

Technical Foundations for Education Digital Transformation

WORKSHOP REPORT

May 2026, Geneva, Switzerland



Executive summary

This report captures the outcomes and emerging directions from the *Technical Foundations for Education Digital Transformation* workshop, held 26-28 May 2026 at ITU headquarters in Geneva, co-organized with UNESCO and UNICEF. The meeting brought together experts, country representatives, and partners to advance the translation of shared principles for public digital learning into technical specifications, reference implementations, and a longer-term roadmap.

This report synthesizes the evidence presented, the working group discussions, and the priority actions that emerged, with a focus on the outer layers of the education digital ecosystem: interoperability, safeguards, data sovereignty, and governance architecture. It consolidates cross-country evidence and best practices and proposes three priority education building blocks identified during the workshop.

The present document is intended as a collaborative knowledge resource rather than a directive guideline and aims to share experiences for navigating the complex developmental pathways of digital education.

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Introduction



1. Introduction

1.1 Digital transformation in education: a systemic perspective

Digital transformation at its core lies in strengthening how learners, teachers, and institutions interact through well-designed, efficient systems. Rather than relying on isolated applications, systemic digital foundations enable education ecosystems to function coherently, securely, and at scale. When systems are interoperable and governed responsibly, connectivity can translate into durable public value.

Governments are increasingly moving from isolated digital tools toward integrated digital foundations – identity systems, interoperability layers, learning platforms, and data infrastructure – built as public assets. Nonetheless, platforms are frequently developed in isolation, governed inconsistently, and inadequately connected to national education systems and broader digital public infrastructure. As schools come online, the question of what digital infrastructure they connect to becomes critical: systems that are fragmented, ungoverned, or poorly interoperable risk undermining the value of connectivity investments.

This systemic perspective is further explored in *Building the Case for a Digital Public Infrastructure for Education* (ITU, 2024)¹.

1.2 Digital public infrastructure as a foundation for education

Digital public infrastructure (DPI) is increasingly recognised as a foundational enabler of digital transformation across public sectors, including education at local, national, and international levels. Globally, governments are moving beyond fragmented digital projects toward integrated, whole-of-government solutions that enable secure identity, trusted data exchange, interoperable registries, and scalable service delivery.

In education, this transformation is particularly significant. Education systems must manage lifelong records, serve children and families, support student mobility, verify credentials for employment, and enable equitable access to services. These demands are driving the emergence of sector-specific DPI ecosystems in education, built on shared national digital identity systems, interoperable education registries, analytics-enabled education management information systems, digital credential verification services and publicly governed digital learning platforms.

¹ International Telecommunication Union (ITU), *Building the Case for Digital Public Infrastructure in Education* (Geneva: ITU, 2025), <https://www.itu.int/hub/publication/s-wp-dpi-education-2025/>

Within the broader education DPI ecosystem, public digital learning platforms represent an important learner and teacher-facing component. They can expand access to educational resources and services while supporting, rather than replacing, schools, teachers and in-person education. It is crucial, therefore, that its development is guided not only by technical interoperability and scalability, but also by educational purposes, public accountability, inclusion, openness, safety and trust.

The urgency of this agenda is shaped by several converging pressures: learning recovery following global disruptions; increasing cross-border mobility of students and workers; growing demand for rapid skills verification; the expansion of AI-enabled education services requiring high-quality interoperable data; and rising expectations for secure, citizen-centred public services.

Without foundational public digital learning solutions, education systems risk fragmentation, duplication, weak interoperability, and inequitable access. With coherent digital strategies, strong governance and sustained public investment, countries can move towards trusted, interoperable, inclusive and resilient education ecosystems.

1.3 The UNESCO-ITU-UNICEF Charter for Public Digital Learning Platforms

In March 2026, UNESCO, UNICEF and ITU released the Charter for Public Digital Learning Platforms. The Charter offers governments a shared normative framework to guide the design, governance, and continuous improvement of public digital learning platforms – asserting that these platforms must uphold the same values and aims that animate public education and complement, rather than replace, the work that happens in schools and with teachers.

The Charter was developed through an international consultative process involving an advisory group of experts and country representatives from the Gateways to Public Digital Learning Initiative², and was further refined through a public consultation process conducted in late 2025 and early 2026. The Charter defines what public digital learning platforms are and establishes seven guiding principles to support their development and governance:

1. Public – governed and financed by public authorities for the public good, in respect of national data protection laws.
2. Inclusive – designed to widen opportunities for all, with multilingual support, accessibility for learners with disabilities, and functionality on low-cost devices with limited connectivity.

² United Nations Children’s Fund (UNICEF), “Gateways to Public Digital Learning,” UNICEF Digital Education, <https://www.unicef.org/digitaleducation/gateways-public-digital-learning>

3. Pedagogical – teacher-led, pedagogically diverse, and balancing guided learning with independent exploration.
4. Complementary – reinforcing rather than replacing, in-person schools and teachers, and embedded within national education policy frameworks.
5. Open – built on open standards, licensed for reuse, and designed for interoperability with wider digital public infrastructure.
6. Focused – starting small, guided by educational needs rather than technological novelty, and expanding iteratively on the basis of data and user feedback.
7. Trustworthy – accurate, reliable, age-appropriate, and responsible stewards of data; AI tools integrated into platforms should be rigorously governed for safety and quality and directed towards educational purposes, reflecting their status as machine tools, not entities with human personalities and values.

The Charter provides the normative anchor for this workstream, and the Technical Foundations convening marks the start of the process of translating these principles into shared technical reference points, specifications, and reusable implementation patterns.

1.4 Glossary

Application Programming

Interface (API): A documented technical interface that enables different software systems to exchange data or use one another's services. APIs support interoperability between education platforms, registries, government systems, and third-party tools.

Cloud Infrastructure: Computing resources—including servers, storage, databases, and software services that are delivered through shared digital infrastructure. In education, cloud infrastructure may support scalable platforms, secure data storage, disaster recovery, and national service delivery.

Competency-Based Education (CBE): An education approach in which learners progress by demonstrating knowledge, skills, and competencies rather than primarily by completing a fixed amount of classroom time.

Content Management System (CMS): A platform used to create, edit, organise, review, publish, and maintain digital content. In education, a CMS may manage lessons, videos, e-books, examinations, and curriculum resources.

Digital Public Good (DPG): Open-source software, open data, open artificial-intelligence models, open standards, or open content that contributes to sustainable development and can be reused or

adapted by different countries and organizations.

Digital Public Infrastructure (DPI): Shared, interoperable digital systems that provide foundational public capabilities, commonly including digital identity, payments, data exchange, and trusted registries.

Education Identifier / Edu ID: A unique and persistent identifier assigned to a learner, teacher, institution, or other education entity so that records can be accurately connected across authorised systems.

Education Management Information System (EMIS): A system used to collect, manage, analyse, and report education-sector data for administration, monitoring, planning, financing, and policymaking.

Educational Technology (EdTech): Digital products, services, platforms, and tools designed to support teaching, learning, assessment, education administration, or professional development.

eLibrary: A digital library that provides searchable access to electronic books, documents, multimedia, and other learning resources.

Geographic Information System (GIS): A system for capturing, managing, analysing, and visualising location-based data. In education, GIS may be used to map schools, connectivity, infrastructure,

population needs, and service coverage.

Internet Protocol Television (IPTV):

The delivery of television or video content through internet-based networks. It can be used to distribute educational programming to schools and communities.

Learning Management System

(LMS): A platform used to organise and deliver courses, learning materials, assignments, assessments, communication, feedback, and learner-progress tracking.

Open Educational Resources

(OER): Teaching, learning, and research materials that are in the public domain or released under an open licence allowing free access, reuse, adaptation, and redistribution.

School Management System (SMS):

A digital platform supporting school administration and operations,

including enrolment, attendance, timetables, grades, staff records, communication, and reporting. In this report, SMS refers to a school management system rather than text messaging.

Single Sign-On (SSO): An authentication service that allows a user to access multiple authorised platforms using one set of credentials.

Student Information System (SIS):

A system used by an educational institution to manage student-related administrative information, including enrolment, courses, grades, attendance, and academic records.

Verifiable Credential (VC): A digitally signed, tamper-evident credential whose issuer and contents can be cryptographically verified. Verifiable credentials may represent qualifications, licences, certificates, or other trusted claims.

Case Studies



2. Case Studies

This section documents the digital transformation journeys presented at the workshop, drawing on the experiences of participating countries and organizations; it provides a comparative overview of the challenges and opportunities shaping education digital transformation across diverse national contexts: different income levels, governance models, platform types, and stages of implementation.

These cases are not intended as a comprehensive or representative global survey of digital learning platforms. They reflect the direct experience of participating teams, and their value lies precisely in the acknowledgement of real implementation choices, encountered obstacles, and hard-won lessons, shared by the people responsible for making them work.

Each case study is structured around five guiding points which were given to the participants to complete:

- (1) What education challenges their current digital learning solution addresses;
- (2) What outcomes are expected for learners, teachers, institutions, and the broader education system upon adoption of the learning solution;
- (3) What evidence of impact currently exists, whether quantitative data, user metrics, or validation work for pre-deployment solutions;
- (4) What key challenges have been encountered or are anticipated in implementation; and finally,
- (5) How those challenges have been or are being addressed through strategies, partnerships, or technical design choices.

2.1 Bangladesh's Integrated Digital Learning Ecosystem: Empowering Teachers, Learners, and Lifelong Learning at Scale

This case study presents Bangladesh's digital education transformation journey, led through a2i in collaboration with the Ministry of Education, the Ministry of Primary and Mass Education, and a broad network of national and international partners. Rather than developing standalone digital platforms, Bangladesh has adopted an ecosystem approach that connects teacher professional development, student learning, skills development, career guidance, and lifelong learning through interoperable, government-owned digital platforms.

Challenges and Opportunities:

- Community, recognition, and bottom-up innovation as adoption drivers.
- Teacher ambassadors, peer learning, content contribution, and open sharing.
- Locally owned platforms supporting scalable professional learning and teachers as change-makers.

Bangladesh's digital education transformation seeks to address several interconnected challenges across the education system, including limited access to quality learning opportunities—particularly in rural, remote, and underserved communities—restricted opportunities for continuous teacher professional development, fragmented learning resources and services, and growing demands for digital, AI, and workforce-relevant skills. Through nationally owned platforms such as Teachers' Portal, MuktoPaath³, Konnect, and NISE, Bangladesh has expanded equitable access to learning while fostering teacher-led innovation, peer learning, open educational resource sharing, and community-driven professional development. Community recognition, teacher ambassadors, collaborative content creation, and bottom-up innovation have been key drivers of adoption and long-term sustainability.

The integrated digital learning ecosystem is generating benefits at multiple levels. Learners gain improved access to quality educational resources, lifelong learning opportunities, digital and future-ready skills, and more inclusive participation, particularly for women, youth, persons with disabilities, and underserved populations. Teachers benefit from continuous professional development, stronger professional networks, improved pedagogical practices, and increased confidence in using digital technologies and AI to enhance teaching and learning. Educational institutions benefit from more efficient service delivery, data-informed decision-making, and scalable capacity development, while the broader education system is becoming increasingly

³ MuktoPaath, "MuktoPaath: E-Learning Platform," Government of Bangladesh, <https://muktopaath.gov.bd>

resilient, coordinated, and responsive to evolving labour-market and societal needs.

Evidence demonstrates both significant scale and institutional adoption. MuktoPaath has supported millions of course enrolments, while Teachers' Portal has evolved into one of Bangladesh's largest professional learning communities, enabling teachers and educators to create, share, review, and continuously improve locally relevant teaching resources. During and beyond the COVID-19 pandemic, these platforms played a critical role in ensuring learning continuity and large-scale teacher professional development. Konnect further complements the ecosystem by providing learners with personalized learning experiences, innovation opportunities, career guidance, and future-ready competencies. Their adoption across government ministries, educational institutions, development partners, and training organizations, together with international recognition through WSIS Awards, demonstrates their growing impact and relevance. User feedback consistently highlights improvements in accessibility, flexibility, learner engagement, collaboration, and lifelong learning. Implementation nevertheless requires continued attention to challenges, including unequal access to devices, connectivity, and digital infrastructure; varying levels of digital literacy; maintaining high-quality and contextually relevant content; and coordinating diverse stakeholders.

Bangladesh has responded through a collaborative, human-centred approach that combines continuous innovation, large-scale capacity development, inclusive digital architecture, supportive policy frameworks, and long-term institutional ownership. Partnerships among government, academia, civil society, the private sector, and development partners - including UNESCO, UNICEF, UNDP, ITU, Code.org, and the World Economic Forum - have strengthened knowledge exchange, technical cooperation, and institutional capacity. Through the ITU–UNESCO–UNICEF Gateways collaboration, Bangladesh aims to further advance digital public infrastructure for education by strengthening interoperability, sustainability, responsible AI, cybersecurity, data governance, and international peer learning while sharing lessons from Teachers' Portal, MuktoPaath, and Konnect. Overall, Bangladesh's experience suggests that digital transformation is most effective when understood as a long-term systemic process grounded in shared leadership, inclusion, capacity building, trusted partnerships, and a common commitment to improved learning outcomes.

2.2 The blended learning model - Educational Broadcasting Cambodia, Cambodia

The Educational Broadcasting Cambodia (EBC) leads an education content distribution model for students enrolled in grades 7-12.

Challenges and Opportunities:

- Content digitisation; blended learning models; teacher capacity building; connectivity partnerships.
- Educational Broadcasting Cambodia integrates LMS/CMS infrastructure with satellite delivery for rural school access.
- Conversion of textbooks and curriculum materials into reusable digital resources such as videos, e-books, quizzes, and presentations.
- SSO or registry integration and telecom partnerships reduce access barriers for learners and teachers.

Educational Broadcasting Cambodia⁴ (EBC) was established by the Ministry of Post and Telecommunications during the COVID-19 crisis with official development assistance from the Republic of Korea between 2020 and 2022. Initially created to maintain learning during school closures, it has evolved into a broader digital learning ecosystem addressing unequal access to quality education, limited learning resources, gaps in digital literacy, and barriers to continuity. EBC provides curriculum-aligned content through a blended learning model that supplements conventional half-day schooling with approximately two additional hours of learning. It also supports teacher development, digital pedagogy, lifelong learning, workforce capacity building, and a more integrated education system through centralised content, learning, and knowledge-sharing services.

