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Education in Emergencies

A Guidance Document for Education Specialists



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Abbreviations and acronyms

Terminology

A **AI**
Artificial Intelligence

ASER
Annual Status of Education Report

AUSO
All Ukrainian Schools Online

D **DPG**
Digital Public Good

E **EiE**
Education in Emergencies

EGMA
Early Grade Mathematics Assessment

EGRA
Early Grade Reading Assessment

EMIS
Education Management Information Systems

EoA
Education on Air

G **GenAI**
Generative AI

H **HALDO**
Holistic Assessment of Learning and Development

I **ICT**
Information and Communications Technology

IP
Intellectual Property

ISELA
International Social Emotional Learning Assessment

ITS
Intelligent Tutoring System

L **LLM**
Large Language Model

LMIC
Low- and Middle-Income Country

LMS
Learning Management System

M **MEL**
Monitoring, Evaluation, and Learning

N **NGO**
Non-Governmental Organisation

O **OTT**
One Teacher Thailand

R **RCT**
Randomised Controlled Trial

RISE
Research on Improving Systems of Education

S **SEL**
Social and Emotional Learning

T **TaRL**
Teaching at the Right Level

U **UDL**
Universal Design for Learning

UX
User Experience

Organisations

ACPHA
Alliance for Child Protection in Humanitarian Action

ICFGEO
International Commission on Financing Global Education Opportunity

DFID
Department of International Development (UK)

ECW
Education Cannot Wait

FCDO
Foreign, Commonwealth and Development Office (UK)

GEC
Global Education Cluster

GPE
Global Partnership for Education

GGHEiE
Geneva Global Hub for Education in Emergencies

INEE
Inter-Agency Network for Education in Emergencies

UNHCR
United Nations High Commissioner for Refugees

Key definitions

Education in emergencies
We have adapted the definition provided by the INEE [1] and define 'education in emergencies' as the quality of current and future learning opportunities for children of primary and secondary-level age in situations of crisis, including non-formal education.

Crisis-affected
We use Education Can't Wait's definition of 'crisis-affected', namely: "likely affected by armed conflict, forced displacement, climate-induced and geophysical hazards, epidemics, or socio-economic challenges [...] the term 'crisis-affected' reflects a broader educational vulnerability, capturing both disrupted access and diminished education quality in countries affected by crises"[2, p. 7].

Teachers
We adopt INEE's definition of teachers: "broadly [...] any learning facilitator or [...] EiE stakeholders who work directly with learners. This may include volunteer teachers—including caregivers/family members or community volunteers—as well as educators and professionals without formal teaching qualifications" [3, p. 16].

EdTech
We use the following definition of educational technology (EdTech): "Technologies—including hardware, software, and digital content—that are either designed or appropriated for educational purposes" [4, p. 8].

Education type
We use the term 'education type' to include formal education, non-formal education, alternative learning programmes and accelerated education.

Blended learning
We use an adapted version of Graham's [5] definition of blended learning systems to refer to a combination of face-to-face instruction with technology-mediated instruction.

Hybrid learning
We adopt INEE's [1] definition of 'hybrid learning' as an educational approach where some individuals participate in person while others participate online simultaneously, using technology.

Remote learning
We adopt UNICEF & EdTech Hub's [6, p. vi] definition of remote learning: "[...] a method of learning where the teacher and learner are not physically present together in an academic institution for reasons related to accommodation and/or in response to emergency situations."

Delivery model
We define 'delivery model' as a description of how the instruction is delivered and timed. Instruction delivery is either face-to-face or technology-mediated, while the timing of instruction is either in real time (synchronous) or not in real time (asynchronous).

Technologies
The different channels through which EdTech can be delivered. Examples are radio broadcasts, television broadcasts, podcasts, text messaging, educational games, online learning platforms, and e-readers. We have opted for the term 'technologies' rather than 'modalities' because 'modalities' is also used in some of the literature to describe delivery models.

CHILDREN IN A CLASSROOM IN IRAQ. IMAGE BY PIXABAY



1. EdTech in crisis settings

More children are affected by crises than ever before, and those living in low- and middle-income countries (LMICs) are hit the hardest. The consequences for their lives, including a staggering erosion of children's education opportunities, are devastating [2; 7]. An estimated 234 million children living in crisis settings need education support, with 85 million out of school [2]. Only 17% of primary-school-age children living in crisis settings attend school and attain minimum reading proficiency [2]. Children with disabilities, like many other marginalised groups, are even more likely to have never attended school and to remain illiterate at age 15 [8]. When quality education is made available, it strengthens children's resilience, supports their health and well-being, and improves their long-term economic prospects, as well as those of their communities and countries [2; 9]. Developing feasible, cost-effective, and sustainable EdTech solutions to the learning crisis not only improves learning today but also safeguards children's future potential.

Education specialists working in education in emergencies (EiE) work with governments, humanitarian education organisations, private-sector technology providers, and other stakeholders to create meaningful education opportunities for children in crisis settings. This work is complex. EiE education specialists operate in weakened education systems and often face damaged or absent school infrastructures, security risks, severe resource constraints, overburdened teachers and caregivers, and children and communities experiencing the psychological effects of crises [2]. Educational technology (EdTech) is not a panacea. However, it is

increasingly demonstrating potential to help address the global learning crisis [↑10; ↑11; ↑12].

Like non-tech alternatives, EdTech interventions must be based on sound pedagogy appropriate to children's learning levels. They must prioritise learner and teacher well-being, and provide adequate teaching support and training [↑12]. Evidence is growing that when EdTech programmes adapt to specific contexts and

A STUDENT WORKING ON THEIR PHONE. IMAGE BY VIC JOSH



secure the right stakeholder support and system integration, EdTech can sustain learning continuity and help close learning gaps [13; 10].

To achieve this, interventions must be cost-effective, contextually appropriate, and feasible and align with national curricula and systems [13]. Only under these conditions can EdTech programmes support formally recognised, sustainable learning pathways that enable learners to continue their education and access economic opportunities [13].

This document aims to serve as a good practice guide for the design and implementation of contextually appropriate EdTech interventions to support inclusive and meaningful learning opportunities for children affected by crises. As highlighted above, implementing education interventions in crisis settings is complex. We acknowledge that the good practices identified in this document cannot always be realised perfectly, and that progress is often intermittent and non-linear. Despite this reality, we contend that those designing and delivering education in crisis contexts must continue to do so informed by the current evidence base on what will best support children's learning, both immediately and in the longer term.

This guidance document focuses on government-led EiE programmes or ones that collaborate extensively with governments, for example, through curriculum alignment and integration with local education systems. It is important to recognise that there are situations in which such collaboration may not be possible, for example, in certain contexts of displacement or state failure. These cases require specific guidance that is beyond the scope of this document. However, the guidance provided here is designed to serve as a foundation for EdTech implementation across a range of crisis contexts. To this end, we have made an effort to highlight areas where the guidance is largely generalisable and areas where high levels of contextualisation will be necessary.

1.1. Why this guidance document is needed

EiE education specialists designing education programmes without a technology component in crisis settings can draw on well-established EiE principles, standards, and supporting guidance. The Inter-agency Network for Education in Emergencies' (INEE) 'Minimum Standards for Education: Preparedness, Response, Recovery' [1] is a widely used example.

However, guidance on integrating technology into EiE programmes remains limited, and in some areas, incomplete. EdTech interventions have specific additional requirements that EiE education specialists must address. These include connectivity and power requirements; technology device management and maintenance; upfront EdTech product development costs and ongoing service and support; teacher and learner digital literacy; and data safety and privacy [13; 14].

A 2024 EdTech Hub review of existing guidance and minimum standards for EdTech interventions in emergencies found that the majority of guidance documents were general in nature. It identified clear gaps in guidance on equity, cost-effectiveness, scaling, and procurement and maintenance [15]. In the same review, Barnes et al. [15] highlight the limited testing and stakeholder input from crisis-affected regions where programmes operate. This increases the risk that the guidance provided may not reflect contextual realities, may not suit EiE education specialists' needs in style or format, and may miss important content and nuance. This guidance document, therefore, places particular emphasis on these aspects

This guidance document also responds to the growing recognition that evidence and practical direction on sound pedagogical practices for the use of EdTech in emergencies are lacking [12]. Given the crucial role pedagogy plays in addressing children's learning gaps in LMICs [16; 17], this guidance is timely. It also comes at a time of increasing donor and government EdTech investments in crisis settings [7]. Clear, up-to-date guidance for how to maximise the impact of these investments is essential.

1.2 Who this guidance is for

This document is intended for technical education advisors working for local and international organisations and governments. These advisors are tasked with facilitating the learning of crisis-affected children using EdTech. This guidance focuses particularly on basic literacy and numeracy (BLN) interventions using EdTech. Throughout this document, we refer to them as 'EiE education specialists', regardless of the type of organisation they work for.

We assume that EiE education specialists are already familiar with core EiE and humanitarian sector principles, standards, and frameworks. They will use this document because they need additional guidance on how to integrate EdTech into programme design and implementation.

This guidance document provides technical guidance for five priority themes (see Section 1.4). While not all education specialists will be responsible for all priority themes, understanding each of them is important. The guidance document can serve as a reference to supplement education specialists' existing skills.

This document is supplemented by a companion contextualisation handbook for testing the applicability of the included best practice in specific contexts. This will support EiE education specialists in generating additional contextually appropriate knowledge and experience needs for their own context and in adapting the overall guidance as they design and implement interventions [↑18].

Recognising that EiE education specialists work in cross-functional teams, the contextualisation handbook provides role-specific guidance when developing tech-enabled learning interventions. The contextualisation handbook also provides insights into managing challenging real-world considerations when operationalising the guidance on good practice included in this document.

1.3 How this guidance is organised

Section 1 provides the background and purpose for developing the guidance, the intended audience, an outline of its organisation, and a list of key definitions.

Section 2 explains the five phases of an EiE programme response to a crisis. These phases focus on **five priorities** for EiE education specialists seeking to make effective use of EdTech in a crisis setting. Sections 3–7 cover each phase in turn.



Sound pedagogy for effective EdTech in crisis settings.
(Section 3)



Sourcing, building, and maintaining technology.
(Section 4)



Ensuring equity and inclusion in EiE EdTech interventions for crisis settings.
(Section 5)



Sustaining EdTech in crisis settings: Financing, cost-effectiveness, affordability, and feasibility.
(Section 6)



Adaptive monitoring, evaluation, and learning across EiE response phases.
(Section 7)

Section 8 provides a brief overview of the priority themes of the guidance document.

"Developing feasible, cost-effective, and sustainable EdTech solutions to the learning crisis not only improves learning today but also safeguards children's future potential."

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2. EdTech for the five EiE response phases

EdTech interventions and programmes must evolve as crisis situations change. They must respond to shifting realities, human capabilities, available resources, and system constraints rather than remain fixed [1]. Because crises are dynamic, EiE programme development is rarely linear. Effective design often begins with simple approaches and adds depth as the situation stabilises and systems recover.

With this in mind, EiE response design, including EdTech, can be understood as operating across five broad phases (0–4):

0. **Preparedness and anticipatory action.** Stakeholders strengthen protocols and institutional capacity. They prepare educational resources, including learning materials, so they can deploy them quickly in future crises. This strengthens education system resilience (adapted from INEE [1] and Stewart & Lowenthal [2]).

1. **Rapid emergency response phase, where contexts are unstable**. EiE education specialists have little time to prepare. They prioritise simplified approaches that rely on existing resources and capacities.

2. **Mid-term emergency response phase, where contexts remain unstable.** Education specialists have had time to review initial responses. They begin developing more structured programmes, including consideration of national system alignment.

3. **Mid- to long-term emergency response phase, where contexts are more stable.** Contexts are more predictable. Education specialists can refine delivery models and plan for, or begin, integration within national education systems.

4. **Sustainability and integration.** Education specialists are focused on systems integration and building resilience to ensure institutionalisation of effective EiE initiatives.

These five phases operate within dynamic systems where humanitarian action, education development planning, and peace-building efforts interact. Distinguishing between unstable and relatively stable crisis contexts helps EiE education specialists adapt to changing conditions and maintain learning continuity, even when situations are unpredictable [↕2]. In practice, responses may move back and forth between phases rather than follow a straight path [↕2].

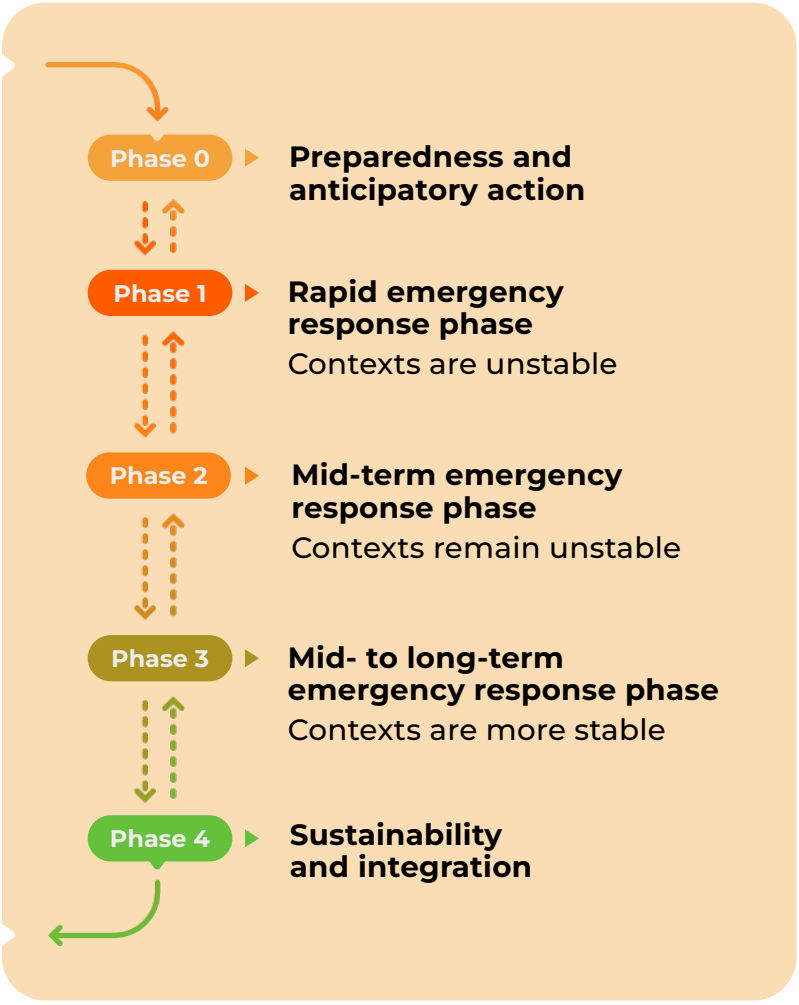


Figure 1. EiE response phases

As with all general guidance, the descriptions below are designed to illustrate what a strong approach in each phase could look like, without being reductive, simplistic, or prescriptive. Indeed, experienced education specialists will recognise that realising each step exactly as presented will be difficult and that they will need to adapt these strategies based on specific crisis types and contextual challenges, including resource constraints or pre-crisis system weaknesses, such as curricula

and teaching practices that may be inconsistent with good pedagogical practice.

Operating within this five-phase emergency response framework requires EiE education specialists to coordinate and collaborate with local and international stakeholders to support "shared goals of alleviating human suffering, strengthening resilience, and preventing conflict" [1 p. 19]. Understanding the principles behind a "nexus approach" which aims to enhance "coherence between short-term humanitarian assistance, longer-term development, and cross-cutting efforts to support peace to reduce chronic vulnerability and risk"[3, p. 3] can help EiE education specialists identify strategies and ways of working to meet these aims. It can also help build understanding of and design for weaknesses within national education systems that existed before the crises occurred.

While emergency response phases may overlap, we outline the main focus of EiE EdTech interventions for each phase below. These considerations are further expanded upon in the later sections on the five EdTech priority themes, beginning from Section 3. In all phases, and as noted in Section 1, we work on the premise that working with government systems is a precondition for developing sustainable EiE interventions.

Phase 0: Preparedness and anticipatory action

Evidence is growing that proactive preparedness planning and the introduction of anticipatory action approaches strengthen national system resilience during crises, enabling them to maintain learning continuity and reduce reliance on external donor support [8]. During the Covid-19 pandemic, for example, countries that had made earlier investments in technology-enabled delivery models, using low- or high-tech options, were better able to provide timely home-based learning [9].

EiE education specialists work with government ministries, local education authorities, and community stakeholders to design

preparedness plans and anticipatory action measures. Thus, ensuring that EdTech solutions reflect local policy, accountability frameworks, and sustainability mechanisms (budgeting, maintenance, localisation of learning content, and teacher training) [8; 10].

Phase 1: Rapid emergency response phase, where contexts are unstable

Rapid emergency responses are characterised by quick and sometimes improvised responses to a crisis event, such as civil unrest or a flood. The crisis event necessitates a transition from a pre-crisis education system to an emergency response, often with limited to no prior planning. Local education stakeholders may have limited strategies in place, whether tech- or non-tech-based, to ensure learning continuity.

During the first weeks of a crisis, EiE education specialists prioritise maintaining learning continuity, ensuring the safety of children and teachers and their psychosocial well-being and, where possible, conducting needs assessments and establishing coordination mechanisms between EiE stakeholders, including government ministries [4]. The INEE Minimum Standards recommend prioritising activities that meet immediate learning access and continuity, as well as safety and well-being needs, for example, by providing temporary learning and child-friendly spaces, recreational, creative, and learning materials, mental health and psychosocial support, social and emotional learning (SEL) activities, and school meals [1, p. 76]). Understanding equitable access considerations specific to gender, disability, linguistic or socio-economic background, and other forms of disadvantage is critical (see Section 5), starting right from this first response phase.

At this stage, integration within national systems may be limited, but accessing any emergency tools developed by the Ministry of Education and other stakeholders is a priority. In addition to initial engagement with the Ministry of Education, EIE education specialists typically liaise with the humanitarian education system, for example, through the country's education cluster system,[1] or, in the case of refugee education responses, the Refugee Education Working Group.[2]

Phase 2: Mid-term emergency response phase, where contexts remain unstable

After the initial rapid emergency phase, EiE education specialists transition from rapid to planned response, yet within still unstable systems. There is a shift to more structured remote and hybrid learning provision and, in some cases, discussions about how and when to integrate displaced populations in national education systems. During this phase, teachers and other learning facilitators receive continued training support. EdTech interventions are shifting from emergency workarounds to more planned programmes designed to address learning loss and provide alternative education options for children who remain unable to access formal schools [5].

