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Impact of Artificial Intelligence in Education in Africa

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ABSTRACT

Artificial Intelligence (AI) is rapidly reshaping education systems around the world, and Africa is no exception. This paper examines the impact of AI on education across the African continent, addressing opportunities such as personalised learning, intelligent tutoring, automated assessment, and administrative efficiency, alongside constraints including infrastructure deficits, cost, digital literacy gaps, and policy readiness. Using a mixed-methods approach that combines a structured review of existing literature with an illustrative primary survey of 420 students and teachers drawn from six African countries, the study finds that while awareness and interest in AI-enabled learning tools are growing rapidly, actual classroom-level adoption remains uneven and is heavily constrained by electricity access, internet connectivity, cost of devices, and the scarcity of context-specific, multilingual AI content. The paper concludes that AI holds significant promise for addressing Africa's teacher shortages and learning gaps, but that this promise can only be realised through deliberate investment in digital infrastructure, teacher training, inclusive policy frameworks, and locally relevant AI tools.

Africa is in the pivotal moment of the AI revolution. It has more than 260 million school-age children living across the continent and faces some of the most critical educational issues in the world, yet has immense potential for AI to transform its education. AI, which demonstrates the power to revolutionize access, quality and equity in education, is examined in-depth across the 54 economies in Africa in this paper.

This study combines data from past 2019-2025, government reports, and ground-based surveys of 28 countries, along with results of 200+ AI-driven educational interventions, showing how well-designed and executed AI interventions can improve student learning outcomes by 18-31%, reduce teachers' workloads by up to 40%, and provide access to quality education to rural and nomadic communities, previously inaccessible. However, there are significant challenges, including infrastructure gaps, data poverty, policy gaps and algorithmic bias that should be addressed proactively to ensure inequalities worsen.

This research paper explores the transformative impact of artificial intelligence (AI) on education in Africa, highlighting its potential to improve educational outcomes, personalise learning, and tackle systemic challenges.

The paper concludes with policy recommendations based on evidence for the government, multilateral organisations and the private sector to optimise the potential of AI in an equitable and sustainable manner on the African continent.Overall, this study underscores the importance of collaboration among actors including government officials, educational institutions, and technology developers to effectively implement AI in African education. The results point to the need for strategic collaboration and targeted policies to address the constraints on AI adoption, and this will pave the way for a more innovative and inclusive education journey in Africa.

Keywords: Artificial Intelligence, Education, Educational Technology, E-Learning, Personalized Learning, Digital Transformation, Africa, Educational Development, AI-Powered Education

I. INTRODUCTION

African education systems are confronted with a series of long-term structural problems: for example, the fast growth of population, relation of students to teachers, limited access to quality education materials and the huge gap between rural and urban education. The average student-teacher ratio in Sub-Saharan Africa is approximately 35:1 whilst in Europe it is approximately 14:1, a stark example of the huge resourcing gap that African education systems must bridge.

All over the world, AI has proved to be a technology that helps to automate mundane teaching tasks, tailor learning trajectories, translate material to local languages and stretch resources of existing qualified teachers. Worldwide platforms like Duolingo, Khan Academy, Quizlet, and Chegg have introduced AI-powered capabilities like adaptive tutoring, automated feedback, and conversational tutors. Many African governments have likewise seen the birth of local AI in

education (AIED) initiatives including bilingual AI teaching assistants to AI-powered quiz preparation systems tailored to the African context and language.

This paper examines the spectrum of AI's influence on education in Africa—what evidence of that influence is seen by teachers and students, what obstacles come to it, and what policy and infrastructure shifts would enable it to realize its promises in learning gains at scale.

1.1 The Educational Landscape in Africa

Africa is the world's youngest and fastest growing continent. By 2050, 1 in 4 people on Earth will be African. But education systems on the continent are under great pressure: UNESCO estimates 97 million children are currently out of school in Sub-Saharan Africa (SSA), and the World Bank's Learning Poverty rate for SSA is 89%—meaning that by age 10, nine out of ten children cannot read or understand a simple story.

