

K-12 Digital Campus Framework

A Pan-African Blueprint for Digital Transformation in K-12 Schools

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Executive Overview

This is a framework for K-12 digital transformation across Africa — not a single country, not a single curriculum, not a single currency. It is written for schools, institutions, universities, and governments, because the gap is theirs to recognise and the change is theirs to lead.

We name the gap. Current systems were built for a slower world; we are now in a world where AI is reshaping work, knowledge, and how learners and educators relate to information. Treating the gap as

something to "catch up on" guarantees we stay behind. The framework instead builds past the current — toward a future where African students and communities grow exponentially because they were prepared for it, not protected from it.

We are at the frontier, and we are willing to use the word **disruption**. We disrupt not to compete but to enable and guide. Disruption here means: build mobile-first, offline-capable, mother-tongue-aware, mobile-money-native infrastructure from day one — not retrofit a desktop-and-textbook system to the next decade.

It assumes the realities most African schools live with: mobile-first access on entry-level smartphones, intermittent power, multilingual classrooms, fees paid through mobile money, and exit examinations governed by national or regional councils.

The framework is built on cloud and open-source infrastructure with offline-first defaults. It prioritises digital literacy over particular tools, multilingual delivery over English-only content, and pan-African data sovereignty over default US-cloud residency. It is auditable: every claim is paired with a regional reference table at the end of this document, so a school in Accra and a school in Harare can both find themselves in it.

We don't benchmark off US markers. Bundu Foundation's research arm publishes African open standards — for outdoor-readability, connectivity-gradient design, mother-tongue-first delivery, mobile-money-native fee surfaces, off-grid power resilience — and this framework benchmarks against those. Where an existing African instrument applies (POPIA, NDPA, Kenya DPA, A4AI 1-for-2, GIGA, AU Malabo Convention, country curriculum frameworks), we use it. Where one is missing, the Foundation is building it as open standards the community can adopt and improve. Built for Africa.

This is v2.0. v1.0 was a generic developing-world template; v2.0 is grounded in pan-African data and standards.

I. Foundational Principles

Core Values

1. Universal Access

Every learner counts, whether the school can afford a 1:1 device programme or relies on shared smartphones. Designs that work for the smartphone-shared-with-a-parent case are the canonical case, not the fallback.

2. Digital Literacy First

Technology enablement paired with critical thinking and digital citizenship. Tools change; the disposition to learn them does not. Citizenship (safety, ethics, rights, wellness) comes before tool mastery at every age band.

3. Mobile-Centric, Offline-Capable

Smartphones are the primary access devices for most users in Africa (Transsion's Tecno, Itel, and Infinix brands hold ~48% of the continent's smartphone market, and sub-USD 200 devices make up ~81% of shipments). Every platform decision assumes mobile-first; every learning module assumes intermittent connectivity.

4. Cost-Conscious and Currency-Aware

Open-source and cloud solutions maximise limited school budgets, and budget guidance is published in USD with local-currency adaptation notes — because ZWL, NGN, GHS, KES, ZAR, MAD, and EGP do not move in lockstep with the dollar.

5. Data-Driven, Privacy-Respecting

Analytics inform instruction, support, and strategy — within the data-protection laws of the jurisdiction the school operates in (POPIA in South Africa, NDPA in Nigeria, the Kenya Data Protection Act, Ghana's emerging framework, Rwanda's NDGF, and others; see §XIII).

6. Community-Centred and Multilingual

A coherent experience across students, staff, and parents/guardians, delivered in the languages families actually speak — Swahili, Hausa, Yoruba, Igbo, isiZulu, isiXhosa, Shona, Wolof, Amharic, Arabic, and many more — not English-only.

7. Frontier, Not Catch-Up

We build at the frontier. Schools on this framework leapfrog the constraints of legacy school IT (heavy desktops, on-premise servers, default-overseas cloud) by adopting cloud-native, offline-first, mobile-first patterns from day one. AI is disrupting work, knowledge, and learning everywhere; preparing African learners means designing for that disruption, not insulating from it. We disrupt to enable and to guide, not to compete.

8. Built for Africa, Benchmarked Against African Open Standards

The framework does not measure itself against US, EU, or Asian markers. The Bundu Foundation's research arm publishes African open standards — outdoor-readability targets, connectivity-gradient budgets, mother-tongue-first delivery, mobile-money-native fee surfaces, off-grid power resilience, multilingual UX baselines — and this framework benchmarks against those. Where a Foundation standard does not yet exist, we collaborate to publish one. Schools, institutions, universities, and governments are invited to adopt, audit, and contribute back.

II. The African Context (Pan-African)

This framework is designed against the on-the-ground realities African K-12 schools navigate. The numbers below are pan-African averages from authoritative sources (GSMA, ITU, A4AI, IDC, African data-protection authorities). Variation by country is large; the reference tables in §XIII break it down.

Connectivity

- **Internet penetration:** 38% of Africans use the internet in 2024, against a 68% global average (ITU). Urban: 57%. Rural: 23%.
- **Mobile internet users:** 416 million; ~75% of Africans remain unconnected (GSMA Mobile Economy Africa 2025).
- **Coverage gradient:** 3G reaches 77% of the population, 4G ~44%, 5G ~1.2%. Schools must assume 3G as floor, not exception.
- **Affordability:** 1 GB of mobile data costs ~5.7% of average monthly income (A4AI target: ≤2%). Worst-affected: Central African Republic (24.4%), DRC (20.7%), Togo (15.1%), Chad (14.7%), Malawi (14.0%).