EiE education specialists work closely with Ministries of Education and education cluster coordination mechanisms and their members to ensure that newly developed and curated teaching

[1] An 'education cluster' is ''An inter-agency coordination mechanism for agencies and organizations with expertise and a mandate for humanitarian response within the education sector in situations of internal displacement [...]. The Education Cluster is responsible for strengthening preparedness of technical capacity to respond to humanitarian emergencies" [1, p. 213].

[2] The Refugee Education Working Group is the coordination mechanism, preferably co-led by UNHCR and the host country government. The aims are to advocate for refugees with national authorities and address administrative barriers to education inclusion [11].

and learning content aligns with national curricula. Programmes are designed to support learning continuity and bridging pathways, including transitions between non-formal and formal education. EiE education specialists promote cross-sector coordination, such as between education and child protection [6].

Collaboration with government ministries, local education authorities, and community stakeholders is embedded throughout programme design and decision-making to ensure that EdTech solutions are locally relevant, policy-aligned, and supported by sustainable accountability mechanisms, including budgeting, maintenance, content localisation, and teacher training.

Education ministries and local and international EiE education specialists may work together to plan or implement either or both of the following:

- Remote or hybrid learning, which is implemented through the formal school system and meets the requirements of government curricula.

- Alternative learning programmes aimed at supporting over-age learners, those requiring catch-up education due to earlier disruption, a transition to another curriculum and / or new language of instruction, or those still unable to access formal school locations.

Phase 3: Mid- to long-term emergency response phase, where contexts are more stable

EdTech EIE interventions or programmes are in place, enabling face-to-face, blended, and remote or distance learning models across formal and non-formal education programmes, in line with contextual realities and learning continuity needs. These should ideally be aligned with government emergency response strategies and plans and adhere to EiE standards and good practice. Teacher professional development and support are

ongoing, as is support for other stakeholders, including caregivers, EiE organisation personnel, and government officials.

As crises stabilise, EiE education specialists further consolidate their programmes and place greater emphasis on working with national education system actors to prepare for integrating emergency programmes into national systems and education certification pathways [7]. Stewart & Lowenthal [2] describe Phase 3 as one in which teacher routines are established and EdTech tools and platforms are launched, but quality is not assured, and disadvantaged groups may be excluded. Stability does not automatically yield better learning outcomes; intentional, equity-focused improvement strategies across pedagogy, teacher support, and learner well-being support learning continuity for all. With governance and delivery improving, national systems can consolidate technology choices, enrich learning and teaching materials, and institutionalise teacher support and learning continuity [7].

During this phase, formal evaluations of learning outcomes, cost-effectiveness, and implementation performance take place. In addition to providing performance feedback for EiE EdTech intervention adaptation and improvement, these evaluations inform strategies for the eventual handover of EdTech EiE interventions to the government or other stakeholders.

Phase 4: Sustainability and integration

During this phase, programmes shift to focus on system strengthening, disaster preparedness, anticipatory action, resilient infrastructure, continuous learning pathways, certification, scaling, and localisation. EdTech is fully integrated into the system (formal and non-formal learning), with an exit strategy or sustainability plan implemented. Teacher professional development is institutionalised, and national policies include emergency preparedness plans and anticipatory action provisions.

The post-emergency preparedness phase marks a shift from recovery to resilience. EiE education specialists translate lessons learnt into institutional policies, protocols, and ongoing capacity building so that pre-planned systems can be activated in future crises.

Figure 2 below provides a high-level snapshot of potential key focus areas for an EiE programme as it evolves through emergency response phases. Specific intervention design decisions for each phase are included in the following five priority themes:

1. Grounding interventions in sound pedagogy
2. Making informed decisions about sourcing, building, and maintaining technology
3. Embedding equity and inclusion from the outset
4. Planning for financial sustainability and cost-effectiveness
5. Strengthening adaptive monitoring, evaluation, and learning.

Across all sections, a common principle emerges: technology must serve learning, not the other way around.

More detailed recommendations for incorporating the above priorities are provided in Sections 3, 4, 5, 6, and 7. For more specific instructions on how intervention teams can make design decisions for each phase in their own context, please refer to the companion contextualisation handbook.



	CONTEXT	FOCUS
Phase 0	**Preparedness** Pre-crisis or post-recovery. Systems are functioning but vulnerable.	Build response readiness, for example, by pre-positioning content; ensuring curriculum alignment; establishing partnerships; training teachers in digital literacy and the use of technology in the classroom; and developing first response protocols.
Phase 1	**Rapid Response** Crisis has just occurred or peaked. High uncertainty, infrastructure shock, data limitations.	Ensure immediate learning continuity and psycho-social well-being, safeguarding, and safety: maintain learning through available devices and connectivity channels, including offline. Prioritise psychosocial well-being and safety. Conduct rapid assessments.
Phase 2	**Mid-Term** **(UNSTABLE)** Crisis is ongoing, but the initial shock has passed. Systems remain fragile	Build a structured response: shift from emergency workarounds to planned programming. Begin curriculum alignment (if not already commenced) and teacher training; commence monitoring and evaluation for mid-term improvements.
Phase 3	**Mid- to Long-Term** **(STABILISING)** Context is more stable, though still in crisis. Systems are recovering.	Consolidate response programmes: formalise interventions; integrate with national systems; conduct outcome evaluations; plan for handover.
Phase 4	**Sustainability & Integration** Post-emergency or long-term recovery. Focus on system strengthening.	Embed full integration into national systems; institutionalise teacher development; build preparedness for future crises.

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3. Sound pedagogy for effective EdTech in crisis settings

This section translates insights from education sciences into practical choices for humanitarian education specialists designing learning programmes for primary-aged children in conflict and crisis settings.

"Focusing on effective instruction improves learning outcomes in reading and numeracy."

Research shows that how we teach matters as much as what we teach [1; 2]. There is strong evidence that focusing on effective instruction improves learning outcomes in reading [3] and numeracy [4]. The global body of research on how children learn points to similarities among children across contexts; see, for example, Verhoeven and Perfetti [5] on reading acquisition and Dehaene [6] on numeracy acquisition.

Yet in low-resource and crisis-affected contexts, instructional quality often suffers: teachers may be undertrained, curriculum pacing may be unrealistic, and learning materials may be limited [7]. The consequences are reflected in global learning levels: despite good progress in school enrolment rates, learning outcomes have improved only modestly over the last few decades. In LMICs, 70% of children struggle to read and understand age-appropriate texts at age 10 [8]. In numeracy, it is estimated that globally, only 44% of children reach minimum proficiency levels by the end of primary school [9]. These low levels of foundational learning have implications for school progression and educational



SCHOOLCHILDREN IN CLASS USING TABLETS. IMAGE BY SCHOOLPRPRO

trajectories. In their review of learning outcomes in Ethiopia, India, Peru, and Vietnam, Kaffenberger et al. [10] found a correlation between children's ability to achieve learning gains and improved school retention. In countries where children are well below minimum proficiency levels, for example, in countries affected by conflict and crisis, catching up with peers from more stable contexts becomes very unlikely [3].

Fortunately, similar pedagogical approaches can be used globally to improve learning outcomes, and the core principles of sound teaching practices apply equally in classroom and remote learning settings, whether in crisis-affected or non-crisis-affected contexts [11]. However, crisis-affected contexts may require significant adaptation in how these pedagogical principles are applied to meet the specific needs of children and youth affected by crises. This includes selecting core curricula to ensure quality, actively engaging caregivers, prioritising learner well-being, and addressing teacher capacity constraints [12]. This section addresses core, sound teaching principles that can be applied across EdTech interventions and will cover three main areas: pedagogical practices that lead to successful learning, teacher training, and useful delivery models for EdTech interventions.

Figure 3. Pedagogical practices for successful learning

01
Lower the cognitive load
Adjust teaching methods to help with poor memory and executive function.

02
Centralise social and emotional learning
Prioritise psychological stability, regulation of emotional responses, development of coping skills, strengthening of social connections, and building resilience and hope.

03
Align with curriculum
Develop in close collaboration with local education professionals to ensure the curriculum remains fully recognisable and relevant.

04
Use relevant, recognisable, and consistent content
Learning materials must use consistent terminology, visualisations, and pedagogical approaches to create a logical order for learners.

05
Give explicit instruction
Learners benefit more from carefully planned and structured activities than from exploring topics with little adult guidance.

06
Teach at their own level
Learning is most effective when lessons build on each child's current level of understanding.

07
Monitor learning continuously
Use validated assessment tools that allow teachers to adjust instruction or provide support when learning slows or stalls.

3.1 Pedagogical practices for successful learning

Lower the cognitive load

Learners affected by crises face many challenges, such as displacement, interrupted schooling, and chronic stress. Stress and trauma can harm both memory and executive function [13; 14; 15], creating an impediment to learning. Children may struggle to focus, remember, regulate emotions, or manage tasks.

Teaching methods can be adjusted to help with poor memory and executive function by reducing the cognitive load [16]. In low-resource, crisis settings, children are already more likely to experience sources of extraneous cognitive load, such as noise or language barriers. Too much cognitive load makes it harder for learners to remember information [16].

Good ways to reduce cognitive load include simplifying tasks, using routines, and breaking down content into smaller, more easily digestible chunks [16]. For example, instead of presenting instructions with many steps, help learners through them step by step, supported by simple examples. Complex visuals can be replaced with simpler, high-contrast images that highlight only the essential information. When presenting learning materials, avoid adding fun but distracting elements on the screen, such as animations or sound, unless they contribute to learning. If you want to use such elements for motivation, it is better to present them separately from the learning content. Keep the interfaces consistent across lessons, so that learners do not have to think about navigation while learning. Break down content into short reading passages, introducing new ideas and concepts one at a time to help learners progress through them.

Centralise social and emotional learning (SEL)

An emphasis on social and emotional learning is particularly crucial for learners in conflict and crisis settings. Create safe and supportive learning environments by using consistent routines



GIRLS HAVING A DISCUSSION IN CLASS. IMAGE BY ANDROS1234

and including SEL activities and life skills [17]; this is increasingly recognised as part of a quality education response [18; 19]. The intentional inclusion of SEL is often referred to as 'holistic learning', although the term is not well-defined in the academic literature. It generally describes an approach that supports the whole learner by addressing cognitive, social, emotional, physical, and psychological needs [20].

Numerous studies show that non-academic skills matter for learning, health, and general well-being [21]. Despite broad agreement on their importance, there is no clear consensus on which specific skills matter most, how they should be defined, or how they should be developed and assessed [21]. The INEE glossary defines SEL as follows below and recognises the many ways in which it has been defined and operationalised [22, p. 231].

"The process through which individuals learn and apply a set of social, emotional, cognitive, and related skills, attitudes, behaviors, and values that help direct their thoughts, feelings, and actions in ways that enable them to succeed in school, work, and life."

In crisis-affected settings, SEL programmes typically prioritise psychological stability, regulation of emotional responses, development of coping skills, strengthening of social connections, and building resilience and hope [18].

Align with the curriculum and follow a logical scope and sequence

Curriculum alignment is widely recognised as a best practice [22], but aligning an EdTech product to a curriculum is not always simple. In some educational systems, formal curricula are inconsistent with effective learning approaches. For example, they may emphasise rote learning and memorisation, or may not be based on the best available evidence [3].

One effective pedagogical approach is to scaffold difficult tasks by providing learners temporary support [23] until they can tackle the tasks independently, at which point you can introduce more complex tasks. A clear scope and sequence, which lists topics in a logical order for teaching, is vital for effective scaffolding [24]. An illogical scope and sequence that is weak, makes scaffolding impossible, and renders teaching less effective and systematic [3].

Aligning lesson content with the national or host country's curriculum may involve adjusting the scope and sequence to strengthen scaffolding and learner progression. These adjustments should be developed in close collaboration with local education professionals to ensure the curriculum remains fully recognisable and relevant. Maintaining alignment with the national curriculum can help integrate accelerated or catch-up programmes into formal education systems and make it easier for learners to later re-enter national schooling and certification pathways.

The goal is to respect the existing curriculum and align with it while integrating sound pedagogical approaches known to be effective for learning within the same educational response.

Use relevant, recognisable, and consistent learning content

Learning content must be relevant and recognisable to learners and educators [↑25]. Using existing materials from the national curriculum supports integration with the education system, reduces teachers' training needs because the content is familiar, and allows learners in the formal system to continue their planned learning. 'Relevant learning content' includes providing learners with learning materials in a language they understand [↑26].

However, developing EdTech products takes time, which is often unavailable in crisis-affected settings. In many cases, programmes need to rely on existing learning materials or products, at least in the early stages. Creating an inventory of learning materials already available for the target group makes it possible to review them against quality, pedagogical, and implementation feasibility standards.

Existing materials may also need to be modified to better meet learners' needs in the specific context. For example, when face-to-face teaching is not possible, exercises need to support more independent learning. Similarly, disruptions to learning increase

A COLOURFUL ABACUS IN CLASS. IMAGE BY PEXELS



the need for remedial learning or catch-up learning, and materials adjusted to these specific aims must be created or localised.

Learning materials must use consistent terminology, visualisations, and pedagogical approaches to create a logical order for learners. Details matter greatly here: what may be obvious to experts can be very confusing to children. For example, fonts with unusual letter shapes or a sudden change in the approach to long division can create confusion.

The World Bank knowledge pack on digital learning outlines the advantages and disadvantages of buying content, adapting free content, and building new content [↑27]. Developing new content offers full control but takes considerable time and requires significant expertise. Selecting open content, such as Open Educational Resources, and aligning it with curriculum standards also takes time, though less than creating new content from scratch. Commercial content can be high quality, but it is often expensive, involves lengthy procurement processes, and may raise licensing and sustainability concerns. The World Bank's EdTech team therefore recommends conducting a careful cost–benefit analysis to determine the most appropriate approach [↑27].

The introduction of GenAI[1] has significantly reduced the time needed for content development and adaptation. GenAI can generate exercises, teacher work plans, videos, images, text, and many other educational resources almost instantly. It can also support the generation of accessible formats for children with disabilities [↑28]. It does, however, still need people with expertise to create the appropriate prompts and assess the quality of the materials generated.

[1] "Generative AI (GenAI) is an artificial intelligence (AI) technology that automatically generates content in response to prompts written in natural-language conversational interfaces. Rather than simply curating existing webpages, by drawing on existing content, GenAI actually produces new content" [↑79 p. 8].

The usefulness of GenAI will depend on the language of the content. Languages spoken by fewer people, or for which fewer digital materials are available to train a model, will result in poorer content [29]. Initiatives to improve the models for various languages are ongoing. For example, AfroBench, a benchmark for African languages in Large Language Models (LLMs) [30], shows progress, though a significant performance gap persists between African languages and English. A similar finding, with performance being worse for African languages with fewer speakers and lower resources, was found when models were tested on the pedagogy benchmark developed by AI for Education's Benchmark Team [31].

Provide explicit instruction, including modelling, guided practice, and regular feedback for learners

Research shows that explicit, direct instruction is more effective than discovery-based instruction for foundational learning [32]. This means learners benefit more from carefully planned and structured activities than from exploring topics with little adult guidance [33; 3]. For younger learners and those with less prior knowledge, a structured approach is especially important [34]. Explicit instruction uses clear explanations and worked examples and is particularly effective in crisis settings, where children may not be able to rely on prior knowledge because of learning gaps and interrupted schooling. **Explicit instruction includes the following elements:**

- **Modelling**, in which a teacher or facilitator explicitly demonstrates how to perform or approach a task, e.g., showing regrouping in subtraction or blending letter sounds.
- **Guided practice with support, prompts, and immediate, specific feedback.**
- **Gradual release to independent work**, where responsibility shifts step by step from teacher-led modelling to learner-led independent practice.

In resource-scarce settings, scripted lesson plans and pre-recorded audio lessons can help facilitators to deliver explicit instruction-based lessons with appropriate modelling and guidance [35; 36].

Feedback for learners should be simple, timely, specific, and encouraging. Learners need to know what is being expected (what 'good' looks like), be able to compare their current performance against that standard, and know how to close any gaps between the two [37]. Children need their teachers' help to do this. Teachers can focus on what has been done well, what can be improved, and how to improve it, using language that promotes a growth mindset rather than judgement. A growth mindset is supported by focusing on effort rather than traits, normalising mistakes, and reminding children of their progress over time [38]. Where this approach is not the norm, introducing it over time through teacher training and mentoring will be required.

Providing high-quality feedback is difficult and cannot be outsourced entirely to algorithms [39; 40]. Much of the feedback in digital learning tools is evaluative, providing responses on what is 'correct' or 'incorrect' [41; 40]. Research shows that while this type of feedback can support learning for rote or procedural tasks [42], it is less effective for developing conceptual understanding and transfer of learning. In these cases, elaborative feedback, which provides explanations or hints, is more effective [43; 44; 45]. Some digital learning tools provide elaborative feedback by explaining why an answer is incorrect or by showing model answers [45]. This kind of feedback is usually written, which assumes learners are literate, although it could also be delivered via audio or video. When designing an EdTech intervention, it is important to consider how feedback is structured and whether it can be improved to include more elaborative feedback.

Technology can support instruction through AI. The promise of technology functioning as a tutor is not new. Intelligent tutoring systems (ITS) were popular in the 1980s, as AI capabilities advanced. Early ITS, also referred to as cognitive tutors, could model a learner's knowledge state, diagnose misconceptions,

provide step-by-step guidance, and adapt the difficulty or sequence of problems based on a learner's performance [46]. Earlier iterations of ITS were typically focused on one subject, followed highly structured decision trees, and relied on rule-based logic. As a result, their interactions were rigid, and their language was limited [47]. With the introduction of LLMs, new possibilities of AI as a tutor are being explored. LLMs enable more natural dialogue and can handle a broader range of questions and situations. There is considerable potential for AI models to assist learners and teachers by providing real-time responses to questions [48]. However, because these systems may occasionally produce harmful or inappropriate content, policymakers should closely examine their performance on safeguarding benchmarks [48]. Complex models often require stable connectivity, but evidence shows that smaller open-source LLMs can match larger models in generating feedback, highlighting their potential value in LMIC environments [48].

