. B., & Sevnarayan, K. (2024). The interconnectedness between Ubuntu principles and generative artificial intelligence in distance higher education institutions. *Discover Education*, 3(1), 1–13. <https://doi.org/10.1007/S44217-024-00289-2/FIGURES/2>

Talema, T. (n.d.). *Artificial Intelligence in Ethiopia: Opportunities, Ethical Dilemmas, and Strategic Pathways for Sustainable Adoption*.

Tripathi, A., Yadav, V., & Kumar, S. (2025). *Leveraging Artificial Intelligence for Rural Education: A Systematic Review of Transforming Learning Opportunities and Bridging the Urban-Rural Divide*. <https://doi.org/10.20944/PREPRINTS202504.0598.V1>

Twabu, K. (2025). Enhancing the cognitive load theory and multimedia learning framework with AI insight. *Discover Education*, 4(1), 1–10. <https://doi.org/10.1007/S44217-025-00592-6/FIGURES/2>

Uddin, M. M. (2024). Rejection or integration of AI in academia: determining the best choice through the Opportunity Cost theoretical formula. *Discover Education*, 3(1), 1–13. <https://doi.org/10.1007/S44217-024-00349-7/METRICS>

Vetri Selvi, M., Upadhyay, P., Revathi, A., Punitha, N., Reshma, S., & Saravanakumar, M. (1 C.E.). Enhancing Urban AI-Powered Transportation Systems With Machine Learning. <Https://Services.Igi-Global.Com/Resolveddoi/Resolve.Aspx?Doi=10.4018/979-8-3693-7984-4.Ch020>, 363–382. <https://doi.org/10.4018/979-8-3693-7984-4.CH020>

Wachira, L. J., Hayker, S. O., Larouche, R., Oyeyemi, A. L., Prista, A., Owino, G. E., Tremblay, M. S., & Onywera, V. O. (2022). Physical activity and active transportation behaviour among rural, peri-urban and urban children in Kenya, Mozambique and Nigeria: The PAAT Study. *PLOS ONE*, 17(1), e0262768. <https://doi.org/10.1371/JOURNAL.PONE.0262768>

Yadav, M., Singh, S. K., Sharma, P., & Hung, T. H. (1 C.E.). AI and Lifelong Learning in Developing Countries: Investigate the Potential of AI to Support Lifelong Learning and Development in Low-Resource Contexts. <Https://Services.Igi-Global.Com/Resolveddoi/Resolve.Aspx?Doi=10.4018/979-8-3693-0884-4.Ch003>, 49–72. <https://doi.org/10.4018/979-8-3693-0884-4.CH003>