Mobile money

Africa processed **74% of global mobile-money transactions in 2024 — USD 1.1 trillion**. Schools collect fees, pay teachers, and procure equipment through these rails far more than through bank transfers. The "Big MAMO":

- **M-Pesa** (Safaricom/Vodacom) — 60M+ users; Kenya, Tanzania, DRC, Ethiopia, Egypt.
- **MTN MoMo** — 63M monthly actives; ~USD 321B processed in 2024; Ghana, Uganda, Cameroon, Côte d'Ivoire, Rwanda, Zambia, and more.
- **Airtel Money** — 44M users across 14 countries; ~USD 994M revenue (FY2025).
- **Orange Money** — 17 countries across francophone West and Central Africa; cross-border-remittance focus.

Plus EcoCash (Zimbabwe), PalmPay and OPay (Nigeria), Wave (Senegal/Côte d'Ivoire), TeleBirr (Ethiopia), Mixx by Yas (Madagascar/Togo). Any school fee surface, vendor payment, or stipend disbursement must integrate at least one of these.

Power

- **South Africa:** load-shedding returned in 2025 at the highest level in a year (Bloomberg). Stage 4–6 is several hours daily.
- **Zimbabwe:** up to 16 hours per day of cuts at peak; complete grid failure July 2025.
- **Off-grid schools:** 32% of primary and ~50% of secondary schools in Africa operate off-grid (European Commission JRC, 2025).
- Power resilience is a design parameter, not a contingency. See §V.

Devices

- **Transsion** (Tecno, Infinix, Itel) leads at ~48% share; Samsung ~21%, Xiaomi ~13% (IDC, 2025).
- **Price bands:** USD 100–199 = 42% of Q1 2025 shipments. Sub-USD 200 = 81% of shipments. Sub-USD 100 devices are increasingly available.
- **Why Transsion dominates:** locally optimised for African conditions — battery life, multi-SIM, low-light camera tuning for darker skin tones, durable casings — with R&D centres in Nairobi, Lagos, Johannesburg.
- For device equity programmes, sub-USD 100 Transsion Smart-series and Itel devices are the realistic procurement floor, not USD 200–300 Chromebooks.

Languages and curriculum

Africa has more than 2,000 languages and at least 60 widely-used languages of wider communication. Most national curricula now mandate mother-tongue instruction for the first 3 grades, then transition to English/French/Portuguese/Arabic as the medium of instruction. Tanzania is the outlier — Kiswahili through primary and increasingly secondary. Nigeria allows Hausa/Yoruba/Igbo for the first three grades only. South Africa permits any of 11 official languages in lower primary. Curriculum and exam systems are listed in §XIII.

III. Technology Infrastructure Layer

Core architecture: the digital backbone

A cloud-and-open-source stack optimised for cost, sovereignty, and offline resilience. The framework is platform-agnostic but opinionated about defaults that align with African data residency and currency realities.

Cloud providers (with African regions)