Expected outcomes include wider anytime-anywhere access for learners to curriculum-aligned materials, interactive resources, and affordable digital services, particularly in rural and low-income communities. Teachers are expected to benefit from standardised resources, professional development, and tools for monitoring student progress. Schools and institutions can implement blended learning, fulfil ICT obligations, digitise administrative processes, and apply credit-hour systems more effectively. In the longer term, EBC is expected to improve learning outcomes, digital literacy, workforce readiness, exam administration, and equity between urban and rural areas, while contributing to a sustainable national digital education ecosystem and Cambodia's ambition to become a digitally empowered, knowledge-based society by 2035.

⁴ Educational Broadcasting Cambodia (EBC), "Platform Ecosystem," <https://ebc.edu.kh/en/platformecosystem/>

Evidence indicates both learning impact and growing national scale. In the first model school, grade repetition declined by 45 per cent, student pass rates increased by 5 per cent, the overall examination pass rate reached 76 per cent, and Grade A achievement rose from 2.4 to 4.1 per cent. EBC has produced more than 7,000 video episodes and developed approximately 6,331 courses and 7,035 learning materials across its LMS, CMS, eLibrary, IPTV, and mobile services. It serves at least 30,000 students and 1,700 educators, supports 21 Community Tech Centres, and has the technical capacity for up to one million concurrent users. Partnerships with Phnom Penh Teacher Education College produced 185 standardised teacher-training courses and videos, while collaboration with KAPE supported blended learning in 13 public schools.

Implementation challenges have included unequal infrastructure, high internet costs, uneven digital literacy, limited teacher readiness for digital pedagogy, and the demanding task of producing large volumes of curriculum-aligned content. Looking ahead, EBC must also secure sustainable funding, scale without compromising quality, keep pace with technological and educational change, close remaining equity gaps, and strengthen data security and privacy. These issues are particularly important as the platform expands beyond its original emergency-response role and as global education approaches continue to evolve.

EBC has responded through strategic partnerships, phased implementation, inclusive delivery models, and scalable technical design. Its multi-channel approach combines LMS access, IPTV broadcasting, mobile applications, and Community Tech Centres, while a Bring Your Own Device model helps reduce hardware barriers. Partnerships with Smart, Metfone, and Cellcard support more affordable and data-free access, and collaboration with teacher-training institutions strengthens digital skills and pedagogy. Pilot testing in selected schools has helped validate stability and effectiveness before wider rollout. Technically, EBC integrates a CMS, LMS, eLibrary, registry, Single Sign-On, and interoperable services, while coordination with government platforms, development partners, international schools, and the MoEYS Mobile App helps reduce fragmentation. Continued partnership-building and investment in flexible infrastructure remain central to addressing future risks and sustaining equitable access.

2.3 Personalised learning support - Smart Education Platform, China

China's Smart Education Platform^{5,6} is a key initiative driving the digital transformation of education. After two decades of sustained development, it has grown into one of the world's largest public service platforms for smart education.

Major Achievements

The platform serves 178 million registered users across foundational, vocational, higher, and lifelong education, covering more than 200 counties and regions. In terms of resource architecture, the platform has established a "Four Horizontal Pillars, Five Vertical Dimensions" framework, with foundational, vocational, higher, and lifelong education as the four horizontal pillars, and moral, intellectual, physical, aesthetic, and labor education as the five vertical dimensions, for which AI-powered knowledge graphs have been developed for each of the five core subjects. In terms of development phases, the platform evolved from curriculum-based distance education through three phases of sustained progress: Phase 1 began in 2003 with the launch of the Modern Distance Education Project for rural primary and secondary schools, investing USD 1.2 billion over five years to introduce modern distance education into impoverished and remote areas, addressing imbalances in rural education; Phase 2 focused on the comprehensive development of educational informatization, and by 2020, 100% of primary and secondary schools had achieved internet access, over 98% had multimedia classrooms, and more than 100 million online learning spaces had been created for teachers and students; Phase 3 implemented the Digital Education Strategic Initiative and officially launched the Smart Education Platform of China. In addition, the platform has built an integrated service system encompassing curriculum-aligned resources, teacher professional development communities, data analytics, and AI applications with expert review, and received the UNESCO ICT in Education Prize in 2022.

Opportunities

Building on these achievements, several opportunities lie ahead. The platform's vast user base and two decades of accumulated data resources offer unprecedented potential for large-scale personalised learning, enabling more precise and adaptive educational support for diverse learners. The "Four Horizontal Pillars, Five Vertical Dimensions" framework provides a replicable model for the systematic structuring of digital education resources, with potential for international outreach and cooperation. Furthermore, the

⁵ Ministry of Education of the People's Republic of China, National Smart Education Public Service Platform (国家智慧教育公共服务平台), <https://www.smartedu.cn>

⁶ Yan, S. and Yang, Y, "Education informatization 2.0 in China: Motivation, framework, and vision. ECNU Review of Education" <https://journals.sagepub.com/doi/10.1177/2096531120944929>

platform's extensive infrastructure and technical capabilities create a solid foundation for deepening AI integration across all education sectors and expanding personalised learning support to underserved populations.

Challenges and Responses

Implementation has nevertheless required careful consideration of several challenges, and China has adopted differentiated strategies to address them.

Challenge 1: Balancing standardisation with local flexibility. A highly centralised platform may risk over-standardization, potentially limiting local curricular flexibility and cultural diversity. To preserve local flexibility, the national platform functions as a "resource supermarket" rather than a mandatory instructional model, while 91 provincial platforms provide localized materials, and teachers retain control over how resources are used.

Challenge 2: Data privacy and security. Data privacy is another important concern, given that the system manages more than 3.48 trillion records of student behavioural data. Data protection is supported by the Personal Information Protection Law (PIPL), which classifies student information as sensitive and requires strict consent. Raw data are anonymized and aggregated at the source, retained within government-controlled cloud systems, and subject to quarterly security audits, while third-party companies are not granted direct access to individual student records.

Challenge 3: Uneven institutional and human capacity. Uneven capacity remains a challenge, particularly where rural schools have limited leadership support or digitally confident teachers. To strengthen human capacity, a seed-diffusion model supports selected schools, digital principals, and seed teachers who subsequently serve as regional training hubs, complemented by online professional communities and initiatives such as AI for Teacher Development.

Challenge 4: International adaptation. Looking ahead, international adaptation will require sensitivity to different curricula, languages, teaching traditions, and data-protection frameworks, as translation alone would not adequately respond to local contexts. Internationally, China is pursuing a gradual, partnership-based approach through a multilingual platform supporting six United Nations languages, an initial emphasis on adaptable STEM content, and pilot initiatives in Thailand and Uzbekistan. Country-specific zones are also being developed, reflecting an approach that prioritizes piloting, local adaptation, and cooperation rather than the direct transfer of a single national model.

Impact and Evidence

China's digital education transformation has focused on addressing persistent inequalities between urban and rural schools, particularly in remote areas where qualified teachers and access to a complete curriculum—including music, foreign languages, and science—may be limited. The expected outcomes extend across learners, teachers, institutions, and the wider education ecosystem. In the near term, schools gain broader access to high-quality digital resources,

students receive personalised guidance through AI learning companions, and teachers participate in online professional-development communities. Over the longer term, these measures are expected to contribute to a significant narrowing of the urban-rural learning gap, with early evidence from rural student performance supporting this direction. Teachers are also expected to become more digitally proficient and confident in using AI tools, while the education system gradually shifts from a primarily hardware-focused approach toward an application-driven, data-informed model of continuous improvement. Current evidence of impact is both quantitative and qualitative. Internationally, the Smart Education Platform received the UNESCO ICT in Education Prize in 2022, providing important external recognition. At the local level, Qixi Town Central School demonstrates how digital tools can expand opportunities in a small rural setting. Although the school has only 72 students and no full-time music teacher, AI-supported music tools have enabled students to perform on city stages. Learners also use smart devices to identify local wildlife and AI-powered translation to communicate in real time with a partner school in Indonesia. From a technical perspective, the system maintains more than 99.9% uptime during peak periods, processes approximately 100 billion new data records each month, and has accumulated 2.11 petabytes of data to support ongoing improvement. These developments are already taking place at considerable scale: the platform serves approximately 178 million users across more than 200 counties and regions, all primary and secondary schools in China have internet connectivity, and multimedia classroom coverage has reached 98%.

2.4 Connectivity and Data Integration – Connectivity Programme, Dominican Republic

The Dominican Republic's connectivity programme expands access to affordable broadband in underserved communities through investments in last-mile infrastructure, targeted subsidies informed by SIUBEN data integration, and focused digital skills training. Together, these measures improve access to digital education for vulnerable learners while promoting more equitable digital inclusion.

Challenges and Opportunities:

- Last-mile connectivity; affordability; rural and underserved access gaps.
- Telecom data and social protection registries for targeted connectivity programmes.
- Interoperability, data protection, consent, and measuring whether connectivity improves platform access and learning outcomes.

In the Dominican Republic, INDOTEL (Dominican Institute of Telecommunications)^{7,8} digital education contribution centres on its role as the national telecommunications regulator and infrastructure enabler. The initiative seeks to reduce the country's digital divide by expanding broadband infrastructure and providing subsidized connectivity, particularly in vulnerable and rural communities. At present, approximately half of Dominican households lack fixed broadband access. This creates an infrastructure challenge, as students in unserved areas cannot access digital platforms, educational content, or online repositories, and an affordability challenge, as many low-income households remain unable to afford commercial internet plans even when coverage is available. To address these barriers, the programme combines fiber-optic last-mile deployment with targeted demand subsidies for students and families from vulnerable socioeconomic backgrounds.

Once fully implemented across the targeted 101 municipalities, the solution is expected to improve access to learning, teaching, and digital education services at scale. Learners will be able to access global educational resources and digital learning tools from home, while teachers will be better positioned to assign digital homework, use modern learning management systems, and maintain communication with students beyond the classroom. Over time, the intervention is expected to support efforts to reduce learning inequalities and prevent academic dropout in rural provinces. For educational institutions and the wider system, universal connectivity will provide a foundational layer of Digital Public

⁷ Instituto Dominicano de las Telecomunicaciones (INDOTEL), "Portal INDOTEL," Government of the Dominican Republic, <https://indotel.gob.do>

⁸ Dominican Institute of Telecommunications. (2025). Proyecto "Mejora de la Conectividad para la Transformación Digital en la República Dominicana". INDOTEL.

Infrastructure, enabling the Ministry of Education to expand digital platforms nationwide with greater assurance that students are not excluded because of insufficient connectivity.

Evidence to date reflects demonstrated results and substantial implementation readiness. During the first phase, more than 14,000 low-income households gained access to affordable, high-quality internet, validating the demand-subsidy model. The planning and procurement process for Phase 2 has been completed, and contracts have been signed with eight major telecommunications concessionaires to begin deployment. For Phase 3, detailed bidding frameworks have been developed to assess technical efficiency, local operator presence, and geographic coverage through Geographic Information Systems. Technical cooperation with the Social Beneficiary Selection System, or SIUBEN, has also strengthened eligibility verification, helping ensure that public investment is directed toward communities with the greatest educational and social needs. Implementation has required careful balancing of regulatory, market, operational, and technical considerations. Some small local cable operators have expressed concern that subsidized connectivity initiatives could create uneven market conditions, making the balance between fair competition and universal access an important regulatory priority. As Phase 3 expands to more than 30 operators, technical reporting, service monitoring, and data coordination will become increasingly complex. Maintaining accurate GIS updates and strong service-level agreements, including reliable uptime in remote and mountainous areas such as the southern region, will also require sustained operational oversight.

INDOTEL has responded by adapting both its partnership model and technical architecture. To address operator concerns, bidding documents were redesigned to provide a 10 to 20 per cent local-presence advantage, encouraging smaller local providers to participate as strategic partners rather than as competitors to the state-supported programme. Under this model, operators receive public subsidies to extend connectivity to vulnerable students and households. To strengthen multi-operator reporting, INDOTEL and SIUBEN are developing a standardised application programming interface architecture through which operators will access relevant eligibility data and provide real-time information on active accounts and service delivery. As digital learning platforms fall under the Ministry of Education, INDOTEL's role is to serve as the technical enabler by constructing a reliable, high-speed digital foundation capable of supporting future educational Digital Public Infrastructure, including content platforms, registries, analytics, and other services that the country may choose to deploy.

2.5 EdTech Innovation Ecosystem, Estonia

Estonia's Digital Service Owner and Provider Selection Guide⁹ supports evidence-based decisions on the design, procurement, and management of digital public services, including education technologies. By helping public institutions determine whether services should be developed in-house or delivered through private-sector partnerships, the framework promotes sustainable, secure, and interoperable digital infrastructure to support national education platforms and digital learning services.

Challenges and Opportunities:

- Balancing public ownership of core education systems with private-sector innovation and expertise.
- Procuring interoperable, secure, and cost-effective digital learning platforms and education services.
- Reducing vendor lock-in while ensuring continuity, cybersecurity, and long-term sustainability.
- Strengthening the EdTech and GovTech ecosystem through transparent procurement and lifecycle management.

Estonia has developed a structured framework to guide public institutions in determining the most appropriate ownership and delivery model for digital public services, including those supporting education. Rather than assuming that education platforms should always be developed internally or outsourced, the guide requires service owners to evaluate market capacity, economic efficiency, risks, and long-term operational needs before selecting a delivery model. This enables education authorities to procure digital services that are sustainable, interoperable, and aligned with national digital government standards.

For education, the framework provides a governance foundation for digital services, including student information systems, admissions platforms, learning management systems, authentication services, and digital credentials. Promoting common procurement principles and lifecycle planning helps ensure that digital education services remain secure, scalable, and adaptable as technologies and user needs evolve. The approach also encourages interoperability between education systems and other national digital infrastructure, reducing duplication and improving the learner experience.

