



ROBOTICS EDUCATION | 2026 PRACTITIONER EDITION

Robotics Education School Implementation Guide

A decision-led guide for building robotics capability that survives beyond kits, clubs and demonstrations.

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For school leaders, curriculum teams, teachers, programme partners and funders designing robotics education in Ghana and across Africa.

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	Define the capability before selecting the kit	A robotics programme needs a learner promise precise enough to guide curriculum, staffing, tools and assessment.
2	Sequence challenge across the school journey	Learners need a pathway from controlled construction to independent systems thinking.
3	Choose physical, virtual or blended architecture	The right laboratory model is the one that delivers sufficient active learning under ordinary conditions.
4	Treat teachers, maintenance and safety as core infrastructure	A kit inventory cannot facilitate learning, diagnose misconceptions or recover from failure.
5	Assess reasoning, transfer and durability	Robotics evidence should reveal how learners think and whether the school can sustain the pathway.
6	90-day application	Use a bounded 90-day cycle to test learning design, teacher capability, participation and continuity before expansion.

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.

Define the capability before selecting the kit

A robotics programme needs a learner promise precise enough to guide curriculum, staffing, tools and assessment.

Robotics is valuable when learners can investigate a problem, model a system, build, code, test, diagnose and explain. Assembly alone is not capability.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Capability promise	Name what learners will independently design, debug and explain at the end of each stage.	Observable performance task and success criteria
Curriculum connection	Link robotics decisions to computing, mathematics, science, design and locally relevant problems.	Curriculum map with explicit learning outcomes
Problem portfolio	Use agriculture, health, accessibility, energy, transport and climate challenges without forcing superficial themes.	Problem briefs reviewed for authenticity
Boundary conditions	State class size, contact time, language, power, storage and budget assumptions before choosing tools.	Constraint register verified in the school

Decision questions

1. What can a learner do without copying a demonstration?
2. Which subject concepts become more visible through the robotics task?
3. What would remain educationally valuable if the preferred kit disappeared?
4. Whose real problem is being investigated, and how was it validated?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
The capability promise, progression and assessment task are agreed before procurement.	The proposal begins with brands, competitions or equipment quantities rather than learning.

Field application

Ask a learner to modify a familiar build for a new constraint and explain every design decision. The gaps you observe should shape the first term of instruction.

Sequence challenge across the school journey

Learners need a pathway from controlled construction to independent systems thinking.

Progression means increasing decision complexity, not merely adding components. Every stage should transfer learning into a less familiar context.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Foundation	Build sequencing, mechanisms, sensing, cause and effect, safe handling and precise explanation.	Short tasks with learner reasoning captured
Integration	Combine structures, electronics, control logic and data while introducing deliberate faults.	Debug logs and system diagrams
Autonomy	Require learners to scope problems, compare alternatives, manage trade-offs and justify iteration.	Independent project brief and design review
Transition test	Use a new tool or unfamiliar problem to test whether concepts transfer beyond memorised routines.	Moderated transfer task and rubric

Decision questions

1. What becomes cognitively harder from one term to the next?
2. Where do learners meet productive failure and receive diagnostic feedback?
3. When do they move from blocks to text, from modules to circuits, or from recipes to design?
4. How will a new teacher understand the intended progression?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
Each stage has prerequisite capabilities, authentic tasks and a transition test.	The pathway repeats beginner projects or confuses a harder kit with deeper learning.

Field application

Lay the last project of each term beside the first. If the required reasoning, independence and integration are indistinguishable, redesign the sequence.

Choose physical, virtual or blended architecture

The right laboratory model is the one that delivers sufficient active learning under ordinary conditions.

Physical and virtual robotics are complementary modes. Select them by learning purpose, access, operating reality and continuity - not ideology.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Physical mode	Prioritise mechanisms, wiring, sensing, fabrication, calibration and interaction with the real environment.	Utilisation data and hands-on role records
Virtual mode	Use simulation for rapid iteration, algorithm practice, pre-lab preparation and access during equipment constraints.	Saved models, code versions and test evidence
Blended sequence	Move deliberately between prediction, simulation, physical testing and explanation.	Mode map linked to each learning objective
Participation design	Set group size and rotating technical roles so every learner makes consequential decisions.	Role observation disaggregated by learner group

Decision questions

1. How many learners can make an active technical decision at the same time?
2. Which objectives genuinely require physical interaction?
3. What is the fallback when power, internet, devices or components fail?
4. Can learners continue meaningful practice outside the specialist room?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
Mode choice is tied to objectives, dosage, participation and a tested fallback.	A laboratory is impressive during a visit but inaccessible during the normal timetable.