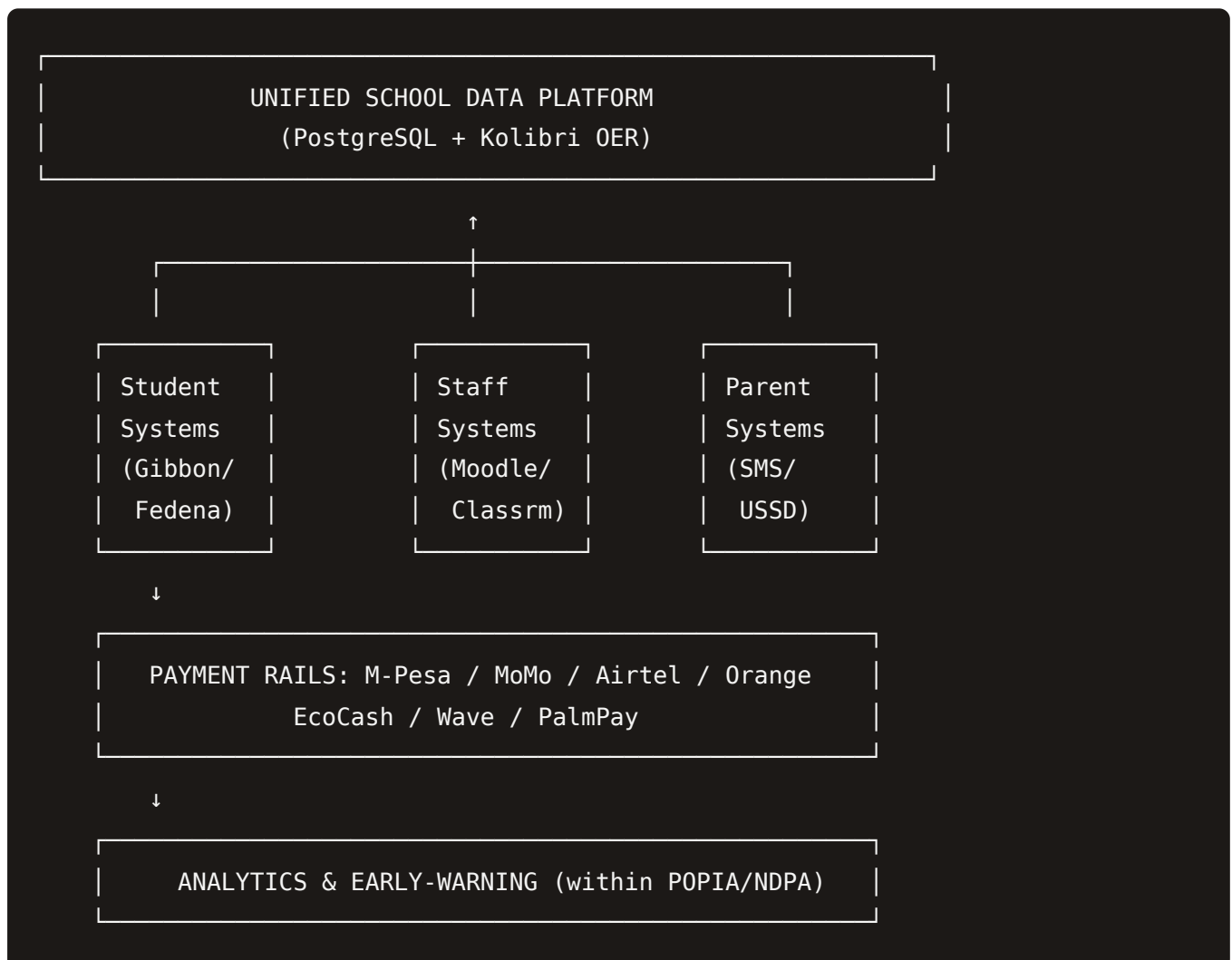
- **AWS** — Africa (Cape Town) region (`af-south-1`). EDU credits via AWS Educate; AWS Imagine grants for non-profits.
- **Microsoft Azure** — South Africa North (Johannesburg) and South Africa West regions. Microsoft 365 Education A1 tier is free for verified schools.
- **Google Cloud** — Johannesburg region (`africa-south1` , launched 2024). Google Workspace for Education Fundamentals is free for accredited K-12.
- **Liquid Intelligent Technologies / Africa Data Centres** — pan-African colocation with sites in Cape Town, Johannesburg, Nairobi, Lagos, Harare, Kigali, Accra, Dar es Salaam.
- **Raxio** — emerging-market data-centre footprint in Uganda, DRC, Ethiopia, Côte d'Ivoire, Mozambique, Tanzania.

A school's choice should be guided by data-residency requirements (see §VIII) and by per-MB egress economics, which differ widely between African regions and overseas regions.

Open-source stack defaults

- **Student Information System (SIS):** Gibbon (PHP, low resource), Fedena, or OpenSIS.
- **Learning Management System (LMS):** Moodle (the largest installed base in African higher-ed and increasingly K-12) or Google Classroom for schools already in Workspace.
- **Offline-first content delivery:** Kolibri (Learning Equality) — open-source, 173 languages, 6M+ users, runs on Raspberry Pi and old laptops. Curated OER aligned to many national curricula.
- **Storage and collaboration:** Nextcloud (self-hosted) or Google Drive / OneDrive (free EDU tiers).
- **Data warehouse and analytics:** PostgreSQL plus DuckDB for school-scale analytics, scikit-learn for predictions.

Central data hub



IV. Digital Access & Connectivity

Closing the digital divide

Connectivity access

1. **Fibre to the school:** where available — Liquid, MTN Business, Safaricom, Orange Business, Vodacom Business, SEACOM, WIOCC, MainOne. Pricing varies 5–20× between countries; always benchmark to a per-Mbps figure.
2. **4G/LTE primary, 3G fallback:** school router with dual-SIM and automatic failover (Tecno Spot, MikroTik LtAP, Huawei). Pair with a daytime data-bundle policy so caps are not blown by a single auto-update.
3. **LEO satellite** where terrestrial is absent — Starlink is now live in Kenya, Nigeria, Rwanda, Mozambique, Zambia, Zimbabwe, Eswatini, Cabo Verde, Benin, Sierra Leone, Madagascar, and others. Approx USD 50/month residential where licensed, with school/business plans available.
4. **Offline-first by default:** Kolibri server on a Raspberry Pi 5 (USD 80) seeds curated content to every classroom WiFi. Students sync when online; everything keeps working when not.

Device equity programme

- **Procurement floor:** Transsion Smart-series and Itel A-series sub-USD 100; Tecno Spark and Infinix Hot USD 100–150; Samsung Galaxy A0x USD 100–180.
- **Tablet option:** Tecno Spark Go Tablet, Itel PadOne, locally-assembled Mara Phones (Rwanda), refurbished Lenovo from regional partners.
- **Refresh model:** 33% per year on a 3-year cycle; community device-repair workshops keep older devices in service.
- **Shared-device patterns:** family-mode profiles, school-day lockers, library lending, household stipends — never punish a learner for not owning a personal device.