⁹ e-Residency, "How to Choose a Service Provider from the e-Residency Marketplace," available at: <https://www.e-resident.gov.ee/blog/posts/how-to-choose-a-service-provider-from-the-e-residency-marketplace/>

Implementation places strong emphasis on managing strategic risks associated with digital education infrastructure. The guide requires institutions to assess cybersecurity, data protection, intellectual property ownership, supplier dependence, and service continuity before making procurement decisions. Considering these factors early helps education authorities avoid vendor lock-in, maintain control over critical public services, and ensure that digital learning systems can continue to operate reliably over time.

By combining structured decision-making with transparent public procurement, Estonia's approach strengthens both digital government and the national education technology ecosystem. It encourages collaboration with private-sector providers where appropriate while preserving public oversight of strategic education services. In the longer term, the framework is expected to improve the quality, resilience, and cost-effectiveness of digital education infrastructure, providing a stronger foundation for future Digital Public Infrastructure that supports teaching, learning, and education administration.

2.6 Four barriers to Africa's EdTech, one proposed project

EdTech Africa¹⁰, an initiative led by the Spix Foundation¹¹, aims to build Africa's DPI-Ed: a continent-scale Digital Public Infrastructure for Education.

Challenges and Opportunities:

- Reducing policy, technology, data, and economic barriers to EdTech access.
- Building sustainable funding, coordination, and institutional capacity across countries.
- Managing scope-creep while keeping DPI-Ed focused and scalable.
- Using privacy-protecting student data to personalize learning and support research.
- Creating Results-Based Financing models for courseware developers and Ministries of Education.

Africa's EdTech landscape faces four closely connected barriers—policy, technology, data, and economics—which are further intensified by poverty and continue to limit learners' access to high-quality courseware across the continent. The African EdTech Breakthrough Project has been proposed as a continent-wide response to these challenges. Its central concept is Africa's Digital Public Infrastructure for Education, or DPI-Ed, which would provide a shared foundation for delivering digital learning resources and services at scale. The initiative is intended not only to develop the required technology but also to establish the human capital, institutions, partnerships, and funding mechanisms needed to support a sustainable education ecosystem.

The project has not yet been implemented, and there are therefore no project-specific results, user data, or evidence of impact at this stage. Its proposed model is informed by the broader experience of digital public infrastructure in other sectors and countries, including India's digital payments ecosystem, which demonstrates how shared infrastructure can support efficiency, innovation, and large-scale service delivery. However, the application of this model to education in Africa remains prospective and will require further development, piloting,

¹⁰ Spix Foundation, "RESPECT: Resilient EdTech Specifications Project for Educational Courseware and Technologies," <https://www.spixfoundation.info/respect>

¹¹ Additional Information: African EdTech Breakthrough Project (2026) *Africa's EdTech Breakthrough: Canon*. Available at: respect.world/canon

African Union (2014) *African Union Convention on Cyber Security and Personal Data Protection*. Addis Ababa: African Union. Available at: African Union website (Accessed: 9 June 2026).

African Union (2020) *Digital Transformation Strategy for Africa 2020–2030*. Addis Ababa: African Union.

AUDA-NEPAD (2025) *Africa EdTech 2030 Vision and Plan*. Midrand: African Union Development Agency–NEPAD.

validation, and coordination among African Union Member States and other stakeholders.

If implemented successfully, the proposed ecosystem would aim to provide learners, parents, teachers, schools, Ministries of Education, and other intermediaries with access to high-quality courseware at no cost. It would also introduce results-based financing models for courseware developers and education systems, use student progress data to support personalised learning while respecting the Malabo Convention on privacy and security, and strengthen research and innovation through responsible data federation. A further objective would be to support the development of African AI systems trained on African data, in African languages, by African people, and for African priorities. These remain intended outcomes rather than demonstrated achievements.

2.7 Low connectivity, prioritised investment – Learning Passport, Eswatini

Eswatini deployed the UNICEF Learning Passport¹² as a national platform. The platform supports the national Competency-Based Education (CBE) curriculum.

Challenges and Opportunities:

- Rural connectivity gaps; uneven device access; teacher digital literacy developing; intermittent electricity access in rural schools.
- Curriculum alignment as a priority.
- Learning Passport by UNICEF supports the national Competency-Based Education curriculum.
- Partnership model: Ministry of Education, UNICEF, Giga/ITU

Eswatini's digital education transformation, supported through the Eswatini Learning Passport and the Giga Initiative, seeks to address several interconnected challenges across the education system. These include unequal access to connectivity and digital learning opportunities, particularly in rural and underserved communities; the need to maintain learning continuity during school disruptions; the effective implementation of Competency-Based Education; limited digital skills among teachers and school leaders; and gaps in education data and connectivity planning. By combining curriculum-aligned digital content, remote and blended learning opportunities, school connectivity support, and improved data systems, the initiatives aim to create a more inclusive, flexible, and resilient learning environment for learners, educators, and families.

The expected outcomes extend across schools, teachers, learners, and the wider education system. Through Giga, more schools are expected to gain reliable internet access, enabling fuller participation in digital learning environments. Teachers and school leaders will be better equipped with the skills and tools needed to deliver interactive, learner-centred, and competency-based instruction through the Eswatini Learning Passport. Learners are expected to benefit from more consistent access to educational content, while the system will be better prepared to sustain teaching and learning during emergencies or periods of disruption. Over time, these efforts are also expected to reduce educational inequality by expanding access to technology and digital opportunities, while improved mapping and connectivity data will support stronger planning, resource allocation, and policy development.

Evidence to date indicates meaningful progress. The Eswatini Learning Passport has expanded nationwide access to curriculum-aligned digital resources for learners, teachers, and parents, supporting both classroom-based and remote learning. The platform played an important role during school closures

¹² Ministry of Education and Training, Kingdom of Eswatini, "Eswatini Learning Passport," <https://eswatini.learningpassport.org>.

associated with COVID-19 and continues to support blended learning approaches. Teachers and school leaders are gradually adopting digital tools and learner-centred teaching practices following training and exposure to online platforms. Through Giga, schools have been mapped and connectivity gaps identified, providing a clearer understanding of infrastructure needs and helping inform investment priorities. The initiatives have also strengthened cooperation among government institutions, development partners, and telecommunications stakeholders, while increasing national awareness of the importance of digital inclusion and equitable access.

Implementation nevertheless continues to face several practical challenges. Many schools, particularly in remote areas, still experience unreliable or limited internet connectivity, insufficient devices and ICT infrastructure, and high costs associated with data, equipment, and technology services. Some teachers, learners, school leaders, and parents require further support to build confidence and capability in using digital tools effectively. Schools may also have limited access to technical support and maintenance services, while unstable electricity supply can affect the consistent use of digital systems. In addition, the transition from traditional teaching methods to technology-supported approaches has been gradual in some contexts, and long-term sustainability will depend on continued financing, infrastructure upgrades, and institutional commitment. Eswatini has responded through a collaborative and phased approach. The Government has worked closely with UNICEF, telecommunications providers, and other education partners to support implementation. Giga's school mapping and connectivity assessments have helped identify priority areas and guide the expansion of internet services, especially in underserved communities. Training programmes and orientation workshops have strengthened teachers' and school leaders' digital literacy and pedagogical capacity, while the Eswatini Learning Passport provides accessible, curriculum-aligned materials for classroom and remote use. Schools have also been encouraged to adopt blended and flexible learning models that combine traditional instruction with digital resources. Continued advocacy has helped build support for digital inclusion, while improved education data has strengthened evidence-based planning and resource allocation. By implementing the initiatives progressively, Eswatini has enabled schools and stakeholders to adapt over time, incorporate lessons learned, and refine the approach as digital education efforts continue to expand.

2.8 Data sovereignty as a legal architecture decision - KOSKI and Lampi, Finland

Finland's KOSKI¹³ (National Information System for Students and Study Rights) covers the entire education system from pre-primary to doctorate. Some architecture principles include: (1) Registry as an authoritative source. (2) API as public and documented. (3) Consent built into the legal framework. (4) Lampi operates as a datalake that can support analytics and the creation of anonymised views or extracts. Data sovereignty is highlighted as a legal architecture decision, not just a technical one.

Challenges and Opportunities:

- Data sovereignty is a legal architecture decision, not only a technical one.
- Legislation mandates data submission from all institutions.
- The registry is the authoritative source; the API is public and documented; consent is built into the legal framework.
- Lampi operates as a datalake that can serve as a backend for analytics and create anonymised views or extracts where required.
- Trusted data infrastructure, governance, reconciliation, analytics, and maintenance as foundations for digital transformation.

Finland's national registries and information platforms, including KOSKI and Lampi, together with the broader digital ecosystems connected to them. When information is scattered across disconnected systems or stored in non-standard formats, knowledge exchange between learners and organizations can be hindered. These limitations also create barriers to knowledge-based decision-making at the national level because essential information concerning studies, education, qualifications, and educational institutions may be outdated or not readily available. Finland's approach seeks to establish trusted, standardised, and interoperable information services that enable education data to be produced, exchanged, and used more effectively.

The expected outcomes extend to all parties involved. Learners can use verified information concerning their education whenever it is needed throughout their lives, including when applying for further education or employment. They no longer need to provide the same education-related information repeatedly to different authorities or organizations on paper, by email, or in the format required. Instead, organizations can retrieve standardised information from a central service, either through a legally established right of access or with the learner's consent. Although KOSKI and Lampi are not primarily classroom teaching platforms, teachers and other education professionals may benefit

¹³ Juho Mikkonen, "KOSKI—A National Registry and Data Transfer Service for Study Rights and Completed Studies," Finnish National Agency for Education, 27 January 2021, https://www.oph.fi/sites/default/files/documents/Mikkonen_koski_en_25012021.pdf.

indirectly from reduced administrative duplication, more reliable information, and better coordination between organizations. Educational institutions and central government can use real-time data to support decision-making and the coordination of the education sector, potentially with information available at the level of an individual learner. Information security is also expected to improve as decentralised and distributed processes and non-uniform formats are replaced by secure, centralised exchanges and standardised data structures. Evidence to date indicates that learners, government authorities, and organizations in the private and third sectors have positively received the development of national registries, information platforms, and knowledge-exchange services. There is broad agreement that adopting this digital ecosystem has made processes requiring education-related data more labour-efficient, cost-efficient, robust, and reliable. Statistics Finland, for example, has been able to discontinue data-collection activities that had previously cost the organisation tens of thousands of euros each year, and other comparable examples of increased efficiency also exist. More broadly, the ecosystem formed by KOSKI, Lampi, and related services creates a national chain of trust by using verified data from trusted sources. This contributes to democratic governance by giving learners greater control over their information and by making the processes through which their data are accessed and used more transparent. Implementation remains complex. It requires long-term political and financial commitment, sustained stakeholder engagement, and a shared ontology and data model capable of representing Finland's education system. Achieving genuine interoperability has also proved particularly demanding because it depends on the ontology and data model underlying the systems. The KOSKI data model must function as a standardised conceptual representation of the Finnish education system, particularly in relation to degrees, qualifications, and their structures. Developing an overarching ontology for such a complex governance sector requires a careful balance between extensive dialogue and cooperation with stakeholders at all levels and a clear mandate to make executive decisions. A further challenge is that different parts of the ecosystem must be developed over many years, requiring strategic and complex architectural planning that can endure over time while remaining adaptable to changing circumstances. This challenge has only been partially resolved: while much of the architecture is well designed and broadly independent of changing conditions, some components overlap, certain solutions have been optimised locally, and technologies are not always used consistently. Some services within the Studyinfo ecosystem date back to 2013, and higher education institutions continue, in part, to develop digital services without being required to ensure full technical and semantic interoperability with the wider Finnish ecosystem. Finland has addressed many of these challenges by establishing clear responsibilities, legal mandates, and decision-making authority within the

relevant jurisdiction. The Finnish National Agency for Education, EDUFI, is legally responsible for defining the KOSKI data model and can therefore make an executive decision when definitions cannot be resolved through stakeholder dialogue. It ensures that responsibility and final decision-making power are clearly embedded in the regulatory framework governing the ecosystem. The challenge of locally optimised and partially inconsistent architecture has not yet been fully resolved, and becomes more difficult to address the later it is identified. Therefore, Finland is working toward more holistic architectural planning and more consistent use of technologies across the national digital education ecosystem. Studyinfo services have existed since 2013; the transition toward a more coherent architectural model is expected to take several years. Full architectural sophistication will also remain difficult to achieve until higher education institutions are required to ensure stronger technical and semantic interoperability with the national ecosystem. At the same time, Finland's approach recognises that the pursuit of perfection should not prevent practical progress. An architecture that functions technically and is also financially sustainable and organisationally manageable for the development and maintenance of its different components may be considered sufficiently robust, even while further improvements continue.

2.9 Reusable building blocks for scaling - Sunbird, India

Sunbird¹⁴ is an open-source (MIT license), configurable, extendable, modular, digital infrastructure for learning and human development designed for massive scale implementations.

Sunbird provides reusable building blocks that enable key interactions of learning, capacity building, and administration in three scenarios of learn, help learn, and manage learning for key actors (personas) involved in learning - Learner (students, youth, and adults), Parent (any caregiver), Teacher (anyone providing formal/Informal teaching), Administrator (anyone who can help manage the learning and capacity building processes), and Community Member (anyone from society, Including market players). Sunbird-Ed is the out of the box reference solution that offers a portal, mobile app, and a desktop app with reference UX and workflows.

Through these building blocks Sunbird addresses the challenge of enabling scalable and equitable access to learning opportunities to anyone, anytime, anywhere. Sunbird is designed for population of scale and to be able to meet diverse learning needs of countries. Sunbird's building blocks enable various functionalities such as contribution, curation, and publishing of content; progress tracking; credentialing; tagging to rich taxonomy; data analytics and exhaust; user management and more. Sunbird also handles multiple languages not only for user interface, but also for content/assets that are created within the software.

Sunbird can be used by various adopters for school education, teacher development, school administration and school leadership development, upskilling mid-career professionals, financial literacy, technical training, capacity building for civil servants and other use cases related to learning and overall human development. Sunbird with its building block approach enables adopters to roll-out learning platforms as public infrastructure and enable the ecosystem and market players to innovate and offer diverse solutions on the public infrastructure - thereby distributing the ability to solve.