Teach learners at their own level and monitor their progress continuously to adjust instruction

Learning is most effective when lessons build on each child's current level of understanding [49]. This pedagogical approach, called differentiated teaching and learning, matches instruction and materials to learners' different ability levels. A well-known example of this approach is Teaching at the Right Level (TaRL).[2]

[2] See https://www.povertyactionlab.org/evidence-effect/teaching-at-the-right-level. Retrieved 1 March 2026.

CASE  **STUDY**

An example of a tech-enabled TaRL approach is a WhatsApp-based intervention used in a rural region in Punjab, Pakistan, during the Covid-19 pandemic. WhatsApp was chosen to deliver instructions because it is widely used in most schools in the area. Personalised learning materials (including a problem, a video of the solution, and a short quiz) were provided to each learner every week over three months, and learners would respond with a solution to the problem after a week. While English materials included videos from online learning platforms IXL and Khan Academy, teachers created personalised videos for Urdu due to the limited availability of such resources. Teachers were given training sessions over Zoom on using EdTech for instruction [↑50]. A randomised trial conducted during Covid-19-related school closures found that learners' English and Urdu scores improved by 0.56 SD, although no impact was observed in maths scores [↑50].

Assessment is vital for understanding learners' levels of literacy, numeracy, and SEL. Formative assessment gives teachers ongoing information about learners' learning levels, including gaps that need to be addressed [↑3]. Allowing children to learn at their own level is always a good practice, but it is especially important when learning has been disrupted. In these situations, children's ability levels might not match the class or

grade they are officially in. As a result, the gap between what children know and what the curriculum expects them to know can increase. Curricula in LMICs are often overly ambitious, requiring unrealistic rates of progress from both teachers and learners, which leads to children falling behind [51; 52]. Allowing multiple entry points in the curriculum, separating learning level from calendar age, and adjusted pacing help ensure that children can learn at their own level and pace.

Use validated tools for formative and summative assessment

As learners learn at their own pace, continuous monitoring allows teachers to adjust instruction or provide support when learning slows or stalls. Teachers should therefore use (validated) assessment tools administered outside the EdTech product itself.[3]

Several validated formative assessment tools are available. The Annual Status of Education Report (ASER) reading and arithmetic assessment [53] can give a quick overview of reading and numeracy levels. Subtasks of the Early Grade Reading Assessment (EGRA) [54] or the Early Grade Math Assessment (EGMA) [55] are also useful for tracking learning progress. Curriculum-based measurement, widely used in the United States to track progress, also includes useful examples for regular data collection on numeracy and reading skills [56; 57].

Tools for monitoring SEL include the International Social Emotional Learning Assessment (ISELA) [58], the Stirling Children's Wellbeing Scale [59], and the Strengths and Difficulties Questionnaire (SDQ) [60]. Other useful assessments

[3] Monitoring learning is not the same as collecting data logs in a digital learning application, such as attendance logs or learner progression data. Log data does not reliably show what children have actually learnt. When enough data is available which shows consistent results between the log data and validated learning measures, log data can be used as a proxy for assessing learning.

include a home language check to adjust the language of instruction or provide bilingual support, and the Washington Group Child Functioning Module to identify needs for alternative formats of assistive tools [61].

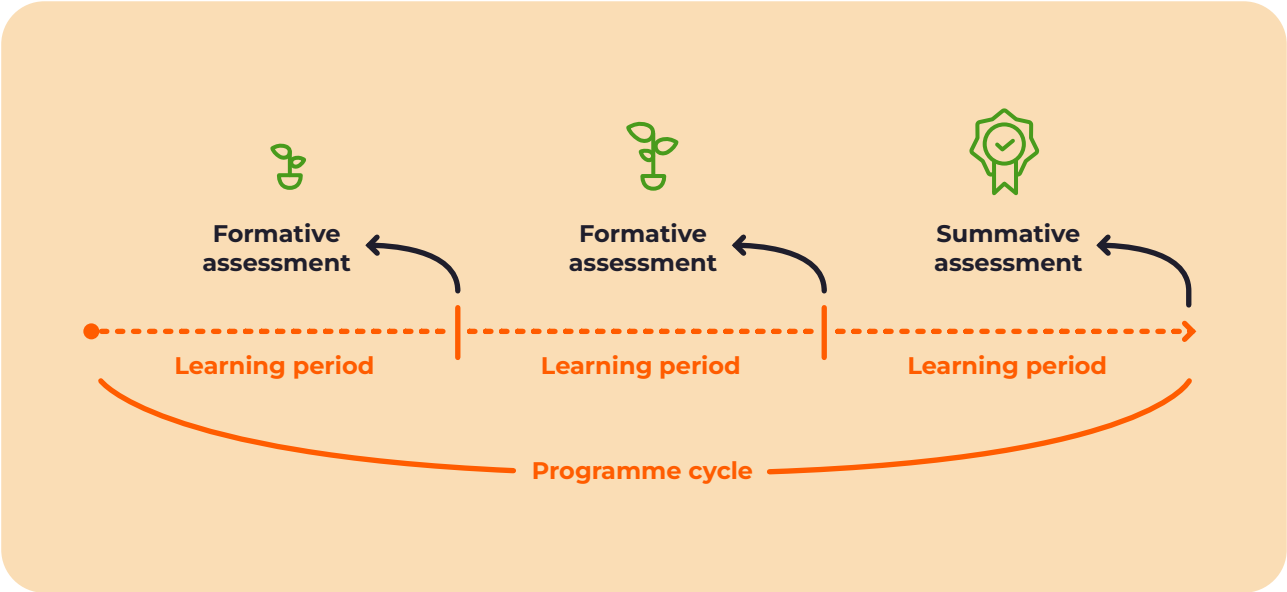


Figure 4. Assessment types over the programme cycle

Summative assessments are conducted at the end of a defined learning period to measure what learners have learnt, for example, at the end of a course or programme cycle [62]. These assessments are usually more comprehensive than formative assessments, include multiple subscales, and take longer to administer. The EGMA [55] and EGRA [54] assessments mentioned above can also be used for summative assessment; whether an assessment is formative or summative depends on its purpose, not the tool itself. Other examples include the Holistic Assessment of Learning and Development (HALDO) for maths, reading, SEL, and executive function [58], and the International Development and Early Learning Assessment (IDELA) for maths, reading, and SEL [63]. Randomised controlled trials (RCTs), in which children are randomly assigned to either a control group or one 'receiving' an intervention, typically use summative assessments or other standardised tests [64]. RCTs are designed to demonstrate the causal effects of a programme [65]. They have become increasingly popular for evaluating education

programmes in LMICs, where governments and development organisations frequently rely on RCT evidence to guide programme design and policy decisions [66; 67]. RCTs conducted to show the effectiveness of EdTech interventions in crisis settings include Can't Wait to Learn, a tablet-based intervention in Uganda [68], a phone-and-SMS programme in Botswana [35], and a phone-based intervention in Bangladesh [69].

Assessments for foundational literacy and numeracy are usually administered verbally to each child (e.g., EGRA, EGMA, ASER) and are therefore time-consuming and costly. Artificial intelligence might help score a child's verbal responses. A case study [70] developing an AI-supported EGRA for isiXhosa showed that the model achieved 91% accuracy in scoring children's performance. However, training the model required extensive human input from linguistic experts and human markers as well as 1,265 learner recordings. One interesting observation that made training the model harder was that human annotators disagreed much more often than expected, with an overall disagreement rate of 19%. Because models are trained on human input, inconsistencies in that input will make the models less precise [71]. This case study demonstrates the potential of using AI for assessment. Upcoming work aims to reduce the model size so it can run on a device and operate offline [70].

3.2 Integrate pedagogical approaches and digital literacy skills in teacher training

Successful EdTech implementation requires comprehensive teacher training that integrates technical and pedagogical skills. Teachers need to know how to use devices and software, and, importantly, how to integrate technology meaningfully into lessons. Continuous professional development has been shown to strongly influence successful EdTech adoption, as digital competence directly affects teachers' ability to deliver effective online instruction [11]. However, many studies report major gaps in teachers' preparedness. A lack of training in digital skills and

online pedagogy remains a key barrier to effective remote education [72].

Training should therefore focus on the following key areas:

- **Digital literacy and technical proficiency**, ensuring teachers can confidently use devices, platforms, and offline tools suited to low-connectivity settings.
- **The pedagogical design of the EdTech intervention(s)** itself, and which practices are included and why.
- **Pedagogical strategies for blended and remote learning**, including how to design engaging lessons, manage virtual or hybrid classrooms, and provide differentiated support to learners. Training should emphasise how to integrate EdTech meaningfully into the curriculum, using tools such as educational apps, interactive content, and radio or SMS-based learning, to enhance, rather than replace, human interaction and active learning.
- **A focus on SEL and inclusive teaching approaches** that enable teachers to respond to trauma, ensure gender equity, support children with diverse needs, and understand how to include them in blended and remote learning settings.

While this training should ideally commence prior to a crisis, there are often gaps, particularly for under- or untrained teachers. EdTech interventions need to bear this in mind in their design and, as far as possible, provide adequate training and support. Teacher training and support, however, need to take into account the significant strain that teachers may be under as they work in resource-constrained circumstances, support displaced or traumatised learners, and manage their own crisis-related professional and personal challenges [83] [84].

Research shows that successful teacher training initiatives often use accessible platforms, such as social network groups or learning management systems, to deliver training and foster collaboration [12].

CASE  **STUDY**

The One Teacher Thailand (OTT) programme (formerly One Teacher Network), launched in 2015 by UNICEF Thailand, leveraged technology to support teacher professional development and peer learning, and to integrate technology into their teaching practices. Led by and designed for teachers, the programme began in Thailand's southern provinces in response to disruptions to learning caused by political unrest and conflict, and then expanded to other regions in Thailand, particularly in response to the Covid-19 pandemic. OTT combined weekly Facebook live training sessions with annual in-person training sessions and hosted virtual talks to help teachers build skills. Teachers who participated in the programme reported improvements in their mental well-being, understood the importance of updating their teaching practices to meet evolving needs, and found peer learning helpful [↑73].

3.3 Choose your delivery model: Consider multiple technologies to ensure access and flexibility

Delivery models describe how learning takes place. EdTech interventions in crisis-affected settings need flexible delivery models that can respond to infrastructure constraints, interrupted schooling, and diverse learner needs. Understanding the differences between delivery models is essential for appropriate intervention design.

A delivery model has two main elements:

1. How instruction is delivered
2. When instruction takes place.

Instruction can be delivered face-to-face or be technology-mediated. **These approaches can also be combined, resulting in blended or hybrid learning.** Blended learning combines face-to-face instruction with technology-mediated instruction.[4] Hybrid learning is an educational approach in which some participants attend in person while others participate online simultaneously using technology [↑22].

The distinction between face-to-face and technology-mediated learning partially overlaps with distinctions based on location. Face-to-face learning often takes place in a classroom, while technology-mediated instruction is common in remote or distance learning. However, face-to-face learning can also take place at home, and digital learning applications can deliver technology-mediated instruction in the classroom.

A second distinction relates to the timing of teacher-led instruction. **Instruction that happens in real time is known as synchronous learning. Instruction delivered through previously created learning materials is asynchronous learning** [↑12]. A subset of asynchronous learning is self-paced learning, where learners control the pace themselves. All self-paced learning is asynchronous, but not all asynchronous learning is self-paced.

[4] We use a modified definition of blended learning, based on Graham's definition [↑81], substituting computer-mediated instruction with technology-mediated instruction to be more applicable to the EIE context. Other definitions of blended learning include online learning as a key characteristic [↑80; ↑82; ↑22], in an EIE setting, offline solutions are often used, therefore, any definition, including online learning, is less appropriate.

When selecting delivery models for an EdTech intervention, the guiding principle should be to **choose the simplest feasible approach that still meets the learning objectives.** In most crisis settings, this means prioritising low-tech, offline, asynchronous, or self-paced options before considering more complex blended or hybrid models [74]. The selected model must also be inclusive. Learners may face multiple barriers, including shared devices, low digital literacy, disability, language needs, and limited caregiver support. Asynchronous and self-paced approaches often provide greater flexibility and equity. In contrast, synchronous or hybrid models can exclude learners with unstable connectivity.

Teachers and caregivers remain essential across all delivery models, so they should be supported with clear guidance, simple routines, and accessible instructions to help sustain learning, whether in schools, at home, or in temporary learning spaces [12]. Furthermore, **EdTech interventions must be designed for flexibility and continuity, enabling smooth transitions between delivery models as conditions change.** For example, programmes may need to move quickly from blended learning to remote or offline options during school closures. This adaptability ensures that learning can continue despite the unpredictability of crisis environments.

Learning should be accessible through multiple technologies. These might be radio or TV broadcasts, online platforms or preloaded offline applications. A common theme across the literature is the importance of providing varied options to sustain learning when access to devices, connectivity, or electricity is limited [75; 76; 12]. As Barnes & Katrin [74] note, many EdTech interventions deployed during the Covid-19 pandemic were effective only for learners with the financial means to access the required hardware and data. Ensuring low-tech pathways is essential for reaching more learners in the short term, while addressing the underlying inequalities is a long-term challenge.

"Ensuring that EdTech interventions are available across a range of technologies strengthens resilience, maximises reach, and supports equitable participation for learners in diverse and resource-constrained environments."

CASE STUDY

In South Sudan, schools were closed for 14 months during the Covid-19 pandemic, leaving 3 million children in need of educational support. Radio-supported learning was a strong educational enabler in this context, where 89% of the population lacked access to the internet or a mobile phone. Through their Education on Air programme (EOA), the Ministry of General Education and Instruction and UNICEF provided curriculum-aligned, interactive radio lessons and a toll-free helpline for learners to call teachers with questions. While the EOA programme has not published learning impact data, 329,063 learners (168,201 girls) were reached, with 79.1% ranking the lessons as 'good' or 'very good' and over half reporting increased knowledge about water, sanitation, and hygiene (WASH), well-being, Covid-19 prevention, and motivation to learn [↑77].



In low-income countries, pupils tend to have lower digital literacy and fewer available devices for online learning. Learning programmes must therefore account for infrastructural constraints. Education decision-makers are encouraged to incorporate widely accessible technologies such as television, radio, and phones alongside more advanced digital tools [↑78]. Producing digital content in multiple formats (e.g., text, audio, or

video) and distributing it through several technologies (e.g., radio, TV, mobile devices) can be an effective strategy for reaching rural and remote learners. **Designing interventions that can be used offline, either through pre-loaded materials or downloadable resources, further expands access** by reducing reliance on continuous connectivity.

Ensuring that EdTech interventions are available across a range of technologies strengthens resilience, maximises reach, and supports equitable participation for learners in diverse and resource-constrained environments.

A CLASSROOM IN A VILLAGE IN MYANMAR. IMAGE BY THOMAS PEDRAZZOLI





3.4 Resources

» **Rosenshine's Principles of Instruction (2012).** Rosenshine's Principles of Instruction provide a concise, evidence-based guide to effective teaching practices grounded in cognitive science. The framework outlines ten key instructional strategies, including reviewing prior learning, presenting new material in small steps, asking frequent questions, modelling processes, guiding practice, checking for understanding, and scaffolding tasks before independent work. The principles emphasise explicit instruction, structured practice, and gradual release of responsibility to support mastery and retention. Widely used in teacher training and curriculum design, the guide offers practical, research-informed strategies that can strengthen both classroom teaching and digitally supported learning environments.
Go to https://www.aft.org/sites/default/files/Rosenshine.pdf.

» **The Digital Learning Resource Hub** brings together resources to help countries and educators plan and improve digital learning for children. It organises guidance, tools, and examples into themes like curriculum, safe online use, technology access, and inclusion, making it easier to design strong and equitable digital-education programmes.
Go to https://www.unicef.org/digitaleducation/digital-learning-resource-hub.

» **Learning assessment tools.** A range of organisations provide assessment tools to measure learning and well-being in crisis and low-resource contexts.

- Mapping of academic assessment tools by INEE. Academic Learning Measurement and Assessment Tools in Education in Emergencies: Identifying, Analyzing, and Mapping Tools to Global Guidance Documents.
Go to https://inee.org/resources/academic-learning-measurement-and-assessment-tools-education-emergencies-identifying.

- EGRA & EGMA Toolkits. EGRA | EGMA. Go to https://ierc-publicfiles.s3.amazonaws.com/public/resources/EGRA%20Toolkit%20V2%202016.pdf

↳ and https://shared.rti.org/content/early-grade-mathematics-assessment-egma-toolkit.

- Assessment tools from Save the Children with links to publications and guides. Go to https://www.learningassessmenttools.com/.
- SEL and psychosocial support (PSS) measurements and assessment tools in education in emergencies by INEE. Go to https://inee.org/resources/sel-and-pss-measurement-and-assessment-tools-education-emergencies-identifying-analyzing.

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4. Sourcing, building, and maintaining technology

A successful EdTech intervention combines technology, pedagogy, and delivery model to create an effective and relevant learning experience:

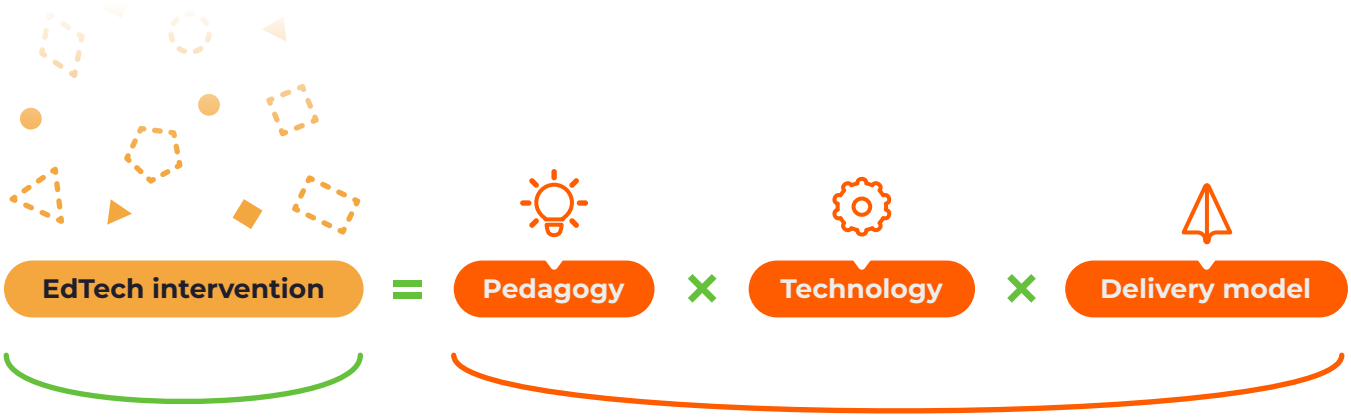


Figure 5. The parts of a successful EdTech intervention

The strength of an EdTech intervention depends on the quality and coherence of all its parts. If one element is poorly designed for the target learners, the overall effectiveness will be reduced.