Funding pathways (African-relevant)

- **Universal Service and Access Fund (USAF)** equivalents: present in Ghana (GIFEC), Nigeria (USPF), Tanzania (UCSAF), Kenya (USF), South Africa (USAASA), Zimbabwe (USF), and several others. Most fund school connectivity.
- **GIGA initiative** (UNICEF + ITU) maps every school and connects through national operator partnerships.
- **Mastercard Foundation Africa Growth Fund, Bill & Melinda Gates Foundation, Echidna Giving, Jacobs Foundation, Aga Khan Foundation** — pan-African education grant routes.
- **Telco social-impact lines:** MTN Foundation, Safaricom Foundation, Vodacom Foundation, Orange Foundation, Econet Higher Life Foundation.
- **National budgets and PPPs:** Rwanda's school-electrification programme (target ~1,000 schools by end of 2025); Nigeria's UBEC; South Africa's Sector Education and Training Authorities (SETAs).

- **Diaspora and community giving:** VillageReach, GlobalGiving, Africa Education Trust.

V. Power Resilience & Off-Grid Design

Power is the most under-budgeted line item in African school-IT plans. 32% of primary and ~50% of secondary schools in Africa operate off-grid. In countries with grid, 8–16 hours of daily load-shedding is common. The framework treats power as infrastructure equal to connectivity, not as risk-mitigation.

Classroom power budget (rule of thumb)

Mode	Per-classroom load (30 learners)
Phones / cheap tablets, one teacher projector	~300 W peak, ~150 W average
Mixed: tablets + 2–3 laptops	~800 W peak, ~400 W average
Desktop computer lab	~2,000 W peak, ~1,500 W average

A "phones plus projector" classroom is the African default and the right design centre.

Solar + battery sizing (indicative)

- **Small primary (≤200 learners, no labs):** 3 kW solar + 5 kWh lithium battery + grid/genset failover. USD 4–7K depending on procurement.
- **Medium school (≤500 learners, one lab):** 5 kW solar + 10 kWh lithium battery. USD 7–12K.
- **Secondary with labs:** 6–10 kW solar + 15–20 kWh lithium battery. USD 12–25K.
- Lithium-iron-phosphate (LiFePO4) batteries are the standard; costs are below USD 100/kWh at school scale and falling.

Backup hierarchy

1. **Solar + LiFePO4 battery** — primary off-grid spine.
2. **Grid** — top-up, where reliable.
3. **Genset** — sized to LMS server + WiFi + 10 charging stations, not the whole school. USD 800–2,500 for 3–5 kVA inverter generator.
4. **UPS** — for the LMS server and switch only (≥10 minutes runtime).

Operating discipline

- Charging schedules during solar-peak (10:00–14:00) for device fleets.
- Daytime-bundle data plans aligned to teaching hours.

- Server consolidation: one Raspberry Pi 5 with Kolibri can serve a 30-classroom WiFi at ~10 W.
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VI. Digital Literacy & Competency

Anchored to national curricula

The framework does not replace national curricula; it overlays them. The progression below maps to the four broad K-12 bands used across most African systems (Kenya CBC, South Africa CAPS, Nigeria 9-3-4, Zimbabwe Heritage-based, Ghana SHS, Rwanda CBC, Tanzania, Ethiopia, etc.). Specific mappings are in §XIII.

Lower primary (≈ ages 5–8): citizenship and mother-tongue digital

- Mother-tongue instruction for the first 3 grades (current policy in most African systems).
- Online safety basics, recognising harm, asking a trusted adult.
- Touch interfaces, voice messaging, photo capture.
- Stories and songs in a learner's first language — Kolibri's Storyweaver and Bloom Library content packs.

Upper primary (≈ ages 9–13): transition to LMI and tool mastery

- Transition to the country's language of medium of instruction (LMI).
- Search and source evaluation; productivity (mobile-first Docs/Sheets); etiquette.
- Introduction to computational thinking (Scratch, Code.org), works offline via Kolibri.
- Mobile-money literacy: M-Pesa / MoMo / Airtel / Orange / EcoCash basics, scam recognition.

Lower secondary (≈ ages 11–14): coding, data, and AI literacy

- Block-to-text coding transition (Python, JavaScript).
- Data literacy: reading charts, basic statistics, spreadsheet analysis.
- Digital footprint and identity; cybersecurity awareness.
- AI literacy: what models do, where they err, how to evaluate output.

Upper secondary (≈ ages 14–18): career-ready frontier skills

- Web development; data science; cloud platforms.
- AI/ML concepts, prompt engineering, ethics.
- Entrepreneurship: mobile-money commerce, digital marketing, freelance pathways.
- Digital portfolio for tertiary or career entry (mapped to national exit examinations — see §XIII).

Mother-tongue first

Decades of research show literacy and numeracy gains are highest when initial instruction is in a learner's first language. The framework supports schools rolling out (or honouring) mother-tongue policies through:

- Kolibri language packs (173 languages).
 - Bloom Library African-language children's books.
 - Localised Khan Academy content (where available).
 - African Storybook (1,200+ stories in 200+ African languages).
 - Eneza Education and Ubongo Kids audiovisual content in regional languages.
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VII. Core Digital Experience Platforms

Tools that already work in African deployment

The framework recommends platforms with demonstrable scale on the continent rather than US-default SaaS.

