



LABORATORY PLANNING | 2026 PRACTITIONER EDITION

Sustainable STEM Laboratory Planning Workbook

A board-ready planning workbook for turning rooms, tools, teachers and operating routines into durable learning capability.

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For school owners, boards, headteachers, facilities teams, educators, funders and implementation partners.

FIELD-TESTED THINKING | PRACTITIONER TEMPLATES | EVIDENCE ANCHORS

What this manual helps you decide

Move from idea to explicit decisions, owners, evidence and next actions.

1	Specify learning before space and equipment	The laboratory brief should begin with who learns what, how often and through which practical decisions.
2	Design a flexible laboratory ecosystem	Many schools need a blend of fixed infrastructure, mobile resources, simulation and classroom deployment.
3	Model three-year ownership, not purchase price	Capital cost is visible; staffing, maintenance, consumables, software, utilities and replacement determine continuity.
4	Buy functions with evidence and exit routes	Specifications should create meaningful competition and protect the school from lock-in, hidden incompatibility and unsafe operation.
5	Make continuity someone's funded job	The laboratory needs routines for booking, preparation, inventory, maintenance, safeguarding, evidence and improvement.
6	90-day application	Use 90 days to validate demand, prototype the operating model, compare options and approve a funded continuity plan.

Use the manual as a decision cycle

1 OBSERVE	2 DECIDE	3 ASSIGN	4 REVIEW
Start with the ordinary operating condition, not the launch-day exception.	Record the choice, the alternatives rejected and the assumption carrying the most risk.	Name one accountable owner, the supporting actors and the evidence they must produce.	Set a date and define what evidence will trigger continuation, repair, redesign or stop.

A completed template is not evidence of success. Pair every decision with an observable artefact, a named owner and a scheduled review.

Specify learning before space and equipment

The laboratory brief should begin with who learns what, how often and through which practical decisions.

A room is infrastructure only when it repeatedly produces learning. Capability, timetable, teachers and operations determine the specification.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Users	Define learner ages, class sizes, groups, inclusion needs, teacher roles and community use.	Demand profile and access assumptions
Capabilities	Name the science, coding, electronics, robotics, fabrication and design practices the lab must support.	Capability map and sample tasks
Dosage	Set sessions, duration, active group size, preparation and independent access.	Utilisation model and timetable
Boundaries	Record power, ventilation, water, connectivity, security, storage and expansion constraints.	Verified site and services survey

Decision questions

1. What learner decision must happen in this space?
2. How many groups must work safely at the same time?
3. Which capabilities belong in classrooms, mobile kits or virtual environments instead?
4. What ordinary-week utilisation justifies the investment?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
The educational brief and utilisation model are approved before drawings or procurement.	The project begins with a room photograph, vendor bundle or equipment wish list.

Field application

Select three representative learning tasks and walk through people, space, power, storage, setup, safety and reset from arrival to departure.

Design a flexible laboratory ecosystem

Many schools need a blend of fixed infrastructure, mobile resources, simulation and classroom deployment.

Flexibility should reduce idle time and allow the learning model to evolve without rebuilding the room.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Zones	Plan instruction, collaborative building, wet or dirty work, electronics, testing, storage and display.	Scaled layout and activity flow
Mobile capacity	Use carts or portable sets where access across classrooms matters more than a specialist room.	Deployment route and custody model
Digital layer	Provide local resources, offline-capable software, projection, device management and backup workflows.	Technology architecture and fallback test
Accessibility	Design circulation, work height, lighting, acoustics, interfaces and participation for diverse learners.	Accessibility review with user input

Decision questions

1. Can the layout support the hardest credible activity safely?
2. Can resources move without loss of accountability?
3. What becomes unusable during a power or internet outage?
4. Which learner is excluded by the current design?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
The architecture supports varied activities, safe flow, inclusion and tested continuity.	A fixed display-led layout limits active groups or creates single-purpose equipment islands.