Sunbird has been adopted by the Ministry of Education, Government of India to launch a national school education platform called DIKSHA. DIKSHA has been used extensively in each of the 36 States and Union Territories in India across 30+ languages. Through DIKSHA (which is built completely on Sunbird), millions of students, teachers, parents, educational leaders, and communities in India are accessing learning opportunities. During Covid-19 it has proven to be an instrumental large scale platform for maintaining learning continuity. Sunbird (in

¹⁴ Sunbird, "Sunbird," available at: <https://www.sunbird.org>

full or partial) is also adopted by adopters across government and private sectors.

Sunbird is also at the core of the iGOT Karmayogi platform in India - a digital platform for training government employees all over India. This has been the backbone of capacity building initiatives in India in the recent past. Sunbird has been adopted by FMPS, the largest NGO for pre-school education in Morocco. They have launched MAHARAT, a platform for training over 25000 of their educators, based on Sunbird.

Adopting Sunbird involves identifying the appropriate building blocks, composing them into the capabilities required for the solution, and configuring or extending them to meet local requirements. Successful solutioning, however, extends beyond technology. It requires a thorough understanding of the problem being addressed and the impact the solution is expected to achieve; familiarity with the available building blocks and how they can be combined; identifying the right ecosystem partners to support implementation; and carefully planning deployment, adoption and scale through programmes that enable sustained impact.

Drawing on its experience of implementing Digital Public Infrastructure at scale, Centre for Open Societal Systems (COSS) serves as both an advisory and co-creation partner to help adopters successfully navigate their implementation journey. COSS supports organisations in framing the right problem statements, defining meaningful impact outcomes, and identifying the most appropriate solution approach. It also offers training and certification on Sunbird building blocks through accredited partners in the Sunbird ecosystem, helping build local implementation capacity. Beyond technology, COSS connects adopters with the broader ecosystem of implementation partners - including system integrators, technical assistance providers, policy advisors and programme delivery organisations - to ensure solutions are effectively deployed, adopted and sustained at scale.

2.10 Prioritising teachers in digital transformation - Rapor Pendidikan, Indonesia

Indonesia's experience shows that education digital transformation is not simply about launching applications. It is about building public digital learning infrastructure that enables a large, decentralised education system to diagnose problems, align priorities, strengthen educators, reduce administrative burden, and improve continuously. This case draws on practitioner lessons from the 2019 to 2024 Merdeka Belajar ¹⁵(Emancipated Learning) reform period, with selected platform figures updated using the latest information shared for the workshop. It should not be interpreted as an official statement of current government policy.

Challenges and Opportunities:

- Education problem first, not application first: learning crisis, learning loss, fragmented data, unequal access to professional learning, administrative burden, and decentralised governance.
- People-centred sequencing: strengthening teachers, school leaders, schools, and local governments as the frontrunners of change.
- Integrated public ecosystem: Rapor Pendidikan for diagnosis and planning, Platform Merdeka Mengajar for educator learning and practice sharing, ARKAS for school budgeting and reporting, and SIPLah for transparent procurement.
- Inclusive design: mobile first access, low bandwidth environments, older devices, varied digital capabilities, and continuous product iteration.
- Institutional architecture: shared goals, cross directorate collaboration, technology teams as policy partners, user research, change management, governance, and long term sustainability.
- Adoption and trust: voluntary use and perceived value are critical for meaningful engagement, while mandatory integration can increase usage but may also create resistance if users are not yet ready or convinced of the value.

Indonesia began from the scale and urgency of the education problem. The country's education system serves more than 60 million students, 4 million teachers, 400,000 schools, 17,000 islands, and 552 local governments. Before the pandemic, around 70 per cent of 15 year old students were below minimum competency in literacy and numeracy, and COVID-19 intensified the learning crisis after extended school closures. Merdeka Belajar was designed to shift the system toward schools as learning environments that nurture competent,

¹⁵ Wang, C., Zhang, M., Sesunan, A. and Yolanda, L. (2023). Technology-driven education reform in Indonesia: A look into the current status of the Merdeka Belajar program. Oliver Wyman.
<https://repositori.kemendikdasmen.go.id/30538/1/Indonesias-K-12-Education-Quality-Improvement-English-05122023.pdf>

lifelong learners with strong character. Digital transformation was therefore not treated as a stand alone technology agenda. It was framed as part of a wider transformation involving problem formulation, business process redesign, technology ecosystem intervention, organisational culture change, and a focus on lasting system impact.

A central design choice was to support the people and institutions closest to learning. Instead of focusing first on direct digital intervention for students, Indonesia prioritized teachers, school leaders, schools, and local governments because they are the actors who translate policy into everyday practice. Rapor Pendidikan helped schools and local governments move from data access to data informed reflection, priority setting, and improvement planning. Platform Merdeka Mengajar expanded access to professional learning, teaching resources, peer communities, and teacher-generated practice sharing. ARKAS simplified school budgeting, reporting, and compliance. SIPLah connected procurement to school plans through a more transparent marketplace. Together, these platforms were intended to connect diagnosis, educator learning, school planning, budgeting, procurement, monitoring, and improvement into one coherent public infrastructure.

The ecosystem showed strong evidence of adoption and use, while learning gains should be understood as part of the wider reform agenda and not attributed to technology alone. According to the latest figures shared for the workshop, Rapor Pendidikan included six priority indicators and more than 200 sub indicators; around 95 per cent of schools had used it for data informed decision making; 91 per cent of school principals used it to identify improvement priorities; and more than 80 per cent considered it more effective for school improvement planning. ARKAS had been used by around 420,000 schools and reduced budgeting and reporting time by more than five hours per month. SIPLah had reached around 350,000 schools and engaged around 280,000 small and medium sized enterprises. Platform Merdeka Mengajar recorded more than 4.9 million logged in users, including more than 3.8 million active users, with more than 160,000 teacher communities, more than 6,000 self learning modules, more than 54,000 teaching tools downloaded more than 17 million times, and around 1.8 million pieces of teacher uploaded content. National Assessment data also indicated broader learning recovery, with literacy competency increasing from 53 per cent in 2021 to 68 per cent in 2024, and numeracy from 33 per cent to 66 per cent.

Implementation faced persistent constraints. Many users worked with unstable connectivity, low bandwidth, older smartphones, and varied levels of digital confidence. Legacy government technology practices also created barriers: technology had often been procured after programmes were designed, products

were shaped more by institutional assumptions than user needs, vendor changes weakened continuity, and applications were often unreliable. Within government, formal organisational structures encouraged silos even though implementation required cross directorate collaboration. There were also cultural tensions between the stability, compliance, and accountability expected in bureaucracy and the faster, more exploratory ways of working used by professional technology teams. Another important lesson came from adoption dynamics. In 2022, Platform Merdeka Mengajar grew rapidly because teachers used it voluntarily and found practical value in micro learning, communities, and user generated content. In 2024, integration with the Teacher Performance Management System shifted adoption toward system wide institutional use, increasing scale but also introducing resistance and operational challenges among users who were not yet ready or convinced of the platform's value.

Indonesia addressed these challenges by beginning with the education problem, not the application. Products were developed through discovery, delivery, and distribution processes that brought together policymakers, engineers, product managers, designers, researchers, data specialists, operations teams, educators, and local governments. The design principles were to build for lasting change, stay close to users, start with what is good enough to learn from, keep improving, and think in ecosystems. Cross functional task forces, shared goals, steering committees, and professional technology teams helped align policy, product development, user adoption, and institutional ownership. The central lesson is that public digital transformation requires both technical architecture and institutional architecture. It needs platforms, data, interoperability, and product reliability, but also governance, trust, collaboration, leadership, data stewardship, funding, user protection, and continuous improvement. Technology becomes transformative only when it strengthens the agency and capacity of teachers, school leaders, local governments, and schools to serve learners better.

2.11 Digital education initiatives for targeted challenges - Learning Passport, Lesotho

Strengthening digital education through initiatives such as the Learning Passport, Akello Smart Learning, Digital Schools, and Giga. These efforts aim to improve connectivity, expand access to curriculum-aligned content, build teacher digital skills, and support blended learning. While challenges such as limited infrastructure, high costs, and unequal access remain, strong partnerships, offline solutions, privacy safeguards, and phased implementation offer opportunities to create a more inclusive and resilient education system.

Challenges and Opportunities:

- Teacher digital skills gaps and teacher motivation.
- Need for stronger assessment and feedback platforms.
- Learning Passport, online training and certification, and maturity-tiered guidance using interoperability and privacy standards.
- Offline or low-bandwidth solutions, privacy safeguards, capacity building, and realistic procurement choices as priorities.

Lesotho's digital education initiatives—including the Lesotho Learning Passport¹⁶, Akello Smart Learning, Digital Schools, and Giga—address unequal access to connectivity and digital learning, particularly in rural and underserved communities. They also respond to the need for learning continuity, wider access to curriculum-aligned content, and more effective implementation of the national competency-based curriculum through flexible, learner-centred, and self-paced approaches. In addition, the initiatives seek to strengthen teachers' and school leaders' digital skills and to improve education data and connectivity planning through Giga's school mapping and assessment activities.

Expected outcomes include more reliable school connectivity, greater access to digital resources, and stronger teaching using interactive, competency-based tools. Teachers are expected to become more confident in digital pedagogy, while learners benefit from remote and blended learning opportunities during both normal schooling and periods of disruption. Institutions and the wider education system should become more resilient, inclusive, and capable of making evidence-based decisions through improved connectivity data, planning, resource allocation, and policy development. The Ministry also intends to pursue zero-rating for approved educational platforms and is considering endorsing one platform as the national learning platform.

Evidence to date shows that the Lesotho Learning Passport and Digital Schools have expanded access to curriculum-aligned materials for learners, teachers, and parents, supporting classroom and remote learning. These platforms

¹⁶ Ministry of Education and Training, Lesotho. LESOTHO LEARNING PASSPORT. <https://moetls.learningpassport.org/>

helped sustain education during COVID-19 school closures and continue to support blended approaches. Teachers and school leaders are gradually adopting digital tools and learner-centred practices following training and exposure to the platforms. Giga has mapped schools and identified connectivity gaps, improving the evidence available for infrastructure planning. The initiatives have also strengthened cooperation among government, development partners, and telecommunications stakeholders and increased national awareness of digital inclusion and the needs of rural learners.

Implementation continues to face limited and unreliable connectivity, insufficient computers, tablets, projectors, and supporting infrastructure, as well as the high cost of data, devices, and internet services. Some teachers, leaders, learners, and parents require further support with digital skills, and many families do not have smartphones. Schools may also lack technical maintenance and troubleshooting services, while unstable electricity or inadequate power infrastructure limits consistent use. Progress has sometimes been gradual because of resistance to change and varying confidence in technology-supported teaching.

Lesotho is addressing these challenges through partnerships with UNICEF, UAE Digital Schools, telecommunications providers, and other education stakeholders. Giga's mapping supports the prioritisation of underserved schools, while Digital Schools has trained 450 primary teachers to integrate ICT into education, complemented by orientation workshops on digital literacy and pedagogy. Curriculum-aligned content is being provided through the Learning Passport and related platforms, and schools are encouraged to combine classroom teaching with flexible digital learning. Advocacy promotes equitable access, Giga data supports policy and resource decisions, and phased implementation allows schools and stakeholders to adapt gradually while lessons inform continued improvement and expansion.

2.12 Multi-sovereign regional platform serving eleven member states - Learning Hub, OECS

The OECS Learning Hub¹⁷ supports digital education across small island states by providing shared infrastructure while allowing each member state to maintain curriculum control. It addresses challenges such as fragmented curricula, limited digital resources, weak connectivity, gaps in teacher capacity, and inconsistent assessment practices. Through curriculum-aligned content, lesson-planning tools, teacher collaboration, offline-first design, and data-informed improvement, the platform aims to strengthen teaching and learning and advance regional education equity.

Challenges and Opportunities:

- Shared platform hosted by the OECS Commission, built around a jointly developed regional curriculum framework.
- Teacher empowerment; lesson planning; assessment tools; communities of practice.
- Teacher-generated content, quality assurance, open licensing, and AI-supported capabilities.
- Shows how small states with limited technical capacity can share common infrastructure while retaining curriculum sovereignty.

The OECS Learning Hub was developed to address structural, geographic, and pedagogical challenges across the Eastern Caribbean. These include fragmented curricula across member states, limited access to quality curriculum-aligned resources, weak connectivity and device availability, inconsistent electricity supply, insufficient support for digital lesson planning, limited tools for creating interactive, locally relevant content, fragmented assessment practices, and limited visibility into learning outcomes. Built around the OECS Harmonised Primary Curriculum, the Hub seeks to provide a common regional platform that supports teachers, learners, schools, and education authorities across all 11 member states.

The expected outcomes include improved access for more than 100,000 primary learners to regionally relevant, curriculum-aligned digital content and stronger continuity as students progress through the education system. Teachers are expected to benefit from ready-made resources, AI-assisted lesson planning, reduced preparation time, more interactive instruction, and greater professional collaboration across small-island contexts. Schools should gain more consistent curriculum delivery and stronger digital assessment tools, including early childhood assessments. The wider regional system is expected to benefit from

¹⁷ Organisation of Eastern Caribbean States (OECS), "OECS Learning Hub," <https://oecsllearninghub.org>.

greater curriculum coherence and, as data capabilities mature, a stronger evidence base for policy, professional development, and curriculum review. Evidence from the May 2026 monitoring data and the March 2026 independent MindBloom pilot report indicates growing adoption. The Hub had 3,599 registered users, including 1,164 new registrations between October 2025 and April 2026, and teachers had created 17,572 lesson plans, including 2,186 through the Kindergarten planner. In March 2026 alone, hundreds of plans were created across Mathematics, Language Arts, Science, and Social Studies. During the pilot, 75 per cent of observed teachers were using the digital harmonised curriculum, based on 591 observation and coaching sessions involving 305 teachers in 64 schools across six states. The wider pilot reached 74 schools in eight states, enrolled more than 1,300 educators in professional development, trained over 25 facilitators, and 73 per cent learner engagement was recorded during classroom observations in the pilot, exceeding the 70 per cent target.. The platform's professional communities feature attracted 159 members. Implementation has nevertheless faced major challenges. Curriculum review and approval processes were slower than planned, resulting in bottlenecks, formatting issues, and alignment gaps between platform content and curriculum requirements. This delays content updates and increases the risk of misalignment. Data sovereignty also remains a concern because the platform was initially built on commercial cloud services, whereas a fully sovereign, redundant hosting model would require substantial capital and operating costs beyond current internal capacity. This raises hosting-transition risks. Sustainability is also constrained by reliance on project funding, a small in-house technical team, limited technical support, uneven digital skills, weak infrastructure, and coordination across 11 sovereign states. This limits long-term maintenance and rollout capacity. Further risks include incomplete ministerial engagement, the absence of a formal regional funding mechanism, outdated content, uneven broadband and device investment, declining user engagement after the pilot period, and possible technical obsolescence. The OECS Commission has responded through phased publication of content, hard review deadlines, specialist-led editing, and closer collaboration between curriculum officers and technical teams. The Hub's architecture organises content by subject, grade, and curriculum outcome, while AI-assisted lesson planning supports stronger alignment. A phased hybrid hosting strategy is gradually moving sensitive data to nationally and regionally governed infrastructure; and the platform's open-source, offline-first design reduces licensing costs, vendor dependence, and connectivity barriers. Financial sustainability is being pursued through OECS operational funding, member-state co-financing, national budget commitments, and a proposed recurrent regional mechanism. Planned ministerial briefings and a tripartite agreement among governments, the OECS Commission, and development partners aim to

strengthen governance. Future development also includes automated feedback loops that use analytics to identify learning gaps and support teacher resources.