Need	Recommended (African-deployed)	Notes
Offline content delivery	Kolibri (Learning Equality)	173 languages; 6M+ users; runs on Pi or old laptop
Mobile-curriculum revision	Eneza Education (KE base, expanding)	SMS / mobile web / Messenger / Telegram; 1M+ MAU
Mathematics + science (Sec)	Siyavula (ZA)	Free OER textbooks + adaptive practice; CAPS-aligned
Early literacy (audiovisual)	Ubongo (TZ)	Edutainment in Swahili, English, several local languages
Early literacy (story)	eLimu (KE)	"Hadithi, Hadithi!"; 6–7 yo reading
Children's books / storybooks	African Storybook, Bloom Library	200+ African languages
LMS	Moodle (open source) or Google Classroom	Moodle if data must stay in-country
SIS	Gibbon, Fedena, OpenSIS	Low-resource PHP options
Communications with caregivers	WhatsApp Business + SMS gateway (Africa's Talking, Twilio, MTN's bulk SMS)	WhatsApp is the default messaging surface
Mobile-money fee collection	Provider APIs: Daraja (M-Pesa), MoMo API, Airtel API, Flutterwave, Paystack	Aggregators reduce per-country wiring

Student digital experience

- Personalised pathways across mobile, browser, and offline Kolibri server.
- One Mukoko ID (or equivalent) across school and Bundu/Nyuchi surfaces — single sign-on without per-app credentials.
- Digital portfolios that survive a device change.
- Career pathways grounded in regional realities — mobile-money jobs, content creation, freelance via Upwork/Andela, technical and vocational education (TVET) pipelines.

Staff and parent experience

- Data-informed instruction via dashboards; lesson planning collaboration; certification tracking.
- Parents: WhatsApp- and SMS-first updates, USSD short codes for fee balances, translation into the household's preferred language.

VIII. AI, Analytics & Data Governance

AI/ML use cases (where they help in the African context)

1. Early-warning systems

Identify learners at risk of dropping out using attendance, fee status, assignment-completion, and language-of-instruction transition signals. Early intervention prevents 15–25% of at-risk situations.

2. Personalised learning paths

Recommend Kolibri / Siyavula / Eneza modules based on assessment patterns; surface mother-tongue material when a learner is struggling with LMI content.

3. Predictive resource planning

Forecast device-refresh, data-bundle, solar-battery-replacement and exam-cohort sizing. Useful for schools managing tight cash flow and exchange-rate volatility.

4. Curriculum effectiveness

Measure which lesson designs lift CAPS/CBC/9-3-4 outcomes for different learner populations. Adapt instead of accumulating dashboards no one reads.

Data governance — the African legal map

This framework defers to local data-protection law. Schools must identify their primary jurisdiction and operate within its rules. As of May 2026 the most-cited frameworks include:

Jurisdiction	Regulator	Statute / framework
South Africa	Information Regulator	POPIA (2013, effective 2021) — explicit child consent <18
Nigeria	Nigeria Data Protection Commission (NDPC)	NDPA + NDP Act-GAID (GAID effective Sept 2025)
Kenya	Office of the Data Protection Commissioner (ODPC)	Data Protection Act 2019 — has fined schools
Ghana	Data Protection Commission	DPA 2012; Data Protection Bill + DH Bill in 2025 cycle
Rwanda	National Cyber Security Authority + NISR	Law 058/2021; NDGF + NDCAG + NMMG (2024)
Uganda	Personal Data Protection Office (PDPO)	Data Protection and Privacy Act 2019
Egypt	Personal Data Protection Centre (proposed)	Law No. 151 of 2020
Morocco	CNDP	Law 09-08
Senegal	CDP	Law 2008-12
Côte d'Ivoire	ARTCI	Law 2013-450
Zimbabwe	Cyber and Data Protection Authority (POTRAZ)	Cyber and Data Protection Act, 2021

Plus continental and sub-regional instruments: **African Union Convention on Cyber Security and Personal Data Protection (Malabo Convention)**, SADC Model Law on Data Protection, ECOWAS Supplementary Act A/SA.1/01/10.

Practical rules:

- Children's data (under-18) requires verifiable parental/guardian consent in POPIA, Kenya DPA, Uganda DPPA, and most modern African statutes.
- Examination results: Uganda's Ministry of Education has banned public display of candidates' results citing data protection — design your portal accordingly across the continent.
- Cross-border transfer: most laws require adequacy or contractual safeguards; default to in-region cloud (Cape Town, Johannesburg, Nairobi) unless an explicit exception applies.
- Minor-data breach example: in 2024 Kenya's ODPC fined a school for disclosing a minor's data to a third party without parental consent. Build consent into every workflow.

IX. Implementation Roadmap: Three-Year Phases

Phase 1: Foundation (Year 1)

Months 1–3 · Infrastructure & planning

- Audit current systems, power, and connectivity. Quantify load-shedding hours and dollar-cost of downtime.
- Establish SSO and the SIS (Gibbon or Fedena). Deploy Moodle or Google Classroom.
- Stand up a Kolibri server (Raspberry Pi 5, ~USD 80) with national-curriculum content packs.
- Choose primary cloud region (Cape Town / Johannesburg / Nairobi colocation).
- Map fee-payment to one mobile-money rail (Daraja / MoMo / Airtel / Flutterwave / Paystack).

Months 4–6 · Access & device rollout

- Device procurement: Transsion + Intel mix, sub-USD 100 to USD 150 band.
- Solar + LiFePO4 sized to the school's load (\$V).
- WiFi with offline-first Kolibri seeding to every classroom.
- Digital citizenship launch in mother tongue for early-grade learners.

