

The Digital Transformation of Education:

Connecting Schools, Empowering Learners

September 2020

BROADBAND COMMISSION
FOR SUSTAINABLE DEVELOPMENT

The Digital Transformation of Education: Connecting Schools, Empowering Learners



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The report has been written and compiled by Ana Sepúlveda and facilitated by Doreen Bogdan-Martin (Director of Telecommunication Development Bureau, ITU), Alex Wong (ITU Focal Point and Giga Co-Lead) and Chris Fabian (UNICEF Focal Point and Giga Co-Lead), Borhene Chakroun (UNESCO Focal Point), Anna Polomska (Broadband Commission Secretariat, ITU), and Samantha O'Riordan (Giga Secretariat). A special word of thanks also goes to the ITU team – Miguel Alcaine, Istvan Bozsoki, Vladimir Daigele, Jose Maria Diaz Batanero, Hani Eskandar, Aminata Amadou Garba, John Garrity, Farid Nakhli, Sylvia Poll Ahrens, Martin Schaaper, Christine Sund, Nancy Sundberg, Sandeep Taxali and Cleveland Thomas; Frank McCosker, Global Good Networks; James Lo, Softbank; Fengchun Miao, UNESCO; UNICEF team – Jaime Archundia, Janice Dean, Sophia Farrar, Sunita Grote, Aditi Poddar, and Naroa Zurutuza; Nanjira Sambuli and Kavita Gupta; for their strategic directions and inputs into this report.

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Members of the Working Group

(By alphabetical order of institution, followed by alphabetical order of surname):

BROADBAND COMMISSIONERS:

- América Móvil (Carlos Jarque)
- Columbia University (Jeffrey Sachs and Radhika Iyengar)
- Digicel (Denis O'Brien and David Gaery)
- EUTELSAT IGO (Piotr Dmochowski-Lipski and Estelle Schnitzler)
- Facebook (Kevin Martin, Chris Hemmerlein, and Robert Pepper)
- Global Partnerships Forum (Amir Dossal)
- GSMA (Mats Granryd, Genaro Cruz, Lauren Dawes, and Belinda Excelby)
- Huawei (Sun Yafang and Ivan Huang)
- Inmarsat (Rupert Pearce and Donna Murphy)
- Intelsat (Stephen Spengler and Jose Toscano)
- ISOC (Andrew Sullivan and Constance Bommlear)
- ISTIC (Dato' Ir. Lee Yee Cheong)
- ITSO (Patrick Masambu and Renata David)
- ITU (Doreen Bogdan-Martin)
- KT Corporation, (Dr Ku and Byungki Oh)
- Microsoft (Paul Mitchell)
- MTN (Rob Shuter and Mophete Molestane)

- Nokia (Pekka Lundmark)
- Novartis Foundation (Ann Aerts and Lucy Seitan)
- Rwanda (Patrick Nyrishema)
- UNCTAD (Mukhisa Kituyi and Severine Excoffier)
- UNESCO (Audrey Azoulay)
- UNHCR (Filippo Grandi, Olivier Madjora, Dustin Okazaki, Jacqueline Strecker, John Warnes, and Eva Zakie)
- UNICEF (Henrietta Fore)
- Verizon (Hans Vestberg, Sarah Altschuller and Nicole Karlebach)
- World Bank (Makhtar Diop, Doyle Gallegos, Boutheina Guermazi, and Lucine Park)
- World Childhood Foundation USA (Dr. Joanna Rubinstein and Lina Fernández)
- Worldwide Web Foundation (Adrian Lovett and Sonia Jorge)

EXTERNAL EXPERTS:

- ACTAI Global (Bill Tai)
- Artificial Intelligence Development (Kathleen Siminyu)
- AT&T (Amy Alvarez)
- Blue Like An Orange Sustainable Capital (Amer Baig)
- Center for Innovation in Brazilian Education (Lucia Dellagnelo)
- Convergence Partners (Andile Ngcaba)
- DBSA (Mohan Vivekanandan)
- DIAL (Laura Walker McDonald)
- Directorate of Science, Technology and Innovation, Sierra Leone (David Sengeh)
- Executive Office of the UN Secretary-General (David Kelly)
- Fundación CEIBAL (Maria Florencia Ripani)
- Global Partnership to End Violence Against Children (Marija Manojlovic and Howard Taylor)
- Government of Kenya (Rose Mosero Maina and Philip Thigo)
- Government of Niger (Ibrahima Guimba Saido)
- IADB (Antonio García Zaballos)
- IEEE (Sampathkumar Veeraraghavan)
- Instituto de Informática Educativa (Enrique Hinostroza)
- Intel (Turhan Muluk and John Roman)
- LAMAP Foundation (David Jasmin)
- NetHope (Lauren Woodman)
- New York Academy of Science (Ellis Rubinstein)
- Norad (Liv Marte Nordhaug)
- NYU (Angelina Fisher)
- Olin College of Engineering; Mangata Networks (Whitney Lohmeyer)
- People Centered Internet (Mei Lin Fung)
- PowerSchool Group (Mike Lawrence)
- Brazilian Network Information Center (NIC.br) / Regional Center for Studies on the Development of the Information Society (Cetic.br). (Alexandre Barbosa)
- Royal Holloway, University of London (Tim Unwin)
- Smithsonian Science Education Center (Carol O'Donnell)
- Social Accelerator for a Green Economy (Naza Alakija)
- SoftBank (Catherine Lenson)
- Teach for All (Tarek Chehidi)
- Telecom Infra Project (Vishal Mathur)
- UNESCO-UNEVOC (Shyamal Majumdar)

- United Nations Economic Commission for Africa (Vera Songwe)
- University College London (Mutlu Cukurova)
- University of Johannesburg (Shafika Isaacs)
- University of Pennsylvania (Christopher Yoo)
- Virgin Orbit (Monica Jan)
- Zerde National Infocommunication Holding, Kazhakstan (Pavel Koktyshev)

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Foreword

In today's increasingly digital world, 3.6 billion people still have no access to the Internet. Those without access are typically the most vulnerable: minorities, people with disabilities, indigenous and marginalized groups, as well as women, children and youth from disadvantaged socio-economic backgrounds or living in areas affected by conflict and violence. Lack of Internet access reduces paths to a world of information available online, and limits the potential to learn and grow, all of which contribute to the digital divide. If we are to succeed in "Leaving no one behind", as established in the United Nations' 2030 Agenda, then we need to ensure that we are working to provide everyone, especially children and young people, with safe and secure access to the Internet, not to mention the digital skills they need to learn and improve their lives.

The COVID-19 crisis has shown us how Internet connectivity is crucial to everyday activities such as work, learning and staying in touch with family and friends. Children lacking quality and reliable Internet access were disproportionately impacted by global shutdowns, as they were unable to continue their education. Today more than ever, there is a need to strengthen national infrastructure to ensure that connectivity is more widely available. Equally important is the need to strengthen school connectivity plans and to invest in quality learning in order to improve the educational access, learning outcomes and earning potential of young people, as well as the socio-economic development of their communities and countries.

The Broadband Commission Working Group on School Connectivity was launched in September 2019 with the goal of addressing the global school connectivity challenge. Co-chaired by the ITU, UNESCO and UNICEF, this group brings together Broadband Commissioners, development partners and external experts to examine the issues faced by many governments when developing and deploying school connectivity initiatives. Over the past year, the Working Group has shared experiences, examined innovative ideas, and documented case studies to help countries address this issue. Discussions looked at ways to better understand the school connectivity landscape and requirements, evaluate the benefits of different technologies for different environments, and analyze business and financial models, as well as suitable content articulating connectivity with quality, safe, and inclusive learning. Using schools as an access point to provide meaningful connectivity to communities and citizens was another key driver behind the efforts of the Working Group.

The Working Group provided advice for the development of two global initiatives aimed at connecting schools to the Internet: **Giga**, a joint initiative between ITU and UNICEF to connect every school to the Internet and every young person to information, opportunity, and choice; and **UNESCO's e-schools Initiative**, which seeks to ensure the value for learning of connectivity and to align infrastructure investment with education sector plans and ICT in education policies. This has led to the recognition of the Giga Initiative in the UN Secretary General's Roadmap for Digital Cooperation as a Key Way Forward in developing regional infrastructure and accelerating digital connectivity. It has also contributed to the work and initiatives of the Global Education Coalition launched by UNESCO in 2020 to support the continuity of learning during the COVID-19 pandemic and beyond.

We would like to take this opportunity to thank the members of the Working Group on School Connectivity for their valuable input and commitment. With their combined knowledge, resources and expertise, we have produced a comprehensive report that builds upon the lessons learned by previous school connectivity initiatives, establishing a solid foundation for future work.

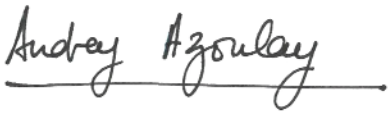
Today there is an unprecedented opportunity to address the issue of education and connectivity both at school and at home. Together we can help close the digital divide and work towards connecting all schools to the Internet, making sure that every young person has safe access to the information, opportunity and choice they need to fulfill their potential. We ask the members of the Working Group to join our efforts by leveraging their respective resources and networks to turn our discussions into actions. Join ITU and UNICEF in their efforts to connect every school in the world through Giga, and follow our progress through the Giga Interim Experts Group, and support UNESCO and the 150 partners in the Global Education Coalition as they work to provide connectivity to all teachers and learners.

We also ask the Working Group and other members of the Broadband Commission to build on outcomes and capitalize on the momentum for technology in education. Only in this way can we ensure that connectivity is a driver for inclusive and gender-equal learning, employability and

livelihoods especially for the most marginalized. This is the goal of the political process that UNESCO intends to launch with a view to adopting a declaration on connectivity for education by 2021.

Governments, international organizations, industry, civil society and the wider community need to act in a collaborative and aligned fashion, not only by placing emphasis on infrastructure, affordability, regulatory and technology-related challenges, but also by focusing on closing the gaps between learners and teachers when it comes to digital and literacy skills.

Schools need to continue being a safe place where children and youth can gather, grow and learn. Through connectivity, schools and other education institutions can become hubs of knowledge, prosperity, and sustainable development.



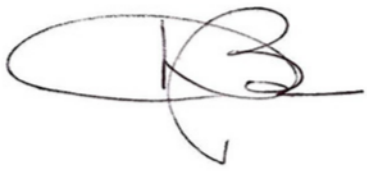
Audrey Azoulay, Director General, UNESCO, Co-Vice Chair of the Broadband Commission.



Henrietta Fore, Executive Director, UNICEF.



Houlin Zhao, Secretary-General, ITU, Co-Vice Chair of the Broadband Commission.



Doreen Bogdan-Martin, Director, Telecommunication Development Bureau (BDT), ITU and Executive Director of the Broadband Commission.

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Executive Summary

Education, the Internet and broadband connectivity have a tremendous potential to solve some of the world's most pressing challenges including the achievement of the Sustainable Development Goals (SDGs). Nevertheless, today 3.6 billion people still have no access to the Internet and about 258 million children are out of school. For those enrolled and attending school, the COVID-19 pandemic created an unprecedented challenge, forcing 94 percent of learners worldwide to continue their education at home regardless of whether they were lucky enough to have connectivity and safe access to the Internet. The pandemic has undoubtedly caused a big impact to the global outlook for connectivity and education; it could even reverse some of the progress made in recent years in the attainment of the SDGs, especially those related to education, gender equality, industry, innovation and infrastructure, reduced inequality, and the promotion of peace and end of violence and abuse.

But not everything related to the pandemic is negative. The COVID-19 crisis also brought much needed attention to the importance of connectivity both at school and at home. It also brought a deeper understanding of the many dimensions of the digital divide, equity gaps, and issues around children's safety online. It showed governments the need to work closer with development partners to remove technological barriers and lower connectivity costs, as well as the need to invest in digital infrastructure and digital literacy, especially for marginalized populations.

