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Where AI Fits and Where It Doesn't:

A framework for problem-led AI integration in African education

Introduction

The problem with solutions in search of problems

The history of technology in education is littered with well-funded interventions that produced disappointment. The “laptop per child” initiatives of the early 2000s are perhaps the most instructive: billions invested in hardware, with evidence of impact that ranged from modest to negligible, and a mounting body of research suggesting that the binding constraint was never access to a device. It was teacher capacity, curriculum quality, language of instruction, and the time a child could spend in school.

AI risks repeating this pattern on a greater scale and with more convincing promises. The allure of large language models (LLMs) has generated a wave of EdTech products that ask, “What can this technology do in an education context?” *We think that is precisely the wrong question to ask. The right question is:*

> ***What is the binding constraint on educational outcomes in my context — and what is the most appropriate intervention to address it?***

What follows is a proposed framework for answering that question, with AI as the focus of intervention. It is organised around educational challenges rather than AI capabilities, and it is deliberately critical: identifying not only where AI has genuine potential but also where it is being overapplied, where it risks harm, and where other interventions are more effective or cost-appropriate.

Starting with the Problem

Across Sub-Saharan Africa, children are losing out on quality education and even simply losing access to education altogether. This can result from a variety of constraints. A teacher who lacks subject knowledge, a school without electricity, a curriculum delivered in a language the child doesn't speak at home, a menstrual cycle, or a parent who withdraws their child to contribute to household income.

The Compounding Constraint Problem:
Why learning fails across a lifetime

System Capacity / Infrastructure

System capacity Breakdown
Student-teacher ratios exceed **1:60** in many regions, paired with a **70%** lack of school electricity.

Tech addresses only a fraction.

Household Economic Pressure
High opportunity costs force families to choose child labor over schooling in resource-constrained homes.

The Critical Secondary Transition
Enrollment plunges to **40%** as gender norms and increased school fees prioritize boy's education.

The Learning-Adjusted Gap
SSA children lose 4-5 years of quality schooling relative to high-income country benchmarks

Early Childhood
Ages 0-7

Primary School
(Ages 7-18+)
~66%
(1 in 3 fail to finish)

Lower Secondary
41%

Upper Secondary
23%

Lifecycle Impact Data

Education Level	Completion Rate (%)	Major Constraint Type
Primary School	~66%	System Capacity / Infrastructure
Lower Secondary	41%	Economic / Social Norms
Upper Secondary	23%	Labor Market Alignment / Fees

The Foundation Gap & Gatekeepers

The Early Childhood Foundation Gap
SSA pre-primary enrollment is only ~40% leaving children without cognitive readiness for primary school

98 Million children locked out
Prohibitive travel distances (5km+) and lack of birth documentation prevent primary school entry.

Economic / Social Norms

Labor Market Alignment / Fees

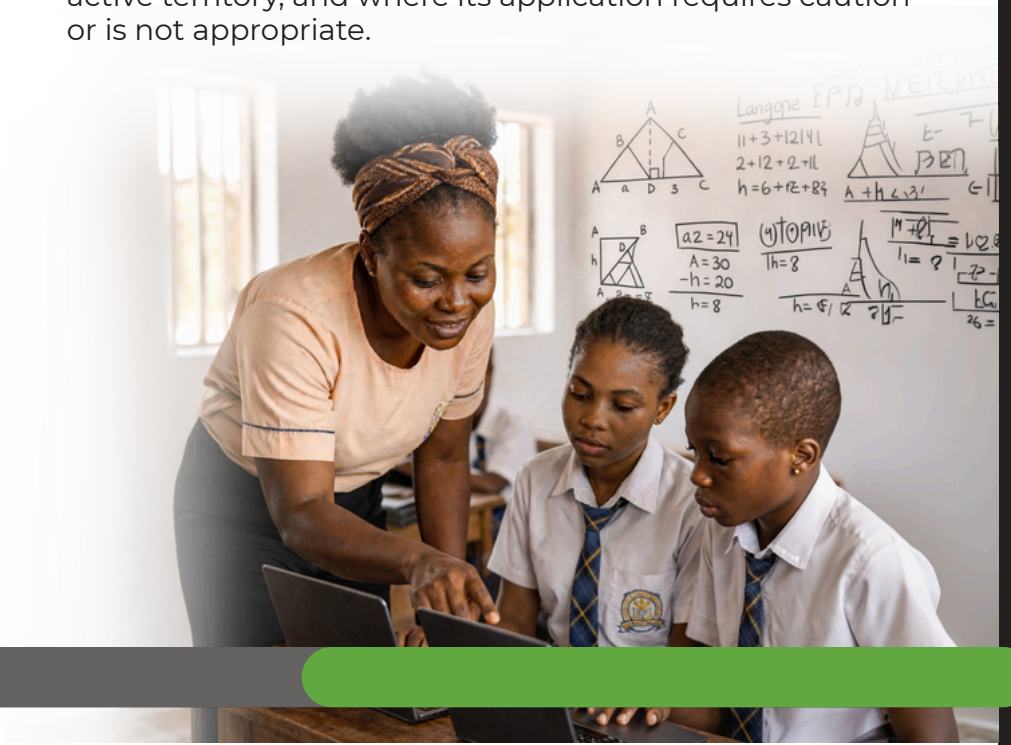
This multiplicity of causes matters enormously for technology integration. Each requires a fundamentally different response. Applying AI to the wrong constraint not only wastes resources; it can also crowd out more appropriate interventions and create a false sense of progress. This is particularly costly in systems where resources are already acutely scarce.