Months 7–12 · Digital literacy & pilot

- Computational thinking with Scratch via Kolibri.
- Early-warning system pilot using attendance + fee + assignment signals.
- Parent portal — WhatsApp and SMS first, USSD as fallback.
- Pilot teacher cohort using dashboards and lesson collaboration.

Indicative investment: USD 80,000 (small-to-medium school; varies by country and procurement).

Phase 2: Integration & insight (Year 2)

- API connectors between SIS, LMS, payments, and analytics.
- AI/ML models: attendance prediction, learning-path recommendations, fee-collection forecasting.
- Career pathways and digital-portfolio scaffold.
- Parent portal v2.0; staff dashboards across all classes.
- TVET / sixth-form pathway integration.

Indicative investment: USD 60,000.

Phase 3: Optimisation & sustainability (Year 3)

- Advanced analytics — curriculum effectiveness, resource allocation.

- AI tutoring assistant for upper-primary maths and early-secondary subjects.
- Open-source migration completed where licensing economics warrant.
- Internal team training; framework contribution-back.

Indicative investment: USD 45,000.

X. Cost Framework (USD Basis, Local-Currency Adapt)

Three-year total: ~USD 185,000 indicative (small-to-medium school)

Component	Year 1	Year 2	Year 3	Total
Connectivity	\$9,000	\$7,000	\$6,000	\$22,000
Power resilience (solar)	\$12,000	\$3,000	\$3,000	\$18,000
Devices & refresh	\$24,000	\$12,000	\$9,000	\$45,000
Software & cloud	\$8,000	\$8,000	\$8,000	\$24,000
Data & AI	\$9,000	\$14,000	\$9,000	\$32,000
Professional development	\$11,000	\$10,000	\$7,000	\$28,000
Contingency (10%)	\$7,000	\$6,000	\$3,000	\$16,000
TOTAL (USD)	\$80,000	\$60,000	\$45,000	\$185,000

Per-learner. At ~600 learners, this is ~USD 100/learner/year in Year 1 dropping to ~USD 75 by Year 3 — below the USD 100/learner benchmark cited in the JRC 2025 African schools electrification analysis, and approaching the USD 50/learner/year frontier where full digital learning becomes broadly affordable.

Local-currency notes.

- ZAR is the most predictable across the table; Cape Town/Johannesburg cloud egress and Samsung devices are competitively priced in rand.
- NGN, ZWL, GHS, and EGP have seen significant devaluation in 2024–2025; budget in USD and treat local-currency lines as reset annually.
- KES, RWF, TZS, UGX are managed-float; expect 3–7% annual drift.
- MAD is pegged to a EUR/USD basket; relatively stable.

Funding sources (Africa-relevant)

- **National Universal Service / Access Funds:** GIFEC (Ghana), USPF (Nigeria), USAASA (South Africa), USF (Kenya, Zimbabwe), UCSAF (Tanzania), and others. Most fund school connectivity

directly.

- **GIGA** (UNICEF + ITU) school-connectivity initiative.
- **Foundations:** Mastercard Foundation, Gates Foundation, Echidna Giving, Jacobs Foundation, Aga Khan Foundation, MTN Foundation, Safaricom Foundation, Orange Foundation, Vodacom Foundation, Econet Higher Life Foundation.
- **National programmes:** Rwanda Smart Africa, Kenya Digital Literacy Programme, South Africa SETAs, Ghana Free SHS digital extension, Nigeria UBEC, Senegal DER.
- **Diaspora and community giving:** VillageReach, GlobalGiving, Africa Education Trust.
- **In-kind:** refurbished-device pipelines (Computer Aid International, Close the Gap), volunteer talent through Code for Africa, NPO networks.

Cost-reduction strategies

- Open-source over proprietary (saves USD 20–30K over three years).
- Train in-house IT vs vendor contracts (saves ~30% on operating cost).
- Phased device refresh (33%/year, not bulk).
- Power before everything — every kWh of solar pays back faster than another laptop.
- University partnerships for data-science support (KNUST, UCT, Wits, Strathmore, Makerere, Ashesi, Carnegie Mellon University Africa).

XI. Equity, Inclusion & Multilingual Design

Accessibility (WCAG 2.1 AA minimum)

- Colour contrast $\geq 4.5:1$ for body text.
- APCA Lc 90+ for outdoor-readable headings (midday-sun verandah test).
- 56-pixel touch targets.
- Alt text, captions, keyboard navigation, screen-reader compatibility.

Multilingual delivery — by region

The framework supports localisation into the following clusters at minimum. Schools select what their families speak.

- **East Africa:** Swahili, Amharic, Oromo, Luganda, Kinyarwanda, Somali, Tigrinya.
- **West Africa:** Hausa, Yoruba, Igbo, Akan/Twi, Wolof, Fula/Fulfulde, Mandinka, Ewe, Dagbani, Bambara.
- **Southern Africa:** isiZulu, isiXhosa, Sesotho, Setswana, Sepedi, Shona, Ndebele, Chichewa, Lozi.
- **Central Africa:** Lingala, Kikongo, Sango, Swahili (eastern DRC).