The Broadband Commission for Sustainable Development advocates, showcases and documents the power of Information and Communications Technology (ICT) and broadband-based technologies in achieving the SDGs. It has set seven ambitious targets to be accomplished by 2025, four of which are specifically linked to affordability, connectivity, digital skills, and empowerment of youth and adults. The **Working Group on School Connectivity**, co-chaired by the International Telecommunication Union (ITU), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations International Children's Emergency Fund (UNICEF), and established by Broadband Commissioners and other development partners and external experts, advocates and provides advice and guidance for the implementation of key projects aimed at connecting schools to the Internet and at turning schools into entry points for connecting entire communities.

This report is the result of the effort, research and discussions held during the past year by the Working Group on School Connectivity and identifies a set of core principles, which aim to help governments and other interested stakeholders to develop more holistic school connectivity plans. It focuses on school connectivity and introduces a methodology and framework for connecting primary and secondary schools to the Internet based on a four pillars approach: **MAP**, **CONNECT**, **FINANCE** and **EMPOWER**.

Getting all schools of the world connected to the Internet is indeed an ambitious task requiring multiple stakeholder collaboration to identify: where schools are actually located, the reasons why they are disconnected in the first place, and how they can serve as anchors for demand aggregation. Furthermore, it recognizes the importance of analyzing a variety of technologies and funding mechanisms to increase affordable and safe Internet access in schools, especially in hard to reach areas. But equally important, it looks at the human element of connectivity, and the type of solutions and content that can help empower learners, teachers and entire communities once connectivity has been established. Schools are at the center of most communities the

world over, and so the power of meaningful connectivity can also help them transform into digital hubs of prosperity.

The content of this report has been developed based on the outcomes of the discussions and the consultation process provided by the Working Group to two global initiatives aimed at connecting schools to the Internet and at turning schools into entry points for bringing connectivity to entire communities: **Giga** and **UNESCO's e-schools Initiative**. The Executive Summary compiles hereunder the core principles and some of the key insights and conclusions outlined in the report, which address the issue of school connectivity across the above-mentioned pillars.

SECTION A. CONNECTING SCHOOLS

- All children **must** have access to high quality education; articles 28 and 29 of the United Nations Convention on the Rights of the Child (UNCRC) clearly state the importance of the right to learn and the goals education should pursue. Having access to high quality education is undisputable and should be granted to every child regardless of its gender, ethnicity, socio-economic background, geographic location, legal or refugee status, and personal, physical or cognitive abilities.
- Connectivity and access to information can pave the way to providing other essential services such as health to children and can also play a very important role in the creation of opportunities that uplift entire communities. Schools are therefore a very important unit for **aggregating demand** for connectivity as they can also serve as an anchor to further connect and **empower the communities** that surround them. Connecting schools to the Internet has a broader impact and therefore should not be seen as a mere "education" related effort.
- **Accurate data** about schools' location is critical to the provision of high-quality education and the promotion of life-long learning (SDG4), to ensure equal access to opportunity (SDG10), and eventually to reduce poverty (SDG1).

1. MAP THE SCHOOLS

- **Mapping** schools and their connectivity is a **core building block** for any strategy or connectivity plan; knowing where schools are and what they need, as well as preparing the ICT landscape should be the first steps towards school connectivity.
- **Accurate Mapping** of school locations and their connectivity can help governments improve their overall education system and development goals by:
    - Helping estimate data about the number of children out of school, and in conjunction with other elements, help identify factors that impact learning outcomes.
    - Having a publicly available baseline dataset, which can help ensure that equity is at the core of national connectivity programs and that necessary resources such as access to information and opportunities also reach the most vulnerable.
    - Aggregating demand, thereby providing governments with the tools they need to build a more solid business case for investing in un-served and underserved areas.
    - Better estimating the costs and requirements of extending broadband connectivity to every school and classrooms through the overlaying of school connectivity data with other datasets such as topography, electricity or infrastructure. This helps governments enable the development of appropriate financial models thereby unlocking the corresponding sources of funding.
    - Using comprehensive datasets around educational facilities to inform programs across different sectors (i.e. health, education, emergency preparedness and response),

improving planning and resource allocation for governments and international organizations.

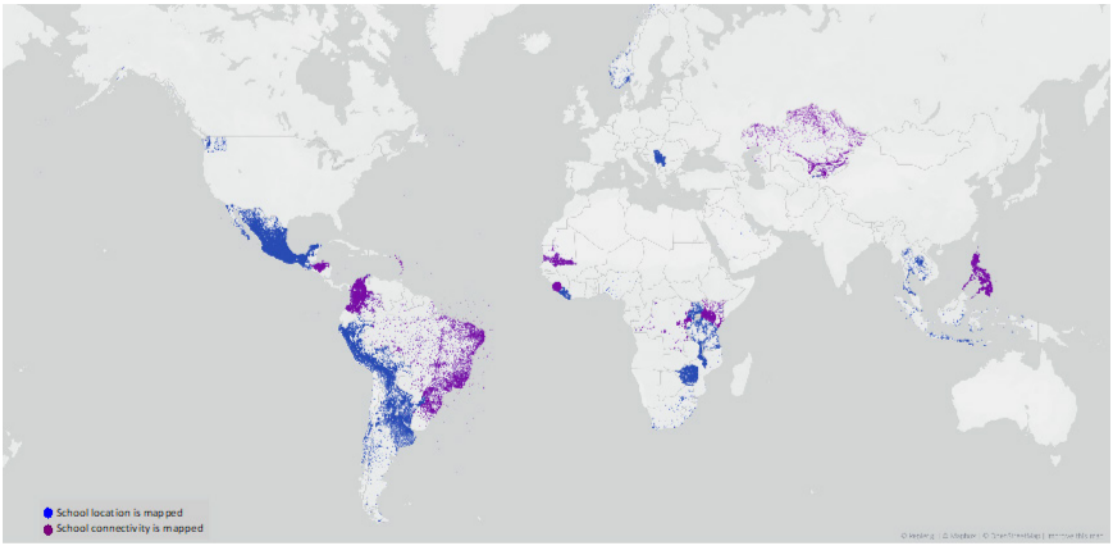
- Using data better to coordinate delivery and response efforts during national or global emergency crises such as forced displacement or the COVID -19 pandemic: better estimations of the number of children impacted and their educational needs; broader understanding on how to provide critical information and other supplies to schools and communities; better mapping the levels of vulnerability of the communities surrounding schools.
- Using reliable data on the number of schools, children and communities impacted to identify gaps, better design national tenders or bids for school connectivity programs, and mobilize the necessary funds to get all schools connected.
- Using reliable research and survey data to better understand existing digital inequalities in schools, providing feedback to policymakers to incorporate changes in ongoing policies or other actions that may be formulated.
- Bridging digital gaps and working towards the attainment of the sustainable development goal SDG4.

- **Real time monitoring** of school connectivity:
  - Is a way to address challenges faced by governments when monitoring progress of school connectivity programs at scale. It provides a means to hold providers **accountable** in the fulfillment of their **contractual obligations** regarding connectivity levels, by allowing decision makers to **monitor progress** in the implementation of their connectivity programs. This helps reduce inefficiencies, and increase transparency.
  - Might also help governments **optimize their education systems** by improving the measurement of data around broadband Internet connectivity, schools, and education services as a whole. Moreover, once schools are connected, the concept of real time monitoring can also be used as part of the overall school connectivity strategy, to measure data and real time progress of learning outcomes, as well as the real time needs of students and teachers. Real time monitoring is a powerful evidence for multiple stakeholders to **advocate for increased and meaningful connectivity** around the world.
  - Might also help governments **optimize their education systems** by allowing school actors (teachers, students) and community (parents, mediators) to monitor schools' infrastructure reality, making comparisons, identifying, gaps and empowering them to act as transforming agents of their present and future possibilities.

- **Data analysis** allows policymakers to assess and monitor policies' effectiveness and anticipate outcomes. Data analytics and Artificial Intelligence (AI)-based systems can benefit from real-time data to work on predictive models that allow a better understanding of school and policy settings. Using **reliable data** on where schools are, which schools need broadband connectivity (and how much), and **how many children and their communities are impacted**, **helps governments** identify gaps, better design national tenders, and national/regional bids for school connectivity programs and mobilize the necessary funds to get them connected.
- **Data Sharing Principles:**
  - **Public data gathered with public money creates public goods**. Digital cooperation is a key enabler for school connectivity. It is reflected in the priorities of many organizations and recommended by the United Nations Secretary General's High-Level Panel on Digital Cooperation.

- **School location data is a public good**. The ability to know where education and other foundational resources can be found is a public good, similar to any health center or government building. In most places where data exists, school locations are already shared publicly on sites like Google Maps, 2GIS, and OpenStreetMaps.
- **Child Online Protection should always be prioritized**. Adherence to Child Data Protection Policies and Principles of Responsible Data for Children is of utmost importance and relevance. Mapping initiatives should aim to provide information that can have a positive impact without putting children at risk.

- **Data sharing frameworks** must differentiate between raw vs. processed connectivity data. **School demographic data** for example, should always be treated as **sensitive**.
- **Connectivity data** is critical to the mission of connecting every school to the Internet; this data is essential in order to determine where and how connectivity must be extended.
- Mapping schools and their connectivity is a major but necessary undertaking for any country, which requires the collaboration of multiple stakeholders and the development of consistent and thorough frameworks and principles for **collecting**, **validating**, **maintaining**, **safeguarding**, **sharing** and **governing data.**



Giga. Mapping of School Connectivity. 2020 (www.projectconnect.world).

2. CONNECT THE SCHOOLS

The following principles are recommended when designing a methodology for connecting schools:

1. Reviewing the already existing options for connectivity

- After the mapping of schools has taken place, all existing solutions and interventions for connectivity must be analyzed. In here it is key to look at: the types of interventions currently available, the schools' connectivity requirements, affordable business models, as well as technology and regulatory frameworks.
- A proper analysis of a school's connectivity requirements must be done considering the needs of teachers, learners, administrators and parents alike.
- Understanding the **school's readiness** and that of the **country's educational system** is primal to integrating connectivity. School readiness refers not only to technology and infrastructure, but also to the human and regulatory aspects (educators' adoption readiness, regulation, government support, and data privacy policies). It also refers to

the readiness of the community to which the school belongs: parents and children's basic knowledge and awareness of the Internet, its benefits and risks.

- When evaluating business models that could help increase school connectivity, is always useful to consider different mechanisms to target remote and hard to reach areas by looking at **aggregating demand** and by **clustering schools** according to socio-economic indicators, proximity to backhaul, urban vs. rural, and Ministries of Education related criteria. Governments must see schools as **anchors** of the surrounding communities.
- When it comes to connecting schools to the Internet, **there is no one fit all technology**. Connectivity models and interventions must be **technology agnostic** and respond to specific needs of the target populations. There are many technologies that can support governments' connectivity plans and their efforts for getting schools connected to the Internet. Different technologies can be used depending on the context, the specific connectivity needs and the intended usage. In many instances it might even be required to mix different types of technologies in order to grant connectivity. **The end result should be to provide schools with affordable, fast and high quality connectivity, a goal that should be technology independent**.