Field application

Calculate active decision minutes per learner, not devices per school. Observe who codes, wires, tests, explains and waits during one ordinary lesson.

Treat teachers, maintenance and safety as core infrastructure

A kit inventory cannot facilitate learning, diagnose misconceptions or recover from failure.

Teacher capability and operational continuity are part of the robotics specification. They must be funded, rehearsed and evidenced like equipment.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Teacher rehearsal	Require teachers to plan, build, debug, adapt and assess before independent delivery.	Observed lesson, task demonstration and coaching notes
Support route	Define first-line checks, escalation, spares, repair turnaround and vendor responsibilities.	Support map, service record and spare inventory
Safe practice	Cover tools, electricity, moving parts, batteries, soldering, storage and online interaction.	Risk assessment, routines and incident route
Ownership	Assign timetable, inventory, curriculum, safeguarding, budget and evidence responsibilities.	Named RACI and review calendar

Decision questions

1. Can two local teachers deliver and troubleshoot without the programme founder present?
2. What fails most often, and how quickly can learning resume?
3. Which consumables and subscriptions recur each year?
4. Who can stop unsafe activity and document an incident?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
Teachers demonstrate capability and the school owns a funded continuity routine.	Delivery depends on one champion, imported expertise or an undefined repair promise.

Field application

Remove one critical person, device and connection from the next rehearsal. Record whether learning continues, degrades safely or stops.

Assess reasoning, transfer and durability

Robotics evidence should reveal how learners think and whether the school can sustain the pathway.

Attendance and completed models are starting points. Strong claims require learner reasoning, independent performance, transfer and institutional continuity.

DESIGN MOVE	WHAT IT REQUIRES	EVIDENCE TO KEEP
Performance	Assess planning, construction, code, testing, debugging, evidence use and explanation with a shared rubric.	Moderated artefact, observation and learner defence
Transfer	Change the context, materials or constraints and require adaptation without a step-by-step guide.	New-context task and revision record
Equity	Examine device access, technical roles, feedback, confidence, retention and progression.	Disaggregated participation and outcome evidence
Durability	Track timetable protection, teacher independence, utilisation, repair, budget and curriculum integration.	Termly operating review and decision log

Decision questions

1. What claim can the present evidence honestly support?
2. Could another assessor reproduce the judgement using the rubric?
3. Which learners participate but do not advance into technical agency?
4. What capability remains after external support reduces?

Decision gate

PROCEED WHEN	PAUSE OR REDESIGN WHEN
Scale follows repeated evidence of learning quality, equity and operational continuity.	Expansion is justified by reach, publicity or competition results alone.

Field application

Select the programme's strongest public claim and trace it to raw evidence, denominator, method and limitation. Narrow the wording if the chain breaks.

Move from robotics idea to an operating pathway

Use a bounded 90-day cycle to test learning design, teacher capability, participation and continuity before expansion.

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

Capability promise	_____
Priority learner group	_____
Curriculum connection	_____
Delivery model	_____
Teacher owner	_____
Critical operating risk	_____
Evidence at day 60	_____
Decision at day 90	_____

Do not scale a robotics programme because the pilot looked exciting. Scale only what ordinary teachers can deliver, ordinary learners can access and evidence can defend.

Evidence anchors and further reading

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

SOURCE	RESOURCE	ADDRESS
NaCCA	Secondary Education Curriculum (2025)	https://nacca.gov.gh/secondary-education-curriculum/
NaCCA	Robotics Curriculum for Secondary Education (2023 curriculum, published online 2025)	https://nacca.gov.gh/wp-content/uploads/2025/04/ROBOTICS-Curriculum.pdf
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
World Bank	Devices for Education Knowledge Pack (2025)	https://documents1.worldbank.org/curated/en/099916207092523135/pdf/IDU-88a5de28-77c9-40f7-a841-9d425cdc505d.pdf

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 robotics capability, not robotics theatre

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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