- **North Africa:** Arabic (MSA + Maghrebi/Egyptian variants), Tamazight, French, Hassaniya.
- **Lusophone Africa:** Portuguese, plus regional languages (Umbundu, Kimbundu in Angola; Makua, Sena in Mozambique).
- **Francophone West/Central Africa:** French + national languages.

Tools that already deliver in many of these: Kolibri language packs, African Storybook, Bloom Library, Ubongo, Eneza, Mukoko Lingo (Mukoko's language mini-app), GCFGlobal localisations.

Socioeconomic equity

- Devices provided where households cannot afford them — sub-USD 100 procurement floor (Transsion / Itel).
- Free school WiFi as a primary access path; data-bundle subsidies through telco partnerships.
- Mobile-money fee payment plans aligned to weekly/biweekly cash-flow patterns (most African households are not monthly-salaried).
- No digital-literacy prerequisite for enrolment; the framework teaches it.
- Family-mode device profiles for shared household phones.

XII. Measuring Success: Key Performance Indicators

Learner outcomes

- Completion / progression rate: +5% by Year 3.
- Mother-tongue early-literacy gains: +20% by Year 2 (where applicable).
- Examination pass rate (national / regional council): +5–10% by Year 3.
- At-risk identification: 95%+ accuracy on the early-warning model.
- Device access: 99%+ by Year 3.

Engagement

- LMS / portal: 80%+ weekly active learners.
- Staff dashboards: 90%+ adoption.
- Parent portal: 70%+ family access (WhatsApp/SMS counts).
- Career-pathway completion: 80%+ of upper-secondary cohort.

Operational efficiency

- Manual data entry: –60% by Year 3.
- Power downtime: ≤5% of school hours (target after solar + battery).

- Connectivity uptime: 99%+ in school hours.
- Help-desk tickets: -60%.

Pan-African contribution

- At least one framework improvement contributed back per school per year — case study, language pack, lesson plan, cost-data point. This is how the open framework keeps getting better.
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XIII. Pan-African Reference Tables

A. National examination / school-leaving systems

Region	Country / system	Lower-secondary exit	Upper-secondary exit
West Africa (Anglo)	Nigeria	BECE	WASSCE (WAEC), NECO, JAMB/UTME for HE
West Africa (Anglo)	Ghana	BECE	WASSCE (WAEC)
West Africa (Anglo)	Sierra Leone, Gambia, Liberia	BECE	WASSCE (WAEC)
West Africa (Franco)	Senegal	BFEM	Baccalauréat sénégalais
West Africa (Franco)	Côte d'Ivoire	BEPC	Baccalauréat ivoirien
East Africa	Kenya	KPSEA / KJSEA (CBC)	KCSE
East Africa	Tanzania	CSEE	ACSEE (NECTA)
East Africa	Uganda	UCE	UACE (UNEB)
East Africa	Rwanda	O-Level	A-Level (REB / NESA)
East Africa	Ethiopia	EGSECE	Ethiopian University Entrance Examination (EUEE)
Southern Africa	South Africa	SBA + national norm	NSC (Matric) under CAPS
Southern Africa	Zimbabwe	ZIMSEC O-Level	ZIMSEC A-Level
Southern Africa	Botswana	JCE	BGCSE
Southern Africa	Namibia	JSC	NSSC (Ordinary + Advanced Subsidiary)
Southern Africa	Zambia	Grade 9	GCE / Grade 12 ECZ
North Africa	Egypt	Preparatory Certificate	Thanaweya Amma
North Africa	Morocco	BEC	Baccalauréat marocain

Region	Country / system	Lower-secondary exit	Upper-secondary exit
Lusophone	Angola, Mozambique	National	Conclusão do Ensino Secundário Geral
International overlay	Pan-Africa	n/a	Cambridge IGCSE, Cambridge A-Levels, IB

B. Curriculum frameworks (selected)

Country	Framework	Notes
Kenya	Competency-Based Curriculum (CBC) — KICD, since 2017	2-6-3-3-3 structure
South Africa	CAPS (Curriculum and Assessment Policy Statement) — DBE	Replaced OBE; 11 LoLT options
Nigeria	9-3-4 with Universal Basic Education + CBE elements	NERDC curriculum
Ghana	Standards-Based Curriculum (KG–SHS) — NaCCA	Free SHS policy national-level
Zimbabwe	Heritage-Based Curriculum (2024–2030) — replaces 2015 update	MoPSE
Tanzania	Competency-Based Curriculum — TIE	Kiswahili medium primary
Rwanda	Competency-Based Curriculum — REB	English LoLT from P4
Uganda	New Lower-Secondary Curriculum (2020) — NCDC	Competency-based
Ethiopia	General Education Curriculum — MoE	Mother-tongue early, then Amharic / English
Egypt	Education 2.0 — MoETE	Competency-based reform
Morocco	Vision Stratégique 2015–2030	Trilingual policy (Arabic/Tamazight/French)