2. ***Selecting affordable, financially viable and sustainable solutions***

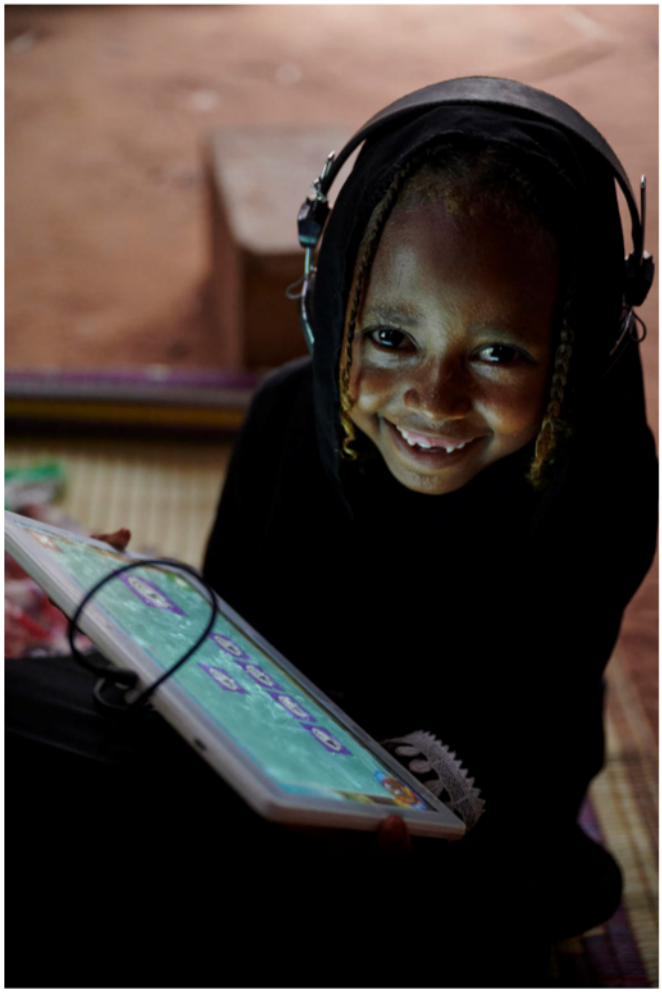
- Identifying the most feasible and affordable connectivity solution should be an iterative process requiring identification and refinement of the options made within the principles of **Affordability**, **Usage**, **Financial Viability**, **Structure** and **Sustainability**:
  - **Affordability**. Ensuring that connectivity service user pricing falls within affordability thresholds.
  - **Usage**. Identifying the applications and services that need to be available, and the level of Quality of Service (QoS), that those applications and services require.
  - **Finance Viability**. In the case of schools connectivity projects (as these often are associated with high socio-economic pay offs even with limited financial viability), this principle is more focused towards "efficiency" or choosing the right technology option/business model to connect schools.
  - **Structure**. Articulation of the business model of the service delivery, and identifying any regulatory constraints on the model and technologies utilized.
  - **Sustainability**. An understanding of the revenue model of the service, and any potential subsidy (one-time, and/or recurring) if necessary.

3. ***Implementing interventions***

- Must be done considering present and future usage needs for all stakeholders (students, teachers, administrators, community), and understanding the school and community readiness and that of the education system (learning programs, teacher skills, training needs, percent of computers at schools and homes, child online protection and safeguarding).
- School location and basic indicators of infrastructure needs to be shared across ministries (cross-sectorial data share). This will ensure that integrated solutions will reach the schools in terms of health, Water, Sanitation and Hygiene (WASH), nutrition and others.
- Connectivity models and interventions must allow for expansion of economically feasible service provision and cater for one-time financing or limited subsidy interventions that **de-risk private investment**.
- Enabling policies and regulatory frameworks should adopt flexible "light-touch", multi-sectorial, forward-looking, neutral and transparent policy and regulatory approaches.

These should foster competitive and investment friendly environments, and provide incentive regulations for infrastructure, service and applications development while achieving social goals. School connectivity and the effective management and use of real-time data, can help make and accelerate policy decisions to achieve the SDGs.

- An ambitious (yet realistic) vision of school connectivity should include safe "**out of school**" access to the Internet and should be supported by the appropriate technologies that enable high quality learning. An active involvement of the different key stakeholders, a strong commitment from the government, as well as the local community (including teachers and students), is key for any effort oriented towards mapping and connecting schools. Recognizing that there is no one-way to connect schools and that all relevant options, technologies and approaches are valid is also a critical element for success.



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A girl child smiles while using her tablet at the UNICEF supported Debate e-Learning Centre in a village on the outskirts of Kassala in Eastern Sudan.

3. FINANCE SCHOOL CONNECTIVITY

- School connectivity has the potential to bring in long term returns through **economic growth** coming from more skilled and knowledgeable populations that create stronger digital economies with higher consuming spending power. Ensuring affordability of access to reliable, fast and secure networks (as well as to devices and equipment) is of utmost importance to guarantee long-term success in any school connectivity plan.

- Developing a **holistic approach** enables the overall sustainability of connectivity plans; a holistic approach includes boosting the demand side, ensuring access to relevant content and services (including government services), and building capacity to teach the skills needed to go online and be able to use those tools. Any government support for broadband networks aiming for a holistic approach should ensure that these issues have been addressed, to increase uptake and usage, which in turn will help to promote further investment.
- Financing connectivity should be **technology agnostic** and establish a model that awards business to the most appropriate solutions based on specific connectivity requirements. Identifying the most feasible and affordable connectivity solution should be an iterative process requiring identification and refinement of the options made within the principles of **Affordability**, **Usage**, **Financial Viability**, **Structure** and **Sustainability**.
- **Affordable** and **economically sustainable financial models** for last mile connectivity must engage the community who would be the customers of the new service, in a participatory, multi-stakeholder process.
- **Aggregating demand** helps tackle costs, generate economic returns, and bring investment by:
    - Clustering attractive opportunities for investment thus creating "**clusters of connectivity demands**", which could reduce information asymmetries, fragmented offerings and models, and ultimately lower the costs of deploying or expanding connectivity.
    - Providing an opportunity to combine **different levels of risks** in the same "package", facilitating access to finance to those countries/locations that may be perceived as higher risks and making the overall package more interesting to investors.
    - Using schools as **anchor** for **demand aggregation**. They are physical places to which students can relate to and benefit from a safe and secure space to learn. Moreover, they are also neuralgic cells, which can act as an **anchor** for connecting and uplifting the communities that surround them, and making a more attractive case for investment in un-served and underserved areas.
- When building a **case for investment** in school connectivity projects, governments must think of models that target the interests and needs of several stakeholders according to key principles that ensure inclusiveness and openness. This can be achieved by:
    - Using principles for **data transparency**, **regulatory reform** and **public financing** to help establish the "case for investment".
    - Leveraging **public sector funding** to subsidize the creation of fast-growing connectivity markets that enable private investors to achieve outsized returns comparable to those of typical private sector infrastructure financing projects.
    - Developing **cost models from the bottom up** (by using school location and user profiles to determine school bandwidth needs, the appropriate last mile technology solutions and the costs to procure and maintain that technology), which help develop targeted and more structured investment and business models.
    - Introducing concepts such as cost sharing of **network deployment** to the extent possible for the last mile; this helps strengthen the business case and ensures inclusion of un-served and underserved populations.
    - Combining **private** and **public funding** and establishing **partnerships** to cover connectivity infrastructure, build out, and operation costs to offer a more holistic approach to financing of school connectivity.
    - Using **private venture capital** to cover community empowerment related costs that could contribute to the development of local entrepreneurship ecosystems.

- **Projecting revenue from the economic growth** and Internal Rate of Return (IRR%) from connected communities.
- **Using best practices in accountability and governance** to help assess the level of investment needed for deploying solutions, building capacity, and ensuring economic sustainability.

- Finding solutions to address school connectivity challenges depends on understanding the reasons on why schools are not connected in the first place, as well as on the "opportunities" that could be used to maximize investment. Careful identification and assessment of "opportunities" can help reduce cost or increase value so that there is a business case for investment. Understanding the impact of "opportunities" in lowering costs and enhancing returns can help create attractive packages for funders and donors. It might even contribute to de-risk investments in technology.
- The development of proactive **risk mitigation measures**, including and in particular **political and regulatory** risk mitigation will be essential to attract investors.

SECTION B. EMPOWERING LEARNERS

4. EMPOWER LEARNERS

- The success of school connectivity programs requires a **comprehensive approach**; it equally depends in addressing supply side related challenges (e.g. access to infrastructure, affordability, regulation, and available technologies that are safe for children), as well as in addressing demand driven factors like: digital skills and literacy barriers; open, relevant and localized educational content; lack of awareness of the importance of connectivity; fear of adoption, as well as socio-cultural norms that exclude minorities and girls.
- Educators are **powerful change agents** who can deliver the educational response needed to achieve the SDGs. Their knowledge and competencies are essential for restructuring educational processes and educational institutions towards sustainability.
- Education systems all over the world need to regularly **update and reform** teacher preparation and professional development programs to ensure that all teachers can harness technology for education.
- Education and connectivity must serve a **greater purpose than merely getting schools online**: they must empower learners and help them develop the self-discipline and self-responsibility required to move forward in life, and the resilience and confidence needed to face life challenges.
- EMPOWER is about bringing **solutions for learning on top of connectivity**; it is also about facilitating access to partners, resources and technical assistance that increase access to information, opportunity and choice for children as well as safety, once connectivity has been established.
- EMPOWER is also about helping governments **identify**, **assess** and **support** solutions that facilitate the use of digital technologies for quality learning in school environments and through remote learning, as well as guarantee inclusiveness, facilitate local ownership and decision making, and generate value for the countries developing and deploying these solutions.
- School connectivity must also be about empowering those who are online by providing them with **high quality**, **meaningful**, **inclusive** and **relevant content** that is accessible through safe and secure platforms and delivered by innovative methods of instruction.
- For the purpose of this report, high quality, meaningful, inclusive and relevant content refers to: resources, tools, and applications, learning material, solutions, platforms and Open Educational Resources (OERs) that meet the needs of the learner alongside with those of teachers and instructors, who also play an essential role in the achievement of learning outcomes. This type of content, solutions, applications and platforms, should have the following characteristics:

- Should be developed by taking into account the **local context** and language of the school and the surrounding community.
- Should be **ambitious** in order to provide learners with knowledge, skills, values, and attitudes that allow them to reach their highest potential, to protect themselves, and to thrive in society.
- Should prepare learners for a faster, more connected, and uncertain world by equipping them with **core competencies** in: communication, collaboration, critical thinking, creativity, problem solving, and appreciation of diversity, environmental consciousness, and learning to learn techniques.
- Must be **inclusive**, thereby addressing the needs of girls, children and youth belonging to minorities, indigenous and marginalized groups, refugees and forcibly displaced populations, as well as children with disabilities.
- Must be **suitable** and **safe**, and must be developed and delivered according to principles that guarantee the **online protection of children** at all times.
- Must be deemed **most appropriate by teachers** in order to advance the learning of their students. Efforts should be made to give teachers a wide selection of content; schools should work to obtain content recommended by teachers and, whenever possible, give teachers the ability to tailor content or make their own.
- Should be built on the basis of **open copyrights** and **open source** codes and under **open ecosystem principles**, so users are not thrust into others' walled gardens.
- Must be made available online to **every child** and young person in the world and facilitate local ownership and decision making, while generating value for the **local ecosystems** creating and deploying these solutions.
- The school closures generated through the pandemic highlighted the fact that a great percentage of children and young people among vulnerable populations in the developing world have no access or limited access to the Internet. Learning content should be made accessible online **in formats that are also suitable to low connectivity contexts**, and alternative analogue platforms if necessary.



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Ange, an 8 year old girl, is preparing herself to take classes on television at home, in Man, in the West of Côte d'Ivoire.

- When **assessing high quality content and solutions** the following dimensions must be considered:
    - Ensuring "product quality and openness".
    - Usability of the content or solutions and how they will be used in real life contexts; integration of solutions in the education processes; usage in building teachers capacities; monitoring and evaluating its use, and adaptability to local contexts.
    - Inclusion to local Edtech providers who can adopt, curate, support and build on top of solutions. This third dimension is critical to ensure that content and solutions will be owned, maintained and adapted by the local publishing ecosystem to ensure cultural appropriateness and relevance to local contexts.
- **Vetting criteria** must be put in place for examining digital solutions and content, specifically related to educational outcomes, impact and adaptability to local context. Vetting, assessment, and monitoring of content and solutions should also be real time and include principles and practices for Child Online Protection. Moreover, vetting criteria should be applied to both: educational content and cultural consumptions. Since almost half of the population has no access to the Internet, there is still a large dependency on radio and TV content for pedagogical continuity; **vetting criteria should also be applied to the content delivered through these channels**.
- In order to **increase access** to vetted and secure content, it is important to determine value added business models that can be applicable for the learning content and solutions selected. These must be developed in accordance to the context of the country where those solutions and content will be deployed and used. This also implies localization and translation efforts, and ensuring that vetted solutions adhere to cyber-security practices, and the principles of intellectual property, data privacy, data ownership, and Child Online Protection.
- Teachers are another element to help increase access. The way in which they interact with open educational resources and digital content; how they incorporate new pedagogical

practices for interactive learning, and whether they have the appropriate skills set to do that, highly impacts adoption and usage of digital content in the classroom.