2.13 Quality-assured lessons in open-licensed content - Oak National Academy, UK

Oak National Academy¹⁸ supports digital education in England by providing teachers and pupils with free, high-quality, curriculum-aligned resources from the early years to Key Stage 4. It addresses challenges such as the time and cost required to create effective materials, limited access to sequenced curricula across subjects and phases, teacher workload, and the lack of educationally grounded AI infrastructure. Through rigorously quality-assured lessons, planning tools, openly licensed content, curriculum knowledge graphs, and responsible AI capabilities, Oak aims to improve pupil outcomes, reduce the disadvantage gap, and help teachers use technology effectively without weakening their professional judgement. As an arm's-length-body of the Department for Education, Oak works specifically on creating resources and building infrastructure for the English and UK context.

Challenges and Opportunities:

- Free, publicly funded digital curriculum infrastructure that is strategically aligned with the Department for Education while remaining operationally independent.
- Teacher workload reduction through sequenced lessons, adaptable resources, and AI-assisted planning from the early years to Key Stage 4.
- Openly licensed curriculum content, knowledge graphs, APIs, and MCP integration that enable responsible innovation by schools and EdTech developers.
- Demonstrates how high-quality curriculum resources and pedagogically grounded AI can support disadvantaged pupils, strengthen teacher retention, and improve access to consistent teaching materials at national scale.

Oak seeks to improve pupil outcomes and reduce the disadvantage gap by helping teachers deliver and pupils access a high-quality, well-sequenced curriculum. Its approach responds to evidence that effective teaching, supported by strong curriculum design, is particularly important for disadvantaged pupils. Oak addresses barriers, including the time and cost required to create high-quality resources, limited subject and phase coverage, and the prevalence of isolated lesson materials rather than coherent curriculum sequences. It also responds to technological challenges, including AI tools that may not align with the English curriculum or sound pedagogy, the risk of cognitive offloading by

¹⁸ Oak National Academy, "Free, Time-Saving Teacher Resources," accessed 16 June 2026, <https://www.thenational.academy>.

teachers, and limited infrastructure for representing relationships across subjects and key stages.

Expected outcomes include lower workloads for teachers, subject leads, and school leaders, alongside wider pupil access to rigorously tested curricula. Oak supports lesson planning and resource creation from the early years through Key Stage 4, encouraging teachers to use technology and AI thoughtfully to create relevant, tailored, and pedagogically strong materials. Its open infrastructure also enables EdTech developers to train tools using high-quality, openly licensed content and build services on shared AI and curriculum infrastructure.

Current evidence indicates substantial scale and reach. Oak provides 13,506 lessons and approximately 100,000 resources across 17 subjects, with more than 200,000 teacher users and use in 72 per cent of schools nationally. Its AI lesson assistant, Aila, has more than 40,000 users and is currently being evaluated through a randomised controlled trial by the Education Endowment Foundation. Use is 36 per cent higher in schools serving the most disadvantaged communities; 85 per cent of teachers report a positive workload impact, with an average saving of four hours per week. Oak users are also less likely than non-users to expect to leave education within two years, at 8 per cent compared with 23 per cent.

Implementation challenges include building accessible and intuitive digital infrastructure, establishing institutionally agreed standards in a rapidly evolving AI environment, and maintaining high-quality resources at scale as curricula change. These challenges require Oak to balance innovation and speed with pedagogical quality, accessibility, reliability, and continued alignment with the national curriculum.

Oak addresses these challenges through its status as a publicly funded government arm 's-length body that is strategically aligned with the Department for Education while remaining operationally independent. This enables sustained investment, innovation, and a strong focus on user experience and educational quality. Oak is developing openly licensed model content and knowledge graphs, made available under the Open Government Licence and integrated through APIs and MCP, to provide a stronger educational context for AI tools. It also works closely with curriculum partners across the sector, combining specialist expertise with rigorous quality assurance to create and maintain trusted resources.

2.14 Shared credentialing infrastructure – MyeQuales, Australia and New Zealand

MyeQuals¹⁹ is a decentralised shared-service credentialing infrastructure for Australian and New Zealand tertiary education. Powered by Parchment by Instructure, it enables institutions to issue, share, and verify academic credentials through a trusted digital network while retaining control over their own credentialing processes. The platform addresses challenges such as credential fraud, slow and costly verification, learner mobility barriers, limited learner control over academic records, and sector fragmentation. Through secure digital issuance, learner-controlled records, interoperability with international systems, and network-based verification, MyeQuals strengthens trust, reduces administrative burden, and supports cross-border education and employment mobility.

Challenges and Opportunities:

- Shared credentialing infrastructure serving 146 providers across Australia and New Zealand while preserving institutional autonomy and sector governance.
- Learner empowerment through lifelong, portable, verifiable academic records that can be shared instantly with employers, institutions, embassies, and regulators.
- Fraud reduction, faster verification, lower registrar workload, and stronger trust between institutions and credential receivers.
- Interoperability with international credentialing networks and standards, including MyCreds in Canada, China's CSSD verification network, European Commission data standards, W3C Verifiable Credentials, and 1EdTech.
- Demonstrates how education systems can share common digital infrastructure while retaining institutional control, supporting mobility, trust, and long-term digital transformation at scale.

MyeQuals addresses inefficiencies in tertiary credential movement between institutions, countries, and employers. Paper transcripts and PDFs can be falsified, while manual verification creates repeated work for registrars, admissions offices, employers, embassies, and regulators. Credential fraud has become a sector-wide concern, with the diploma-mill industry reportedly growing from USD 1 billion in 2015 to USD 22 billion in 2022. Learners may also lack timely, affordable access to their own records, while institutions have historically operated separate issuance and verification systems. MyeQuals provides portable, learner-controlled credentials with a network-anchored trust signal, allowing receivers to verify information against its source. The network

¹⁹My eQuals, "My eQuals," available at: <https://myequals.org>

has expanded from more than 40 universities at launch to 146 university, VET, and TAFE providers across Australia and New Zealand.

Expected outcomes include lifelong, portable, and instantly shareable academic records for learners, greater control over personal data, and the removal of reissuance fees. Institutions benefit from lower credential-processing costs, reduced fraud risk, faster admissions, and the ability to redirect registrar time toward higher-value work. At the sector level, MyeQuals provides a shared trust anchor across two national tertiary systems, allowing employers, regulators, and other receivers to verify credentials through a consistent process. It also supports international mobility by allowing graduates to use the same verifiable record across countries. The production network has issued more than 14 million records, facilitated the sharing of more than 10.5 million records across over 135 countries, created more than 3.8 million learner accounts, and connected 146 providers.

Evidence from the first three years of full operation shows that all quantitative business-case targets were exceeded. Between 2019 and 2021, realised savings reached USD 20.8 million, 55 per cent above the projected USD 13.4 million, while net benefits exceeded USD 30 million—approximately ten times the original estimate of USD 3 million. Although revenues were expected to decline by USD 10.4 million, they instead increased by more than 140 per cent in one institutional example, as reduced friction stimulated demand. No document fraud incidents were reported across the network, user satisfaction reached 85 per cent, and digital document demand grew by 13.6 per cent annually, compared with 2.3 per cent growth in the student population. Growth has since stabilised at approximately 5.5 per cent annually. While no updated financial audit has been published, the network continues to expand and has informed comparable systems in Canada, Japan, Ireland, the United States, the United Kingdom, China, and Europe.

Implementation required shared governance across autonomous institutions and two sovereign jurisdictions without relying on a single ministry mandate. Other challenges included integrating decades-old student information systems, responding to evolving standards such as PESC, Open Badges, and W3C Verifiable Credentials, and balancing sovereignty, functionality, and user experience. New technologies may offer only parity with the established secure PDF model before delivering sufficient additional value to justify migration. Millions of existing users must also be supported throughout a gradual transition. Looking ahead, challenges include fragmented digital wallet ecosystems, the long-term coexistence of PDF and verifiable credential formats, and procurement processes that do not consistently require interoperability, which can encourage disconnected point solutions.

MyeQuals addresses these challenges through a decentralised shared-services model in which universities co-own the network and Higher Ed Services acts as

the steward, keeping governance within the sector rather than with a vendor. Adapters connect existing institutional systems to a standardised interface, avoiding costly replacement projects. Its layered standards strategy allows one credential to function as a conventional PDF, include a secure trust anchor, and provide a verifiable-credential payload for technically prepared receivers. Verification tools require no specialist software and are designed around the needs of registrars and employers. Migration is managed through pathways rather than abrupt switches: existing credentials remain valid, new credentials enter the evolving model, and both verify through the same network. Through Parchment, APIs, China's CSSD, European standards, and peer networks such as Canada's MyCreds, interoperability is treated as a core requirement. The architecture treats interoperability with peer networks as a baseline requirement, not a feature. MyeQuals operates as a working instance of the Portable Profile and Credits building block named in the ITU's DPI for Education framework. It demonstrates Charter Principles 4.3 (integration with DPI), 5.1 (interoperable systems), and 5.2 (modular architecture) in production. The Charter's primary scope is K-12 and MyeQuals is tertiary, so the architecture and governance lessons translate. The specific outcomes do not.

Use Cases



3. Use Cases

The case studies presented in the previous section illustrate how different nations and organizations have approached education digital transformation in practice – each with its own starting conditions, governance choices, and implementation challenges. Across these experiences, certain recurring system functions emerge: verifying teacher credentials, managing student records, tracking attendance, issuing certificates, and delivering curriculum-aligned content.

This section takes three recurring functions and presents them as structured reference scenarios, mapping at each step the actors involved, the system interaction, and the digital learning platform components. The below examples are deliberately grounded in everyday education system interactions: a student logging in to an education portal, a teacher downloading verified curriculum content, and a parent checking on their child's progress. The scenarios are intended as a practical reference, helping countries and implementers understand where digital learning solutions fit within broader education workflows and what foundational building blocks need to be in place to support them.

3.1 Somjai's Access to Curriculum Content

Somjai is a new educator in rural Bangkok. Like many teachers outside major urban centers, she faces inconsistent internet connectivity and limited time to search across scattered sources for materials she can trust. To prepare for her courses, she needs to access quality materials that are aligned with the national curriculum, including examination materials, in a way that works even when she is offline.

Step	Description	Education Building Blocks
1	Somjai completes standard administrative procedures, and her credentials are formally recorded within the Ministry of Education's official registries.	Registries are used to record her professional status as an educator, and an Educational ID (a functional identity specific to the education sector) is issued.
2	Somjai enters a centralized platform to retrieve the latest curriculum resources published by the Ministry of Education, and locates the specific content corresponding to	Edu ID allows verification of credentials as a teacher and grants access to the platform. The Content Repository/Curriculum