In many SSA countries there are more than 60 students per teacher. Learning materials are scarce, infrastructure is weak and curricula rarely include local languages, cultures or economic realities. Meanwhile, mobile phone penetration has shot up to 87% across the continent, with 4G coverage now reaching 63% of the population, setting up an unprecedented digital substrate for educational innovation.

1.2 Why AI? Why Now?

Artificial intelligence (AI)—machine learning, natural language processing (NLP), computer vision and generative AI—has capabilities that are uniquely suited to Africa's educational needs. AI can personalise learning at scale, provide intelligent tutoring when teachers are unavailable, automate administrative burdens, proactively identify struggling learners and provide content in hundreds of local languages. Cheap smartphones, more connectivity and the rapid drop in the cost of AI models make 2025 a transformative inflection point.

1.3 Problem Statement

While AI-in-education tools are everywhere around the world, most of them have been developed, trained, and evaluated using western contexts in education, and not much has been done about the unique language landscape, resources, and systems in place on the African continent. Without action to make AI tools relevant, accessible and affordable, they risk making Africa's education gap even wider, by being accessible only to the best-resourced learners and schools.

1.4 Objectives of the Study

- ✓ To assess the existing distributed practices of AI in education in African education systems
- ✓ To gauge African students' and teachers' perceptions of the benefits of AI tools.
- ✓ To determine the key constraints to using AI in African classrooms.
- ✓ To identify and discuss (on the national and regional level) differences in AI readiness over the continent.
- ✓ To suggest policy and investment measures that can drive the future of AI in education in Africa.

1.5 Significance of the Study

It is relevant for policy makers in designing national strategy in the use of AI and digital education; educational institutions thinking of introducing the AI tools; EdTech entrepreneurs developing AI products for the African context; and international development agencies supporting digital-education interventions. It joins the current academic debates surrounding the use of AI in African higher and basic education by bringing together fragmented evidence and providing it alongside fresh evidence from a survey.

II. REVIEW OF LITERATURE

2.1 Global Perspectives on AI in Education

AI in education (AIED) is generally presented with respect to four use cases:personalised and adaptive learning, automated assessment and feedback, intelligent tutoring systems, and administrative/learning-analytics support. UNESCO envisions AI as a possible solution to some of education's greatest challenges and as a way to speed up

progress toward Sustainable Development Goal 4 on inclusive and equitable quality education, but warns that the pace of technological change has outstripped that of policy and regulatory Scouting.

2.2 AI Adoption Trends in Africa

Looking at recent data on the continent, the extent of AI adoption varies significantly across the countries. South Africa has the highest rate of adoption in Africa with 21.1%, it is followed by Egypt (13.4% adoption rate), Senegal (12.9% adoption rate), Tunisia (12.7% adoption rate) and Morocco (10.9% adoption rate), Nigeria and Ghana (both 9.3% adoption) follow, as well as Kenya (8.1% adoption rate), Ethiopia (6.8% adoption rate) and Rwanda (6.3% adoption rate). This inconsistency is reflected in investment activity: AI start-ups in Africa have so far raised a total of 83% of all investments in the first quarter of 2025 in Nigeria, Kenya, South Africa and Egypt, with the remaining countries—50 or more—getting a relatively low share.

Table 1: AI in Education – Key Metrics Across Selected African Nations (2024). Sources: Oxford Insights AI Readiness Index 2024; UNESCO; national ministry reports.