- **Institutional capacity and the development of local ecosystems** for the production of vetted, high – quality content and Digital Public Goods (DPGs) are also key to the sustainability of any school connectivity program. Moreover, the human factor is one of the key ingredients for making connectivity work for learning. **Teachers are key in driving successful adoption of high quality content, DPGs, and technology.** Teacher training allows them not only to acquire new skills and competences, but also to overcome fears of using technology; this in turn helps in the deployment and adoption of online tools and content, and empowers them to become more vested in the process of vetting and assessing those solutions.
- When **deploying and using** learning content and solutions, **planning and allocating resources and partners** that could provide support in local adoption, rollout and piloting activities, must be accounted for, as well as support for increasing usage of vetted content. Community approaches that leverage teacher engagement to produce and publish content helps increase adoption and enrich platforms while creating ownership, and increasing visibility.
- **Monitoring and assessing the learning outcomes** that should occur through the delivery of high quality online content and DPGs is essential when evaluating the success of any connectivity initiative.
- **Child Online Protection** (COP) must be a **top priority** not only for governments, but also for providers, the private sector and all stakeholders involved in education and technology. There is a need for stronger collaboration among these stakeholders to disseminate and enforce many of the tools already available. Access to the Internet needs to take place in a safe and secure way that protects children from online dangers:

    - Children are more acceptive of new tools and technology and therefore they should be actively encouraged to adopt and use the tools that empower them and help to avoid risks in the online space.
    - Children need to be empowered with information and tools for online safety (incl. raising awareness about how to report and respond to harmful content and abuse).
    - Parenting guidance and advice is also needed to prevent children from online harm (including improving parent's digital literacy).
    - Online learning experiences must be created "safe" for students from the beginning on.
    - Making online platforms safe and accessible for children (including through collaboration with industry and regulators) should be a priority for governments and the industry.
    - Governments need to strengthen their national preparedness and response (incl. through legislative action) to address the issue of Child Online Protection.
    - More collaboration needs to take place between governments and the tech industry to integrate safety into their products according to "safety by design" principles.
    - Child Online Safety (COS) education should be mandatory for students, teachers and caregivers.
    - Detection and reporting of Child Sexual Abuse Material (CSAM) on educational platforms should also be mandatory.
    - The private sector should make available broadcasting capacity for Child Online Protection. It should also provide safe, secured and transparent platforms for education and digital tools for children, parents and teachers, and provide access to reporting mechanisms.
    - Children and their communities should be better prepared for interacting and learning online. There is a need to raise awareness among communities about the importance of

COP even before connectivity arrives. As the required infrastructure might take time to be deployed, it is important to provide communities with tools regarding digital skills and basic knowledge on online safety so children are ready when connectivity is established.

  - Governments also need to encourage/promote the development at national level of an appropriate regulatory framework and environment for data protection and privacy: ethical standards, use, share and store of data, respect and enforcement in the learning environment.
  - Child Online Protection is a very important and sensitive element that must be present in the design and deployment of any strategy for school connectivity.

- Connectivity has to be more than just connecting schools. In order for school systems to be resilient, shock absorbent, and crisis respondent, **connecting learners** should also be part of the focus of any connectivity program and strategy.
- The engagement through partnerships and appropriate coordination of multiple stakeholders (Telecommunication companies, Content providers and developers, Teacher Training institutions, among others) is an imperative for designing technology-enabled crisis-resilient school systems.

Now is the time to act and make global school connectivity a reality. There has never been an opportunity like this one to raise the issue of education and school connectivity, and the importance of connectivity overall and everywhere: at school and at home. School connectivity must be addressed with a comprehensive approach that looks not only at infrastructure, affordability, regulation and technologies, but also at the human component, which includes: closing digital and literacy barriers for all learners and teachers, having localized and meaningful content, measuring the impact on learning outcomes and strengthening the capacities and the role of educators.

Schools need to continue being the building blocks they are to societies and economies. Through the future work of **Giga** and **UNESCO's e-Schools Initiative**, the key learnings and proposals coming out of this year of collaboration will continue making an impact at the country level. These two initiatives will ensure schools get the support they need to go online, and that learners are provided with the right skills for employability and for safe access to information, opportunity, and choice.



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Bashar (foreground), 11, grins while using a laptop computer at a UNICEF supported Makani centre in the Za'atari camp for Syrian refugees. Mafraq Governorate, near the Syrian border.

Introduction

The Internet and broadband connectivity have a critical role in solving many of the world's most pressing challenges. The Internet offers important avenues for countries to transform themselves into hubs of knowledge, innovation and progress; broadband technologies are a means to access the Internet, and they are also widely recognized to make a significant contribution to productivity and employability. Globally, an increase of 10 per cent in fixed broadband penetration yields an increase of 0.9 per cent in Gross Domestic Product (GDP) per capita, and in the case of mobile broadband the increase is about 1.5 per cent.[1] More specifically, in the Americas for example, fixed broadband penetration is associated to 1.9 per cent increase in GDP;[2] some econometric models from institutions such as the Inter-American Development Bank (IADB), associate high broadband penetration in the region with 2.61 per cent higher productivity, and an average of 67,016 new jobs.[3] The Internet and broadband technologies can even help accelerate progress towards national and international development targets, and in particular, towards the achievement of the United Nations (UN) Sustainable Development Goals (SDGs).[4]

As stated by the UN Secretary-General's High-Level Panel on Digital Cooperation, digital technologies "*make a significant contribution to the realization of the 2030 Agenda for Sustainable Development*".[5] Moreover, the UN-backed report: "The State of Broadband 2019"[6] developed by the Broadband Commission for Sustainable Development underscores the urgent need to find new ways to reach those still unconnected, and to focus on meaningful connectivity to drive global development. Meaningful connectivity encompasses broadband adoption that is not just available, accessible, relevant and affordable, but that is also safe, trusted, empowering users and leading to positive impact. Broadband and Information and Communications Technology (ICT) advancements play an important role in bridging socio-economic and digital gaps, thereby achieving inclusion and equality. The International Telecommunication Union's (ITU) "Connect 2030 Agenda for Global Telecommunication/ICT Development" highlights the importance of building more inclusive information societies by extending access, affordability and effective use of ICT to all peoples including women and girls, youth and marginal populations, people from lower socio-economic groups, indigenous peoples, refugees and forcibly displaced populations, older persons and persons with disabilities.[7]

Education sits at the center of sustainable development, for it is not only a human right, but also a powerful mechanism for lifting people out of poverty and for bridging inequality.

1 International Telecommunication Union, (ITU). (2018). The Economic Contribution of Broadband, Digitization and ICT Regulation.
2 International Telecommunication Union, (ITU). (2019). The Economic Contribution of Broadband, Digitization and ICT Regulation. Econometric model for the Americas.
3 Interamerican Development Bank, (IDB). (2012). Socioeconomic Impact of Broadband in Latin American and Caribbean Countries.
4 United Nations. (2020). Sustainable Development Goals.
5 United Nations. (2020). High-Level Panel on Digital Cooperation. Recommendations 1A – Global Connectivity: "*..by 2030 every adult should have affordable access to digital networks...*" and 1B – Digital Public Goods: "*a broad, multi-stakeholder alliance, involving the UN, to create a platform for sharing digital public goods...*".
6 ITU/UNESCO Broadband Commission for Sustainable Development. (2019). The State of Broadband: Broadband as a Foundation for Sustainable Development.
7 International Telecommunication Union, (ITU). (2020). Agenda 2030.

Providing citizens with access to inclusive and quality education, as well as with lifelong learning opportunities must be a priority for all governments.

Although some progress has been achieved, in 2018, 17 per cent of the global population of children and youth were still out of school; that is: about 258 million people, of which, 59 million children were of primary school age, 62 million of lower secondary school age, and 138 million of upper secondary age.[8] According to the World Bank, as many as one third of these children lived in 2018 in fragile countries or in conflict zones.[9] Children in already vulnerable positions (gender, disability, caste, ethnicity, war) are among the first to be left out of school thereby perpetuating the cycle of poverty, exclusion and violence. If the ultimate goal is to achieve SDG4 on education thereby ensuring *inclusive and equitable quality education and the promotion of lifelong learning opportunities for all*, it is clear that more work needs to be done and faster.

The Internet and broadband connectivity have an enormous potential to bridge education divides. They enable innovative ways to reach out to learners, including those belonging to minority or disadvantaged groups, as well as those with special needs. By increasing access to information and educational resources, the Internet and broadband connectivity help equip learners with many of the skills they need to thrive in the digital era. However, this is only possible if people actually know how to leverage those technologies and do so in a safe and protective manner. Digital and soft skills development depends on a number of factors including: strong government involvement, teacher training, multi-stakeholder collaboration and local engagement.[10]

Notwithstanding the global awareness about the importance of the Internet, broadband connectivity, and their linkages to education and socio-economic progress, today about 46.4 per cent of the world's population (3.6 billion people) still live without Internet access, of which 90 per cent reside in developing countries.[11] Only 48 per cent of women globally are connected to the Internet[12] and 184 million fewer women than men own a mobile phone.[13] This is despite the fact of 97 per cent of the world population living within reach of a mobile cellular signal and 93 per cent within reach of a 3G or higher network.[14]

Connecting those offline is undoubtedly a major development challenge faced by many countries, especially those in the developing world. It requires leadership, multi-stakeholder collaboration, a rethink of existing telecommunication regulatory frameworks and policies, sustained efforts to lower the cost of networks and devices, and the development of innovative infrastructure financing mechanisms to extend existing networks to unconnected communities. It must also go beyond the supply-side of the problem, and focus on demand side issues such as lack of awareness of the importance of connectivity; fear of adoption; digital skills, socio-cultural norms, and digital and literacy barriers.

8 UNESCO Institute for Statistics, (UIS). (2018). Out of School Children and Youth.
9 The World Bank. (2018). World Development Report. LEARNING to realize Education's promise.
10 ITU/UNESCO Broadband Commission for Sustainable Development. (2017). Working Group on Education: Digital Skills for Life and Work.
11 International Telecommunication Union, (ITU). ITU Statistics. (2019).
12 International Telecommunication Union, (ITU). (2019). The digital gender gap is growing fast in developing countries.
13 Equals Global Partnership. (2020).
14 International Telecommunication Union, (ITU). ITU Statistics. (2019).

How the COVID-19 pandemic forced the digital transformation of education

With the arrival of the COVID-19 pandemic, it became obvious that connectivity and access to the Internet are now more urgent than ever. As the virus started spreading, global health efforts to contain it forced entire countries into lockdown and pushed businesses, cultural venues, congregation centers, and schools into closure. According to the United Nations Policy Brief: "The Impact of COVID in children,[15] " 42 to 66 million children this year could fall into extreme poverty, adding to the estimated 386 million children already in extreme poverty in 2019. The pandemic is also expected to exacerbate children's malnutrition due to the suspension of school meals across 143 countries, impacting 368.5 million children;[16] the heavy toll in global immunization campaigns (which have come to a halt in at least 23 countries) is also expected to be devastating. Moreover, the well-being of children and their mental health might also be affected due to the stress caused by isolation and by missing out on friends and time out.