In this section, we provide guidance on choosing between reusing, adapting, or building EdTech for foundational literacy, numeracy, and SEL in crisis settings. We then expand on considerations and good practice for building and adapting technology. We introduce EiE education specialists to testing

methodologies for reusing, building, and adapting technology, and end the section with a discussion on procurement, logistics, and environmental impact.

4.1 Reuse and adapt before building new technology

Deciding whether to reuse, adapt, or build technology is a foundational step in EdTech-enabled emergency response. The decision is not purely technical; it involves balancing learner needs, education system requirements, time and capacity availability, procurement and logistics strategy, processes and operations, and implementation context.

The decision on whether to build and adapt or re-use depends on whether an appropriate tool already exists for a particular crisis setting. Where re-use is not possible, EiE education specialists need to explore whether existing technology can be adapted or contextualised, or whether a full new build is required. The decision pathways for reusing, adapting, or building technology involve analysing the contextual appropriateness of existing technology, evaluating trade-offs, and clearly understanding the investment requirements for each alternative (see Figure 6 below).

Figure 6. Decision pathways for reusing, adapting, or building



A useful description of what to consider when you want to build your own software can be found in Jordan's *Don't Build It* guide for development sector practitioners working with technology [1]. The guide contains practical, detailed advice on evaluating the real need for new technology, assessing existing solutions, determining long-term maintenance requirements, and identifying the organisational capacities required for sustainable software development. One key takeaway is that just because you can build something doesn't mean you should. Jordan's *Don't Build It* guide encourages EIE education specialists to assess whether a (new) technological solution is genuinely needed or whether existing solutions are already available that could meet learning and other EdTech intervention objectives [1].

"Just because you can build something doesn't mean you should. Assess whether a new technological solution is genuinely needed. Do existing solutions meet learning and other EdTech objectives?"

Deciding whether to select or build the technology is a crucial step in designing an education response, especially in crisis contexts where time and resources are limited, and needs are urgent. In such situations, the priority should be to build on what is already in place [2]. In many cases, this means reusing content or adapting EdTech interventions already in use before the crisis [3; 4]. While reusing existing hardware, software, and/or learning materials may be quicker and more feasible than building from scratch, it still requires expertise in intervention development and testing. Even when re-purposing existing technology, adaptations should accommodate learners' specific needs and contextual realities.

Regardless of the choice to reuse, adapt, or build technology, education specialists will need to factor in cost and implementation considerations and provide support across the full intervention lifecycle (see Section 4.4).

4.2 Design, build, and sustain context-responsive EiE EdTech interventions

In this section, we provide guidance on assessing infrastructure, selecting an appropriate design and development team, developing durable systems and operational processes, and applying a 'total cost of ownership' approach. We also highlight cross-cutting considerations that should be embedded from the outset, including privacy and security by design, the use of Digital Public Goods, and responsible approaches to licensing and intellectual property, as well as building technology solutions well today to ensure effective implementation and adaptability in the future.

Assess connectivity, power, devices, and physical infrastructure early

To make the right decision about building or selecting a technology solution, it is essential to understand the technical context in which that application must operate. Any digital learning application depends on the availability and reliability of the underlying infrastructural environment. A first step is to assess the connectivity, power supply, devices, and physical infrastructure [5; 6]. We recommend the following:

- **Map inequalities in internet connectivity, electricity supply, and phone network access** due to socio-economic status, geographic regions, or other disadvantage factors. Electrical grid reliability assessments and a review of alternatives, such as solar charging and battery packs, should be conducted. Furthermore, electricity and internet connectivity costs are major obstacles in many LMICs, especially in low-income countries, and can account for more than half of the total costs of delivering digital learning for all [7].

- **Capture device availability and access in homes, schools, and learning and community centres**. Assess the ratio of devices to household members and device ownership to estimate realistic

access levels, particularly for girls [6]. Not all devices are suited to all purposes; additional considerations include device memory and computational power. Digital learning applications that require significant memory or computational power can widen the access and intervention retention gap between specific groups and individuals. The quality and availability of accessories, such as headphones or protective covers for devices, should also be considered, as they may enhance or hinder learners' experiences [8].

- **Conduct an assessment of physical Infrastructure**; this includes secure device storage, charging options, and weather protection. The storage of technology equipment can present significant challenges in crisis settings, where limited space in learning centres and schools, and the risks of theft, humidity, and dust, demand careful protective measures [8].

Assemble your co-design and development team

If you decide that a new learning application needs to be built, or an existing application requires adaptation, then consider the following team capacity recommendations from Jordan's *Don't Build It* guide [1]:

- **Prioritise hiring a full-time senior technology lead.** Fully outsourcing the work, or operating without strong technical oversight, all pose major risks.

- **Keep the core development team small and develop junior in-house talent** to build long-term capability.

- **Involve people who understand the context** in which the product will be used. Train them in user experience (UX) techniques to understand user needs and improve user-friendliness, enabling them to translate their observations into actionable insights for the software development team.

- **Use open source where possible**, choose popular programming languages, and invest in tooling (CI/CD,[1] documentation, code quality) to support long-term maintainability.

When building digital learning applications, it is essential that software developers, pedagogical experts, and teachers[2] work together to ensure that technical and functional considerations do not undermine the pedagogical integrity of the learning content. Software developers contribute important skills in technical solutions. They must, however, work closely with pedagogical experts and teachers to ensure that these are used to enhance, rather than hinder, pedagogical approaches [↑9). By continually collaborating with teachers and pedagogical experts throughout the development process, software development teams have rapid, consistent access to pedagogical expertise, content, and curricular knowledge, enabling timely, accurate decisions.

Develop durable operational systems and processes

Developing a digital learning application or EdTech intervention is not only about building features. It is about establishing the right systems and processes to sustain the EiE EdTech intervention, improve it, and safely hand it over to new teams over time. Durable systems reduce the risk that an EdTech intervention will become fragile or unusable when funding cycles end or personnel change [↑10]. Prioritising the development of systems and processes is particularly important in crisis-affected settings, where personnel turnover, regime change, or shifting donor priorities are common [↑11]. Systems and processes must balance instructional priorities, safety, and technical feasibility, and can be supported by maintaining a focus on the following:

[1] CI / CD (Continuous Integration / Continuous Delivery) is a software-development practice where code changes are continuously integrated, tested, and delivered, and a practice in DevOps (see Section 4.3 for more information on DevOps).

[2] Some teachers will be able to fulfil both the pedagogical expert and teacher role.

- **Product and roadmapping** to decide feature priorities, what types of evidence and engagement inform decisions, and determine how changes are approved [12; 13].
- **Pedagogy and curriculum alignment** to ensure new features remain instructionally sound and culturally relevant [9; 14].
- **Data and safeguarding** to set data minimisation rules, consent pathways, and breach response [15; 16].
- **Intellectual property and licensing** to determine maintenance responsibilities and review processes [17; 18; 10].
- **Localisation and accessibility** to manage translations, inclusive design, offline capability, and accessibility requirements.
- **Documentation** to record procedures, user instructions, and credential control [19].

Effective operational systems are underpinned by structured documentation, including technical READMEs,[3] deployment scripts, data dictionaries, content authoring guides, API documentation, and instruction and implementation manuals. Documentation should evolve with the EdTech intervention and not be written solely at handover to new owners or stakeholders. EdTech interventions often cannot be sustained because knowledge resides with consultants or agencies that are no longer under contract [10].

Embed privacy and security considerations in the design

Privacy-and security-by-design approaches involve designing an EdTech intervention to prevent privacy and security breaches, wherever possible, and to limit their impact if they occur [15]. For

[3] A technical README is a file located in the directory of a software project that provides essential documentation for users and developers.

example, databases containing personally identifiable information should be hosted on a separate server, separate from other databases.

A related and valid question is: Why is personal, identifiable data needed in the first place? Does it provide a benefit for the user? If it provides a benefit, a second question is whether this data should be stored centrally on a server, or if there are local, and potentially safer solutions. **Collect and store only the data you must, and consider how to reduce risks for data subjects**. For example, sensitive data, such as disability status, is important to collect from an equity perspective, but should be stored, if at all, with care and in line with relevant data protection frameworks in central databases. An alternative is to store group statistics for sufficiently large groups.

Frameworks to comply with include national data privacy legislation, research guidelines regarding human subjects, and data privacy and child protection laws [↑20]. See Section 7.4 for further discussion on the use of data in EdTech interventions.

Build well today to support implementation tomorrow

Software used in crisis settings should be robust and relatively easy to maintain. Structure the software build into small, independent modules (e.g., authentication, offline storage, data synchronisation) so that individual parts can be updated or replaced without disrupting the entire system [↑21]. Prioritise clean, readable code and documentation [↑22]. Implement strong DevOps[4] practices that bring together software development and operations teams to ensure systems are built, tested, and deployed reliably and repeatably. Including

[4] "DevOps: A set of practices to enable new code to be continuously integrated into existing code and deployed swiftly and reliably. The specific tools for integrating code and deploying it are called "continuous integration / continuous deployment" (CI/CD) [↑1, p. 28].

automated pipelines that run tests, scan code for security vulnerabilities, verify that dependencies are up to date, and support packaging new releases [↑1].

Even if software is perfect at delivery, all digital learning applications require maintenance.[5] Maintenance can be classified into three categories [↑23].

1. **Adaptive maintenance** keeps software usable in a changed or changing environment. It involves updates to the operating system, libraries, and framework. Software is not built from scratch but built upon other software, libraries, and frameworks, which periodically require updates [↑24]. This includes security updates.

2. **Corrective maintenance, also known as bug fixing,** is used to correct faults that are discovered. A bug-fixing routine should be established, with errors tracked. Ensure field teams and teachers have a clear, simple way to report issues and receive timely support.

3. **Perfective maintenance** improves performance or software maintainability; this might include improving loading times or cleaning up code.

Select licensing and ownership models that enable reuse and promote sustainability

This section focuses on legal ownership, specifically Digital Public Goods, licensing models, and intellectual property (IP) arrangements that determine who can reuse, modify, localise, and redistribute software and content over time. Prioritising consideration of ownership elements is critical for sustained usage of software, hardware, and content. Even within a single

[5] Any new features or content updates are not considered maintenance, but development [↑23; ↑24].

context, ownership challenges can emerge quickly during regime change, personnel turnover, contract transitions, or funding shifts. Ownership elements include the use and development of Digital Public Goods, software licensing models, and intellectual property agreements.

Digital Public Goods (DPGs) are open, reusable digital solutions, such as software, data sets, standards, and AI models, that are freely available and meet a set of criteria ensuring they are safe, interoperable, and designed for public benefit.[6] Digital Public Goods offer an opportunity for localised adaptation, providing the design and development team with greater control and independence by reducing the risk of vendor lock-in [↑25, pp. 7–8]. The Digital Public Goods Registry offers a catalogue of Digital Public Goods that can be adapted or reused [↑17].

There are two important concepts to consider regarding reusing code or content in software development: **open source** and **open standards** [↑20]. Open source is software whose source code is publicly available, allowing anyone to use, modify, and redistribute it under an open license. Open source does not mean cost-free. Deployment still requires technical capacity for installation, documentation management, security patching, and long-term support [↑1]. Open standards are shared technical specifications (like SCORM,[7] xAPI,[8] or H5P[9]) that ensure compatibility of data and content across systems, allowing resources to be integrated into other platforms without re-engineering. In practice, they enable a learning activity or resource created in one platform to be reused, modified, or integrated into another platform. Open source and

[6] An overview of available Digital Public Goods can be found on the digital public good registry: https://www.digitalpublicgoods.net/registry.

[7] **SCORM** is a standard for packaging and tracking e-learning content (see https://scorm.com). Retrieved 10 December 2025.

[8] **xAPI** is a specification for recording learning experiences across systems (see https://xapi.com). Retrieved 10 December 2025.

[9] **H5P** is an open-source tool for creating interactive learning activities (see https://h5p.org). Retrieved 10 December 2025.

open standards are not synonymous. Open-source code may use open standards, but does not have to. Likewise, open standards can be used in proprietary or open contexts [↑26]. Principles for Digital Development [↑20] recommend using open standards wherever possible to enable system integration and reusability.

Selecting an appropriate licence determines how development teams and implementers can legally use the software or content in the future. Permissive licences (for example, MIT)[10] permit broad reuse, including commercial modification with minimal restrictions. Copyleft licences (for example, the GPL)[11] require any adapted work to remain open-licensed, which aligns well with equity goals but may restrict partnerships involving proprietary systems [↑27; ↑18].

Content licensing also requires careful consideration, particularly when creating or adapting learning materials. Creative Commons licenses (i.e., CC-BY or CC-BY-SA) allow materials to be translated, localised, or adapted without renegotiation [↑17]. This can be an important feature for scaling EdTech interventions in crisis settings, where content is adapted to address learning gaps and support equity considerations, such as by integrating home-language instruction for refugee learners.

Procurement contracts for software should specify who owns the codebase, learning content, translations, and future iterations, including whether governments or partners retain perpetual rights to modify or redistribute materials. Without clear and appropriate IP clauses, tools risk becoming unusable once

[10] **MIT** licences permit use, modification, and distribution of the software, with the condition that the original copyright notice and the licence text are retained in the redistributed software. See https://tlo.mit.edulicense-comprehensive-guide. Retrieved 10 December 2025.

[11] The **GNU General Public License (GPL)** is a free, copyleft licence for software and other kinds of works. See https://www.gnu.org/licenses/gpl-3.0.en.html. Retrieved 10 December 2025.

vendors exit or grant cycles end. This issue has been observed across multiple EdTech deployments in LMICs [44].

Finally, facilitating sustainable use of open-source software requires active, ongoing software stewardship, including governance models, funding strategies, community contribution guidelines, and maintenance pipelines. Many open-source, software-enabled interventions stop not due to poor design, but because long-term stewardship is unfunded, making it difficult to maintain and adapt software over time [10 p. 12]

4.3 Test and iterate to improve learning outcomes and quality

Testing is a core element of the design-and-build process and continues once implementation starts. The ultimate aim of any EdTech intervention is that children learn. For this to happen, the digital learning application should be thoroughly tested. Importantly, test results should influence the next iteration of the technology as part of an iterative process [28]. Testing occurs at multiple levels, including user experience and pedagogical alignment, technical functionality, and learning outcomes. Below, we outline tests to ensure an EdTech intervention is usable, instructionally sound, and effective in improving learning.

User experience and pedagogy

In crisis-affected areas, digital learning applications must be simple, intuitive, and accessible to users with limited digital skills, and grounded in strong pedagogical foundations [29]. Regularly involving end-users, such as learners and teachers, in testing during development is a key factor in user experience (UX) testing.

The Nielsen Norman Group UX research glossary [30] includes definitions of test types and available tools; prototype and usability testing are two very useful types.

- **Prototype testing allows for testing before software coding commences.** Prototyping tools, including using paper mock-ups or static slides, allow users to experience and provide feedback on planned technology designs [30].

- **Usability tests involve a facilitator guiding participants through tasks in a digital learning application.** The facilitator observes the participant's behaviour and listens for feedback. This might be combined with a think-aloud protocol, in which participants are asked to verbalise their actions and thoughts while using the intervention [30]. Usability tests can be conducted in controlled environments, such as a temporary test location, or in real-life environments that present more authentic situations.

UNICEF's EdTech for Good Framework (see Section 7.5) highlights key dimensions of sound pedagogical design, including flexibility for learners and teachers, strong learner engagement, opportunities for creativity, support for collaboration, the use of multimodal content, thoughtful gamification where appropriate, and meaningful assessment of learner progress [29].

In addition to utilising frameworks like the EdTech for Good Framework, there are other pedagogical test examples that can be valuable during software development. For example, you can test the technology-integrated learning content with a mixed team of subject-matter experts, curriculum experts, and instructional designers. The content, pedagogy, and technology should reinforce each other. Especially in large digital applications, it can be challenging to oversee how everything will fit together in the final product. For example, a video might explain multiplication as repeated addition, then follow up with an exercise that uses multiplication as an array. While both are correct and have a place in a maths curriculum, this combination might confuse learners.

Technical functionality

Technical testing is a standard component of the software development process, included in all major software-engineering models and international standards [24; 31]. The goal of the technical test is to verify that the software functions as intended when used by a child, a teacher, or other stakeholder. It can be helpful to use a testing checklist at delivery [24] to ensure all tests are completed and to list their outcomes.

Pressman and Maxim [24] and Sommerville [31] list the following as helpful in testing technical functionality:

- Consider building automated tests, including unit tests, to catch bugs earlier in the development and integration process and verify that all application components work together. Because the tests are automated, they can be run frequently at low cost.

- Test the software on the actual devices and connectivity conditions used by teachers and learners, including low-end smartphones or intermittent networks.

- If many users are expected to join a platform simultaneously, test the platform's capacity before implementation by conducting stress testing or load and performance testing.

- Test the administrative tasks in the digital learning application, including creating, modifying, adding, or removing schools. Any operation that happens during actual implementation should be tested. For example, use-case testing tests the system using the exact tasks and workflows that real users perform.

- Test the data logged in the EdTech intervention and whether the behaviour in the digital learning application matches what is logged by the system.

- Once the software code has been delivered, an external party should conduct an independent review of both the codebase and the associated documentation. Independent reviews provide an objective assessment of software quality and adherence to established standards.