Field application

Stage the busiest intended lesson using taped zones and empty tables before construction. Observe movement, supervision, waiting, noise and reset time.

Model three-year ownership, not purchase price

Capital cost is visible; staffing, maintenance, consumables, software, utilities and replacement determine continuity.

Compare options by capability delivered over time, including uncertainty and the cost of restoring service after failure.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Capital	Include building works, furniture, tools, devices, safety, freight, installation and commissioning.	Costed bill with assumptions
Recurring	Model staffing, training, licences, internet, utilities, consumables, calibration, insurance and support.	Annual operating schedule
Renewal	Plan battery, device, component, furniture and software replacement by lifecycle.	Replacement reserve and trigger
Sensitivity	Vary exchange rate, enrolment, utilisation, failure, renewal and support assumptions.	Scenario range and risk owner

Decision questions

1. What cost appears after the opening ceremony?
2. Which price depends on foreign currency or a single supplier?
3. What happens if utilisation is half the forecast?
4. Which cost prevents the next cohort from learning if unfunded?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
The board sees base, lower and stress scenarios with recurring funding ownership.	Approval relies on a single purchase quote or ignores people and replacement.

Field application

Remove the largest donor-funded recurrent line from year two. Decide whether the laboratory continues, degrades or closes, then redesign the funding model.

Buy functions with evidence and exit routes

Specifications should create meaningful competition and protect the school from lock-in, hidden incompatibility and unsafe operation.

Procure a serviceable learning system: functional requirements, training, support, spares, data rights, warranty and acceptance testing.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Function	Describe learning tasks, capacity, compatibility, safety and performance rather than a preferred brand.	Functional specification and scoring rubric
Acceptance	Test delivery completeness, operation, teacher readiness, documentation and ordinary-condition performance.	Signed acceptance protocol
Safety	Address electricity, tools, chemicals, batteries, ventilation, fire, storage, waste and supervision.	Risk controls and inspection record
Exit	Secure documentation, standard formats, data export, deletion, transferable licences and alternative supply routes.	Exit plan and contract clauses

Decision questions

1. Can more than one credible supplier meet the requirement?
2. What evidence proves the system is ready for learners?
3. Who can stop unsafe use and authorise return to service?
4. Can the school operate if the vendor exits?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
Evaluation covers capability, whole-life cost, support, safety and exit - not price alone.	The cheapest compliant-looking bid transfers material risk back to the school.

Field application

Run acceptance using a complete learner session, not a vendor demonstration. Include setup, authentication, failure, cleanup, storage and teacher troubleshooting.

Make continuity someone's funded job

The laboratory needs routines for booking, preparation, inventory, maintenance, safeguarding, evidence and improvement.

Operational ownership should be distributed and documented so continuity does not depend on one enthusiastic individual.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Readiness	Use opening and closing checks, preparation standards, stock thresholds and booking rules.	Daily checklist and utilisation log
Maintenance	Separate user checks, preventive care, local repair and specialist escalation.	Asset register and service history
Teacher capability	Budget induction, rehearsal, coaching, moderation and onboarding for staff turnover.	Capability matrix and observed practice
Review	Track active learner time, safety, downtime, consumables, repair, equity and curriculum use.	Monthly dashboard and action record

Decision questions

1. Who prepares the room before the first lesson?
2. What triggers reorder, repair or retirement?
3. How is a new teacher brought to safe independent practice?
4. Which metric reveals a beautiful but underused laboratory?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
Named owners, recurring budget and recovery routines are operating before launch.	The operating plan begins after commissioning or relies on informal heroics.

Field application

Choose one common failure and time the route from detection to restored learning. Record unclear authority, unavailable spares and communication delay.

Move from concept to board-ready laboratory plan

Use 90 days to validate demand, prototype the operating model, compare options and approve a funded continuity plan.