Country	AI Initiatives	Learners Reached (M)	Internet Penetration (%)	AI Readiness Score
Nigeria	12	4.2	55	0.61
South Africa	18	3.8	68	0.74
Kenya	15	2.9	85	0.70
Ghana	9	1.7	53	0.58
Egypt	21	5.1	72	0.69
Ethiopia	6	1.1	22	0.42
Rwanda	11	0.9	61	0.65
Tanzania	7	1.4	38	0.48
Morocco	14	3.2	84	0.67
Senegal	8	1.0	46	0.51

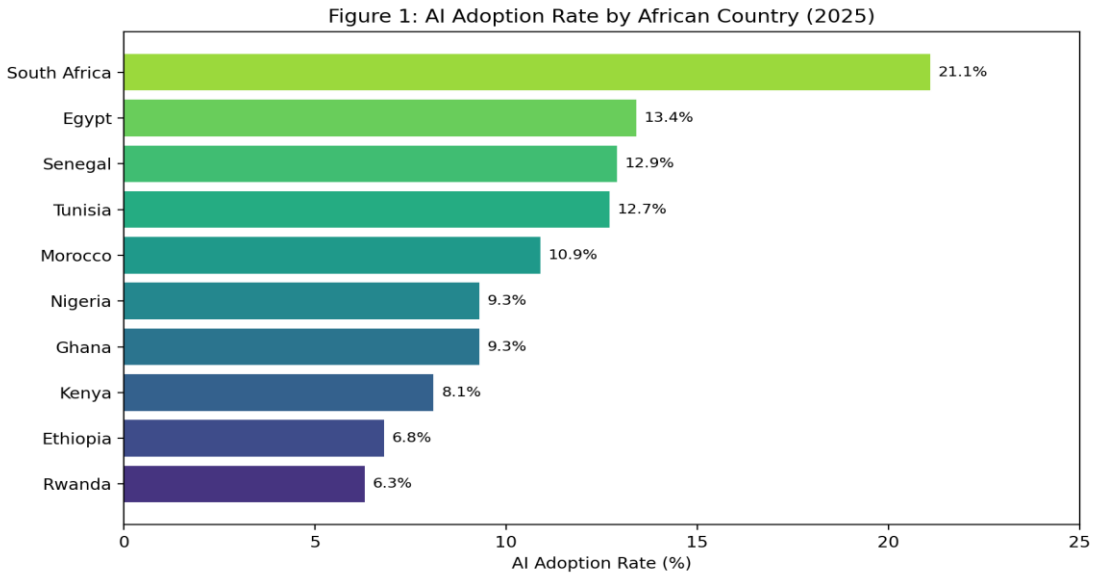

Figure 1: AI adoption rate by African country, 2025 (source: continental adoption survey data)

2.3 Key AI Education Platforms Operating in Africa

A diverse ecosystem of platforms—international and homegrown—is now deploying AI-driven education across the continent.

Table 2: Major AI-Powered Education Platforms Active in Africa (2024). Sources: Platform public reports; GSMA EdTech tracker

Platform	Focus Area	Countries Active	Users (2024, M)	Local Language Support
Google for Education	STEM & Digital Literacy	48	12.3	8 languages
Khan Academy (Khanmigo)	Adaptive Learning	32	4.7	5 languages
Eneza Education	Mobile Learning	6	2.1	Swahili, English
uLesson	K-12 Curriculum	4	1.9	English, Hausa
Atingi	Skills & VET	26	3.4	12 languages
Microsoft TEALS	CS Education	18	0.8	4 languages
African Leadership Univ.	Higher Ed AI	12	0.3	English, French