Test for improvement after EdTech intervention roll-out

After a digital learning application has been built and extensively tested during the build and delivery process, different types of tests are useful for measuring whether children are learning and for optimising the performance of the EdTech intervention.

It is common to pilot-test with a small sample in the early stages of implementation. This might include a control group for comparison, but can also be a pretest-post-test design with only an intervention group. The time between the pre- and post-test might be shorter than is typical in an RCT. The outcome measures should reflect shorter implementation time periods and be competency measures that can change relatively quickly; for example, letter-sound scores improve more quickly than reading comprehension test scores.

Qualitative data and observations from the pilot, both during and after, can inform the EdTech intervention, including pedagogical design, in subsequent phases. Qualitative data can be corroborated with log data, implementation fidelity scores, an observational checklist, and learning outcomes to provide a rich picture of the EdTech intervention's current functioning and identify areas for improvement.

A/B tests assess the effectiveness of potential intervention modifications. A/B tests compare two variations of an EdTech intervention, randomly assign learners to them, and are useful for optimising EdTech interventions [32]. See Section 7.3 for more information on A/B testing.

To test the causal effects of an EdTech Intervention, an RCT in which learners are randomly assigned to the intervention or a control group is considered the gold standard [33]. An RCT can include measures and analyses to provide additional insight into possible improvements to the EdTech intervention, for instance, by combining the RCT with observations, qualitative reports, log data, and analyses of the learning outcomes or subsets of learners. For more details on RCTs, see Section 7.3.

4.4 Procure strategically and prepare costings and implementation protocols across the full intervention lifecycle

This section provides an overview of procurement and environmental impact considerations when developing EdTech interventions. It also includes an overview of a 'total cost of ownership' approach to costing and budgeting EdTech interventions.

Procurement considerations and specifications

Effective EdTech procurement begins with a clear problem definition and an accompanying technology needs assessment [7; 34; 8]. Insufficient attention to this stage often results in poorly specified requirements, over-reliance on vendor-driven proposals, and underperforming or non-scalable investments [7; 35]. A market analysis and structured use cases within requests for proposals help align suppliers around functional requirements and expected outcomes, rather than narrow or overly rigid technical specifications [35].

A recurring theme in this guidance is the importance of moving beyond upfront acquisition costs to a total-cost-of-ownership approach (see Sections 4.4 and 6.1). Procurement processes that prioritise the lowest bid without accounting for ongoing operational costs risk creating unsustainable systems, and idle or obsolete equipment [7]. Integrating warranties, service-level

agreements, and bundled maintenance or update services into contracts is therefore critical to protecting long-term value and continuity of use [7; 35].

Vendor neutrality and interoperability are important procurement principles [7; 35]. Open standards, data portability, and avoidance of proprietary lock-in enable governments to adapt systems over time, switch suppliers if needed, and integrate new tools as technology and the market evolve [7; 35]. This applies to both software, such as digital learning applications and management systems, and hardware, where durability, repairability, offline functionality, and compatibility with locally available accessories are essential considerations for low-resource environments [7; 35; 8].

Effective procurement is an essential component of any EdTech intervention. Technology investments require parallel resource allocations to teacher training, ICT support structures, governance arrangements, and monitoring of use and impact [7; 34; 8]. If procurement decisions are not aligned with local conditions, investments may remain underutilised. Procurement is not a 'once and done' task; it is part of a broader, iterative process aimed at ensuring that EdTech investments are educationally relevant, financially sustainable, and capable of delivering measurable benefits for learners and national education systems over time.

Total cost of ownership

Purchasing, building, adapting, and using technology are not one-off costs. Technology, whether hardware or software, requires up-front investments and incurs ongoing implementation, maintenance, and monitoring costs [36]. In general, initial technology investment costs represent a smaller percentage of the total cost than operational expenditure [7]. Understanding the long-term costs of technology is essential to sustaining EdTech interventions. Total cost of ownership calculations capture the total cost of technology purchases, whether software



A TECHNICIAN REPAIRING A PHONE. IMAGE BY MILITIA MOBILES

or hardware, from initial purchase through disposal. The Cabinet and Home Offices of the UK Government [37] suggest including the following when calculating the total cost of ownership:

- **Cost to create**: acquisition, licences, design, build, and training.
- **Cost to operate**: carbon footprint, maintenance, upgrade, change, and training.
- **Cost to change:** integration, customisation, training, and corrective maintenance.
- **Cost to end**: decommission, replacement, and data migration.

Section 6 provides a more detailed discussion of EdTech intervention costs and cost-effectiveness, and their implications for EdTech intervention affordability and feasibility.

Budgeting and resources for support and maintenance

Procurement decisions must be matched with reliable budgeting for maintenance, replacement, training, and support; otherwise, even well-designed EdTech interventions can struggle to maintain results. Below are important planning, maintenance, and resource considerations for procuring technology services and products.

Planning for hardware servicing and maintenance

Robust maintenance planning significantly reduces device attrition and extends project lifespan. Budget lines must be in place for device repair, accessory replacement, purchasing or renewing licenses, communicating with parents or caregivers, supporting ongoing professional training for teachers, and conducting ongoing needs assessments [38]. Digital Promise, a non-profit organisation supporting EdTech product development, suggests including a support helpdesk, device onboarding workflows, and distribution management in procurement plans to reduce rollout challenges [38]. Hardware maintenance requires a functioning support ecosystem. Plan Ceibal in Uruguay, for example, has established a distributed repair network, remote troubleshooting via phone/email, and a national service support call centre [39].

Software and platform maintenance

Software systems also require continuous technical upkeep, including updating libraries and frameworks, monitoring usage data for failures, managing user accounts, and adapting features based on performance reviews of EdTech interventions (see Section 4.2). Procurement contracts should therefore include service-level agreements that cover uptime targets, bug-resolution timelines, and responsibilities after handover [7]. Procurement decisions must be supported by reliable budgets for maintenance, replacement, training, and support to safeguard the performance of EdTech interventions over time [7].

Implementation capacity gaps at the school and system level
Even when devices and digital learning applications are available, schools often lack the capacity to manage and sustain them without external support. UNICEF's experience, rolling out the UNICEF Akelius Digital Learning Initiative in 12 countries, including crisis-affected Lebanon, underscores the need to ensure hardware protection protocols and teacher training for blended and hybrid learning for sustainable implementation [↑8]. Sustainable EdTech is not just about supply (hardware, connectivity) but also about demand-side capacities (school-level management, teacher competencies, maintenance systems) and the institutional partnerships that support them [↑8]. UNICEF-Innocenti's review of the UNICEF Akelius Digital Learning Initiative found that schools and non-formal learning centres need support in managing technology, and that teachers require training to integrate digital tools into pedagogy, particularly in blended or hybrid learning environments. This should include practical guidance on preparing software and hardware for distribution, preventing hardware damage, and developing maintenance, repair, and support plans [↑8]. This guidance should take into account all the digital tools employed in a given context to ensure efficient distribution and maintenance processes and minimise resource needs.

4.5 Consider environmental impact

Environmental impact considerations are increasingly recognised as a critical dimension of EdTech policy and practice. While EdTech has reshaped education systems by expanding access, flexibility, and continuity of learning, it also relies on digital infrastructure that consumes significant energy and material resources [↑40]. The environmental footprint of EdTech extends well beyond classroom use, encompassing device manufacturing, data transmission, storage, and end-of-life disposal [↑41; ↑40]. Ethical adoption of EdTech at scale, therefore, requires attention to full life-cycle impacts [↑40].

There are several potential environmental benefits associated with EdTech. Digital learning materials can reduce paper consumption, thereby lowering deforestation, waste, and emissions from paper production [41]. Similarly, remote and hybrid learning models may reduce travel-related emissions and the environmental costs of maintaining physical education facilities [41]. There is also evidence that EdTech can play a positive role in environmental education itself, helping learners develop awareness of sustainability challenges and supporting behavioural change. However, these benefits are not automatic and must be weighed against the environmental costs associated with the devices, networks, and platforms that underpin digital learning [41].

At the same time, the negative environmental impacts of EdTech are substantial and often underestimated [41; 40]. The production of digital devices depends on intensive extraction of raw and rare materials, with associated ecological damage and social harms [40]. Studies indicate that most of a device's energy use over its lifetime occurs during manufacturing rather than use [40]. Energy consumption is another primary concern: data centres, cloud services, and AI-driven applications require substantial electricity, and water supplies for cooling [41; 40]. The rapid growth of AI in education further intensifies these challenges, given the high energy demands of training and operating large models [41; 40]. Electronic waste, much of which is poorly tracked and inadequately recycled, remains a persistent global problem [40].

The scale of the global e-waste challenge underscores the urgency of these mitigation strategies. According to the *Global E-waste Monitor*, a record 62 million tonnes of electronic waste was generated worldwide in 2022, an 82% increase since 2010, with global e-waste rising five times faster than documented recycling rates [45]. By 2030, e-waste generation is projected to reach 82 million tonnes, with the formal recycling rate expected to be only around 20% [45]. For education specialists deploying EdTech at scale, these figures make clear that responsible end-of-life planning for devices is an integral consideration of ethical and sustainable programme design.

In response, the literature emphasises the importance of integrating environmental stewardship into EdTech decision-making. Warren, McGuffin, & Beck [40] propose using total cost of ownership and life-cycle assessment approaches to make environmental impacts visible before technologies are adopted at scale. Practical mitigation strategies include reducing the number of devices required, extending device lifespans through reuse and repair, selecting energy-efficient hardware and software, and establishing transparent and responsible end-of-life disposal plans [41; 40]. Educational institutions are also encouraged to use their collective market power to promote longer-lasting, repairable devices and greater vendor transparency [40].

Overall, environmental impact considerations do not argue against the use of EdTech, but they do call for a more balanced and deliberate approach. Aligning EdTech adoption with broader sustainability frameworks, such as the UN Global Digital Compact [42] and UNESCO's Greening Education Partnership [43], can help ensure that digital innovation supports learning without undermining environmental goals [41]. A measured focus on both benefits and trade-offs allows for informed choices that recognise EdTech as part of a wider ecological and ethical system, rather than as a neutral or purely technical solution [41; 40].



4.6 Resources

» Jordan, L. (2021). ***Don't Build It: A Guide For Practitioners In Civic Tech / Tech For Development***. Grassroot (South Africa) and MIT Governance Lab (United States). https://www.google.com/url?q=https://mitgovlab.org/resources/dont-build-it-a-guide-for-practitioners-in-civic-tech/&sa=D&source=docs&ust=1765797832755947&usg=AOvVaw1LImiaC8UVFlnOg43ZLZ-8

This resource is a clear, direct, and highly practical guide for practitioners considering digital solutions in public-sector contexts. It challenges the instinct to 'build an app' and instead emphasises careful problem definition, validation of real user demand, and consideration of non-technical alternatives. The guide provides concrete advice on team structure, technical oversight, iterative development, and responsible decision-making. Its pragmatic approach is particularly relevant for EdTech interventions, encouraging implementers to prioritise simplicity, evidence, and sustainability over unnecessary technological complexity.

» Digital Promise & Education Industry Association (EIA). *(2014).* ***Improving Ed-Tech Purchasing. Identifying the key obstacles and potential solutions for the discovery and acquisition of K-12 personalized learning tools***. Digital Promise and EIA. https://digitalpromise.org/wp-content/uploads/2014/11/Improving_Ed-Tech_Purchasing.pdf

This resource highlights key challenges in how schools and districts find, evaluate, and procure EdTech, including mismatches between instructional needs and available tools, limited evidence of effectiveness, and fragmented procurement processes that hinder sound decision-making. The report recommends steps such as formalising needs assessments, involving end users, and strengthening evidence and procurement practices, so education specialists can make more informed, equitable, and effective EdTech investments.

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5. Ensuring equity and inclusion in EdTech interventions for crisis settings

Equity is not an automatic outcome of technology use in crisis settings. EdTech interventions for EiE sit within existing social, economic, and structural inequalities. Without deliberate design choices, they can amplify disadvantage rather than reduce it [1; 2; 3].

An equity-oriented EdTech intervention deliberately aligns learners' needs with technology choices and pedagogical strategies, supported by appropriate delivery models and financing decisions. How well an EiE EdTech intervention serves disadvantaged learners depends on the coherence of these elements. If learners cannot access an intervention, if teaching is not adapted to diverse needs, or delivery models exclude some groups, equity and learning outcomes will suffer.

In this section, we provide EiE education specialists with practical guidance on prioritising equity when designing and implementing EdTech interventions. We begin with key considerations for identifying and addressing the needs of least-reached learners, including inclusive design approaches, technology selection, pedagogy, and language of instruction. We offer guidance on building a compelling case for equity in resource-constrained contexts.

Learners with disadvantages, whether due to gender, disability, displacement, minority status, or other marginalisation drivers, consistently find themselves either excluded or enrolled in inappropriate EiE programmes for their needs [4; 5]. Existing inequalities in access to quality education disproportionately affect these learners. In crisis-affected and low-resource settings, equitable access to technology does not happen by default. Without deliberate design, EdTech interventions risk reinforcing existing disparities [1; 2; 3].

Integrating equity considerations into Education in Emergencies (EiE) from the outset ensures technology can effectively expand learning opportunities for crisis-affected learners [1]. While the evidence base for EdTech in crisis settings remains relatively new compared to high-income or less-affected LMIC contexts, current research highlights EdTech's potential to support disadvantaged learners. Specifically, EdTech can increase access when learning facilities or printed materials are unavailable, facilitate learner accommodations, and enable differentiated learning through competency-based and remedial instruction [1; 3].

Important considerations for EiE education specialists to help prioritise equity and inclusion in intervention design and delivery are listed below.

5.1 Twin-track approach: The basis for equity-focused programmes

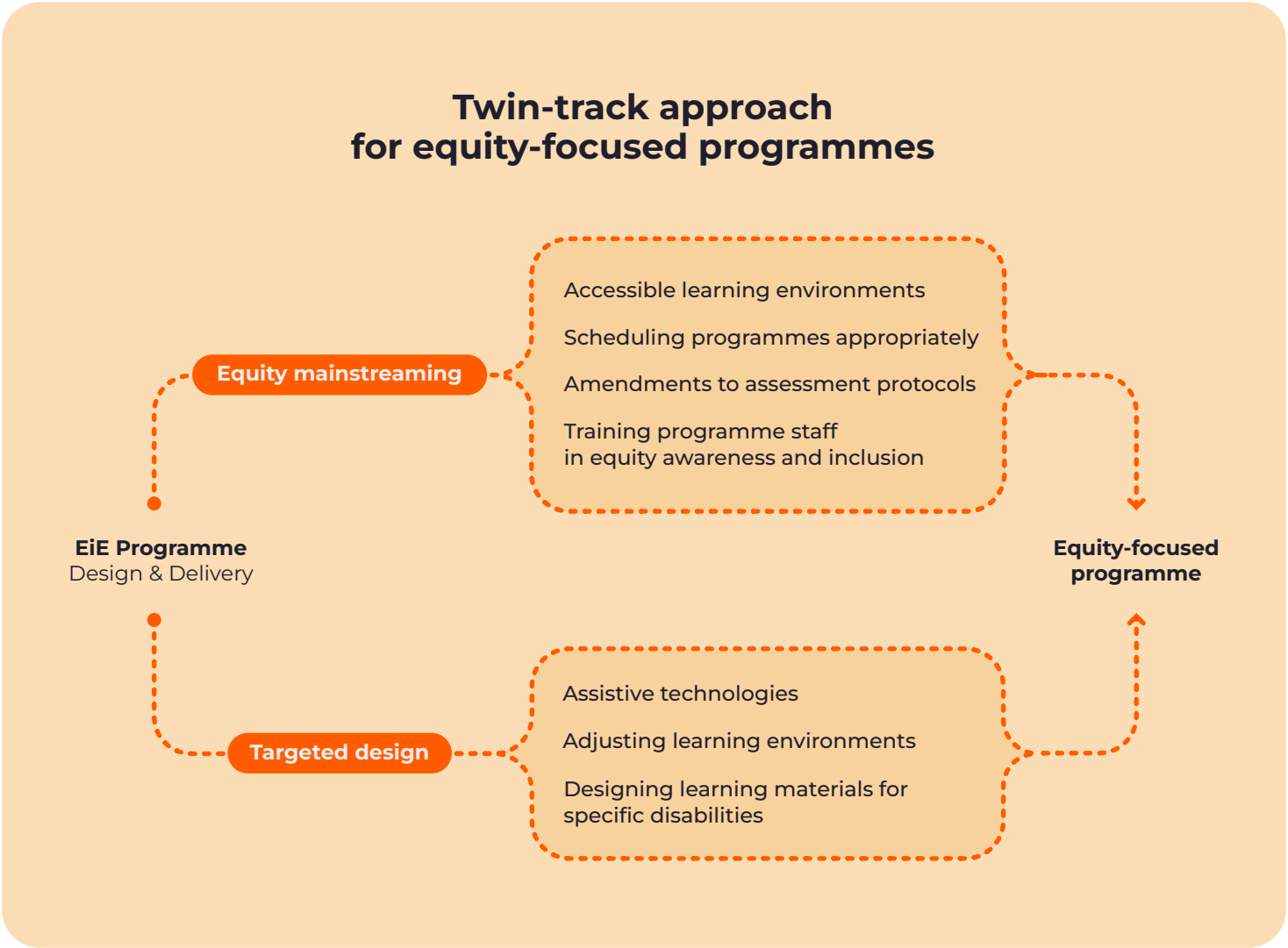
The twin-track approach reflects a fundamental principle of equity-focused programmes, namely the importance of simultaneously:

- Mainstreaming equity and inclusion in all EiE programming;
- Designing targeted programmes to address the needs of specific vulnerable and/or marginalised populations [6].

Examples of equity mainstreaming include providing accessible learning environments, scheduling programmes appropriately, allowing for amendments to assessment protocols, and training programme staff in equity awareness and inclusion [7; 6]. In EiE EdTech interventions or programmes, mainstreaming equity also includes capturing disaggregated data on gender, disability, and geographic location in monitoring and evaluation systems, and ensuring marginalised groups can access the programmes.

Examples of targeted design include utilising assistive technologies to improve access, adjusting learning environments to maintain access, and designing learning materials for specific disabilities [7; 6].