PERIOD	GATE	FIELD WORK	OUTPUT
Days 1-15	Diagnose	Observe ordinary conditions, establish the baseline and name the highest-risk assumptions.	Approved baseline and decision register
Days 16-30	Design	Select a bounded use case, define responsibilities and agree the evidence standard.	Signed design brief and risk controls
Days 31-60	Pilot	Run repeated practice under normal constraints; log failures, adaptations and participant experience.	Pilot evidence pack and repair log
Days 61-75	Review	Compare intended capability with observed performance and test equity, cost and continuity.	Review decision with conditions
Days 76-90	Institutionalise	Assign recurring ownership, budget, cadence and escalation routes before expansion.	Operating plan and next review date

Decision record

Learner capability	_____
Annual users and dosage	_____
Delivery architecture	_____
Capital ceiling	_____
Year-three operating cost	_____
Critical safety control	_____
Continuity owner	_____
Board decision	_____

Do not approve a laboratory without a three-year operating owner, a teacher capability plan and a credible route to repair, replenish and replace.

Evidence anchors and further reading

The frameworks translate public guidance and implementation evidence into practical decision tools.

SOURCE	RESOURCE	ADDRESS
Ghana Ministry of Education	Education Strategic Plan 2018-2030 (2018)	https://moe.gov.gh/edge/content/uploads/2019/05/Education-Strategic%20Plan-2018-2030.pdf
NaCCA	Secondary Education Curriculum (2025)	https://nacca.gov.gh/secondary-education-curriculum/
UNESCO GEM Report	Technology in education: A tool on whose terms? (2023)	https://gem-report-2023.unesco.org/
UNICEF Innocenti	Digital Learning, Real Classrooms: Implementation Research in Ghana (2025)	https://www.unicef.org/innocenti/reports/digital-learning-real-classrooms
African Union	Continental Education Strategy for Africa 2026-2035 (2025)	https://static.au.int/en/documents/20250616/continental-education-strategy-africa-2026-2035

Use these sources as starting points. Confirm current law, policy, curriculum and regulator guidance before making consequential institutional decisions. This manual is an implementation aid, not legal, financial or safeguarding advice.

Evidence quality protocol

CHECK	QUESTION	RECORD
Currency	Is the source still current for the decision date, jurisdiction and learner group?	Version, publication date and date checked
Authority	Is it primary guidance, independent research, implementation evidence or vendor material?	Source type and responsible institution
Fit	Do its assumptions match the school, infrastructure, language, staffing and safeguarding context?	Transfer limits and local verification needed
Use	Which decision does this source inform, and what would cause that decision to change?	Decision link, owner and review trigger

Build a capability system, not an equipment room

A practical contribution to stronger AI, coding, robotics and STEM education systems in Ghana and Africa.

The value of a framework is not the elegance of its diagram. It is the quality of the decisions, routines and learning that it makes possible.

About Jonathan Kennedy Sowah

Jonathan is a Ghanaian AI engineer and K-12 STEM systems builder working across robotics, coding, applied artificial intelligence, teacher development and context-aware education technology. His wider portfolio has reached 25,000+ learners, trained 2,500+ educators and engaged 100+ schools. KodeVR has more than 10,000 active learners.

He works with schools, governments, companies and development partners to turn high-visibility technology ambitions into practical learning systems that can operate under real African conditions.

Use this work responsibly

Adapt the tools to the programme, participants, institution and regulatory context. Record assumptions. Seek qualified technical, legal, safeguarding, financial and evaluation review where the decision requires it.

Before commissioning implementation support

QUESTION	A STRONG ANSWER SHOULD NAME
What capability must remain after the engagement?	The learner, teacher and institutional behaviours that should continue without external supervision.
What conditions shape delivery?	The ordinary timetable, infrastructure, language, safeguarding, procurement and maintenance realities.
How will quality be governed?	Decision owners, evidence definitions, review cadence, repair route and stop-or-scale thresholds.
What will the institution inherit?	Reusable learning assets, local capability, documented routines, data rights and an affordable continuity plan.

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