Mapping AI Capabilities Against Educational Challenges

This framework organises AI by what it does. We define five functional capabilities that are relevant to education contexts in Africa:

- **Diagnose & Predict:** draws on historical and real-time data to surface insights, identify risks, and forecast needs at classroom, school or even system levels. Its value lies in making visible what would otherwise be hidden: a student at risk of dropping out, a school whose resource allocation is inefficient, a district where demand for secondary places will outstrip supply, or a ministry that under- (or over-) spends.
- **Personalise:** tailors content, pacing, and learning pathways to individual learners or teachers in real time. A mature AI application in EdTech globally, interventions use machine learning recommendation systems to adjust difficulty or sequence based on students' performance data and provide professional development and tailored coaching resources for teachers.
- **Generate & Translate:** produces content, materials and assessments at scale, including across languages and contexts. This is primarily the domain of LLMs. The area attracts considerable investment but requires careful attention to cultural and linguistic appropriateness.
- **Automate:** reduces the administrative burden on teachers and school systems: planning, marking, scheduling, reporting, and ministry-to-frontline or school-to-parent communication systems. The value is not glamorous, but it is significant in systems where teachers already spend substantial time on non-teaching tasks.
- **Simulate:** creates virtual or augmented environments that substitute for physical ones, from chemistry experiments to geography field trips to engineering challenges. Virtual facility tours also enable ministries to conduct remote compliance inspections and allow parents to vet schools without travel costs. This is the least-discussed capability in African EdTech.

The matrix on the following page maps these five functional capabilities against six education challenges relevant to African contexts. It identifies where AI has strong and underexplored potential, where it is already an active territory, and where its application requires caution or is not appropriate.



Legend: Opportunity/Underserved | Active territory | Not applicable / out of scope