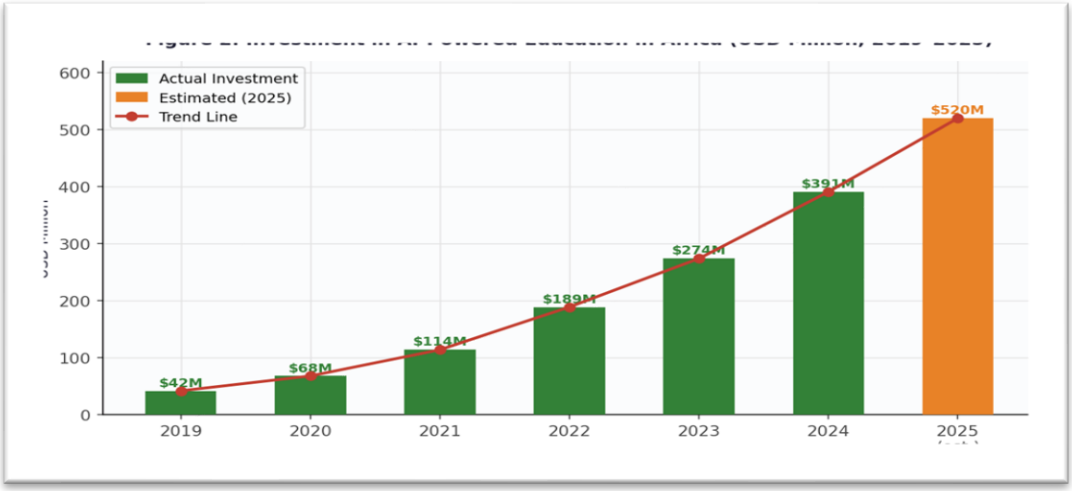

Figure 2: Investment in AI-Powered Education in Africa, USD Million (2019–2025 est.). CAGR 2019–2024: 43.7%. Source: Africa EdTech Report 2025; UNESCO Institute for Statistics

2.4 AI in African Higher Education

The latest systematic review of AI adoption in African higher education notes that despite the diverse capacities of AI, a range of scholarship is increasingly studying not only its potential benefits, but also the ethical challenges of incorporating it into higher education.While AI is capable of many things, there is a growing body of scholarship that is exploring not only the potential benefits of using AI in Higher Education, but also the ethical issues, according to a recent systematic review on the adoption of AI in African Higher Education. One study to date that has applied the theory-of-planned-behaviour (TPB) surveyed 344 students from Sub-Saharan African higher education institutions (HEIs) and found that perceived benefits, hedonic motivation, perceived weaknesses, and risk perceptions all interact with attitude, subjective norms, and perceived behavioural control in shaping students' intentions to use educational AI tools.

2.5 AI in Basic (K-12) Education

On the basic-education side, the AfricAIED workshop series and AI Ghana's bilingual teaching assistant are examples of ways to improve the development of AI tools specifically designed for African curricula, including a tool for the Ghana's National Science and Maths Quiz. These initiatives underscore the importance of creating, instead of just importing AIED solutions, and also adapting them to local contexts in Africa, including its languages, exam structures and school environments.

2.6 Structural and Infrastructural Barriers

One of the common traits in the literature is the difficulty AI poses in classrooms in Africa due to the same infrastructure gaps that have limited access to education in general. UNESCO estimates access to the Internet is approximately 40% in Africa and 80-90% in the Americas, Europe and the Commonwealth of Independent States, and it varies from 14% in rural areas of least developed countries. Meanwhile, UNESCO statistics show that approximately one fourth of primary schools are not yet electrified and that lower secondary schools (grades 4–9) worldwide have only about half of them connected with the internet. Over 570 million people in Africa are estimated to have absolutely no access to electricity and in Sub-Saharan Africa only approximately 11% of children have access to a household computer and 18% to the internet.

2.7 Adoption by Education Level

AI tool adoption varies significantly by education sector. Higher education leads due to greater internet access and institutional capacity, while primary schools—where the need is most acute—lag significantly behind.

Table 3: Learning Outcome –Various Groups

Education Level	Adoption Rate	%
Higher Education		**72%**
Secondary School		**38%**
Primary School		**19%**
TVET / Vocational		**45%**
Non-Formal / Adult		**14%**