Figure 7. Twin-track approach for equity-focused programmes



5.2 Diagnose the situation of the least-reached learners at the outset

Pro-equity design begins with identifying who is left behind, and why. Start with a desk review to map existing national and subnational disparities in education access and quality, and identify specific technology-related inequalities in device access, connectivity, electricity, and digital literacy. Desk reviews may also uncover earlier research studies and implementation agency reports on equity-related challenges, along with current or past actions to address them.

Next, complement desk studies with household and school surveys disaggregated by gender, disability, language, rural/urban status, minority group, and socioeconomic status. If the proposed intervention falls within an international humanitarian sector response that is not refugee focused, then the Global Education Cluster[1] can be a useful source for needs assessments and other surveys conducted by non-governmental and government actors. The education cluster can also offer opportunities to join forces with other organisations to conduct needs assessments. For refugee-focused responses, the relevant Refugee Education Working Group can be a useful source of data.[2]

Review needs assessments carefully to ensure that disadvantage factors are adequately covered. Data collection to cover the needs of children with disabilities in crisis settings, for example, is often unreliable, with too narrow a range of disability categories covered [↑8; ↑9]. You may need a supplementary assessment to capture the barriers faced by specific groups of children. Using participatory approaches to elicit feedback from caregivers, teachers, and learners and uncover hidden barriers to participation, such as social norms, safety and protection concerns, and caregiver burdens, provides important contextual insights. The 'UNHCR

[1] See https://www.educationcluster.net/. Retrieved 23 February 2026.

[2] See https://data.unhcr.org/. Retrieved 19 May 2026

Toolkit for Participatory Assessment' provides practical guidance for participatory assessment in crisis settings [10].

5.3 Select technologies based on access constraints

Selecting the right delivery model and technology is vital to avoid exacerbating existing disadvantages and inequities [11]. Research during the Covid-19 pandemic, for example, showed digital divide gaps for poor, rural, and linguistic minorities, as well as girls and children with disabilities [11; 5].

Review studies often point to radio as one of the most feasible and equitable technology options in areas with limited connectivity [12]. Using multiple delivery models and technologies can also facilitate multiple entry points, helping address specific barriers to access [1; 11]. A combination of strategies, including 'use your own or your family's own personal device' and offline learning applications, has also been used to increase reach in crisis settings [11].

Even with internet connectivity, access to technology-related equity issues (e.g., data costs and shared devices in classrooms) may hinder uptake [1]. Lennox, Reuge, & Benavides [11] argue for partnerships among governments, mobile operators, and device manufacturers to provide device subsidy schemes, zero-rate internet access for disadvantaged groups, and educational programmes to expand equitable access during crises.

Even when you select low-cost delivery models and technologies, equitable access for learners with a disadvantage can entail additional costs, such as assistive technologies and additional teacher training support [13; 5]. During crises, learners with disadvantages may lose support mechanisms they previously had, and the situation for those who never had them can worsen [5]. EiE EdTech programmes often need to make a clear case for these additional costs to achieve equitable inclusion.

5.4 Equity-focused pedagogy is critical

A well-designed pedagogical approach ensures that EdTech amplifies learning for learners with disadvantages, rather than replicating existing inequities [7]. Technology is a medium, not a method. On its own, it cannot guarantee learning or inclusion. Without effective instructional scaffolding, learners may be idle, misdirected, or excluded.

Learners with disadvantages often face double barriers: limited access plus weaker pedagogical support. For instance, a child with a learning disability might receive a tablet, but without tailored scaffolds or support, the child may struggle to use it effectively. Thoughtful pedagogy, for example, with scaffolding, multiple representations, and pivoting to low-tech and/or assistive technology, helps bridge the gap. Inclusive education reviews stress that programmes should pair technology with pedagogical adaptation rather than rely solely on accessibility features [14; 15; 16].

Learners with disadvantages often need more scaffolding, flexibility, multiple pathways, and support. By anticipating diverse needs, for example, disability, gender, language, and connectivity, EiE education specialists can ensure EdTech is not just accessible but genuinely inclusive. Below are strategies for three categories of potential disadvantage, disabilities, geographic location, and gender, to illustrate what equity-focused pedagogical design can look like in practice.

Pedagogical design in practice 1

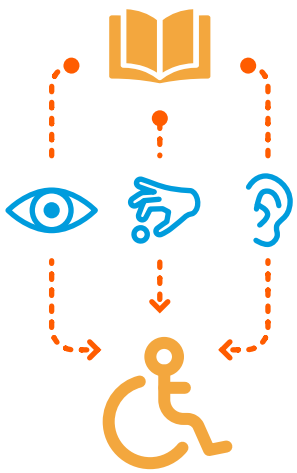
Equity-focused pedagogical design **for learners with disabilities**

01
Use multi-modal and alternative channels.

For learners with sensory or motor impairments, programmes should allow multiple ways to facilitate learner engagement, such as combining visual, auditory, and tactile cues, offering alternative navigation (e.g., voice commands, switch controls), and simplifying interfaces. A systematic review by Navas-Bonilla et al. [15] shows that interactive applications, augmented reality, and adaptive interfaces can support more equitable engagement for learners with diverse needs.

02
Design accessibility beyond simple accommodations.

Instead of adding accessibility features, such as captions and screen readers, to pre-existing materials, it may be more effective to redesign curricula, pedagogical approaches, and access modalities. For example, a redesign for learners with visual impairments might include integrated tactile diagrams, pre-distributed hands-on kits, and structured peer support. Thus, reducing the need for after-the-fact adaptations [16].



Pedagogical design in practice 2

Equity-focused pedagogical design **for disadvantaged groups**

01
Embed contextual relevance and gender identity representation.

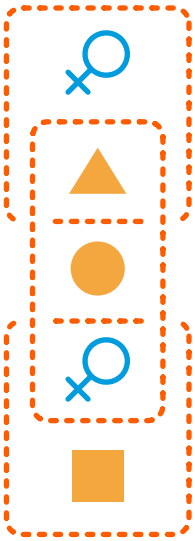
In their literature review on girls' education and EdTech, Myers, Jordan, & Zubairi [17] found that negative gender representations, underrepresentation of girls, and unrelatable content are barriers to girls' participation in EdTech programmes. Pedagogical design can foreground locally relevant storylines and role models that resonate with marginalised identities.

02
Pair peer support and structured collaboration.

Girls and other marginalised learners may benefit from peer collaboration [18]. EdTech programmes can integrate collaborative problem-solving, small-group work, or 'buddy' systems through appropriate channels and technologies, increasing avenues for support and co-learning.

03
Create opportunities for participation and build learner confidence.

In settings with large gender gaps, basic digital literacy and support for participation can be valuable outcomes in their own right. Access to digital technology and the acquisition of new skills can also increase perceptions of empowerment and foster independence [17].



Pedagogical design in practice 3

Equity-focused pedagogical design **for remote or rural learners**

01

Bridge between technologies to address connectivity issues.

Where internet connectivity is intermittent, EdTech programmes can offer lower-tech as a safety net to maintain learning continuity during outages. For example, they can switch to low-tech, phone-message-based quizzes, radio prompts, or print worksheets, while maintaining alignment with learning objectives and learning progress cycles. This prevents connectivity gaps from disrupting learning continuity.

Beyond EdTech-specific considerations, in their review of intervention approaches for children with multiple disadvantages in LMICs, Pisani et al. [19] highlight factors linked to positive outcomes:

- Incorporating caregiver and community engagement;
- Using equity-related indicators to inform implementation practice;
- Increasing teacher capacity to support learners with different or additional needs.

Lynch et al. [20] similarly highlight the need for additional skills training for teachers in their review of EdTech to support learners with disabilities. They further emphasise the need to lobby for additional investment in digital equipment and assistive technologies, and to pursue strategies to reduce assistive technology costs [20]. Alasuutari et al. [7] build on this by stressing the need for donors to provide countries with the space to develop contextually appropriate disability inclusion plans that meet specific country needs. These strategies are just as important for technology-enabled interventions as for non-tech ones.



CASE STUDY

ENEZA Shupavu291, an SMS-based study tool used in the Dadaab and Kakuma refugee camps in Kenya, is a strong example of how an EdTech programme can generate equity-related impact. ENEZA Shupavu291 allows primary and secondary learners to access the full Kenyan national curriculum, assessments, and live teacher support on basic mobile phones without internet connectivity. It provides personalised, low-cost



A HAND HOLDING A MOBILE PHONE. IMAGE BY PEXELS

study support for refugee learners. Research studies have demonstrated that high exposure to the platform led to improved learning outcomes for refugee girls, increased parental acceptance of girls' technology use, and reduced gendered barriers to access, enabling girls to participate more fully in learning [↑18].

5.5 Language choice: Enable instruction in home languages while building dominant language skills

Technology-mediated instruction in the languages children speak at home, or in their daily lives, can reduce exclusion, sustain learner engagement, and support learning outcomes [21; 22]. Nakamura et al.'s [23] systematic review of 45 studies, for example, finds strong learning outcome benefits, particularly in early grades, for children who learn in their home languages compared with those who do not.

"Technology-mediated instruction in the languages children speak at home, or in their daily lives, can reduce exclusion, sustain learner engagement, and support learning outcomes."

Technology can, when appropriately used, enable cost-effective development of learning content adapted to local languages and contexts [24; 25]. This contrasts with earlier cost-effectiveness calculations for printed learning materials, which favoured dominant-language book publications [26].

Inclusive education experts, while highlighting the importance of home languages, also point to the value of children learning dominant languages to expand economic and other life opportunities [22]. EiE education specialists should carefully consider language choices, including opportunities for instruction in home languages and support for dominant-language acquisition.

EdTech programmes should incorporate children's proficiency levels in the language of instruction into their pedagogical design [22]. Where the choice between dominant and home language was previously often an either/or calculation, technology can enable scaffolded and differentiated approaches. For example, EiE EdTech interventions can explain new concepts in children's home languages, offer additional help in home languages, provide extra reading practice and instruction in the more unfamiliar (dominant) language, or gradually transition instruction from one language to another [27; 28].

5.6 Make the case for equity and inclusion and advocate for it

When resources are limited, and there is pressure to minimise educational costs per child, education systems may overlook children from disadvantaged backgrounds, denying them appropriate opportunities [↑22]. EiE education specialists, as key education system stakeholders in crisis settings, may do the same. To improve access and learning outcomes, funders may need to provide additional financing for targeted inputs that meet the needs of disadvantaged groups [↑29]. Donors and other stakeholders must understand both these needs and the strategies that address them. If programmes do not secure extra time and resources for accommodations, they risk deprioritising equity [↑22].

The case for prioritising equity and inclusion in EdTech programmes in crisis settings is compelling. Below are three important rationales for prioritisation and investment that EiE education specialists use when advocating for equity and inclusion-focused EdTech.

A ROW OF COLOURFUL WOODEN CHARACTER TOKENS. IMAGE BY IMAGINE THAT STUDIO



01

Equity and inclusion are fundamental to a rights-based approach in crisis settings



Equity and inclusion are not optional; safeguarding and promoting equity and inclusion are a part of a legal and normative obligation. Under the UN Convention on the Rights of the Child (Articles 28–29) [30] and the Education 2030: Incheon Declaration [31], Equity and inclusion are core components of quality education. In crises, inequities intensify. Conflict, climate shocks, and displacement disproportionately affect girls, children with disabilities, refugees, nomadic groups, and linguistic minorities [32]. An EdTech programme in crisis settings cannot fulfil its humanitarian or development mandate without directly tackling these disparities.

02

An equity focus delivers effective, efficient returns on investment



Equity and inclusion-driven programmes can yield high impact, at both individual and societal levels and offer good value for money. A Plan International & Citi GPS study found that achieving 100% upper secondary completion for girls in eight LMICs could raise GDP by up to 10% by 2030 [33]. In their review study, Colquhoun et al. found that investments in girls' education can deliver substantial impact relative to costs, particularly when steps are taken to monitor and measure benefits from the outset and when resources are allocated to support longer-term outcomes, such as transitions to further education and economic opportunity [34]. Outcomes included literacy and numeracy gains, as well as community and health benefits.

Review studies also highlight that the cost of educating a learner with a disability can provide individual and societal returns on investment two to three times higher than providing education to learners without disabilities [35]. Prioritising an equity and inclusion focus delivers demonstrable returns for individuals and society.

03

Investing in equity strengthens system resilience and protects learning during and after crises



Evidence shows that equitable systems recover faster, while inequitable systems widen gaps that then become permanent. In their study of education system resilience,[3] on behalf of the Global Partnership for Education (GPE), Kelcey et al. [36] identified that systems which prioritise the needs of all stakeholders, including those with disadvantages, for example, groups from linguistic or ethnic minorities or rural locations, can demonstrate greater resilience in crises.

[3] "'Education system resilience' is increasingly used to describe these intentional efforts to build strength into education systems to withstand and adapt to a widening range of disruptions" [8 p. 3].

"Review studies highlight that the cost of educating a learner with a disability can provide individual and societal returns on investment two to three times higher than providing education to learners without disabilities."



5.7 Resources

» UN High Commissioner for Refugees. (UNHCR) (2025). ***Practical guide for participatory assessments (Provisional release).*** United Nations High Commissioner for Refugees. https://www.unhcr.org/media/practical-guide-participatory-assessments-provisional-release

The UN High Commissioner for Refugees' *Practical Guide for Participatory Assessments* (Provisional Release) is a step-by-step operational guide outlining how to conduct participatory assessments to meaningfully consult with forcibly displaced and stateless people and ensure their perspectives shape programme design. It offers practical methods to engage affected communities in needs assessment and planning, improving relevance, accountability, and effectiveness of education responses.

» Castillo, N. M., Wagner, D., Alrawashdeh, G., & Moog, C. (2023). ***EdTech and Marginalization: Scaling for learning equity.*** UNESCO GEM Background paper. https://doi.org/10.54676/ZKZT2998

Edtech and Marginalization: Scaling for learning equity is a background paper from UNESCO's Global Education Monitoring team that examines how educational technology can either help reduce or unintentionally reinforce inequities in learning, especially for historically disadvantaged groups such as learners with disabilities, those from rural or minority language communities, and other marginalised populations. It highlights practical challenges and strategies for designing, scaling, and evaluating EdTech to promote learning equity.

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6. Sustaining EdTech in crisis settings: Financing, cost-effectiveness, affordability, and feasibility

Sharp reductions in humanitarian funding, combined with renewed calls to prioritise localisation, present new challenges to international EiE actors [1; 2]. International NGOs (INGOs) and UN Agencies have typically led the design and implementation of emergency education responses, especially during the early stages. However, their role is expected to shift from direct implementers to enablers. In this role, they support national governments and their partners assume greater ownership of EiE responses [3].

In some crisis settings, there may be no legitimate government, and minority groups may be marginalised. In such contexts, international actors may still need to act as implementers. Guided by the principle 'international as necessary, as local as possible' [4, p. 3], international actors should prioritise the leadership and ownership of national and community organisations and EiE response groups. This guidance document therefore promotes EdTech responses that clearly prioritise and plan for national government ownership in both the short and long term, while also defining when and how international involvement remains necessary.

There is limited evidence and best-practice guidance on integrating and scaling EdTech EiE interventions within national

education systems [5]. Doing this well requires collaboration with many stakeholders across the education system. It also demands adaptive design and management, a strong understanding of context, and the ability to navigate political and social norms [6].

This section does not provide a comprehensive overview of scaling processes in education systems in LMICs experiencing crises. Instead, in the context of declining education aid and increasing needs, it focuses on how cost-effectiveness, financing, and affordability shape the design, implementation, and long-term sustainability of EdTech programmes in crisis-affected contexts.

6.1 Prioritise cost-effective EdTech for impact and scale

Humanitarian and development aid budgets have been falling sharply [1; 37]. At the same time, the number of children affected by crises worldwide increased by 35 million between 2022 and 2024 [7]. In this context, it is essential to prioritise EdTech programmes that deliver meaningful education to the greatest number of children at the lowest possible cost. With EdTech funding allocations increasing as a proportion of the limited EiE funding available [8], focusing on the cost-effectiveness of EdTech interventions is even more pressing. As programmes move through the five phases of emergency response (Section 2), EdTech investments must deliver benefits for learners in the short and longer term. They must also remain feasible within the constraints of national education systems.

Questions about cost-effectiveness include those such as ‘How much does it cost to achieve a specific outcome (for example, improved learning?’ and ‘Do these costs represent good value compared to alternatives?’ There are few published evaluations of the cost-effectiveness of EdTech interventions in crisis settings. However, a small but growing body of evidence examines EdTech cost-effectiveness in LMICs more broadly [9].

This evidence shows that investing in hardware alone is often a poor use of resources. In contrast, EdTech programmes can be both impactful and cost-effective when they combine technology with teacher training and support. Using widely available devices such as mobile phones and aligning learning with national curricula also helps [9]. For example, Angrist et al.'s 10 review of over 150 education interventions in LMICs found that EdTech programmes using existing hardware, paired with adaptive or self-paced software tailored to individual learners, can be cost-effective.

Many cost-effectiveness measures focus on final learning outcomes, but this does not capture the full picture [11]. Cost-effectiveness analysis can also provide valuable information on programme progress and enable comparisons across different delivery models. For instance, programmes can compare the costs and impacts of interim assessment results across teaching schedules or class hours. EiE education specialists can use this analysis to make timely adjustments to costs and implementation approaches. Doing so increases the likelihood that investments remain useful and feasible over time despite constraints related to staffing, infrastructure, or governance [12; 11; 8].

Measuring the cost-effectiveness of EdTech investments requires accounting for the factors that affect all education programmes. However, EdTech investments also involve specific drivers and costs that teams should consider. The recommendations below highlight these EdTech-specific considerations.

Use cost-effectiveness metrics to compare different delivery models, including those with and without technology

National ministries of education and humanitarian organisations delivering EdTech interventions often need to choose a combination of face-to-face, hybrid, blended, and remote delivery options. Cost-effectiveness analysis is most useful when it allows

decision-makers to compare realistic, context-appropriate education options, whether or not they include technology [8].