Education Challenge	Diagnose & Predict	Personalise	Generate & Translate	Automate	Simulate	Example
Education Finance Budget constraints, poor financial management and allocative inefficiencies	• Budget forecasting • Big-data informed pricing • National, district, or school-level resource planning	• Tailored payment plans for parents	-	• Fee mgmt, • Admin automation	-	
Physical infrastructure Inadequate infrastructure, electricity, sanitation, build and maintenance constraints	• School density mapping • Build needs and demand forecasting	-	-	• Dynamically renting facilities to generate additional revenue	• Virtual tours/GIS data for compliance checks	
Qualified teachers Severe teacher shortages, insufficient training, qualifications and pedagogical capacity	• Resource forecasting and localised, needs-based allocation • Real-time monitoring of where classrooms are staffed, have received + are using materials	• Adaptive training and professional development • Teacher performance monitoring	• Lesson planning • Classroom activities design and content	-	• Teacher training using videos and interactive feedback on good practices	*Siyavula* *Edutech Institute,* *Mindspark* *Mindjoy*
Quality, inclusive learning and resources Lack of learning materials, out-of-school children	• Identifying out-of-school children & risk factors • Track a unique child from birth through school	• Personal tutors • Personalised learning pathways	• Rapid translation of existing global digital resources • Multilingual & sign language content	-	• Virtual labs, AR/VR experiments	*VamboAI* *Mindjoy* *Siyavula* *Edutech Institute,* *Mindspark* *EEDI*
Assessment and wrap-around support Inability to identify and remedy learning gaps, special needs	• Predicting learning gaps and potential issues with future curricula	• Detailed assessment feedback and suggested learning	• Assessment design	• Marking automation & admin reduction • Automated early learning checks for sight/hearing impairments	-	*Marking AI* *The Marking App* *EEDI* *Mindjoy* *Edutech Institute,* *Mindspark*
Parental & community engagement Poor awareness, trust and affordability as barriers to parental/ community buy-in	• School identifier, pre-screening • Collect and understand parent feedback, engagement trends	• More regular and low-effort parent-teacher communication about progress. • Parental education on needs-based nutrition, healthcare, and support	• Multilingual school comms	• Fee reminder and collection, • Benefits/ grant integration	-	

While much attention focuses on what happens inside the classroom, the barriers that keep children out of school, and the communication infrastructure that could address them, are largely neglected by EdTech builders developing AI solutions and the funders supporting them. AI for physical infrastructure planning is nascent despite being a pressing challenge. Predictive models to identify optimal school locations, assess the potential for community asset repurposing, or forecast enrolment demand have high-impact potential as interventions. Virtual laboratory simulation has the potential to democratise access to science education at a fraction of the cost of physical lab infrastructure, yet remains niche in African contexts.

Student tracking and personalised learning pathways attract the largest share of EdTech AI investment. This is not inappropriate as the need is real, and several well-designed products are producing evidence of impact. Additionally, it is easier to define and onboard clients for these use cases than for some other areas currently not being explored, where the natural client would be the government. It is also the easiest area to implement AI operationally, as the core solutions already exist, making it easier to adapt these solutions to include AI as a new feature.

Considerations for Adopting AI for Impact

EdTech implementers integrating AI into their solutions are navigating complex design and deployment questions with differing approaches. For example, both Mindspark (via EduTech Institution) and Siyavula apply adaptive algorithms to address challenges related to teacher capacity, access to learning resources, student tracking, and wraparound support. While Mindspark has integrated generative AI features for both learners and teachers, Siyavula has consciously chosen not to introduce generative AI directly to end users at this stage, using it only within its own workflows. Although approaches may differ, there are fundamental considerations common to all EdTechs grappling with AI integration.

CONSIDERATION ONE:

Prioritising pedagogical substance over technological facades

The introduction of AI risks fundamentally altering classroom dynamics: how students engage with material, with each other, with teachers, with parents, and with technology itself. The danger is that it enables students to bypass the cognitive work required for genuine learning. When AI generates essays, solves problems, or answers questions on behalf of learners, it creates the appearance of learning without the substance.

> *"LLMs are not designed from the ground up to be good for pedagogy"... [One needs to consider] "What problem are we trying to solve, and is that problem best solved with technology? But even before that, what do we know about how learning happens?" – Siyavula*

This requires returning to first principles: what does cognitive psychology tell us about how knowledge is acquired? Effective AI integration must be grounded in learning science, not technological capability. Strong instructional guardrails can help here: requiring learners to submit AI interaction logs alongside assignments, asking them to critique AI-generated responses with justification, and structuring tasks so AI becomes a scaffold for thinking rather than a shortcut around it.
"I am not biased against AI, and not for it. It needs to be used very carefully to ensure learning is happening—that is the most important thing." – Mindspark

CONSIDERATION TWO:

Augmenting teacher capacity instead of seeking substitution

When AI is framed primarily as a solution to teacher shortages, it can inadvertently shift focus from essential investments in teacher training, professional development, and retention. AI's more appropriate role is to reduce administrative burdens such as marking, assessment generation, and reporting, freeing teachers for the relational and instructional work where they add irreplaceable value.