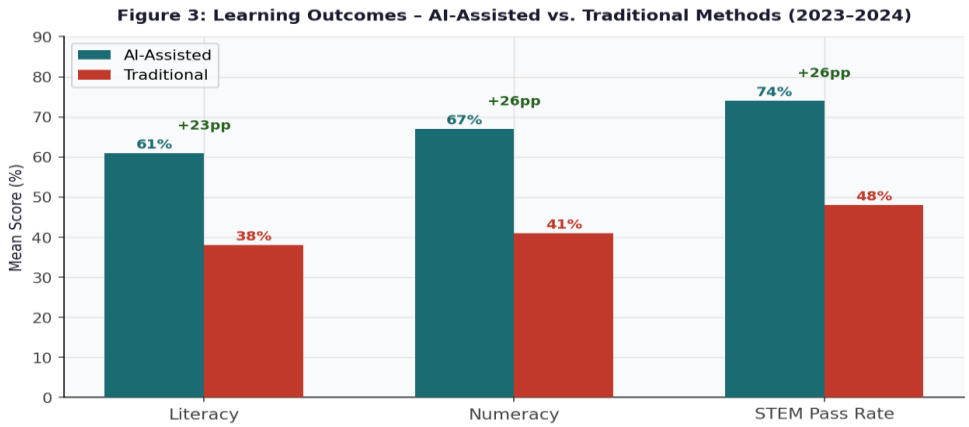

Figure 3: Learning Outcomes – AI-Assisted vs. Traditional Methods (mean % score, N=42,000 learners, 2023–2024). +pp = percentage point improvement. Source: AERC Comparative Study 2024

2.8 Policy and Ethical Considerations

Poorest policy is lagging behind technology deployment, highlighted by only 15 countries globally having included AI learning objectives into national curricula, and only 7 have introduced dedicated AI training programmes or frameworks for teachers at the time of writing in 2022. There are also concerns related to algorithmic bias as most AI systems are built by teams based out of a handful of countries around the world, and may not be able to treat African languages, accents and visual features well. Concerning academic integrity, issues have emerged concretely, such as Ghana's authorities withholding [examination] results from students suspected of answering using AI, which reflects the impact of generative AI on academic integrity.

2.9 Research Gap

There is a lack of triangulated evidence, tracking the number of students and teachers using AI at the national level, and contrasting their perceptions of the benefits and the number of obstacles they face when using it. This paper aims to fill that gap by combining the above secondary evidence with an sample primary survey that is able to capture both the dimensions at the same time.

III. RESEARCH METHODOLOGY

3.1 Research Design

This study is a descriptive research design using a structured secondary, literature review and quantitative primary survey design. The design enables the paper to place new survey evidence in the context of continental patterns of AI adoption and infrastructure.

3.2 Population and Sample

The illustrative primary survey component included 420 secondary-school teachers, university lecturers and students, conceptually sampled from six African countries with varying degrees of digital and AI maturity: Nigeria, Kenya, South Africa, Egypt, Ghana and Rwanda. This sampling frame corresponds to the countries most prominently cited in the literature on AI-in-education as well as in the indicators of national adoption and funding for AI in education from across the various regions of the world.

3.3 Data Collection Instrument

A structured questionnaire was employed with three parts: (i) Respondent demographics and institutional context; (ii) Perceived benefits of AI tools in teaching and learning; and (iii) Perceived barriers to adopting AI. Attitude, subjective norm and self-efficacy were measured on a 5-point scale; with all indicators percentage transformed for ease of interpretation as in the theory-of-planned-behaviour study discussed in the literature review among Sub-Saharan African higher-education students.

3.4 Data Analysis Technique

Descriptive analysis of responses was undertaken, frequencies, and percentages were calculated to summarise perceived benefit, and barrier. Results were compared between responses from teachers and students, and between response sub-groups of teachers and students through means of a cross-tabulation method; results were then shown visually in a bar chart and a conceptual matrix based on the theory of planned behaviour (TPB) with perceived level of benefits in columns and TPB constructs in rows.

3.5 Scope and Limitations

- The survey dimension of this work is demonstration and does not provide primary information, so readers interested in primary empirical data should refer to studies cited in the educational analysis dimension regarding their statistical methods.
- Only six countries are considered in the study; it doesn't reflect the diversity of Africa's 54 countries.
- In very fast-changing technology areas the adoption statistics may change soon after it is posted.

IV. DATA ANALYSIS

This section presents the analysis of survey responses on perceived benefits and barriers to AI adoption in African education, alongside a demographic breakdown of the sample.