Calculate the total cost of implementation, and account for cost variances over an intervention's implementation lifespan

Many cost-effectiveness studies in education do not capture all programme costs and instead focus on the largest cost items. This can lead to systematic underestimation of true costs [17; 38]. Using a total cost of implementation approach helps address this risk by accounting for upfront investments, delivery costs, and ongoing expenses such as maintenance and monitoring throughout the full lifespan of an EdTech intervention [8]. Capturing total costs also supports feasibility assessments by clarifying whether systems have the operational, financial, and technical capacity to sustain an intervention over the long term. Specific cost capture categories for EdTech in crisis settings include:

- Initial technology procurement investment
- Maintenance, repair, and replacement costs
- Data and connectivity costs, training and support expenses
- Ongoing learning and teaching content development or licensing costs (13; 8].

Costs and cost-effectiveness will change over the lifespan of an EdTech intervention and across each phase of emergency response. For example, the costs of developing and maintaining digital learning applications evolve as content requires updating or software ages or becomes outdated. Modelling both short- and long-term cost scenarios can therefore provide valuable evidence on the return on investment of EdTech, as education system needs and capacities change over time [12].



PAPUAN CHILD WRITING ON WHITEBOARD DURING OUTDOOR LEARNING ACTIVITY.
IMAGE BY TABAH ZAMAN

Use sector-recognised frameworks and tools for cost-effectiveness calculations

Using existing measurement frameworks and tools helps ministries of education, donors, and other stakeholders compare results and analyse cost-effectiveness across different education programmes. Commonly used approaches include the FCDO's 4Es framework for value for money [↑14], the World Bank Learning-Adjusted Years of Schooling (LAYS) [↑15], and the Strategic Impact Evaluation Fund (SIEF) cost approach [↑16].

Understand what makes EdTech programmes feasible in practice

Even when EdTech interventions demonstrate strong cost-effectiveness, broader contextual factors determine whether they

are affordable and feasible in a given setting. These include constraints within the education system, available financing options, and the capacity of different stakeholders to implement and sustain the intervention [11; 8]. See Section 6.3 for further discussion.

Begin cost-effectiveness strategy development and measurement right from the start

Measuring cost-effectiveness often requires changes to how organisations capture costs in their financial systems, as well as to programme, budgeting, and reporting processes [17]. It may also require skills training for both financial and programme staff so that they understand and can support the cost capture and analysis process. Building these activities and system adjustments in the design phase makes cost modelling and cost-effectiveness calculations possible later [17]. For example, in fully online nationwide learning systems, electricity and connectivity costs can account for more than 50% of total costs at scale [13]. With timely cost modelling, EiE education specialists may have time to negotiate zero-rated internet contracts with telecommunications companies, helping to reduce connectivity costs over time and support affordable integration into national education systems.

6.2 Finance considerations throughout EiE emergency response phases

The financing landscape for EdTech EiE interventions is rapidly evolving. Donor prioritisation of EdTech, seen during the Covid-19 pandemic, continues [13]. However, both humanitarian and development funding for education are decreasing [1; 18; 19]. This section illustrates the types of financing EdTech interventions typically receive during each emergency response phase. In addition, we discuss specific examples of trends in financing from government treasuries and from multilateral and philanthropic donors. The section concludes with a brief overview of innovative financing mechanisms along with sources for further information.

Section 6.3 further discusses financing and funding, as well as cost and cost-effectiveness, by introducing considerations for the feasibility and affordability of EdTech programmes.

An illustration of funding changes over an emergency response's lifespan

Understanding how the financing of an EdTech intervention is likely to change over time aids planning and helps mitigate any financing gaps or delays. The overview below is not a comprehensive list of financing options for each phase. Rather, it illustrates changes in financing types over time, highlighting the importance of a financing strategy that covers all response phases.

In the rapid emergency response phase, EdTech financing often comes from flexible sources that can be activated quickly. An example of early-stage humanitarian funding is the Disasters Emergency Committee,[1] a public appeal supporting UK-based humanitarian organisations. Disaster risk financing reserves emergency response funding in advance as part of preparedness or anticipatory action strategies. This funding tool is crucial for maintaining learning continuity during early-stage responses [↑20].

As a crisis context shifts into a mid-term emergency response, EiE education specialists move from rapid, often pragmatic responses to more formal programme development (see Section 2). Here, financing typically blends multi-year humanitarian grants (for example, Education Cannot Wait's Multi-Year Resilience Programmes)[2] with more traditional humanitarian education funding, for example, through bilateral donors, UN agencies, and the large humanitarian INGOs such as Save the Children, International Rescue Committee, Norwegian Refugee Council, and Plan International.

[1] See https://www.dec.org.uk/. Retrieved 8 December 2025.

[2] See https://www.educationcannotwait.org/our-investments/funding-windows. Retrieved 8 December 2025.

As a context becomes more predictable, EdTech intervention financing objectives shift to supporting both ongoing implementation and adoption within government systems, even where humanitarian needs persist. At this stage, EiE education specialists deliberately prioritise linking programmes to national education sector plans, if this has not already occurred. Development partners such as the World Bank, regional development banks, and the Global Partnership for Education may then provide financing to support systems integration, infrastructure, and national scale-up. For example, the World Bank and its partners may support remote and blended learning systems, often tying EdTech investment to broader sector reforms and learning continuity objectives. See later in this section for specific examples from Sudan and the Sahel.

Post-emergency preparedness and anticipatory action build resilience in education and protect learning continuity, even during crises. UNICEF's *Risk-Informed Education Programming for Resilience* [21] urges integrating risk analysis, contingency planning, and diversified delivery models into regular education planning. This includes creating dedicated contingency budgets to quickly enable digital and low-tech solutions. It also calls for pre-arranged financing in disaster risk management and for the use of innovative EiE financial tools to secure emergency funds ([22]).

Trends in EdTech financing in crisis settings

Introducing EdTech is a priority for many governments in LMICs [13]. After accounting for financing through regular ministry budgets, emergency-response financing is one of the three major public funding sources for EdTech in LMICs. Antunes de Carvalho, Lee, & Byanjeru [13] highlight that public emergency response funding, like other emergency funding sources, can suffer from an immediate-term focus and hasty decision-making. This may result in eventual investment loss. UNICEF and EdTech Hub's review of 180 learning management systems (LMSs) after the Covid-19 pandemic confirms this. Their analysis found that over 32% of LMSs no longer existed, were inaccessible, or had not been

updated [23]. There are, however, strong examples of earlier EdTech investments being leveraged in subsequent emergencies. The Ministry of Education and Science of Ukraine's (MoES) Covid-19 response included developing an LMS known as All-Ukrainian School Online (AUSO). AUSO provides learning materials for learners in Grades 5–12 and remains operational. It is now core to the MoES's remote and blended learning EiE response following the February 2022 invasion by the Russian Federation [24].

In addition to public funding, development banks are making substantial investments in education programmes with integrated or standalone EdTech components [13]. For example, the World-Bank-funded Sudan Primary Education Emergency Support Project (SPEEP) is financing UNICEF's digital education programme [25]. The World Bank's Regional Engagement for Learning and Collaboration in Education Project (RELANCE) will support the development of a tech-enabled cross-border Open School in the Sahel, beginning with Chad and Mauritania [26]. Mirroring development bank priorities and moving away from a historical emphasis on funding for pilot EdTech projects, technical assistance, and research, bilateral donor funding can now include significant investment in nationwide EdTech interventions [13]. Such large-scale investments have major implications for feasibility. They will require robust implementation capacity, cross-ministry coordination, and long-term, recurring financing to be sustainable.

Philanthropic organisations are also playing an increasingly important role in funding EdTech interventions in crisis settings. For example, Profuturo Foundation, a collaboration of the Fundación Telefónica and Fundación 'la Caixa', is financing UNHCR EdTech programmes in Rwanda, Nigeria, and Zimbabwe [27]. UBS Optimus Foundation and Jacobs Foundation have made EdTech-focused grants to Ukraine's emergency education response [28; 29]. Foundations, however, have tended to channel their funding through multilateral organisations or NGOs, albeit often with the aim of developing interventions that will later be adopted by governments [13].

With recent changes in the funding landscape, EiE education specialists are increasingly being asked to explore alternative or innovative financing options. A financing trends analysis highlights the important role that government, community-based financing, and household contributions already play in EiE programmes [18]. As humanitarian and development education aid declines, these financing sources are set to become even more important [30; 18]. UNESCO's toolkit, *Financing the Digital Transformation of Education*, provides guidance on 25 financing options, illustrating the wide spectrum of available financing options. Financing options include grants, loans, results-based financing, crowdfunding mechanisms, and commercial partnerships [31].

TWO CHILDREN USING A PHONE WHILE STUDYING. IMAGE BY I_AM_ZEWS



6.3 Ensure affordability and system feasibility

Although there are strong examples of EdTech financing (see Section 6.2), humanitarian aid funding remains extremely tight. Humanitarian donor support for education is decreasing, and development aid cannot cover the funding gap. In fact, in crisis-affected countries, overseas development assistance to education is decreasing relative to need [↑7; ↑1; ↑18]. Governments face significant financial challenges in accommodating additional costs associated with technology-driven changes in education delivery, particularly in crisis-affected settings [↑13]. Therefore, even seemingly inexpensive and cost-effective EdTech interventions may remain unaffordable for many LMIC governments [↑13].

Given these financial challenges, affordability is a key concern. Affordability is the extent to which an EdTech intervention's upfront and recurrent education expenditures can be financed sustainably within current and anticipated public budgets and external financing [↑32]. Affordability is an important component of feasibility, which refers to the degree to which an EdTech programme can be realistically implemented within the intended system. Other feasibility considerations include:

- **Operational feasibility:** delivery within current system capacity or with realistic upgrades, such as teacher skills or infrastructure.
- **Institutional feasibility:** compatibility with existing governance structures, mandates, and accountability systems.
- **Technical feasibility:** effectiveness of the delivery model, curriculum, technology, and pedagogical approach.
- **Political feasibility:** alignment with political priorities, system policies, and stakeholder priorities [↑33; ↑6; ↑34].

Assessing affordability and other feasibility considerations together supports Education Specialists to build their understanding of the costs and implementation characteristics

required to support large-scale EdTech implementation in crisis-affected education systems.

Collaborating with national and international EiE stakeholders can reduce costs and improve cost-effectiveness. So too can seeking alternative or innovative financing mechanisms. EiE sector stakeholders also advise designing evidence-based lobbying campaigns to secure ongoing and increased investment from donors, governments, and the private sector [13; 1]. Guidance on building the case for equity (Section 5.3) outlines how to create evidence-based lobbying campaigns. These collaborative approaches can further address feasibility constraints by pooling technical skills, infrastructure, and human resources across agencies and system levels.

Beyond the cost-reduction, resource-sharing, financing, and lobbying strategies discussed above, what practical steps can make EdTech interventions more affordable? Examining strategies through the lens of the thematic areas covered in this guidance document demonstrates how affordability gains can be planned for every aspect of EdTech EiE interventions.

Planning for multiphase emergency responses

As discussed in Section 2, planning for an EdTech intervention begins well before a crisis. Preparedness plans and anticipatory action provisions are essential to effective early responses [22]. These steps help ensure that EiE responses are aligned with national curricula and existing teacher professional development programmes, and are managed through existing government procedures and systems. For example, aligning digital learning investments with national education strategies helps ensure interventions remain useful beyond an emergency and are feasible by leveraging current system capacity, delivering a long-term return on investment.

Sound pedagogy

As Section 3 emphasises, EdTech interventions, like any other educational interventions, rely on sound pedagogical practice for lasting learning outcomes. Global evidence shows that evidence-based instructional design can help learners maintain learning gains over time [35]. Embedding sound pedagogical practice in EdTech interventions leads to better return on investment, as learners are more likely to be able to progress through national education systems, for example, from primary to secondary school. This also supports national learning continuity and educational attainment objectives. Additionally, sound pedagogy supports technical feasibility by ensuring that EdTech tools are integrated into teaching and learning in ways that teachers can realistically implement.

Sourcing, building, and maintaining technology

Section 4 stresses the need for deliberate plans for the procurement, maintenance, and renewal of technology and infrastructure. Given resource constraints, it is advisable to base technology choices on local contexts, build on what is already available, include users in design and testing, and involve relevant technical experts to increase value for money and maintain utility over time [13]. Aligning technology with national education strategies and other relevant policies will help avoid duplicate or inappropriate spending. These choices are central to technical and operational feasibility; for example, choosing devices and platforms that existing connectivity, power supply, and local repair ecosystems can support.

Equity

Section 5 highlights the economic and social value that equity-focused programmes can deliver, including their role in strengthening the resilience of the education system. Although addressing the specific needs of individuals or groups with

disadvantages may require additional investment, it can, for example, lead to lower government expenditure on health and economic support in the long run [36]. Therefore, from a feasibility perspective, designing with equity in mind not only supports these long-term savings but also helps ensure that EdTech interventions realistically reach the most marginalised learners and communities, rather than only those with better connectivity, devices, or language advantages.

Monitoring, Evaluation, and Learning (MEL)

Section 7 provides an overview of MEL strategies for each emergency response phase. Importantly, a robust MEL framework and plan can provide timely data and analysis to inform the implementation of EdTech interventions. Given evidence gaps about EdTech interventions, capturing data on the following and then sharing it will help support feasible and cost-effective intervention design and adaptation:

- Outcome and learning data
- Implementation progress and experiences in each phase
- Stakeholder feedback and adoption.

Explicitly integrating feasibility questions into MEL frameworks, for example, tracking teacher workload and national policy alignment, can help EiE education specialists identify feasibility constraints early, thus ensuring EdTech interventions can be adapted as needed.

6.4 Resources

» Perlman Robinson, J., & Winthrop, R. (2016). ***Millions Learning: Scaling up quality education in developing countries***. Brookings Institution. Available at https://www.brookings.edu/wp-content/uploads/2016/04/final-millions-learning-report.pdf.

Millions Learning synthesises global evidence on how effective education interventions scale, identifying practical 'ingredients' for expanding access while maintaining learning quality in low-resource contexts. It includes essential elements for designing, delivering, financing, and enabling scaling of quality education. The report offers concrete guidance on creating adaptable, cost-effective, and scalable programmes in low-resource settings.

» Antunes de Carvalho, F. C., Lee, C., & Byanjeru, Y. (2025). ***Innovative Financing of Education Technology: As Part of Maximizing Financing for Development***. World Bank Group. https://openknowledge.worldbank.org/entities/publication/ad56955d-d64b-4271-89d4-5c6166dd29c3

This World Bank working paper provides a practical framework for planning, financing, and sustaining EdTech investments, highlighting how governments can improve efficiency, address total cost of ownership, strengthen procurement, and unlock underused financing sources beyond devices alone. It provides guidance on designing fiscally realistic, outcome-oriented EdTech programmes that remain sustainable in resource-constrained settings.

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7. Adaptive monitoring, evaluation, and learning across EiE response phases

This section outlines considerations for developing a monitoring, evaluation, and learning (MEL) framework for EdTech interventions. It provides an overview of MEL priorities across different emergency response phases and describes key approaches, tools, and data practices relevant to crises and EdTech-supported interventions. This section also introduces two quality assurance benchmarks for EdTech interventions.

7.1 MEL frameworks for EdTech in crisis settings

In crisis-affected settings, the continuity and quality of education are under severe strain. MEL frameworks must provide useful and timely data. They should do so without unnecessarily burdening already overstretched human and financial resources.

EiE education specialists require a MEL framework that captures disaggregated data on learning and SEL outcomes, stakeholder engagement, cost-effectiveness, integration in national systems, and implementation performance. Implementation metrics include appropriateness, engagement, intervention fidelity, affordability, and feasibility. Effective EdTech interventions are those that integrate with national systems, leverage and

collaborate with multiple stakeholders, and offer learners pathways to additional education and economic opportunities. MEL frameworks should include system and stakeholder monitoring and evaluation approaches and tools, alongside a focus on individual learner outcomes.

A robust MEL framework in crisis settings, whether for EdTech or non-tech programmes, has the following four characteristics:

1. Ensures accountability to learners, communities, ministries, donors, and other stakeholders ('what was achieved, for whom, and at what cost?').

2. Enables EiE stakeholders to review and adapt interventions in (near) real time, including under access and security constraints.

3. Fosters EiE stakeholder programme ownership by adopting participatory MEL approaches and tools.

4. Builds capacity and sustainability, so EdTech interventions can be co-developed, maintained, and absorbed by national education systems.

In addition to more general EiE intervention-focused guidance on developing MEL frameworks, there are examples of guidance focused on EdTech interventions. A strong example is USAID's roadmap for developing MEL frameworks for distance learning interventions [1]. The roadmap outlines three steps to designing a MEL framework:

1. Define what will be measured.

2. Identify how data will be collected, including remote and face-to-face methods.

3. Select measurement methodologies and tools [1].

The roadmap [↑1] identifies three MEL foci, namely:

1. **Reach:** This includes disaggregated beneficiary numbers, for example, learners, teachers, officials, and government and non-governmental organisations. In the case of distance learning, it should also cover access to technology (hardware and software) and the availability of infrastructure (electricity, internet, and phone connectivity).

2. **Engagement:** This includes adherence to intervention implementation protocols; for example, are learners receiving the agreed number of hours of learning per week? Engagement also includes how learners and others perceive the relevance and quality of the EdTech interventions. Whether the intervention motivates children to learn should also be included.

3. **Outcomes:** These include changes in academic and social and emotional learning.

Effective EdTech interventions are those that integrate with national systems, leverage and collaborate with multiple stakeholders, and offer learners pathways to additional education and economic opportunities. This means that the MEL framework foci included in the roadmap above should be supplemented with system and stakeholder monitoring and evaluation approaches and tools, alongside individual learner-focused outcomes. This includes tools to analyse, monitor, and evaluate systems and stakeholders, as well as to measure cost-effectiveness, affordability, and feasibility; as well as tools to review progress from smaller-scale implementation to integration with national systems.

Section 7.2 provides an overview illustrating how MEL framework measurement and learning priorities might change in each emergency response phase. In addition to highlighting the measurement approaches and tools discussed in earlier sections, we provide an overview followed by brief descriptions of key MEL approaches and tools not covered earlier.

7.2 Adjust MEL priorities to each EIE response phase

This section discusses MEL priorities for each of the five phases of EiE response outlined in Section 2. The discussion illustrates MEL priorities rather than a prescriptive priority list.