By mid-April 2020, 94 per cent of learners worldwide were affected by the pandemic, representing 1.58 billion children and youth, from pre-primary to higher education, in 200 countries.[17] The potential losses on educational attainment are expected to be significant as a result of postponed or rescheduled exams in at least 58 countries, and canceled exams in 11 countries.[18] Moreover, the implications of school closures for children living in the poorest countries are expected to be disastrous: children are now more vulnerable to violence and at an increased risk for sexual abuse, exploitation, radicalization, child labor, and marriage. The effect of the COVID-19 pandemic could even reverse progress made on the attainment of SDG5 on gender equality,[19] and on SDG16 (in particular target 16.2).[20] In those places where schools have been reopened, teachers are noticing that girls are notably absent. Some are getting married (being married off), forced to work or falling pregnant, all whilst remaining without access to their teachers who might provide them with support in these difficult times. For many children, the school's safe and secure environment vanished in the blink of an eye.[21]

The unprecedented nature of this challenge prompted many UN organizations to move the issues of school connectivity and education to the forefront of their agendas. Giga, a global Initiative launched by ITU and UNICEF is one example of a global multi-agency and multi-stakeholder collaboration to address the issue of school connectivity; another example is UNESCO's Global Education Coalition, which involves several multilateral organizations (including the ITU, and UNICEF), as well as multiple stakeholders to provide distance education to all learners, so that learning continues despites schools and university closures.

The COVID-19 crisis also prompted many governments (whether prepared or not) to take measures and make an overnight switch to online learning: during the pandemic, 65 per cent of lower middle-income countries, and less than 25 per cent of low-income countries have set up remote learning platforms.[22] This option is however not available to everyone: as many as 465 million children and youth (almost 47 per cent of all primary and secondary students

15 United Nations. (2020). Policy Brief: The Impact of COVID-19 on Children.
16 United Nations. (2020). Policy Brief: The Impact of COVID-19 on Children.
17 United Nations. (2020). Policy Brief: Education during COVID-19 and beyond.
18 United Nations. (2020). Policy Brief: The Impact of COVID-19 on Children.
19 United Nations. (2020). Policy Brief: The Impact of COVID-19 on Women.
20 SDG16: "Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels." SDG 16 Target 16.2: "End abuse, exploitation, trafficking and all forms of violence against and torture of children."
21 End Violence Against Children. 2020. Safe to Learn during COVID-19: Recommendations to prevent and respond to violence against children in all learning environments.
22 World Economic Forum. (2020). Torn safety nets: How Covid-19 has exposed huge inequalities in global education.

being targeted by national on-line learning platforms), do not have access to the Internet at home.[23] But even in those places where Internet connectivity at home is not an issue, the crisis revealed that device accessibility at home and the digital skills gap of parents and caregivers are important barriers that affect the quality of online learning. The crisis brought a deeper understanding of the many dimensions of the digital divide, equity gaps, and issues around children's safety online. It showed governments the need to work closer with development partners to remove technological barriers and lower connectivity costs, as well as the need to invest in digital infrastructure and digital literacy, especially for marginalized populations.[24]

For those children who are fortunate enough to access the Internet at home, whether permanently or intermittently, whether for learning or for entertainment, the pandemic is also increasing their connectivity time and reliance on online platforms, thereby augmenting their risk to inappropriate content and cyber-bulling, including the worst forms of online child sexual exploitation and abuse.[25] Children represent more than 33 per cent of today's Internet users;[26] during the pandemic, the number of individuals searching for child sexual abuse content has increased, as well as access to adult content online.[27,28] Any government effort or program aimed at connecting learners online must take all necessary measures to safeguard the privacy and vulnerability of children. The Broadband Commission for Sustainable Development in its "**COVID-19 Agenda for Action for Faster and Better Recovery**" urges governments, the private sector, international organizations and academia to provide online training and safe digital tools to parents and teachers to keep children safer online, and to use the broadcasting capacity to provide guidance to the general population on child online safety, data protection and cyber security measures.[29] To support this work, the End Violence Global Partnership, ITU, UNESCO, UNICEF, the United Nations Office on Drugs and Crime (UNODC), WePROTECT Global Alliance, the World Health Organization (WHO), and World Childhood Foundation USA, have released a technical note and a resource pack to support key stakeholders in implementing these measures to mitigate potential risks, and ensure children's online experiences are safe and positive during COVID-19[30].

The COVID pandemic has also exposed deep systemic failures in entire education systems, even in those places where connectivity and access to online learning is more or less granted. At present, 53 per cent of children in low and middle-income countries cannot read and understand a basic text at age 10; in poor countries, the figure is as high as 80 per cent.[31] Increasing connectivity alone will not help in the ultimate goal of granting universal access to better and higher quality education. Quality learning requires a comprehensive approach that goes beyond connectivity, and that includes safe and friendly environments, qualified and motivated teachers, and content that is relevant and that provides all children with the appropriate skills for thriving in society and for making an impact to their communities. Quality

23 Giannini Stefania. UNESCO. (2020). Distance Learning Denied.
24 United Nations. (2020). Policy Brief: Education during COVID-19 and beyond.
25 End Violence Against Children, UNICEF, ITU, UNODC, WHO, UNESCO, WPGA, World Childhood Foundation. (2020). Technical Note: COVID-19 and its implications for protecting children online.
26 International Telecommunication Union, (ITU). (2019). Children's Online Safety: What is the best approach? Key findings from recent research.
27 Europol. (2020). Exploiting isolation: Offenders and victims of online child sexual abuse during the COVID-19 pandemic.
28 International Telecommunication Union, (ITU). (2019). How Codiv-19 has increased the need for Child Online Protection.
29 ITU/UNESCO Broadband Commission for Sustainable Development. (2020). COVID-19 CRISIS. Broadband Commission Agenda for Action for Faster and Better Recovery.
30 End Violence Against Children, UNICEF, ITU, UNODC, WHO, UNESCO, WPGA, World Childhood Foundation. (2020). Technical Note: COVID-19 and its implications for protecting children online. Resource Pack.
31 The World Bank. (2019). Learning Poverty.

learning also requires that learning outcomes are monitored and fed back into instruction; measuring learning outcomes and identifying the gaps between what is been taught and what it is actually learned by students should also be a top priority for education systems going forward. Teachers will have a fundamental role in accomplishing this, especially once children return to school after the pandemic closures. Teachers need therefore not only to be equipped with sharper ICT competencies but also with the assessment and pedagogical skills required to implement the accelerated curricula and differentiated learning strategies.[32]



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In Côte d'Ivoire, UNICEF, in collaboration with the Ministry of Education, started recording video capsules, which will be broadcast on national television, to give children the opportunity to continue learning from home during the corona crisis.

Teachers and school administrators more than ever will be under pressure to cope with the challenge of up-skilling themselves while at the same time having to upgrade platforms, educational content and instruction methods. As learning moves online, divides are deemed to grow bigger not only between those having access to the Internet, but also between those advantaged enough to profit from it and those who unfortunately are not.

Why connecting schools and learners is of utmost importance…now!

If there is something the world is learning with the COVID-19 crisis, it is that things will never be the same again, nor they should be. The world needs to embrace the lessons from the pandemic and emerge out of this conundrum wiser, more united, and more aware of the huge human, socio-economic, and environmental challenges we will face in the next decade. With only ten years left for hitting or missing the targets set by the UN Sustainable Development Goals, this is an unprecedented opportunity for governments, civil society, multilateral organizations, the private sector, the donor community and for humanity at large to work cohesively towards the resolution of these challenges once and for all.

[32] United Nations. (2020). Policy Brief: Education during COVID-19 and beyond.

Education is at a global state of emergency, and the sudden transformation it is undergoing has fortunately brought much needed attention to this sector making it more relevant than it was before. Government leaders are starting to see first-hand how providing learners with high quality instruction, technology, connectivity and access to new and better resources **now** will have an impact in the speed at which nations recover economically and socially in the years to follow. The economic damage of children dropping out of school is large. The World Bank estimates that if schools remain closed for five months because of the pandemic, pupils will forgo US $10 Trillion of future earnings in today's money.[33] That could rise if COVID-19 is not curbed and schools stay closed for longer.

The challenges for connecting schools and learners are many, and so are the lessons learned from past and present attempts aimed towards that effort: lack of tools for identifying the geographic locations of schools and their connectivity requirements; slow recognition and adoption of new technological advancements; lack of appropriate forecasting of school connectivity costs; capacity building and staff turnover; real time data, as well as its management and use in school administration and assessment processes; out of school connectivity; lack of high-quality, localized content; fear of adoption, and lack of knowledge on how to best incorporate hybrid learning models, are just some of those hurdles.

Nevertheless, the opportunities and conditions for increasing school connectivity are also many, and could not be more favorable than they are now:

1. **Financing:** New global financing instruments are now more sophisticated and can be better applied to school connectivity when having access to the right data.
2. **Technology**: Connectivity technology advancements now make identifying schools and building coverage easier.
3. **Accountability:** New ways are emerging for monitoring progress, increasing transparency, and ensuring service continuity.
4. **Focus:** Concentrating on "schools" as an entry point for investment increases the chances to bring connectivity investments into target communities.
5. **Awareness:** The pandemic helped the education sector by shedding much needed light to the issue of school connectivity and the importance of using schools as gateways to empower communities.

The time to act has come. Children will hopefully and eventually (physically) go back to school; thanks to the digital revolution that started through the pandemic and the many lessons that are coming out of this process, governments inevitably will have to review their approach on school closures, their education systems as a whole, the importance of connecting schools and learners, and the role ICT has in it.

The Broadband Commission for Sustainable Development and the Working Group on School Connectivity

The Broadband Commission for Sustainable Development advocates, showcases and documents the power of ICTs and broadband-based technologies in achieving the SDGs. It campaigns for higher priority to be given to the development of broadband infrastructure and services, to ensure that the benefits of this technology are realized globally. The Broadband Commissioners and the leading experts it assembles embrace a multi-stakeholder approach to

[33] The Economist. (2020). Learn today, earn tomorrow. School closures in poor countries could be devastating. And governments are building their response.

promoting the roll out of broadband in developing countries and underserved communities. The Commission's ultimate aspiration is to help "connect the other half" of the world allowing 3.6 billion people benefit from key social and economic resources. In order to achieve this, the Commission has set seven ambitious targets, four of which are specifically linked to affordability, connectivity, digital skills, and empowerment of youth and adults.

Box 1. Broadband Commission for Sustainable Development 2025 Targets. Targets 2, 3,4, and 7.[34]

Target 2: By 20205, entry-level broadband services should be made affordable in developing countries at less than 2 per cent of monthly Gross National Income (GNI) per capita.

Target 3: By 2025, Internet user penetration should reach: a) 75 per cent worldwide; b) 65 per cent in developing countries, and c) 35 per cent in Least Developed Countries.

Target 4: By 2025, 60 per cent of youth and adults should have achieved at least a minimum level of proficiency in sustainable digital skills.

Target 7: By 2025, gender equality should be achieved across all seven targets.

With these targets in mind, and more specifically, with the objective of addressing the global school connectivity challenge, in September 2019, the Broadband Commission launched the **Working Group on School Connectivity**. Co-chaired by ITU, UNESCO and UNICEF, and established by Broadband Commissioners and other development partners and external experts, the group advocates and provides advice and guidance for the implementation of key projects aimed at connecting schools to the Internet and at turning schools into entry points for connecting entire communities. The group also builds on previous work developed by other Broadband Commission Working Groups such as the ones on Education, Child Safety Online, and Digital Gender Divide.

Over the past decade there have been multiple initiatives aimed at bringing schools online. Through the advisory process provided this past year by the Working Group on School Connectivity, data from approximately 180 initiatives worldwide has been analyzed, including several ones championed by the ITU, UNESCO and UNICEF themselves. The analysis carried out demonstrates not only the importance that school connectivity has had and continues to have in the agendas and mandates of these Institutions and on those of most governments worldwide, but also, exposes the difficulties and localization pitfalls that emerge from such endeavor.