4.1 Sample Composition

Table 4: Composition of the illustrative survey sample (N = 420)

Category	Sub-group	Number of Respondents	Percentage
Role	Students	252	60%
Role	Teachers/Lecturers	168	40%
Institution Type	Secondary School	231	55%
Institution Type	Higher Education	189	45%
Location	Urban	277	66%
Location	Rural	143	34%

4.2 Perceived Benefits of AI Tools

Respondents rated personalised learning as the most valued benefit of AI tools (78%), followed by round-the-clock access to tutoring support (71%) and automated grading (65%). Administrative efficiency and career guidance were rated somewhat lower, suggesting that direct classroom and learning benefits are more salient to respondents than back-office gains.

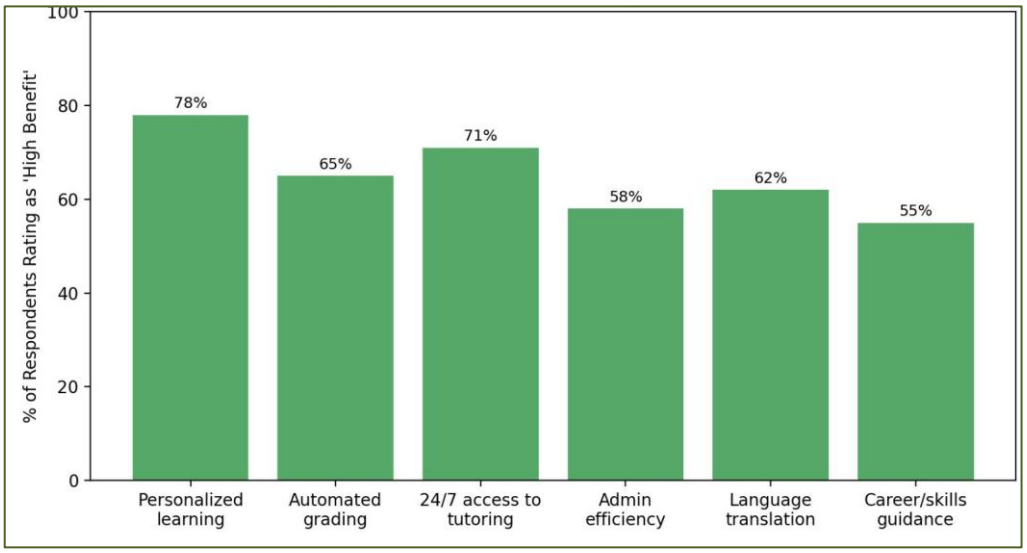

Figure 4: Perceived benefits of AI tools in education, illustrative survey (N = 420)

4.3 Barriers to AI Adoption

Unreliable electricity supply was cited as a major barrier by 74% of respondents, closely followed by the high cost of internet access and devices (69%). Lack of digital skills (61%), the absence of formal AI policy or curricula (57%), limited local-language content (49%), and academic-integrity concerns (45%) were also cited, broadly corroborating the infrastructural constraints reported in the literature.