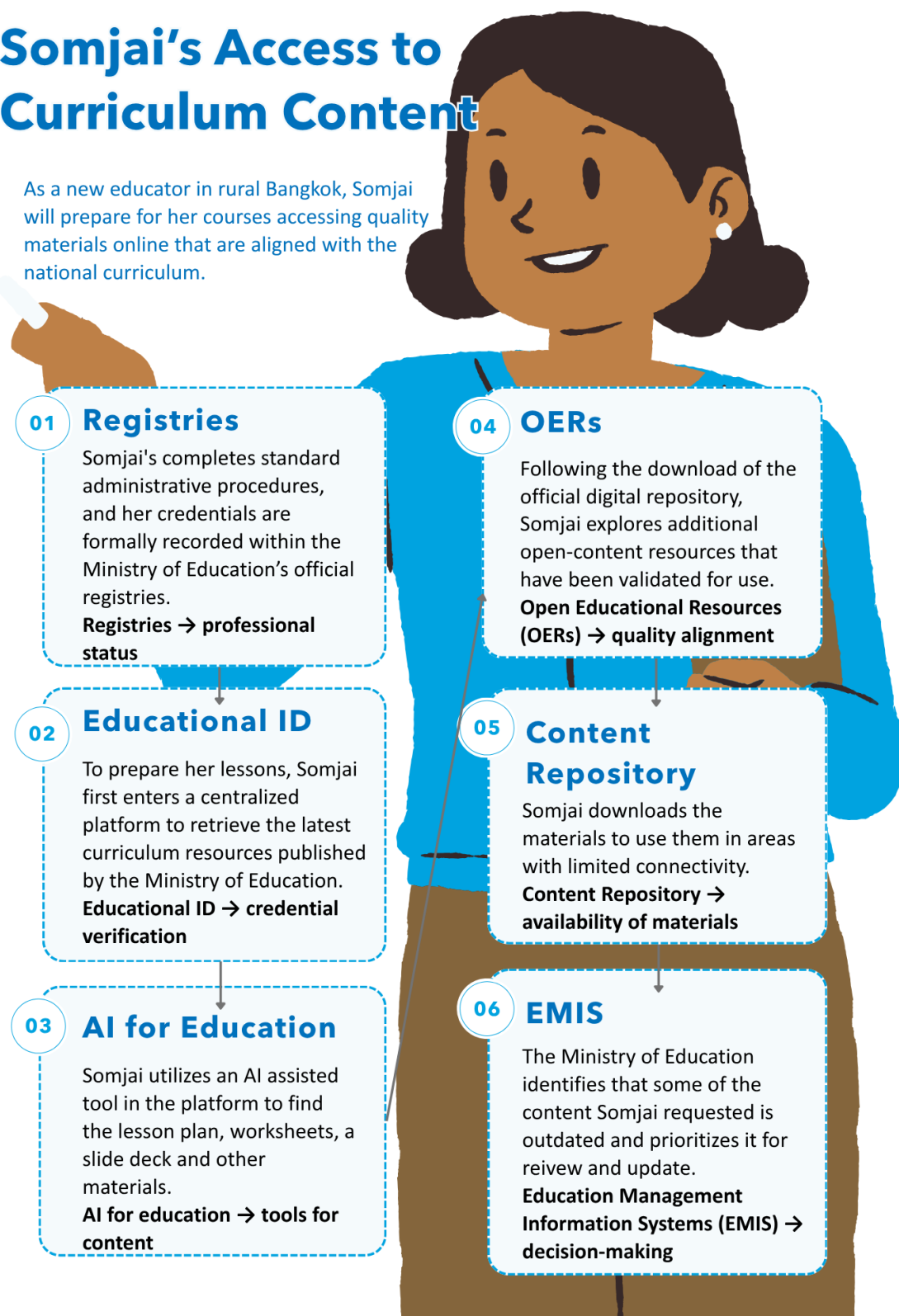
	the grade level and topic of her upcoming lesson.	systematically stores and categorises all materials (using standardised, curriculum-aligned metadata) to ensure efficient and precise retrieval.
3	Somjai uses an AI-assisted tool within the platform to help transform the retrieved curriculum content into the formats she needs – a lesson plan, worksheets, a slide deck – before reviewing and finalising them herself.	AI for Education Services operates on content held in the Content Repository , assisting in drafting these formats while preserving curriculum alignment and provenance. The teacher remains the final reviewer; the tool assists and drafts, but does not autonomously publish or alter authoritative content.
4	Following retrieval from the official digital repository, Somjai also finds additional open-content resources that have been validated for educational use.	Open Educational Resources sit within the same Content Repository/Curriculum , developed by peer educators and curated by the Ministry to guarantee alignment with national quality standards, and are distinguished from official materials only by their licensing status.
5	Somjai downloads the materials she needs in a form she can use offline, given limited connectivity in rural areas.	The Content Repository/Curriculum , decoupled from any single platform, packages and retrieves content as self-contained items along with their metadata, without requiring a live connection.
6	The Ministry of Education identifies that some of the content Somjai has been using is outdated, and prioritizes it for review and update.	The Content Repository/Curriculum tracks version and review-status for every item, which is what allows this kind of gap to be identified and acted on – informed at a system level by EMIS/Analytics , which helps the Ministry decide

		what to prioritize across the whole curriculum.
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This case study demonstrates how a centralized digital repository provides teachers, principals, and education leaders with nationwide access to consistently updated materials. More fundamentally, it illustrates *content as infrastructure*: because the repository exposes its content through open, standardized APIs rather than locking it into one platform, the same curriculum-aligned materials can be reused by other tools and applications – to translate content into other languages, adapt it into videos or interactive formats, or build entirely new EdTech services – without each developer or ministry having to recreate the underlying content from scratch.

Somjai's Access to Curriculum Content

As a new educator in rural Bangkok, Somjai will prepare for her courses accessing quality materials online that are aligned with the national curriculum.



3.2 Modou's Early Warning for At-Risk Students

Modou is a district education inspector in Senegal. Like education systems across many countries, he has struggled to identify which students are at risk of dropping out early enough to intervene – because attendance, behaviour and academic warning signs are observed by individual teachers, but rarely brought together into one picture until a student has already left school.

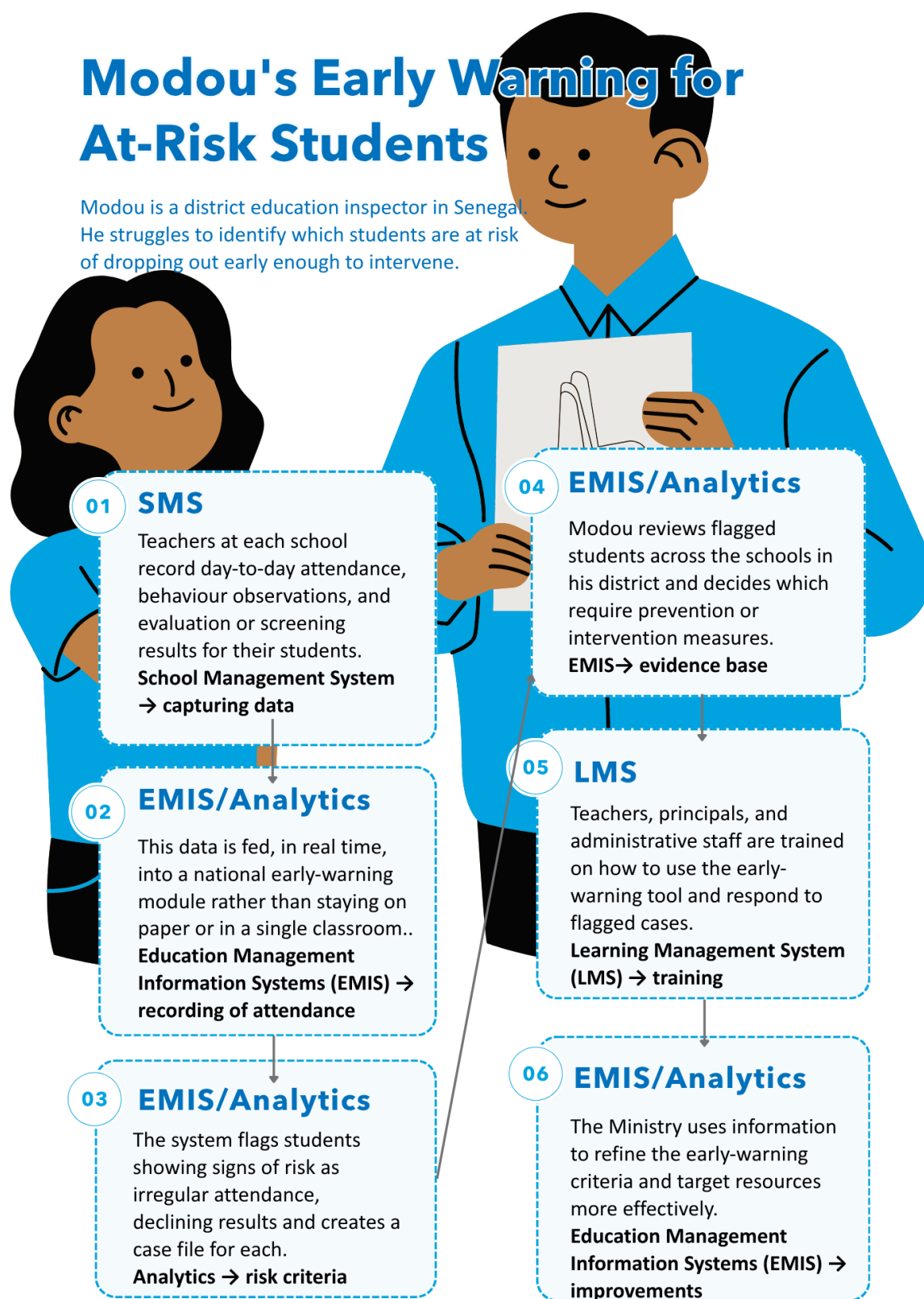
Step	Description	Education Building Blocks
1	Teachers at each school record day-to-day attendance, behaviour observations, and evaluation or screening results for their students.	School Management System captures this data at the school level; assessment structures the evaluation sheets and screening tools used to flag early warning signs.
2	This data is fed, in real time, into a national early-warning module rather than staying on paper or in a single classroom.	EMIS/Analytics ingests attendance, behaviour and assessment data from every school as it's recorded, rather than waiting for periodic manual reporting.
3	The system flags students showing signs of risk – irregular attendance, declining results, behavioural indicators – and creates a case file for each.	EMIS/Analytics applies risk criteria across the reconciled data to identify at-risk students automatically, and maintains a case file tracking each one over time.
4	Modou reviews flagged students across the schools in his district and decides which require prevention, intervention, or compensation measures.	EMIS/Analytics gives her the evidence base (who is at risk, since when, and on what indicators), turning scattered classroom observations into a district-wide view he can act on.
5	Over time, the Ministry uses data on flagged cases, interventions, and outcomes to refine the early-warning criteria and target resources more effectively.	EMIS/Analytics feeds this outcome data back into the system, allowing the early-warning mechanism itself to improve based on what interventions reduce dropout.

This case demonstrates data-driven decision-making at the point of prevention: by reconciling attendance, behaviour and assessment data into one real-time

system, an administrator can identify at-risk students early enough to act – and a connected training layer ensures the people closest to students, teachers and school staff, know how to use that evidence.

Modou's Early Warning for At-Risk Students

Modou is a district education inspector in Senegal. He struggles to identify which students are at risk of dropping out early enough to intervene.



3.3 Verifying Ama's Certificate Abroad

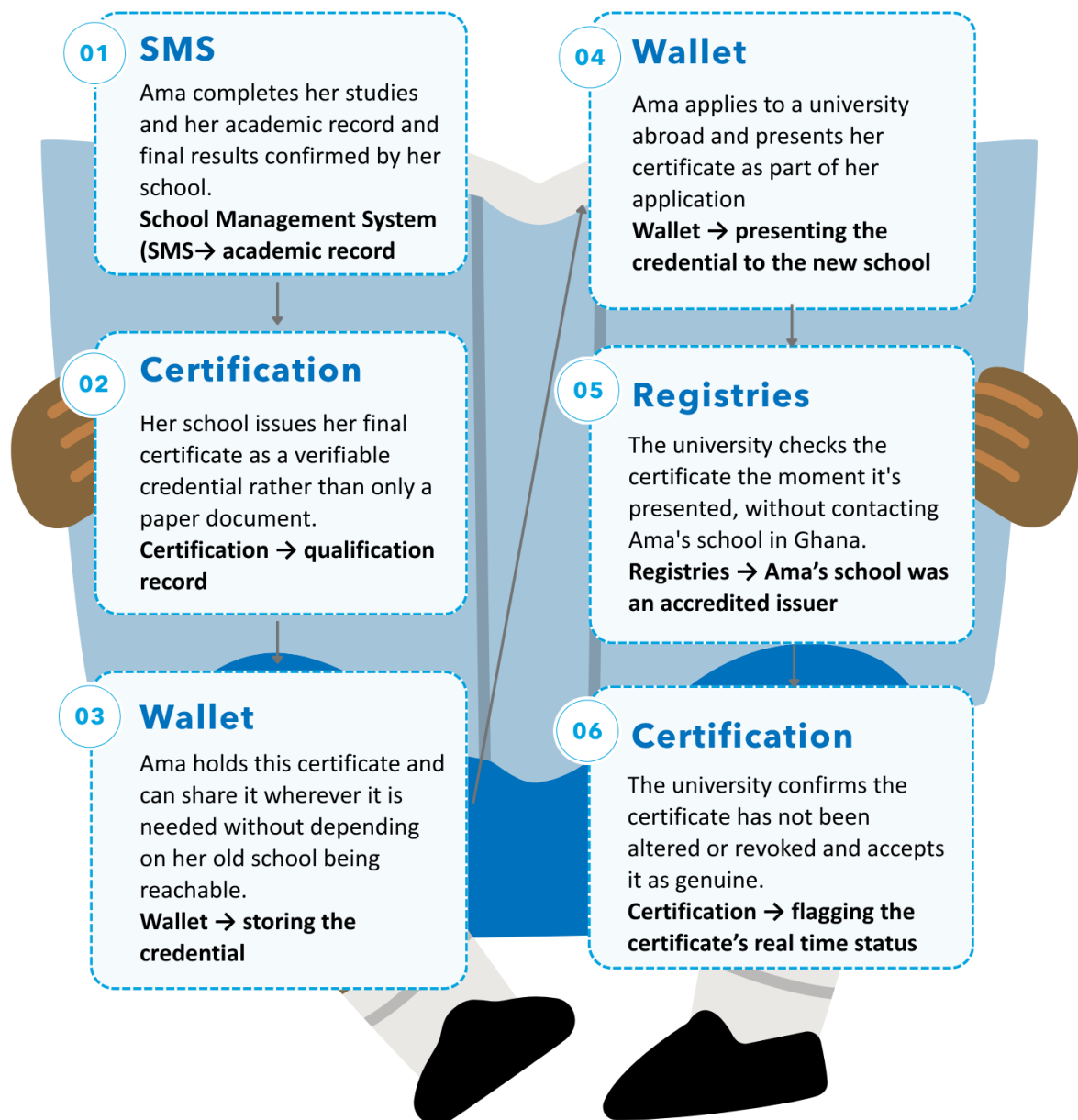
Ama has finished secondary school in Ghana and has been offered a place to study at a university abroad. Like many students seeking to study or work internationally, she faces the risk that her certificate cannot be quickly or reliably confirmed by an institution in another country, causing delays or requiring costly manual checks with her school back home.

Step	Description	Education Building Blocks
1	Ama completes her studies, and her academic record and final results are confirmed by her school.	School Management System holds and confirms her completed academic record, linked to her Education ID , as the basis for the certificate.
2	Her school issues her final certificate as a verifiable credential rather than only a paper document.	Certification provides the standardized, tamper-evident credential format used to issue the certificate, recording the qualification and the issuing school's identity.
3	Ama holds this certificate and can share it whenever it is needed, without depending on her old school being reachable.	Wallet lets Ama store and present the credential herself, independent of her school's ongoing availability.
4	Ama applies to a university abroad and presents her certificate as part of her application.	Wallet supports presentation of the credential to a party with no prior relationship with Ama's school.
5	The university checks the certificate the moment it's presented, without contacting Ama's school in Ghana.	Certification validates the credential's signature and integrity, and confirms – via Registries acting as the trust anchor – that Ama's school was an authorized, accredited issuer at the time it was awarded.
6	The university confirms the certificate has not been altered, revoked, or superseded, and accepts it as genuine.	Certification flags the certificate's current status (valid, revoked, or superseded), giving the university a clear, real-time answer rather than an assumption.