> *"What we're trying to do is restore the joy of teaching rather than replacing the teacher." - Mindspark*

AI that amplifies teacher effectiveness strengthens the profession. AI positioned as a substitute for teachers risks undermining it. As technological capabilities shift rapidly, the boundary between what computers can do and what humans should do must be revisited continuously and critically.

CONSIDERATION THREE:

Navigating infrastructure constraints to ensure equity

> *"How do we protect these kids who've never seen an iPad before, they're still struggling with the basic fundamentals, and then they go leap onto this thing (AI), but they don't know how to do the foundational stuff...So I think for us, it's about the best use case for AI in the public sector because it has to be an ethical, responsible use of it, and we are still on that journey" - Mindspark*

Infrastructure and access to devices are one way in which questions of equity emerge. For example, a major driver of Siyavula's decision not to use generative or chat-based AI is that many of their users, including both teachers and learners, work on lower-end devices with inconsistent connectivity. Rather than shifting the technical burden onto end users, Siyavula currently uses generative AI only internally, for example, to support content creators and subject experts, but avoids assuming that learners have the infrastructure required to interact with generative systems effectively.

Small, on-device AI models are designed to operate with minimal connectivity and computing resources, thereby offering viable pathways for EdTech deployments across the continent. Practitioners and funders should always seek clarity on the minimum infrastructure requirements of any AI-enabled tool, and treat the deployment environment as a core design consideration from the outset, not an afterthought.

CONSIDERATION FOUR:

Aligning automated assessment with pedagogical intent

When AI grades or diagnoses learning gaps at scale, it shapes what teachers prioritise and what students optimise for. But AI-driven assessment introduces two compounding risks. First, quantitative metrics are inherently reductive, and in high-stakes decisions (grade progression, scholarship allocation, intervention targeting) this can be seriously detrimental to vulnerable or marginalised learners.

Second, and linked to consideration 1 above, AI systems can be technically accurate while misaligned with pedagogical intent. An algorithm may correctly identify an error but fail to recognise productive struggle or partial understanding that a teacher may spot. As one interviewee noted, the gap between accuracy and alignment with teacher expectations creates friction that undermines trust and utility in AI adoption.

Importantly, the feedback loop is difficult to reverse once embedded in institutional practice.

Conclusion

AI-enabled EdTech is attracting significant investment, and for good reason. Several high-impact areas remain underexplored: physical infrastructure planning, virtual laboratory access, and multilingual parental engagement tools. More proven areas, such as student tracking, personalised learning, and learning resource generation and translation, demonstrate the potential value of this technology.

But investment priorities do not automatically align with educational impact. The market remains in a learning phase, with implementers working to identify where, how, and under what conditions AI can meaningfully address educational challenges rather than simply demonstrate technological capability.

This discussion aims to reveal both opportunity and caution, and the path forward requires discipline. Critically, the introduction of AI into classrooms requires grappling with fundamental questions about pedagogy, equity, teacher roles, and infrastructure realities that technology alone cannot answer. Before integrating AI into an EdTech solution, these questions must be answerable:

01 What is the specific, binding constraint this solution addresses, and how do we know?

02 Is AI the most appropriate tool for this constraint, or would other interventions be more effective or cost-efficient?

03 What does learning science tell us about how students acquire knowledge in this domain, and how does this tool support that process?

04 Can this solution function in the connectivity and infrastructure conditions of its intended users?

05 Are models trained on data representative of the learner/teacher population - in language, context, and curriculum?

Realising the potential of AI in education requires resisting the pull of technological novelty and returning, again and again, to the problem being solved. Impact will depend less on the technology itself and more on a relentless focus on the problems it is meant to solve.

Key Takeaways

THEME	ACTIONABLE INSIGHT
Expanded AI Capabilities	AI in education extends far beyond generative chat. Implementers should explore the full functional spectrum: Diagnose & Predict, Personalise, Generate & Translate, Automate, and Simulate.
Problem-Led Integration	Current EdTech focus is heavily classroom-based, but significant opportunities exist to use AI to address "out-of-school" barriers, such as infrastructure planning, financial inefficiencies, and parental engagement.
Pedagogy over Novelty	The introduction of AI must be informed by learning science and cognitive psychology, not just technological advancement. Effective tools should scaffold thinking rather than providing a "shortcut" around it.

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