As part of the advisory process, the Working Group on School Connectivity has also provided input on the challenges and opportunities to connect schools to the Internet including: technologies, business models, funding mechanisms, and suitable content that articulate connectivity with quality and inclusive learning to ensure that schools provide students with the right skills for employability, and access to information and opportunities. Getting all schools of the world connected to the Internet is an ambitious task that goes beyond technologies,

[34] ITU/UNESCO Broadband Commission for Sustainable Development. (2018). 2025 Targets: "Connecting the Other Half".

networks and prices. Access to the Internet must also be able to empower those online: learners, teachers and communities at large. Schools are at the center of most communities the world over, and the power of meaningful connectivity can also help them transform into digital hubs of prosperity.

The content of this report has been developed based on the outcomes of the discussions and the consultation process provided by the Working Group to two global initiatives aimed at connecting schools to the Internet and at turning schools into entry points for connecting entire communities: **Giga** and **UNESCO's e-schools Initiative**. Launched in 2019 by UNICEF and the ITU, Giga is an initiative that sets the goal of providing connectivity to every school in the world. It aims at bringing the power of meaningful connectivity to fast track young people's access to educational resources and opportunities.



© UNICEF/UN0143487/Prinsloo
Twelve-year-old Waibai Buka (second left) teaches her friends how to use a computer tablet. Baigai, northern Cameroon.

Box 2. Giga.[35]

Launched in 2019 by the ITU and UNICEF, Giga is an initiative to connect every school to the Internet and every young person to information, opportunity and choice.

Giga is anchored in the UN Secretary-General's High-level Panel on Digital Cooperation1's recommendations 1A and 1B, which state, respectively, that by "2030 every adult should have affordable access to digital networks" and calls for "a broad, multi-stakeholder alliance, involving the UN, to create a platform for sharing digital public goods". Giga aims to ensure that every child is equipped with the digital public goods they need, and empowered to shape the future they want. Giga also serves as a platform to create the infrastructure necessary to provide digital connectivity to an entire country, for every community, and for every citizen. It is about using schools to identify demand for connectivity, as well as using schools as an analogy for learning and connecting where the community can come together and support its next generation in a world where we are all increasingly digital, where the skills that are required are not formal ones, necessarily, and where learning happens continuously.

Giga addresses the school connectivity challenge with a four-pillar approach (**MAP, CONNECT, FINANCE,** and **EMPOWER**). It identifies and maps schools, and aggregates community demand for connectivity by using student populations; it evaluates the appropriate technologies for connectivity and creates the financing models needed to bring in institutional and public funding to ensure connectivity for all. It also aims at empowering not only the learners, but also the communities they belong to, by identifying and scaling open source solutions and digital public goods, which are home grown thereby encouraging the development of local ecosystems.

Giga currently focuses its efforts on 13 countries in three regions: **Central Asia, Eastern Caribbean,** and **Sub-Saharan Africa**.

In **Central Asia**, Kazakhstan signed on as the "Regional Lead" in January 2020 and the first financial model is being developed for this region. A Giga Regional Center and regional team in Nur-Sultan has been established to implement this initiative. So far, 10,200 schools in Kazakhstan have been integrated into Giga's global mapping platform. In Kyrgyzstan, Giga and the government have connected 691 unconnected public schools. Giga has also generated $200 K savings a year: by seeing all the schools on a map, which previously did not exist, and their connectivity, the government renegotiated contracts, got a lower rate per Gigabyte (by 50 per cent) for its schools, and lowered the total cost.

In the **Eastern Caribbean States (OECS)**, Giga has been working on completing the mapping of school connectivity, and in establishing a Giga Regional Centre and a regional team for OECS to implement the initiative.

In **Sub-Saharan Africa**, Giga has been working with the governments of Rwanda, Kenya, and Uganda in mapping school connectivity real-time, and developing financial models to make connectivity affordable and sustainable.

Giga is moving full speed to map every school and to raise public and private funding to connect them2. In the 13 initial countries (Rwanda, Kenya, Niger, Sierra Leone, Kazakhstan, Kyrgyzstan, Uzbekistan, El Salvador, Honduras, Dominica, St. Lucia, St. Vincent and the Grenadines and Granada), Giga intends to:

- Share open-source remote education tools, as well as innovation in software, learning systems and content that support tele-work, tele-education, tele-health, and financial services.
- Provide additional insights to partners engaged in emergency response by using data that is generated, for example, about school location.
- Work with telecommunication/connectivity partners to use their networks and services to immediately connect disconnected schools.
- Create financing packages for national connectivity and help match those with possible financing partners.

[1] UN Secretary General's High-Level Panel on Digital Cooperation.

[2] GIGA. Connecting Every School to the Internet. UNICEF Office of Innovation.

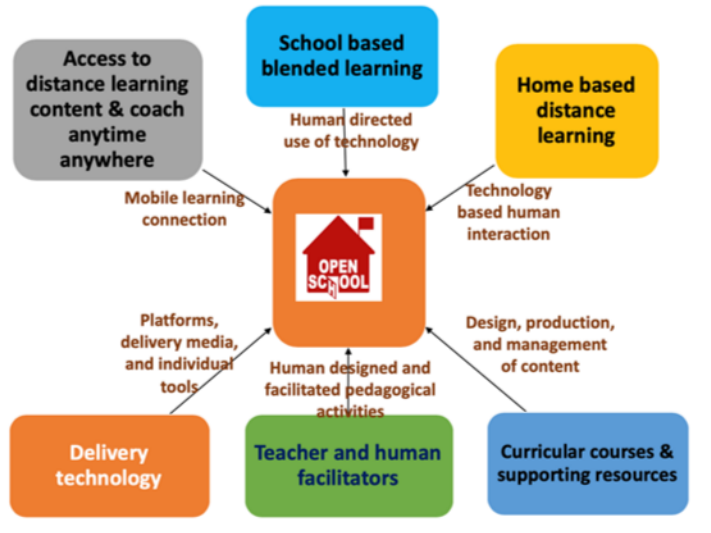
[35] GIGA. (2020).

UNESCO's e-schools Initiative is a global effort aimed at articulating connectivity with inclusive and quality teaching and learning, better learning outcomes and employability for learners. It is based on UNESCO's model for technology-enabled schools, which provides a comprehensive framework that incorporates: policy and resources enablers; technology, content, and human infrastructure; teaching, learning, and assessment into school connectivity programs.

Box 3. UNESCO's e-school Initiative.

UNESCO's e-School Initiative is an effort for connecting schools and learners through institutions whether formal, non-formal or informal, in any given context, involved in the adoption of digital technologies to enable equitable access to quality learning and achieving relevant learning outcomes, teaching, and efficient school management.

The Initiative has been built based on UNESCO's Model for Technology-Enabled Schools, which is structured around three tiers: Policy and resources enablers; Technology, content, and human infrastructure; Teaching, learning, and assessment. The model also advocates for leveraging any technologies available to enable an open form of school systems that can ensure continuity and quality of learning during crises, and a continuous access to school education programs outside physical school spaces.



The e-schools Initiative has supported the design and setting-up of e-schools in resource poor settings in Mozambique Rwanda, and Zimbabwe, and has also provided training on development of digital resources and on teachers' pedagogical use of ICT in teaching. It aims at helping governments develop e-school models around the premises of establishing a clear vision for school-wide programming; creating and updating school-wide mobile learning environments and practices; developing strategies for capacity building and incentives; and measuring results against targets to ensure broader impact and sustainability.

Through the e-schools Initiative, UNESCO provides countries with:

- Access to school readiness assessment framework and toolkit.
- Localized assessments to better understand the response framework.
- Access to a community of practices.
- Capacity building support for the schools leadership.
- Opportunities to contribute to knowledge production.
- Introductions to Global Education Coalition members who could support the country's e-school initiative.

Objectives and Structure of the Report

Through this report, the Broadband Commission Working Group on School Connectivity seeks to:

- Highlight the importance of school connectivity and the potential linkages it has with the improvement of education systems, and the overall achievement of the SDGs, specifically those related to education, gender equality, industry, innovation and infrastructure, reduced inequality, and the promotion of peace and end of violence and abuse.
- Deliver a valuable tool with a suggested methodology, and a set of core principles and frameworks that will further help governments in the establishment and deployment of school connectivity strategies.
- Provide input for future Broadband Commission Working Groups such as the 21st Century Financing Models,[36] on innovative financing, funding and investment strategies to achieve the Commission's targets for broadband connectivity and adoption.
- Motivate the private sector, non-profits, international organizations and the world at large to get engaged and support the cause of school connectivity.

The report focuses on school connectivity and introduces a methodology and framework for connecting primary and secondary schools to the Internet based on a four pillars approach: **MAP**, **CONNECT**, **FINANCE** and **EMPOWER**. The **MAP** pillar draws attention to the importance of identifying the geographic locations of schools, and using schools as units to aggregate demand for connectivity, and as a mean for extending connectivity to communities so they can access digital goods and services; it also introduces a methodology for mapping schools and their connectivity requirements underscoring the importance of real-time monitoring and the existence of frameworks for data sharing and governance. The **CONNECT** pillar addresses the use of practical tools for countries to determine and contextualize the most affordable and sustainable solutions for school connectivity, that can be either technologies, regulations or business models. The **FINANCE** pillar explores some of the funding mechanisms to address the main cost structures related to school connectivity, especially for the middle and last mile. This pillar also analyses the potential returns on investment envisioned for each of the stakeholder groups interested in financing school connectivity, as well as the possible "**opportunities**" and risk mitigation measures that could be used. The **EMPOWER** pillar helps come full circle in the suggested methodology for school connectivity. It introduces core principles for identifying, assessing, supporting and deploying high quality, meaningful, open source content and home-grown solutions through safe and secure platforms that leverage community ownership and generate value for countries and local players. Throughout the report, specific case studies are introduced highlighting global leading practices that address core principles across each pillar. The final chapter of this report presents an outlook for school connectivity and an open invitation to governments, the private sector, non-profits, international organizations and the world at large to engage and stand behind the school connectivity challenge.

This report is the result of one year's multi-agency, multi-stakeholder collaborative efforts and several meetings held between the ITU, UNESCO and UNICEF, and the participants of the Broadband Commission for Sustainable Development Working Group on School Connectivity.

[36] ITU/UNESCO Broadband Commission for Sustainable Development. (2019). Working Group on 21st Century Financing Models.

Section A. CONNECTING SCHOOLS

*All children **must** have access to high quality education; articles 28 and 29 of the United Nations Convention on the Rights of the Child (UNCRC)[37] clearly state the importance of the right to learn and the goals education should pursue. Having access to high quality education is undisputable and should be granted to every child regardless of its gender, ethnicity, socio-economic background, geographic location, legal or refugee status, and personal, physical or cognitive abilities.*

Without skills for lifelong learning, children face greater barriers to earning potential and future employment. They are more likely to suffer the consequences of adverse health outcomes and less likely to participate in decisions that affect them and their surrounding communities. Inclusive and equitable quality education sits at the core of the 2030 Agenda for Sustainable Development (SDG4);[38] increasing school connectivity is an important instrument to achieving this goal.

Over the past two decades, several governments around the world have been working towards achieving high quality education for all, not only because of their commitment to broader national and international development agendas, but also due to a much clearer understanding of the overall benefits and extended impact that education and school connectivity can bring to society.