This case demonstrates cross-border recognition of a learning credential: a certificate issued by one authorised school can be verified as genuine by an institution abroad, instantly and independently, without manual coordination, delay, or reliance on trust built through prior relationships.

Verifying Ama's Certificate Abroad

Ama has finished secondary school in Ghana and has been offered a place to study at a university abroad. She faces the risk that her certificate cannot be quickly or reliably confirmed by an institution in another country, causing delays or requiring costly manual checks with her school back home.



Digital Education Building Blocks



4. Digital Education Building Blocks: from evidence to architecture

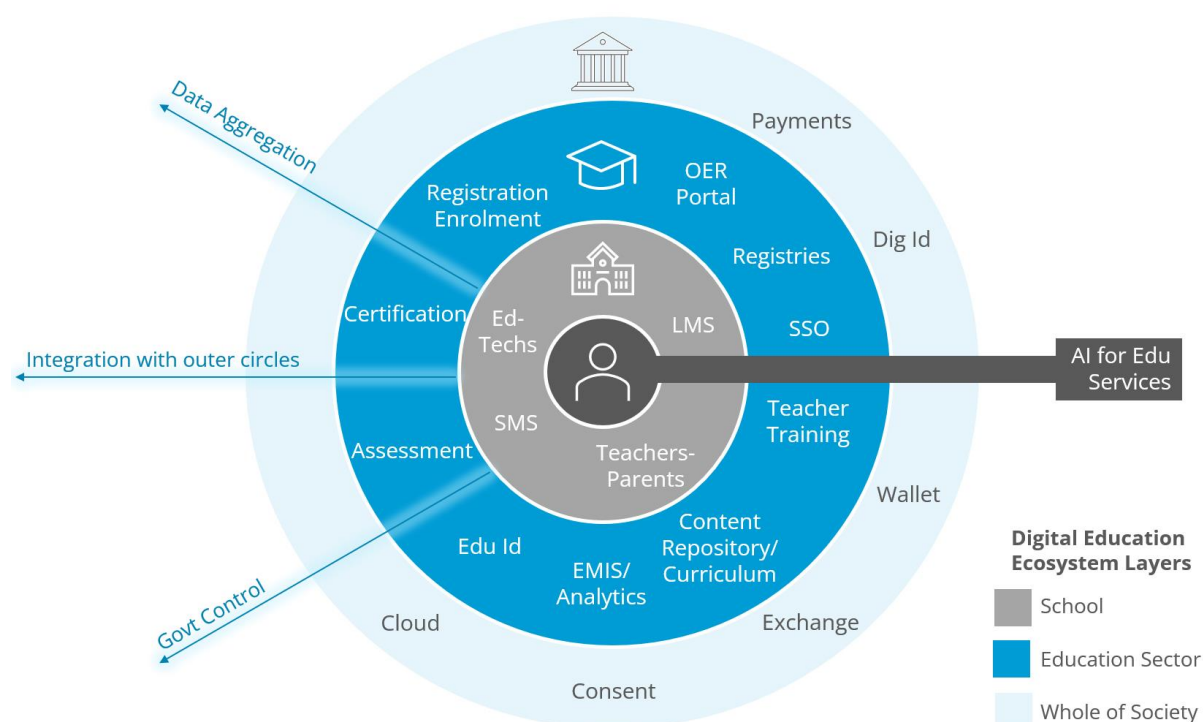
The case studies and reference scenarios presented in the preceding sections reveal a consistent pattern. Across different countries, governance models, and levels of digital maturity, the same categories of digital solution appear repeatedly – sometimes fully built, sometimes partially in place, sometimes identified as a missing foundation. A teacher accessing curriculum-aligned content in Thailand, a student having their certificate verified abroad after leaving Ghana, and a district administrator in Senegal identifying at-risk students through reconciled attendance and assessment data: each draws on a recognisable set of digital functions, even when the specific technologies and institutional arrangements differ significantly.

This section steps back from individual implementations to ask what architecture underlies them. It introduces a framework for mapping the education digital ecosystem, organising the building blocks that countries need to design, sequence, and connect to build coherent, interoperable, and sustainable digital learning environments. Rather than prescribing a single model, the framework is intended as a shared reference point: a way of naming the components, understanding their relationships, and reasoning about investment and sequencing decisions.

The framework distinguishes between building blocks that sit close to the learner and teacher, such as learning management systems, content repositories, and assessment tools, and those that form the broader digital foundations on which they depend, including digital identity, registries, data exchange, and cloud infrastructure. It also recognises AI for education services as a cross-cutting capability, embedded across platform types rather than confined to a single layer.

4.1 The education digital ecosystem as a shared architecture

The diagram maps the digital building blocks that make up an education digital ecosystem, organising them by the level at which they operate and the actors who primarily use them. This representation reflects both a functional logic and a governance logic: as one moves outward from the centre, the systems become more strategic, more shared across the sector, and subject to stronger government oversight and compliance requirements.



(Figure 4. Digital education ecosystem building blocks, organised by their operational level and primary users. Moving outward from the school level to the education sector and wider society, the systems become increasingly strategic, shared and subject to stronger government oversight, integration and compliance requirements.)

At the core sits the learner, surrounded by the school-level building blocks that teachers, students, and parents interact with most directly. These include learning management systems, school management systems, and the broader range of EdTechs that support them — the digital instruments through which learning is delivered, homework assigned, attendance tracked, and classroom life organised. These tools must be able to share data back to central registries and comply with government frameworks, but their primary orientation is toward the everyday experience of education.

Moving outward, the next layer encompasses education sector platforms that operate at system level. These are used by government officials, curriculum developers, and decision-makers, as well as by teachers preparing lessons or tracking student progress over time. This layer includes registries, Education Management Information Systems (EMIS) and analytics, content repositories and Open Educational Resources (OER) portals, certification infrastructure, and enrolment and registration services. These platforms aggregate data from school-level systems, inform policy and planning at national level, and require higher levels of compliance, security, and government control to protect data sovereignty and ensure coherent sector governance. They are strategic assets, systems available across the whole education sector that must interoperate reliably while remaining under strong institutional oversight.

The outermost layer represents digital public infrastructure that operates at the level of society and whole-of-government. Components such as digital identity, data exchange, payments, and consent frameworks are not education-specific, but they are shared national foundations on which education building blocks depend. Without them, education systems risk building parallel, fragmented, and poorly interoperable solutions. With them, education platforms can connect reliably to the broader digital fabric of government services.

Running across all sectors is AI for Education Services; not a discrete platform but a cross-cutting capability embedded throughout the ecosystem. It supports tutoring, content generation, analytics, and adaptive learning at the school level; underpins data-driven decision-making at the sector level; and increasingly connects to national AI infrastructure at the whole-of-government level. The ecosystem is further shaped by three governing dynamics: data aggregates outward from school-level interactions toward large-scale systems; government control and compliance frameworks exert their influence inward; and bidirectional integration ensures that school-level tools remain connected to, and informed by, the structural platforms that surround them.

4.3 The Building Blocks at glance

4.3.1 At the School Level

School-level systems are closest to teaching, learning, and daily administration. They support learners, teachers, parents, and school leaders through operational and instructional tools. Should be able to share data back to central registries and should comply with government frameworks in the diagram, this layer corresponds to the inner circle around the learner and school community.

LMS – Learning Management System

High-level definition	A Learning Management System is a school or institutional platform that organizes courses, learning materials, assignments, communication, and learner progress tracking. It supports the creation and dissemination of educational content and can use assessment tools to evaluate learning objectives.
Key capabilities	● Course and class delivery ● Assignments, quizzes and feedback workflows ● Teacher-student communication ● Learning activity tracking and reporting
Primary users	● Learners / students ● Teachers ● School leaders and administrators

	• Parents or guardians, where parent access is enabled • Ministry or district users, where LMS data feeds into EMIS, registries, or analytics
Value proposition	LMS platforms support day-to-day teaching and learning by providing schools with a single place to manage learning content, assignments, feedback, participation, and evidence of progress. Within the wider Digital Learning Platform architecture, the LMS share relevant data with central systems, including EMIS, registries, analytics platforms, learner records, and content repositories. Playing as a building block for all the other sectors.
Examples of existing software	Educational Broadcasting Cambodia LMS, DIKSHA, Learning Passport, OECS Learning Hub, Platform Merdeka Mengajar, Smart Education of China, Oak National Academy

SMS – School Management System

High-level definition	A school-level operational system used to manage daily administration, student records, attendance, timetables, classes, staff, school communications, and school reporting.
Key capabilities	• Student and staff records • Attendance and timetable management • Class, grade, and section administration • School-level reports and dashboards • Parent or guardian communication • Data sharing with EMIS, learner registries, assessment platforms, and analytics
Primary users	• School administrators • Head teachers / principals • Teachers • Students and parents, where portals are provided • District or ministry officers consuming school data
Value Proposition	Turns school operations into structured data that can improve school management and feed central registries and EMIS. It is especially important for making the inner school-level layer connect back to national data and governances.

Examples of existing software	ARKAS in Indonesia, where school budgeting and administration are connected to planning and reporting; KOSKI in Finland is more national registry than school-level SMS, but it connects institutional education records across the system
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EdTech tools

High-level definition	Digital tools used directly in teaching and learning, such as tutoring apps, practice tools, digital textbooks, learning games, simulations, classroom response tools, or adaptive learning platforms.
Key capabilities	• Digital practice and formative assessment • Personalised or adaptive learning pathways • Interactive learning resources • Offline or low-bandwidth learning content • Learning usage data and activity logs • Integration with LMS, identity, content, and analytics services
Primary users	• Learners • Teachers • Schools • Parents supporting learning at home • Content providers and programme implementers
Value Proposition	Expands the range of instructional support available to students and teachers, especially when quality teachers or materials are limited. EdTech tools should be selected and governed so they can share data securely and avoid becoming isolated pilots.
Examples of existing software	Konnnect, MuktoPaath, Khan Academy-style digital learning through Learning Passport, Akello Smart Learning, Aila by Oak National Academy, AI learning companions in Smart Education of China, QR-code textbook content in DIKSHA

Teachers-Parents communication tools

High-level definition	Digital communication channels that connect teachers, parents or guardians, learners, and schools through messaging, announcements, feedback, alerts, and engagement workflows. Increasing the level of trust and open communication.
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Key capabilities	• Class and school announcements • Attendance or performance alerts • Teacher feedback to parents • Two-way messaging where appropriate • Bulk communication through SMS, app, email, or IVR • Integration with SMS, LMS, and learner records
Primary users	• Teachers • Parents/Guardians • Learners • School leaders • Community support staff
Value Proposition	Strengthens learner support outside the classroom by keeping families informed about attendance, assignments, feedback, school events, and learner progress. Additionally, it strengthens the trust between parents/guardians, using these new digital tools. It maps closely to the client communication workflow described in the SDG Digital Investment Framework.
Examples of existing software	Moodle Workplace, Canvas Catalog, Coursera for Campus, LinkedIn Learning, Teach2030, EdApp, Google Classroom for teacher professional development.

4.3.2 At the Education Sector Level

Shared education-sector platforms used across many schools or programmes. They coordinate common functions such as registration, content, analytics, identity, assessment, and certification so services are consistent and reusable, using strong government control for sovereignty. This is seen as the second-to-last ring in the diagram

Registration and Enrolment

High-level definition	A service for capturing learner, school, staff, and programme participation records, assigning or linking unique identifiers, and recording enrolment in schools, classes, services, or programmes.
Key capabilities	• Learner and staff registration • School and class enrolment records • Unique identifier assignment or linking • Eligibility and programme participation records • Duplicate detection and record updates

	• Data exchange with registries, EMIS, LMS, assessment, and payment systems
Primary users	• School administrators • District education officers • Ministry of registry teams • Learners and families during enrolment • Programme managers
Value Proposition	Creates the starting point for reliable education data. Provides the basis for service access, entitlements, reporting, and longitudinal learner records.
Examples of existing software	KOSKI, OpenEMIS-style registry functions, DIKSHA/Sunbird Registry, SIUBEN data integration in the Dominican Republic, MyeQuals learner accounts

Registries

High-level definition	Authoritative databases or directories that maintain trusted records for core education entities, such as learners, teachers, schools, institutions, programmes, curriculum items, or credentials.
Key capabilities	• Master records for education entities • Directory services and lookup • Record validation and deduplication • Status tracking and lifecycle management • APIs for trusted data sharing • Linking to national ID, EMIS, certification, LMS, and analytics systems
Primary users	• Ministries of education • District and local education authorities • School leaders and registrars • Other government agencies using education data • System integrators and authorised service providers
Value Proposition	Provides shared, trusted reference data across the education ecosystem. Registries reduce duplication, improve data quality, and help different platforms use the same definitions for schools, learners, teachers, and credentials.