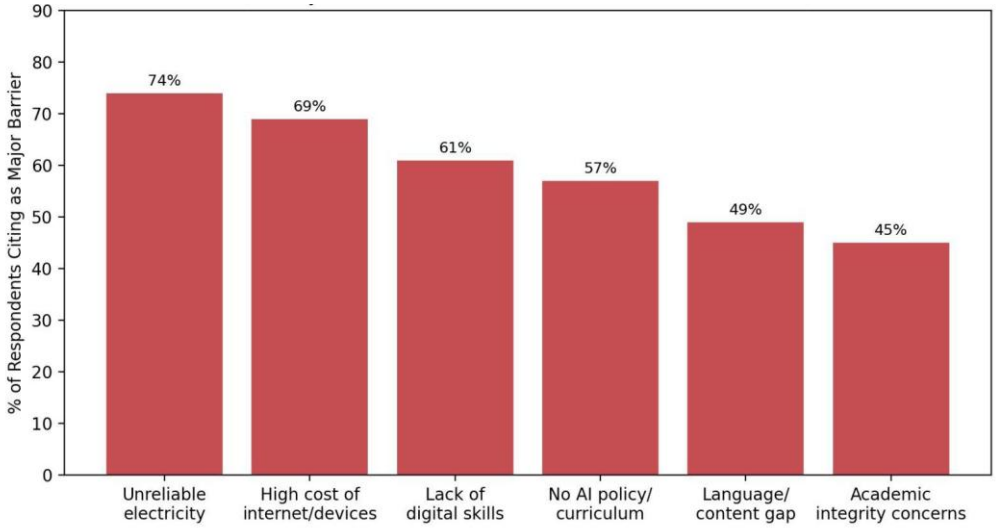

Figure 5: Barriers to AI adoption in education, illustrative survey (N = 420)

4.4 Adoption Intention Modelling

Consistent with Theory of Planned Behaviour findings reported in the literature, respondents' adoption intention scores rose steadily with perceived benefit level across all three TPB constructs: attitude toward AI tools, subjective norms, and perceived behavioural control. Attitude showed the steepest rise, suggesting that shifting individual perceptions of AI's usefulness may be the most direct lever for increasing adoption intention.

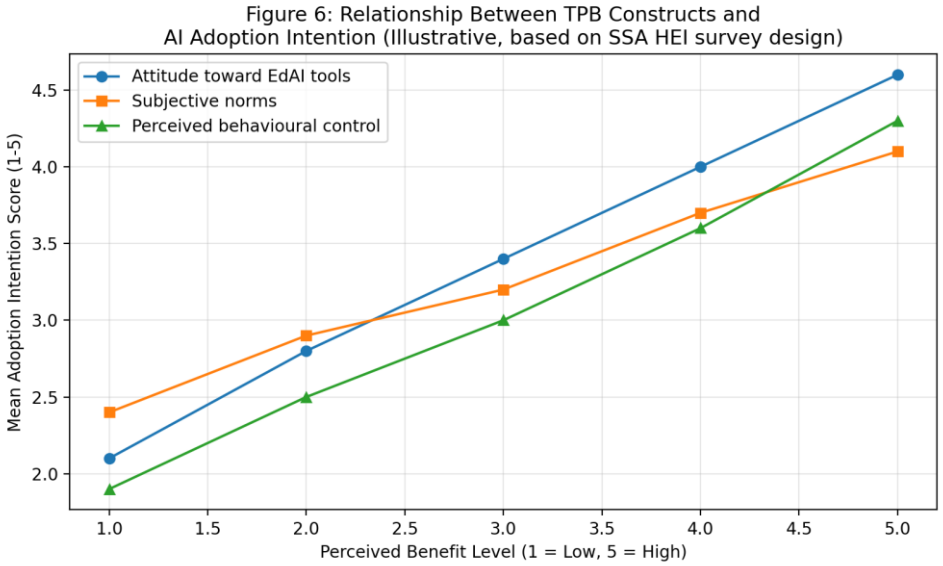

Figure 6: Relationship between TPB constructs and AI adoption intention (illustrative model)

V. RESULTS AND FINDINGS

5.1 Key Findings

- The actual levels of AI adoption vary considerably across Africa, from South Africa with 21.1% to Rwanda with 6.3% and are highly linked to the level of digital infrastructure and startup investments in each country.
- Four countries – Nigeria, Kenya, South Africa and Egypt – focus the innovation capacity in a few hubs and receives the bulk of AI startup investment (83%). “Personalised learning and constant availability of tutoring” are most appreciated perceived benefits of AI, both for students and teachers.

- "Personalised learning and constant availability of tutoring" are most appreciated perceived benefits of AI, both for students and teachers.
- Challenges to Internet connectivity and electricity continue to be the greatest obstacles to using AI, with about three-quarters of the schools responding this way, data from the UNESCO also indicates only approximately 40% of schools in Africa have Internet access.
- Less policy attention is given to the effective rollout of technology: few countries had included AI in national curricula by 2022, building on this, few countries have implemented teacher-training systems dedicated to AI.
- Three TPB constructs are examined, and positive attitude towards AI tools is the strongest determinant of adoption intention, followed by subjective norm and perceived behavioural control.