A CHILD WALKING THROUGH A FLOODED ALLEY. IMAGE BY SHUTTERSTOCK

Phase 0: Preparedness and anticipatory action

During this phase, EiE education specialists support ministries and system stakeholders in implementing crisis preparedness and anticipatory action. MEL activities focus on developing MEL frameworks for rapid deployment during crises and include

training staff in data collection and analysis, as well as data privacy and protection protocols.

Education specialists will use this phase to identify and address gaps in data management systems. This includes ensuring that cost capture markers are incorporated into financial and project systems and that data management aligns with best practices.

Phase 1: Rapid emergency response

During this phase, EiE education specialists have two demanding tasks. They must provide a rapid response to prevent learning loss in the immediate aftermath of a crisis. They will also need to start preparing for subsequent response phases.

To support immediate learner needs, MEL activities focus on providing data necessary to monitor emergency response activities, identify any excluded groups, and develop implementation partnerships. In parallel, EiE education specialists begin gathering the data needed to develop Phase 2 and Phase 3 programmes. This includes conducting needs assessments (see Sections 4.2 and 5.2) and mapping systems and stakeholders (see Section 7.3).

Recognising that operational conditions may be unstable and insecure, MEL tools used to monitor the initial educational response should be lightweight and fast, for example, using message-based activity logs, and, where possible, leveraging existing data and data collection mechanisms and tools. Potential monitoring tools could include attendance and participation registers to identify children who are excluded or at risk of dropping out, as well as distribution and activity records. Rapid assessments of connectivity, device availability, and internet access ensure that the initial response is appropriate, for example, providing printed or low-tech learning materials, where internet access or device availability is low (see Section 3.3). Data disaggregation by disadvantage characteristics is essential from the outset to support the equitable educational objectives of an EdTech intervention (see Section 5.2).

During this phase, EiE education specialists take initial steps to build relationships with government agencies, humanitarian-sector actors, and communities, as well as their coordination mechanisms. Partnering with stakeholders from day one facilitates broad ownership of programme goals and ensures contextually appropriate EiE programme design. Preparations for needs assessments, stakeholder consultations, and systems mapping, including capacity gaps analysis, will commence at this point. Developing a theory of change for the mid-term emergency response helps EiE education specialists clarify their underlying assumptions about how desired outcomes will be achieved (see Section 7.3).

At this stage, education specialists should also confirm that costing and cost-effectiveness markers are in place within the financial and reporting systems of the relevant EiE organisations (see Section 6.1). If these markers were not previously introduced as part of emergency preparedness activities, it is important to add them at this point to ensure readiness for emergency response Phases 2 and 3.

Phase 2: Mid-term emergency response in unstable contexts

By this stage, EiE education specialists will have completed, or will be completing, the needs assessments and stakeholder and system mapping. While an unstable context may require multiple delivery models across various technologies (see Section 3.3), initial implementation protocols and intervention partnerships will be established.

Analysing disaggregated Phase 1 data on access and participation will provide valuable input for equity-focused design. At this stage, formative assessments (see Section 3.1), school management, and teacher-practice feedback and monitoring can provide early indicators of performance. This analysis will begin to isolate which intervention access and retention variables, for example, device ownership, connectivity, caregiver literacy, learner disadvantage

characteristics, seem to correlate with lower participation or lower learning. The insights from this analysis, while indicative rather than causal, can inform adjustments to the delivery model and technology choice, as well as targeted changes to learning and teaching materials and instructional practices.

As with all phases, meaningful stakeholder involvement in MEL activities, particularly among caregivers, teachers, and ministry of education officials, creates a conducive environment for eventual integration of the national education system and recognition of children's learning [2].

Phase 3: Mid-term emergency response in stable contexts

As contexts stabilise or when EiE education specialists are better able to predict and respond to factors causing instability, for example, displacement patterns, MEL frameworks can begin to include summative learning assessments (see Section 3.1). After EdTech interventions have been operating for an adequate length of time, and if contextually feasible, learning impact studies, including RCTs, should be considered to test the intervention's causal effects (see Sections 3.1, 4.3 and 7.3). Learning data can then be combined with cost data to analyse cost-effectiveness to date. This analysis should include understanding the benefits and any additional costs of providing equitable access (see Sections 5 and 6.1). This initial cost-effectiveness analysis provides a basis for cost modelling and affordability and feasibility analysis (see Sections 6.1 and 6.3).

Implementation protocol adherence monitoring, combined with programme stakeholder feedback, will identify areas for improvement and additional support needs for specific stakeholders, such as teachers. Using evaluation methodologies such as A/B testing to test programme adaptations can be very helpful during Phase 3 (see Sections 4.3 and 7.3). This data is also key input when finalising scaling and system integration plans.

Phase 4: Sustainability and integration

In this phase, the focus is on transitioning towards institutionalisation within national systems and on expanding the reach of interventions. EiE education specialists will seek to understand how to sustain learning gains, reduce learning loss for specific learners, and create space for system-level planning and resilience-strengthening activities. The MEL framework will reflect this focus.

MEL questions asked at this stage will include:

- Do gains hold after emergency-specific supports are withdrawn?
- Are equity gaps closing or widening over time?
- Can national data systems, for example, national education management information systems (EMISs), absorb disaggregated tracking of literacy, numeracy, well-being, and vulnerability indicators?
- What implementation or component cost changes are required to allow for integration in national education systems, budgets, and assessment regimes?

During Phase 4, outputs from MEL activities can provide data and knowledge to inform lobbying campaigns for preparedness strategies and anticipatory action provisions [13].

7.3 MEL approaches and tools to support EiE EdTech intervention effectiveness

This section includes a brief overview of theories of change, system analysis approaches, scaling assessment tools, RCTs, and A/B testing. These approaches and tools are also relevant for EdTech interventions beyond crisis settings.

Theories of change

A theory of change explains how and why an intervention team expects change to happen in a specific setting. It emphasises the need to clearly state the assumptions behind the team's logic. This includes how they believe their intervention will create change within a particular ecosystem. It involves understanding how causal links between system drivers, stakeholder behaviour, and resource allocations will support the programme's long-term impact goals. Theories of change are valuable for individual EdTech interventions. They are also useful for developing EdTech investment strategies at the national education system level [4].

Resources to help EiE education specialists develop a theory of change include:

- NESTA's Development Impact and You (DIY) toolkit helps programme teams collaboratively develop a theory of change with system stakeholders, offering tools and practical examples to inform EdTech intervention planning, evaluation, or scaling [5].

- Theory of Change, an initiative from ActKnowledge and the Aspen Institute Roundtable on Community Change, provides tools, case studies, and resources to help build effective theories of change [6].

In addition, Clark-Wilson et al. [7] present an example of EdTech Hub's collaboration with the Bangladesh government, demonstrating the process and outcomes of developing a theory of change for a technology-enhanced national education system.

Systems assessments

Conducting a system assessment helps ensure that EdTech interventions are compatible with national education systems and that system stakeholders are identified. Two resources that support EIE education specialists are the Local Systems Framework [8] and the Research on Improving Systems of Education (RISE) programme's Education Systems Diagnostic Toolkit [9].

The Local Systems Framework is useful for analysing how a national education system currently operates [8]. This analysis can then be used to develop practical strategies to support the integration of interventions into the national system.

The framework makes use of '5 Rs':

1. Rules, including laws, regulations, statutes, norms, incentives, and expectations that determine system structure and stakeholder behaviour within that system.

2. Roles, including formal or informal roles of each system stakeholder.

3. Relationships between different system stakeholders.

4. Resources, including financial and human resources.

5. Results, including intervention outputs, outcomes, or their impact [8].

The RISE Education Systems Diagnostic Toolkit is designed to assess how stakeholders in the education system relate to one another. The toolkit focuses on identifying possible performance and capacity gaps in the education system. The objective is to develop interventions that integrate well in national systems, propose timely and appropriate policy amendments and address identified system gaps [9].



A PERSON IN FRONT OF TWO SCREENS, CODING. IMAGE BY HITESH CHOUDHARY

Analysing EdTech interventions using tools from scaling intervention science

As highlighted in Sections 2 and 6, EdTech interventions in crisis settings often need to deliver short-term results while also supporting the long-term goals of education systems. Incorporating knowledge from intervention-scaling science can aid a four-phase emergency response MEL framework. Consulting tools designed to analyse performance against scaling criteria can be a good source of relevant performance indicators. The Belgian non-profit organisation VVOB [↑10], for example, has developed a User Guide to the Education Scalability Checklist, which asks EiE education specialists to evaluate their interventions against seven criteria: strategy, credibility, support, relative advantage, transferability, organisational fit, and financing.

RCTs and A/B testing

RCTs are useful to demonstrate the causal effect of EdTech interventions. By randomly allocating children to an intervention or a control condition and measuring outcomes, for instance, learning outcomes, at post-test, the effect of receiving a programme can be determined [11]. A/B testing is essentially a simplified, applied form of an RCT, adapted for rapid, iterative decision-making. Both rely on randomisation and comparison, but they differ in scope and purpose. RCTs are typically more comprehensive, theory-driven, and regulated, while A/B tests are pragmatic experiments designed for speed and actionable insights [12]. A/B testing originated in the technology sector, where companies began using it to optimise user interfaces, advertisements, and recommendation algorithms. In education and EdTech, A/B testing has become an increasingly useful method for iterative improvements or optimisation when scaling or adapting programmes (12). Using A/B testing, EiE education specialists can test specific intervention EdTech product features and components or intervention implementation variations. The testing results can provide important insights into how learning outcomes, cost-effectiveness, and feasible, affordable implementation can be best achieved (12).

CASE STUDY

Youth Impact's low-cost phone-tutoring programme to improve foundational numeracy is an example of using A/B testing to improve intervention performance. The programme, which has been implemented across Asia and Africa, including in India, the Philippines, and Botswana, uses targeted instruction delivered via phone calls

to learners on widely accessible mobile phones. Learners access tutoring sessions via a caregiver's phone, and a tutor conducts assessments at the end of each call to determine the learning level. While RCTs demonstrated promising results across multiple regions [13; 14], high costs prevented the programme from scaling. Additionally, evidence suggested that the effectiveness of tutoring programmes decreased when they were scaled [15; 16].

To address this, twelve iterative A/B tests were conducted to reduce costs and enhance effectiveness. Successive rounds of A/B tests were conducted to determine whether a lower-cost version was as effective as the original programme design. To enhance effectiveness, a number of programme amendments were explored, including reduced tutoring session times, motivational nudges, and increasing parental engagement. A key feature of the iterative A/B testing model was its focus on continuous optimisation, with each test informing the next rather than running multiple tests in parallel. This testing approach also demonstrates how regular iteration gives decision-makers enough time to respond to results and enables programmes to scale without compromising effectiveness. All tests successfully reduced costs without affecting learning outcomes, and tests involving caregiver engagement modifications improved the programme's impact at low cost [12].

7.4 Ethical, integrated, and effective data use in crisis settings

Data plays a critical role in EiE interventions, shaping decisions that directly influence access, equity, and learning continuity for crisis-affected children. EiE data is not merely descriptive; rather, it guides resource allocation and intervention priorities in often unstable crisis settings [17]. The effective use of data in crisis settings is constrained by the persistent fragmentation of data systems [18]. EiE data is generated by an ecosystem of diverse actors, including ministries of education, education clusters, NGOs, UN agencies, and national statistics bodies using divergent tools, definitions, and timelines. This fragmentation leads to parallel systems, duplication, inconsistent coverage, data fatigue in schools and communities, and limited interoperability between humanitarian and national education information systems [18]. Organisational capacity challenges further weaken the reliability and timeliness of data collection and analysis, while political sensitivities complicate data sharing and undermine trust [18].

The growing digitalisation of humanitarian action adds another layer of complexity. Digital tools, for example, real-time assessment platforms, digital identity systems, and automated data flows, are now embedded in the operations of humanitarian systems, but they also heighten risks related to privacy, data repurposing, surveillance, and loss of agency for affected populations [19; 20].

Crisis-affected learners are particularly vulnerable: displacement, insecurity, and limited digital literacy increase the risk of data misuse, exposure to harm, and violations of dignity [19; 20]. Increasing reliance on third-party service providers challenges the humanitarian principles of neutrality, independence, and impartiality, making transparency and accountability harder to maintain [19]. In this context, data protection must provide robust safeguards, ethical data management, and protection-by-design approaches to uphold learners' rights and sustain trust between communities and education actors [19; 18]. Frameworks such as the Principles for Digital Development [21] provide practical

guidance on user-centred design, open and ethical data practices, contextual relevance, safeguarding, and sustainability. The recommendations in Box 1 below can guide EiE education specialists in supporting the ethical use of data in crisis settings.

Box 1. Recommendations for strengthening data use in EiE interventions

1 **Prioritise evidence-driven resource allocation and programming**

- Use numbers of affected children and disaggregated vulnerability profiles to guide funding and intervention prioritisation.
- Integrate disaggregation (gender, disability, displacement status, geography) into all assessments to ensure equity-focused responses. This includes using data to identify groups and individuals with complex educational and other needs, such as health and nutrition.

2 **Strengthen coherence and integration across data systems**

- Harmonise indicator frameworks and assessment methodologies between implementing organisations, ministries of education, and funders to avoid duplication. Working closely with the in-country humanitarian education cluster and relevant government agencies supports this aim.
- Establish joint needs assessment teams, shared monitoring dashboards, and interoperable data pipelines.
- Invest in ministry-led institutional information systems capable of capturing both routine administrative data and

crisis- and risk-related data. This could include connecting EMISs and humanitarian systems.

3 **Build sustainable EiE data capacity at all levels**

- Provide targeted training for ministry of education staff, sub-national authorities, and school leaders on crisis-sensitive data collection, analysis, and use for decision-making.
- Develop clear data governance protocols outlining roles, responsibilities, and feedback loops to reduce data fatigue and strengthen accountability.
- Include dedicated budget lines for data management, digital tools, and technical assistance in programme designs.

4 **Embed strong data protection, privacy, and digital safeguarding measures**

- Apply protection-first design practices, ensuring data minimisation, informed consent, secure storage, and strict access controls for all learner information.
- Vet third-party EdTech and data-processing service providers to ensure compliance with privacy standards, humanitarian principles, and child-safeguarding norms.
- Integrate the Principles for Digital Development [21] into all EdTech interventions.

5 **Promote inclusive, ethical, and cross-sectoral data use.**

- Establish partnerships between education actors and specialists in gender, disability, child protection, and health sectors, agencies, and organisations to support intersectional analysis and inclusive intervention design.

- Use data to identify barriers to participation (safety, health, nutrition, transport, gender-based violence risks) and coordinate multi-sectoral interventions that address them holistically.

- Ensure affected populations, particularly learners, caregivers, and teachers, are included in decisions about what data is collected and how it is used.

7.5 Benchmarking and quality assurance tools for EiE EdTech interventions

Using benchmarking and quality assurance tools to assess the quality of EdTech interventions enables EiE education specialists to identify areas for further development and adaptation. Below is a summary of two tools that are actively used for EdTech in crisis and LMIC settings.

UNICEF's EdTech for Good Framework [22] aims to assist decision-makers (governments, NGOs, funders, and schools) in navigating the increasingly crowded EdTech landscape and selecting digital learning tools that are safe, effective, equitable, and scalable. The framework assesses interventions against five criteria:

1. Data safeguarding and privacy for children
2. Demonstrable learning outcomes
3. Child-appropriate and engaging design
4. Cost-effective and feasible design, able to reach children in multiple settings

5. Equity-focused approach that promotes inclusion for children with different abilities.

EdTech Tulna [23] was developed to provide an evidence-based, transparent, and shared benchmark for 'good quality' learner-focused EdTech products, particularly for developing reading and numeracy skills. Similar to UNICEF's EdTech for Good Framework, EdTech Tulna aims to help governments, funders, schools, and other stakeholders make informed decisions in a crowded and often unregulated EdTech market. The EdTech Tulna [23] evaluation framework is built around three core dimensions, each with a set of quality standards and criteria.

1. **Content quality** is correct, clear, and comprehensible, and aligned to national education system standards.

2. **Pedagogical strategies** that use a learner-centric, engaging approach include meaningful assessment, adaptive learning pathways, and opportunities for teacher and caregiver support.

3. **Technology and design** that is accessible, intuitive, and safe for all to use.

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8. Five priorities for EdTech intervention design in crisis settings

Children affected by crises face some of the most severe and persistent barriers to learning. Disrupted schooling, weakened systems, displacement, trauma, and resource constraints compound existing inequities and deepen the global learning crisis. Educational technology is not a panacea for these challenges. However, when thoughtfully designed, carefully implemented, and sustainably financed, it can play a meaningful role in sustaining learning continuity and closing foundational learning gaps.

This guidance outlines five priorities for EiE education specialists integrating EdTech into crisis responses:

1. Grounding interventions in sound pedagogy
2. Making informed decisions about sourcing, building, and maintaining technology
3. Embedding equity and inclusion from the outset
4. Planning for financial sustainability and cost-effectiveness
5. Strengthening adaptive monitoring, evaluation, and learning.

Across all sections, a common principle emerges: technology must serve learning, not the other way around.

Effective EdTech interventions in crisis settings share several characteristics. They align with national systems and curricula and are built on sound pedagogical practice. They prioritise the well-being of learners and teachers. They are built on realistic assessments of infrastructure and capacity. They protect children's data and privacy. They are designed for adaptability across response phases. And they consider long-term ownership, maintenance, and stewardship from the beginning.

"Technology must serve learning, not the other way around."

Responsible EdTech integration requires coordination across humanitarian, development, and government actors. Crisis contexts are dynamic. Interventions must evolve as conditions change. They must move from rapid response to system strengthening and preparedness. This demands a focus on continuous improvement and agility amid complexity.

The decisions EiE education specialists make today will shape whether EdTech interventions remain short-term fixes or become durable components of resilient education systems. To achieve this, education specialists must combine evidence-informed practice with contextual adaptation. By doing so, they ensure investments in EdTech contribute not only to learning continuity in times of crisis, but also to more equitable and resilient systems for the future. Ultimately, the measure of success is not the sophistication of the technology deployed, but whether children learn safely, equitably, and effectively, maximising their life opportunities and those of their communities.

EdTech Hub