Examples of existing software	KOSKI in Finland, Sunbird RC, SIUBEN in the Dominican Republic, Smart Education of China provincial/national platform data systems, Edu ID / learner ID registries connected to DIKSHA or national systems
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EMIS / Analytics

High-level definition	Education Management Information System and analytics capability for collecting, validating, analysing, and reporting education data from schools, programmes, assessments, registries, and digital learning systems.
Key capabilities	• School census and administrative reporting • Dashboards and indicators • Data validation and aggregation • Trend analysis and decision support • Monitoring of access, participation, completion, equity, and quality • Interoperability with registries, assessments, LMS, SMS, and data warehouses
Primary users	• Ministry planning and statistics teams • Policy makers • District education officers • School leaders • Donors and programme evaluators where authorised
Value Proposition	Supports evidence-based planning, resource allocation, monitoring, and accountability. Structured data is collected, normalized, aggregated, and analysed to generate operational and strategic insights.
Examples of existing software	Rapor Pendidikan in Indonesia, Lampi in Finland, Smart Education of China analytics, Giga school mapping in Eswatini and Lesotho, OECS Learning Hub monitoring data, DIKSHA/Sunbird analytics

Teacher Training

High-level definition	Digital platforms and services that deliver professional development, coaching, certification, communities of practice, and instructional support for teachers and school leaders.
Key capabilities	• Online and blended training courses

	• Teacher competency tracking • Coaching and feedback cycles • Micro-credentials or certification pathways • Communities of practice • Links with LMS, content repositories, teacher registries, and analytics
Primary users	• Teachers • School leaders • Teacher trainers and coaches • Teacher training institutions • Ministry professional development teams
Value Proposition	Improves instructional quality and helps scale professional development beyond one-off workshops. It can reuse LMS, certification, content management, identity, and analytics components rather than creating separate platforms.
Examples of existing software	Teachers' Portal Bangladesh, MuktoPaath, Educational Broadcasting Cambodia teacher-training courses, Platform Merdeka Mengajar, Learning Passport teacher resources, OECS Learning Hub teacher communities, Smart Education of China teacher development communities

Content Repository / Curriculum

High-level definition	A managed digital repository for curriculum standards, textbooks, lesson plans, multimedia learning resources, teacher guides, and other approved education content.
Key capabilities	• Create, organize, publish, and secure content • Curriculum alignment and metadata tagging • Search, indexing, and retrieval • Version control and approval workflows • Open educational resource management • Distribution to LMS, EdTech tools, offline servers, and teacher training systems
Primary users	• Curriculum authorities • Teachers • Content creators and publishers • Learners

	• Teacher trainers and education programme teams
Value Proposition	Ensures that schools and platforms can access approved, current, and reusable learning content. Investment Framework content manages workflow: creating, organizing, publishing, securing, and making content easy to navigate and retrieve.
Examples of existing software	DIKSHA, Sunbird ED, Oak National Academy, OECS Learning Hub, Educational Broadcasting Cambodia CMS/eLibrary, Learning Passport, Kolibri Studio-style content repositories, Smart Education of China resource platform

SSO

High-level definition	Single Sign-On is an identity and access service that lets users sign in once and securely access multiple education platforms using a shared identity, authentication, and authorization layer.
Key capabilities	• Central user authentication • Role-based access control • Federated login across platforms • Password and account management • Consent and security policy enforcement • Integration with learner IDs, teacher registries, LMS, SMS, content, and assessment systems
Primary users	• Students • Teachers • School administrators • Parents or guardians where enabled • Ministry ICT and security teams
Value Proposition	Improves user experience and security by avoiding separate accounts for every system. It supports interoperability by making identity and access reusable across the DLP rather than embedded separately in each application.
Examples of existing software	Educational Broadcasting Cambodia SSO, Smart Education of China shared login ecosystem, Sunbird-based identity and access services, OECS Learning Hub account system

Edu ID:

High-level definition	A unique education identifier assigned to a learner, teacher, school, or other education entity so records can be linked across systems over time.
Key capabilities	• Unique ID creation and management • Linking records across systems • Deduplication and identity matching • Lifecycle tracking from enrolment through certification • Data exchange with national ID where permitted • Support for longitudinal learner and teacher records
Primary users	• Learners • Teachers • Schools • Ministries and registries • Assessment, certification, LMS, and EMIS teams
Value Proposition	Enables trusted data linkage across LMS, SMS, assessment, EMIS, certification, and support services. It helps governments understand learner pathways and service access while reducing duplicate or fragmented records.
Examples of existing software	KOSKI learner/study-right records, Sunbird RC, MyeQuals learner-controlled credential accounts, national student number systems, Smart Education of China user identity/data layer

Assessment

High-level definition	Digital systems for designing, delivering, scoring, analysing, and reporting assessments, including classroom formative assessment, national exams, diagnostics, and skills tests.
Key capabilities	• Online, offline, or blended test delivery • Automated and manual scoring workflows • Feedback and reporting to teachers and learners • Exam administration and security controls • Data feeds into LMS, EMIS, analytics, and certification systems
Primary users	• Learners • Teachers

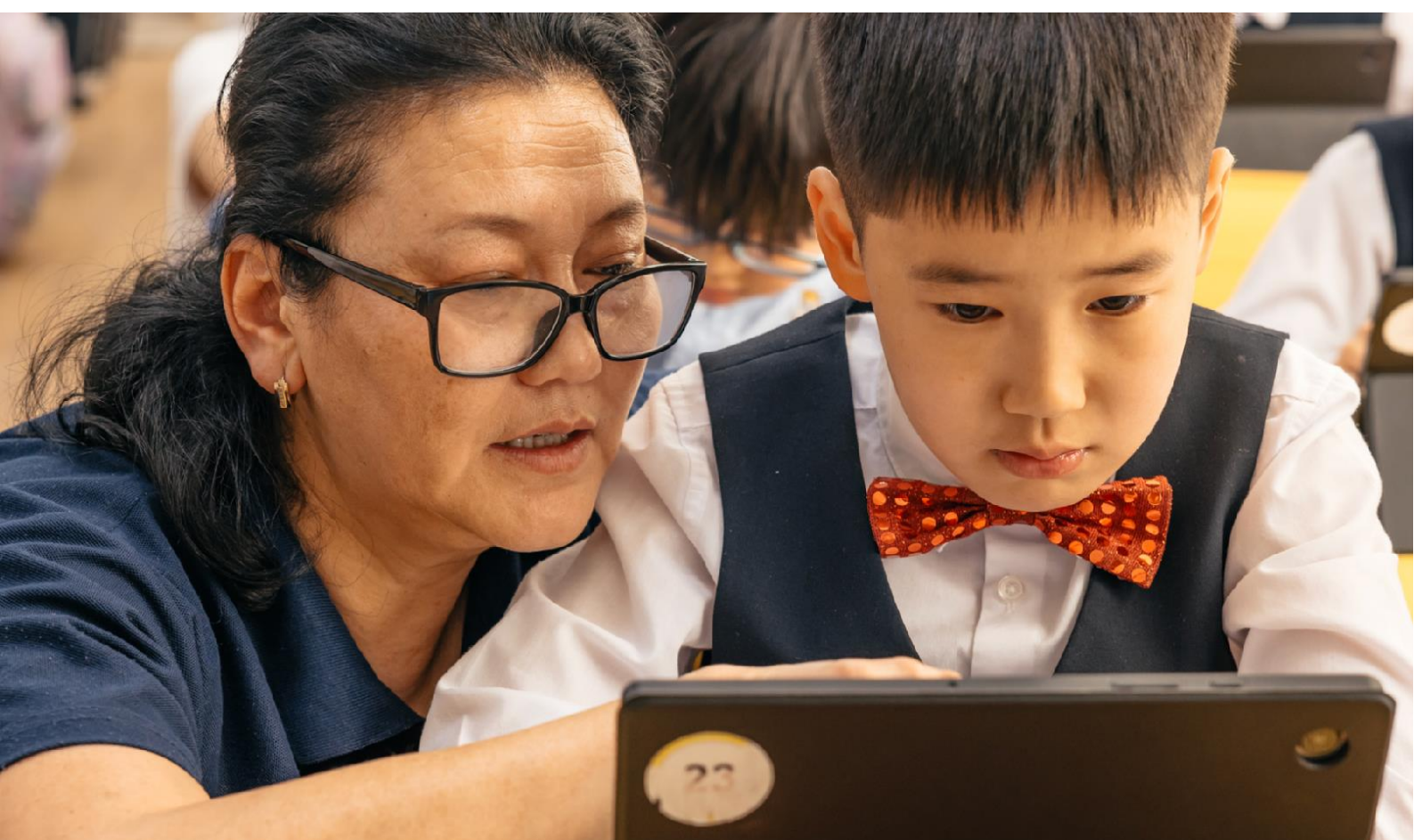
	• Examination bodies • School leaders • Ministry assessment and quality assurance teams
Value Proposition	Provides evidence of learning progress and outcomes. Client education workflow, assessment tools help evaluate whether learning objectives are achieved; at system level, assessment data supports quality monitoring and targeted interventions.
Examples of existing software	Rapor Pendidikan / National Assessment data in Indonesia, OECS Learning Hub assessment tools, Oak National Academy evaluation tools and Aila trial, Educational Broadcasting Cambodia quizzes, DIKSHA assessment/quiz content, Learning Passport assessment resources

Certification:

High-level definition	Systems for issuing, managing, verifying, and sharing credentials, certificates, badges, transcripts, or qualifications earned by learners or teachers.
Key capabilities	• Credential issuance and lifecycle management • Digital certificates, transcripts, and badges • Verification by schools, employers, or agencies • Links to assessment results and learner identity • Fraud prevention and audit trails • Interoperability with wallets, registries, and exchange layers
Primary users	• Learners • Teachers • Examination and qualification authorities • Schools and higher education institutions • Employers and verification agencies
Value Proposition	Makes learning achievements portable, trusted, and easier to verify. When linked to Edu ID, assessment, consent, and exchange services, certification can support transitions between schooling, training, higher education, and work.
Examples of existing software	MyeQuals, Parchment, Sunbird credential layer, MuktoPaath certificates, Open Badges-style

	credentials, Credly / Accredible as comparable credentialing tools
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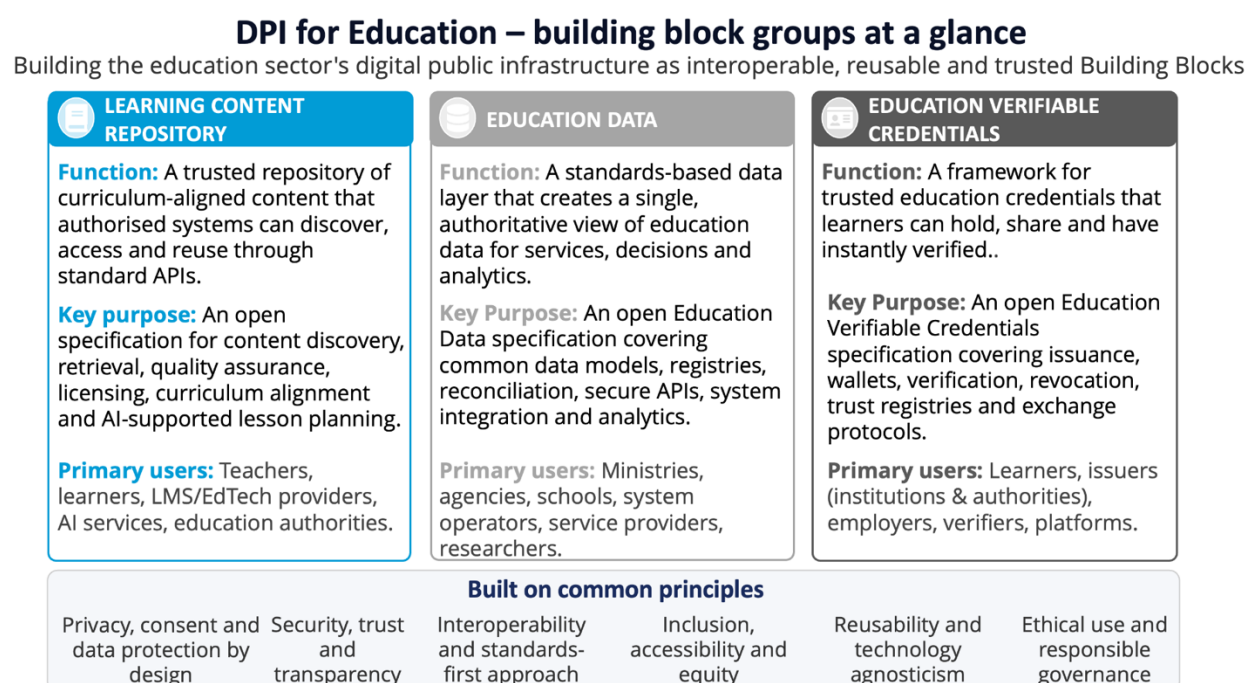
Next steps



5. Next Steps

The workshop and this report have led to the identification of three priority building blocks where shared open specifications would have the highest cross-country impact. Rather than trying to address the full ecosystem at once, the initiative is taking a focused approach: starting where the gap between country need and available technical guidance is clearest, and where common standards would reduce duplication and accelerate adoption across very different national contexts.

Three technical working groups have been established – co-convened by UNESCO, UNICEF and ITU – to develop open specifications for each of these building blocks.



(Figure 5. Overview of the three DPI for Education building block groups—the Learning Content Repository, Education Data and Education Verifiable Credentials—including their functions, key purposes and primary users. All three are underpinned by common principles of privacy, security, trust, interoperability, inclusion, reusability and responsible governance.)

1. **Learning Content Repository** addresses a problem present in virtually every country context reviewed: high-quality digital learning content exists, but is fragmented across platforms, inconsistently described, and difficult for other systems — learning management systems, teacher tools, AI services — to discover or reuse. The goal is to define content as infrastructure: a managed, curriculum-aligned, machine-readable public asset accessible through standard APIs, decoupled from any delivery channel or application.

2. **Education Data** targets the persistent weakness of education systems that are data-rich but information-poor. Learner, teacher and school registries are typically siloed, inconsistently modelled and hard to reconcile into a single authoritative view. This building block defines the common education data layer — shared data models, code sets, registries metadata and APIs, and reconciliation services — that makes system-wide planning, service delivery and analytics possible.
3. **Education Verifiable Credentials** responds to a structural gap in how learning achievements are recognised and carried across institutions, employers and borders. Paper and image-based certificates remain the norm in most systems; digital credentials, where they exist, are fragmented and not interoperable. This building block defines the infrastructure for issuing, holding, presenting and verifying learning credentials in a trustworthy, portable and standards-based way — giving learners lasting control of their achievements.

Each building block group will be led by a technical working group convened under the GovStack framework, with chairs and co-chairs drawn from leading country implementations and technical organisations. The groups will follow a shared methodology: an agreed scope decision note, a landscape review of existing standards and implementations, iterative drafting of an open specification using the GovStack building block template, public consultation, and a peer review disposition report. The work is expected to run over nine to twelve months, with outputs published openly for adoption, testing and certification.

The three building blocks are designed to work together. A learner registry from the Education Data building block underpins the identity binding needed for verifiable credentials; the Learning Content Repository connects to credential and competency frameworks; and all three integrate with broader whole-of-government DPI infrastructure — identity, wallet, consent, information mediator and digital registries — rather than duplicating it.

Countries wishing to engage with the working groups – as members, early adopters, or peer reviewers – are invited to contact gateways@itu.int