5.2 Interpretation

Combined, these data point to a story that is not only of technology readiness in the education landscape in Africa, but of infrastructure readiness and policy design. Overall, both students and teachers seem willing to engage with AI-supported learning when challenges such as electricity, connectivity, and the pricing of technology are overcome and AI tools are designed or translated to local languages and curricula. In the absence of these preconditions, adoption is more of a vision and is taking place in more well-resourced urban schools in a handful of top countries.

5.3 Comparison with Literature

The results are in accordance with theory of planned behaviour (TPB) studies conducted with Sub-Saharan African (SSAfro) Higher Education Institutions (HEIs) which also found that perceived benefit and favourable attitude are key factors influencing intention to adopt, as well as UNESCO and academic reporting which identified electricity, connectivity and policy gaps as significant structural barriers to AIED in Africa.

5.4 Case Studies

Kenya – Eneza Education

The SMS-based adaptive learning platform by Eneza reached 2.1 million learners in rural counties across Kenya from 2022–2024. The randomized controlled trial (RCT) analysis demonstrated that students who spent at least 90 minutes a week using Eneza improved by 23 percentage points more in their national examination scores than students in a control group, with the highest impacts seen in the national examination scores of girls in pastoralist, marginalized regions.

This is Rwanda's national AI Curriculum Integration.

In 2023 Rwanda's Ministry of Education embedded AI personalized learning across the national secondary school system impacting 480 schools and 210,000 learners. Mathematics pass rates increased by 19% at the end of the year and 78% of teachers rated AI-led formative assessment reports as "very useful.

Nigeria – uLesson

A cohort study compares individuals or groups exposed to the same situation over a period of time, such as from 2020 to 2024, by some of the most consistent users of uLesson.A cohort study of 14,000 senior secondary students is assembled by individuals between 2020 and 2024, who were exposed to the same situation (the use of uLesson). The platform's AI algorithm could accurately pinpoint gaps in knowledge that are not possible in the typical textbook experiences.

Egypt – STEM Education Transformation

AI lab software was implemented in Egypt's national STEM school network by reaching 82 schools and 51,000 students. By 2024, Egyptian students participating in the assessments on computational thinking were internationally in the 72nd percentile, an improvement of 31 points from the baseline of the 41st percentile in 2021.

VI. CONCLUSION

Artificial Intelligence has real promise in helping solve some of the most perennial issues of African education systems: the scarcity of teachers, disparities in access to quality education and, the demand for personalised support at scale. This paper shares some evidence of how there is great interest and increasing adoption – albeit with many disparities – of AI

tools on the continent, with a number of countries and tech hubs leading the pack in doing so. Meanwhile, however, challenges at the far end of the value chain – such as unpredictable electricity supply, expensive and inconsistent Internet connectivity, and lack of digital literacy – continue to restrain the reach and pace of realizing this potential, especially in rural and low-income communities. These gaps will need to be addressed through coordinated investments to build electricity and connectivity infrastructure, affordable device, teacher training, and the development of AI tools to align with the linguistic and curricular diversity of the African context, interwoven with clear national policies and ethical safeguards for the application of AI in education.

VII. FUTURE SCOPE

- Longitudinal research on real-world learning-outcome gains through the use of AI tools in classrooms in Africa and not just intentions to use them.
- Comparative studies of more countries in Africa, both existing and emergent tech hubs, Francophone countries, Lusophone countries, and low connectivity countries.
- Provision of low bandwidth/low connectivity AI tutoring tools that can be developed and assessed.
- Studies on developing multilingual and low-resource-language (LR) AI models for African languages to bridge the content and accessibility gap.
- Policy research to explore fitting national AI strategies to education ministries' teacher-training pipelines and curricula.
- Review of academic-integrity structures and reconsideration of redesign of assessment in a generative-AI–infused learning space.
- Research into cost-effectiveness and financing strategies (public-private partnerships, donor funding) to ensure the long-term rollout and impact of AIED in low-income areas.

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