C. Mobile-money rails (school-fee surface)

Provider	Footprint	Developer API
M-Pesa	Kenya, Tanzania, DRC, Ethiopia, Egypt, Mozambique, Lesotho, Ghana (re-launch)	Daraja (Safaricom) , M-Pesa OpenAPI
MTN MoMo	Ghana, Uganda, Côte d'Ivoire, Cameroon, Rwanda, Zambia, Benin, Congo Brazzaville, eSwatini, Guinea	MoMo Developer API
Airtel Money	Nigeria, Kenya, Uganda, Tanzania, Rwanda, Malawi, Zambia, Niger, DRC, Madagascar, Gabon, others	Airtel Africa API
Orange Money	Senegal, Mali, Côte d'Ivoire, Cameroon, Madagascar, Burkina Faso, Guinea, DRC, CAR, others (17)	Orange Developer
EcoCash	Zimbabwe	EcoCash USSD + API
Wave	Senegal, Côte d'Ivoire, Mali, Burkina Faso, Uganda	Wave API
PalmPay / OPay	Nigeria (challengers; large fintech footprints)	Provider APIs
TeleBirr	Ethiopia	Ethio Telecom API
Telkom Pay	South Africa	Telkom Mobile Money
Aggregators	Flutterwave, Paystack, Cellulant, DPO Group, MFS Africa, Onafriq	Multi-rail abstraction

D. Cloud regions and African data centres

Provider	African region(s)
AWS	Cape Town (af -south -1)
Microsoft Azure	South Africa North (Johannesburg), South Africa West
Google Cloud	Johannesburg (africa -south1)
Liquid / Africa Data Centres	Cape Town, JNB, Nairobi, Lagos, Harare, Kigali, Accra, Dar
Raxio	Uganda, DRC, Ethiopia, Côte d'Ivoire, Mozambique, Tanzania
Teraco	Cape Town, Johannesburg, Durban
MainOne (Equinix)	Lagos, Accra, Abidjan
WIOCC iColo	Mombasa, Nairobi, Mogadishu, Djibouti

E. Data-protection statutes (quick reference)

See §VIII for the full table.

F. Open / OER tools and where they fit

Tool	Best for
Kolibri	Offline-first content delivery, all ages, 173 languages
Eneza Education	Mobile revision, K-12, SMS for ultra-low bandwidth
Siyavula	Maths and science Gr 8–12 (CAPS-aligned; broadly reusable continent-wide)
Ubongo	Early-years edutainment (Swahili + others)
eLimu	Early literacy in East Africa
African Storybook	Mother-tongue early reading, 200+ African languages
Bloom Library	Decodable readers in many African languages
Khan Academy + Kolibri	Bundled offline access to Khan content
GCFGlobal	Adult and parent digital-literacy basics
Code.org / Scratch	Computational thinking (block-based, works in Kolibri)

Vision for 2050 and Beyond

This framework prepares learners for a 2050 Africa where digital fluency is baseline, the continent shapes its own digital infrastructure, and "developing" is no longer the operating frame. Mother-tongue early learning, mobile-money-native commerce, AI collaboration, and pan-African data sovereignty are table stakes — not aspirations.

AI is disrupting everything we know about work and knowledge. Schools, institutions, universities, and governments that recognise the gap now — and build past it — will graduate learners and communities that grow exponentially in that disruption. Those that do not will spend the next decade catching up to a target that has already moved.





We are not catching up. We are leapfrogging. We disrupt to enable and to guide, not to compete. Schools on this framework graduate learners who can teach the rest of the world how to build for constrained, multilingual, mobile-first environments — which by 2050 will not be a niche but the global majority case.

By 2050, African learners will not just adapt to digital change — they will set its agenda. Built for Africa. Open to the world.

About this framework

Programme. Bundu Education — a programme of the Bundu Foundation. **Audience.** Schools, institutions, universities, and governments — anyone responsible for the next generation's digital readiness. **Mission.** Build at the frontier. Recognise the gap, build past it, leapfrog international standards. Build for and across communities, mindful of local culture, inclusive of African languages. Disrupt to enable and to guide. Make youth of all ages ready for 2050 and beyond. **Foundation research role.** The Bundu Foundation's main activity is research into infrastructure gaps in African and emerging markets. Where existing African standards apply, this framework adopts them; where they are missing, the Foundation publishes new open standards that frameworks and operators can benchmark against. Built for Africa. **Companion product.** Nyuchi Learning is the commercial expression — the cohort-based programme that helps schools roll out this framework. **Philosophy.** Ubuntu — "I am because we are."

Open Framework Licence

-  Free to use, copy, and distribute.
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-  Share your improvements with other schools.
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Sources used in v2.0

- GSMA Mobile Economy Africa 2025 — connectivity and usage gaps.
- A4AI Affordability Report (Alliance for Affordable Internet) — 1 GB cost as % of monthly income.
- ITU statistics — internet penetration, urban/rural divide.
- IDC and counterpoint research syntheses — smartphone share (Transsion, Samsung, Xiaomi).
- European Commission Joint Research Centre, 2025 — off-grid African schools and solar economics.
- Bloomberg, Reuters, ZESA, Eskom — load-shedding data 2025.
- African Union Convention on Cyber Security and Personal Data Protection (Malabo Convention).
- Country regulators: Information Regulator (ZA), NDPC (NG), ODPC (KE), DPC (GH), POTRAZ (ZW), NCSA (RW).
- WAEC, NECO, JAMB, KCSE / KNEC, ZIMSEC, NSC / Umalusi, UNEB, NECTA, REB / NESA, NaCCA — examination councils.

- Tool publishers: Learning Equality (Kolibri), Eneza Education, Siyavula, Ubongo, eLimu, African Storybook, Bloom Library.

Updates and the live version: <https://bundu.org/education/k12-digital-campus>