Evidence of the link between education, connectivity, and economic performance has also grown stronger, and most recently, its importance has been reinforced through the educational response to COVID-19. The pandemic has demonstrated how having access to digital technologies and connectivity worldwide can help not only in responding effectively to crises, but also in planning for recovery and in building the resilience of education systems. By having a wider pool of educated people, enterprises can take advantage of economic opportunities, increase performance, and economic output; this can lead to greater wealth, which in turn increases the resources and opportunities available to education.[39] Education can influence economic performance by augmenting the capacity of the economy to innovate, by acting as a conduit to spread knowledge, and ultimately by improving the skills and productivity levels of a nation's human capital.[40] Human capital is the most important component of wealth[41] globally, and its importance grows as countries become more prosperous: it makes up 41 per cent of wealth in poor countries, and over 70 per cent of wealth in countries belonging to the Organization for Economic Cooperation and Development (OECD).[42] Without complete education and health, a child born today, by the age of 18, will be only 56 per cent as productive

37 United Nations. (1989). Convention on the Rights of the Child.
38 SDG-Education 2030 Steering Committee Secretariat. (2020). Sustainable Development Goal 4 (SDG4).
39 David Earle, Tertiary Sector Performance Analysis and Reporting Division. Ministry of Education of New Zealand. (2010). How can tertiary education deliver better value to the Economy?
40 Human Capital is defined as the set of skills possessed by the labor force; it also comprises the knowledge and skill sets that enable people to successfully create new enterprises (Davidsson and Honig 2003; Snell and Dean 1992). Human capital is regarded as an asset, and it encompasses the notion that investments in people (e.g. education, training, health) can increase an individual's productivity (or the capacity of creating more output and wealth). Human capital is often calculated as the present value of an individual's expected lifetime employment-related income; it factors in education and skills, as well as experience and the likelihood of labor force participation at various ages.
41 A country's wealth includes produced capital (buildings, machinery and infrastructure); natural capital (land, forests, minerals, oil, coal and gas reserves); human capital and net foreign assets.
42 The World Bank. (2019). Learning Poverty.

as they otherwise could be.[43] Poor education outcomes hence impact decent work creation, entrepreneurship and inclusive growth, as well as the overall future and well-being of nations.

Education and connectivity widen the opportunities young people have in life and improve the outlook of those attending school. Affordable and reliable Internet access is a building block of any forward looking education system as it reduces geographical barriers, and equalizes access to information and resources.

> *Connectivity and access to information can pave the way to providing other essential services such as health to children and can also play a very important role in the creation of opportunities that uplift entire communities. Schools are therefore a very important unit for* ***aggregating demand*** *for connectivity as they can also serve as an anchor to further connect and* ***empower the communities*** *that surround them. Connecting schools to the Internet has a broader impact and therefore should not be seen as a mere "education" related effort.*

Despite this realization, connecting schools remains a complicated endeavor. It is undoubtedly a significant development challenge, and a complex problem that requires commitment, funding, and multi-stakeholder collaboration to:[44]

- Review existing telecommunication regulatory frameworks and policies.
- Deploy/upgrade and provide access to the relevant infrastructure, technologies, and devices.
- Develop innovative financing win-win mechanisms to extend networks to unconnected areas.
- Develop safe, relevant content that is delivered through secure platforms and innovative methods that empower learners and teachers.

It also requires having ample access to accurate data about the number of schools, their location and connectivity status, the number of children reached by those schools, and many other factors, which in most cases have never been gathered, or if so, have hardly ever been updated.

> ***Accurate data*** *about schools' location is critical to the provision of high-quality education and the promotion of life-long learning (SDG4), to ensure equal access to opportunity (SDG10), and eventually to reduce poverty (SDG1).*[45]

Since the end of the nineties, many countries around the world have launched school connectivity programs; some with a certain degree of success (e.g. Uruguay, United States and Australia),[46] and some with less. Issues such as affordability, and the lack of a more accurate forecasting of the schools' future connectivity requirements have severely impacted the sustainability of some programs. Other challenges faced by governments when trying to connect schools to the Internet in the past included: lack of flexibility of school connectivity programs; poor alignment and lack of engagement of all relevant stakeholders; failure to anticipate the impact that the mobile revolution would bring to education; slow recognition and adoption of new technological developments for learning; effective management of ICT equipment's

43 The World Bank. (2019). Learning Poverty.
44 International Telecommunication Union, (ITU). (2020). Mapping schools worldwide to bring Internet connectivity: the 'GIGA' initiative gets going.
45 Project Connect. AI-Assisted School Mapping. (2019).
46 World Economic Forum. (2019). Schools must look to the future when connecting students to the Internet.

obsolescence; lack of appropriate mechanisms for accurately forecasting all costs related to school connectivity (e.g. utilities, system administration costs, related hardware, maintenance costs, etc.); understating the importance of building capacity and strengthening the skills of teachers and school administrators; understanding that data analysis must be accompanied by end-user training and specific case studies;[47] and last but not least, overlooking the importance of out of school connectivity, which is the ability of students to connect to the Internet from home or outside of the school premises.

Failure to recognize the effect of the "homework-gap" (which refers to school age children lacking the connectivity to complete homework at home vis-à-vis those who have access) also has had an impact in the success of connectivity programs. Moreover, fear of adoption, and lack of knowledge on how to best incorporate learning models such as the "flipped classroom",[48] hybrid and personalized learning, and approaches such as Bring Your Own Device (BYOD)[49] have also been difficult challenges to overcome even in those places where access to reliable connectivity, devices, and electric power is granted.

The COVID-19 pandemic brought much needed attention to the importance of out of school connectivity. Overnight, schools in 200 countries were closed and about 1.58 billion children and youth were sent home to continue their education there, whether or not the school itself was ready for it; whether children had the infrastructure, digital skills and equipment/devices required to access the Internet from home safely, and whether or not the learning environment of the child at home was conducive.

The crisis has been a very hard test, which exposed whether countries had effectively prepared their systems, teachers, and students earlier on for being ready for technology use in the years to come. If all countries are to become learning societies, learning cannot be confined to school hours within the school walls. All students must have the opportunity to connect from home and to continue their learning within the principles of safety, privacy, and high-quality content. Having out of school connectivity is also a key element for more inclusive, sustainable and successful connectivity programs that could also leverage the cultural capital of the community and the role it plays in education.[50]

Connecting schools, learners, and teachers goes beyond designing networks and business models, and beyond giving students the possibility to access the Internet and the school's learning platform also from home. As highlighted in the Introduction chapter, connectivity is not the silver bullet, but rather a very important tool for increasing access to better and higher quality education; a means to a higher end. Connectivity must serve an ultimate purpose, and that is to empower those who are online by providing them with high quality, inclusive and relevant content that is accessed through safe and secure platforms, and that is delivered by innovative methods of instruction. Disregarding the importance of content, how it is delivered

47 Radhika Iyengar, Angelique R. Mahal, Liya Aklilu, Annika Sweetland, Alia Karim, Haeln Shin, Balaraba Aliyu, Ji Eun Park, Vijay Modi, Matt Berg & Prabhas Pokharel. (2016). The Use of Technology for Large-scale Education Planning and Decision-making.

48 Flipped classroom or flipped learning is a pedagogical approach in which direct instruction moves from the group learning space into the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guide students as they apply concepts and engage creatively in the subject matter. Flipped Learning Network, 2014.

49 BYOD, Bring Your Own Device is commonly used to mean allowing students to bring personally owned mobile devices (laptops, tablets, smartphones, etc.) to their institution and to use them and incorporate them as tools for the instruction process.

50 Radhika Iyengar, and Haein Shin. Prospects (Paris). (2020). Community-based programs to tackle environmental education and COVID-19: A case study from Millburn, New Jersey.

and integrated into the curricula and how it helps achieve learning outcomes continues to be an area for improvement when deploying school connectivity plans. The success of any connectivity program will be measured by the quality of the learning outcomes it yields; that translates into students' attainment, and the development of skills that help them find and create job opportunities that empower not only individuals, but also entire communities and nations.



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ICT students at Dandora Greenlight Vocational Training Centre, Kenya.

1. MAP the schools

How many schools are there in the world? Where are they located? And how many of them are connected to the Internet?

So far, no one has been able to provide accurate answers to these questions. There is no definite/exact count of the number of schools in the world, nor the number of children reached by those schools, or exact information about schools' connectivity gaps. Lack of accurate data is one of the biggest challenges to overcome: in many places, school location data does not exist; if it does, it is often invalid or lacks information on whether the school is connected to the Internet. There is also not enough data about bandwidth speeds for those connected schools, or about the technical complexities for connecting those that are unconnected. Governments' monitoring capabilities is another major challenge: many governments cannot monitor the progress of their connectivity programs at scale. This is sometimes due to theoretical speeds being reported by providers on a monthly or even an annual basis, not reflecting reality on the ground.

Without access to this kind of information, how can connectivity programs be successful in the near and long term? And how can funders and donors be mobilized for investing in connectivity (especially in hard to reach areas) when the target population and their needs are unknown, and when the results of their interventions are not monitored properly?

The absence of accurate information showing us where schools need connectivity has the potential to increase the digital education divide, as schools already connected to the Internet will receive more technology-based resources while schools currently disconnected will be left behind.[51] Accurately mapping[52] schools is necessary to measure and improve the quality of learning; the data collected through this endeavor can be used to reduce the digital divide in education and improve access to information, digital goods and opportunities for entire communities. Moreover, understanding the data can help governments and international organizations gain critical insights about the needs of vulnerable populations, and better prepare and respond to shocks as disease outbreaks, forced displacement or natural disasters.[53]

The objectives of the **MAP** pillar are to:

- Introduce a methodology for mapping schools and their connectivity requirements, which can be applied to both: unconnected schools, and those schools already connected but with challenges in the quality of their connectivity.
- Underscore the importance real time data and monitoring have not only for assessing the quality of school connectivity, but also for measuring learning outcomes and the overall improvement of education systems.
- Highlight the importance of developing frameworks for data sharing and data governance, as well as for developing criteria for collecting, validating and maintaining data on school connectivity.
- Draw attention to the importance of using schools as units to aggregate demand and as a means for connecting and empowering communities.

This chapter summarizes the key reflections coming out of the advisory process provided by the Broadband Commission Working Group on School Connectivity to the Giga Initiative

[51] Sara Jacobs. UNICEF. Office of Innovation. (2018). Launches First of Its Kind, Interactive Map Visualizing the Digital Divide in Education. Project Connect, in Partnership with UNICEF's Office of Innovation.
[52] The word: "Mapping" in this report refers to a series of techniques and procedures used to determine the physical and geographical location of a school, as well as its connectivity requirements.
[53] Project Connect. AI-Assisted School Mapping. (2019).

on the **MAP** pillar. It provides a brief review of former attempts to map schools, as well as the challenges and suggested approaches on how to address them. It reviews methods and technologies for mapping schools and their connectivity, as well as tools and approaches for real time monitoring. The chapter also introduces some criteria for data collection and validation, as well as a proposed framework for data sharing. The final section of the chapter is dedicated to case studies that address some of the core principles for mapping school connectivity, highlighted in the **MAP** pillar.

The **MAP** pillar focuses on both unconnected schools and schools already connected but with challenges in the quality of their connectivity. It does not split between rural or urban areas or between private versus state sector. Nevertheless, the model and frameworks outlined in this chapter only focuses on schools where primary and secondary instruction is provided; tertiary education institutions were not part of the discussions with the Working Group and are therefore excluded from the initial scope of analysis.

Former attempts to mapping schools

In past years, there have been some attempts to estimate how many schools are connected to the Internet. The World Summit on Information Society (WSIS), has done some work in this regard and so have the UNESCO Institute for Statistics (UIS),[54] the ITU, and other organizations. The UIS collects data on the proportion of schools connected to the Internet for pedagogical purposes, as part of SDG indicator 4.a.1[55], which is under their guardianship. The data shows a mixed picture. Globally, about 60 per cent of schools in secondary education are connected to the Internet, ranging from just over 30 per cent in Least Developed Countries (LDCs) to virtually all schools in Europe and North America. In primary education, the percentages are generally a bit lower, especially in LDCs, where only 17 per cent of schools have access to the Internet.

[54] UNESCO Institute for Statistics, (UIS). Information and Communication Technologies (ICT).

[55] SDG4 Target 4a: "Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all". Indicator 4.a.1 measures the proportion of schools offering basic services, by type of service, with the following services: access to electricity; access to the Internet for pedagogical purposes; access to computers for pedagogical purposes; access to adapted infrastructure and materials for students with disabilities; access to basic drinking water; access to single-sex basic sanitation, by education level; access to basic hand washing facilities.

Table 1. Proportion of Schools with Access to Internet for Pedagogical Purposes, 2017 or 2018 (%).[56]

	Primary	Lower Secondary	Upper Secondary
Least Developed Countries	17.0	35.7	32.6
World	..	61.7	61.3
Arab States	71.7	80.4	84.7
Central and Eastern Europe	..	94.4	97.7
Central Asia	76.7	77.8	83.0
East Asia and the Pacific	83.0	74.5	86.5
Latin America and the Caribbean	44.0	63.8	68.8
North America and Western Europe	95.3	97.2	97.7
South and West Asia	..	..	46.7
Sub-Saharan Africa	..	..	..
Small Island Developing States	56.1	..	..

Despite these efforts, the number of all schools connected to the Internet is yet to be determined. In 2017, Project Connect[57] (in partnership with UNICEF) started mapping schools and their connectivity. The idea came from a request expressed by many UNICEF partners and Country Offices, who needed to know where schools were located and how connected they were in order to inform programs related to education, health and emergencies. The project soon realized that the first step towards connectivity was to map the exact locations of schools and then gather all relevant data around them. Project Connect is an initiative that aims to map every school in the world and provide real time data assessing the quality of each school's Internet connectivity.[58]

When talking about school connectivity, in addition to knowing geographical locations, it is also important to understand why schools are not connected in the first place. Lack of connectivity could be related to **supply driven factors** such as:

- The school is located in an "un-served" area, which is difficult to reach (unconnected and not close).
- The school is located in an "un-served" or "underserved" area, but close (last mile) to an area enjoying connectivity.
- Connectivity prices are too high and out of reach.

[56] UNESCO Institute for Statistics, (UIS). UIS database.
[57] Project Connect. AI-Assisted School Mapping. (2019).
[58] Council on Foreign Relations. (2017). The Challenges of Connecting Schools to the Internet in the Developing World.

But it could also be related to **demand/adoption driven factors**:

- A lack of awareness or lack of digital skills to get schools online.[59]
- Unavailability of educational content in the local language and with the characteristics of the student community it intends to impact.
- False perceptions, skepticism, and unfounded fears about technology and its use in the classroom.
- Cultural norms and exclusion of minorities and women.[60]

A real-time map of every school and their Internet connectivity, will help governments, investors, donors and society at large to better address the factors listed above, and to better allocate resources thereby helping improve education systems as a whole.

Why Mapping, Why Schools?

Before embarking into any school connectivity effort, a number of very basic questions need to be answered. First of all: How is a school defined for the given connectivity project or initiative? Where are schools located? How many schools is the initiative aiming to connect? Are those schools privately run or are they run by the state? What kind of connectivity do the schools currently have? How many learners do they cater for? What are the requirements on connectivity after school hours?

Many governments don't have the answers to these questions nor the capability to monitor in real time the levels of connectivity of those schools, which are connected. There are simply not many reliable sources for measuring connectivity. Answering these questions is a challenging endeavor for developed nations, and more so for least developed ones. Not having accurate data[61] of how many schools exist in a given country or region, where they are located, and what kind of connectivity (if at all) they enjoy, is no doubt one of the toughest hurdles to overcome.

Schools are very useful units to identify the demand for connectivity. The number of students in a school gives an indication of the number of people in a community, which in turn might help estimating the overall demand for connectivity. For the purpose of this report, and particularly for the **MAP** pillar, a school is defined as a place where children go to receive an education, and where equipment (hardware) can be located to connect them and the whole community to the Internet. It is a building or location for learning that can be used (as it often is in emergency settings) in several shifts, to teach more than the regular number of students, and after school hours, to also fulfill the connectivity demands of local communities.

[59] In 40 out of 84 countries for which data are available, less than half the population has basic computer skills, such as copying a file or sending an e-mail with an attachment. International Telecommunication Union, (ITU). (2019). Measuring Digital Development. Facts and Figures.

[60] Overall, the proportion of all women using the Internet globally is 48 per cent against 58 per cent of all men. More men than women use the Internet in every region of the world except in the Americas, which has near-parity. International Telecommunication Union, (ITU). (2019). Measuring Digital Development. Facts and Figures.

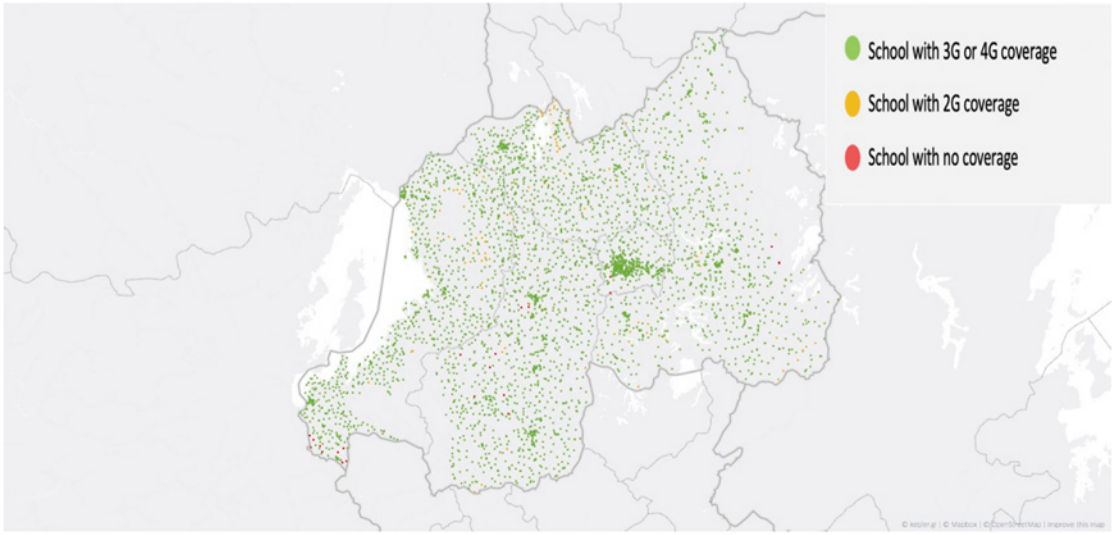
[61] Some available tools like the ITU Broadband Maps might help in this effort by tacking stock of global networks and ICT infrastructure availability, thereby identifying gaps and connectivity investment opportunities. International Telecommunication Union, (ITU). (2020). Public Map. The Broadband Map; Terrestrial Backbone Data Research Summary: Route Km 15,270,633; Transmission links 39,400.

1.1 Methodology for mapping schools and their connectivity

> ***Mapping*** *schools and their connectivity is a* ***core building block*** *for any strategy or connectivity plan; knowing where schools are and what they need, as well as preparing the ICT landscape should be the first steps towards school connectivity.*

Mapping the location and Internet access of every school in the world is undeniably ambitious. There is no single approach that will allow us to achieve this goal. In this section, the Working Group on School Connectivity introduces the approach taken by Giga to address this challenge, which served as the basis of the discussions for the **MAP** pillar. This approach combines a variety of methods to build full, live maps that have never existed before.

Figure 1. Rwanda School Mobile Coverage. Giga Mapping.



The mapping process can be separated into two phases, each with different methods to solve different challenges:

1. **PHASE 1** - Building a **base layer of school location and connectivity data** that serves as the foundation for consequent phases. This static dataset makes it possible to identify gaps and aggregate demand.
2. **PHASE 2** - Building a **live connectivity map** that monitors Internet access in real-time and serves as an accounting platform for ensuring that providers meet Service Level Agreements (SLAs). This second layer reduces inefficiencies, increases transparency, and provides a sustainable model for future delivery.

Challenges and Methods for PHASE 1 – Building a Base Layer of School Location and Connectivity Data

Some of the challenges that impact the process of data collection and validation are:

- Inexistence of schools' location data: in some instances, the number of schools that exist in the country is known, but their location is unknown, or in the case of refugee hosting

schools for example, they are often less likely to be prioritized for digital learning initiatives at the national level even if they are registered within the national system.[62]

- Validity of schools' location data: if location data for schools exist, some times the information is wrong and not valid; or the Global Positioning System (GPS) coordinates do not correspond to a school, but rather to another location.
- Lack of School's Internet data: in other instances, there might be information about the school and its coordinates; even it could be known that the school has coverage but not enough information to determine whether the school is actually connected to the Internet.

These challenges can be addressed by using the following methods:

1. **Machine Learning:** Train machine learning algorithms to identify features of schools based on high-resolution satellite imagery. This allows the mapping of new schools, validating the accuracy of existing school location data, and automatically updating maps when school locations change in the future.
2. **Partnerships:** Bringing all involved stakeholders to the table and identifying appropriate incentive structures that allow an easy sharing of school location and connectivity to develop better maps. Engaging Ministries of Education, Ministries of ICT, as well as Mobile Network Operators (MNOs), Internet Service Providers (ISPs) and other technology companies can help develop open source datasets for schools and telecommunications infrastructure.
3. **Data collection from the field:** For those cases when data simply does not exist, governments, communities, and local groups can be engaged to develop datasets from the ground up and crowd source missing data such as school location and connectivity, as well as validating school coordinates.

Challenges and Methods for PHASE 2 – Building a live connectivity map to measure real-time connectivity and to ensure quality access once schools are connected

Once schools are connected, the next hurdle to overcome is determining whether the quality of that connectivity is actually good enough to support learning. Measuring the quality of connectivity real time is an issue, and currently, most governments do not have the capability to monitor the progress of their connectivity programs at scale. The challenges include:

- Frequency of reporting: operators and providers might typically report theoretical speeds on monthly or annual basis. These speeds often do not match with real speeds on the ground.
- Lack of knowledge on whether connectivity is actually reaching schools: this results in increased inefficiencies and lack of accountability.
- Inaccurate measurement of the real-time usage of connectivity: properly identifying the type of learning applications and activities that are supported by the present connectivity; adequately assessing whether these, actually meet the current and future learning and instruction needs of students and teachers.

> ***Real time monitoring*** *is a way to address these challenges. It provides a means to hold providers* ***accountable*** *in the fulfillment of their* ***contractual obligations*** *regarding connectivity levels, by allowing decision makers to* ***monitor progress*** *in the implementation of their connectivity programs. This helps reduce inefficiencies, and increase transparency.*

[62] UNHCR.

Real time measurement tools help obtain periodical updates on the quality of service of the Internet at schools and create a live map of connectivity. These tools can be either hardware or software based depending on the context. Some of the options include:

Option 1: Partner with ISPs

The most efficient, reliable option to measure the Quality of Service (QoS) is to connect to the Network Operation Centers or Network Management Systems of the providers.

Pros	Cons
• Software already in place • Data easy to access • Low cost	• Requires agreements with different providers (which can be time consuming)

Given the time that it usually takes to set up this type of agreements, this option could be started immediately, in parallel with other solutions.

Option 2: Hardware connected to router

By installing a probe on a Local Area Network (LAN) port of the router at the school, the device measures different QoS Internet indicators directly from the router and sends the data to a database.

Pros	Cons
• Measures on Wide Area Network (WAN) • Self-reliant device • Easy plug & set-up • Managed reporting	• Per-unit price expensive • Staff intensive (distribution and coordinating logistics)

An option to reduce costs, is to install the hardware based solution in a sample set of schools and use it to validate the data obtained through alternative methods.

Option 3: Software on User Device

These applications measure different QoS of Internet indicators by installing new software on user devices, such as laptops, tablets or mobile phone and send the data to a database.

Pros	Cons
• Scalable • Easy to distribute and install • Low cost	• Measures on LAN • Requires device to be on for measuring to occur

Real time monitoring *might also help governments* ***optimize their education systems*** *by improving the measurement of data around broadband Internet connectivity, schools, and education services as a whole. Moreover, once schools are connected, the concept of real time monitoring can also be used as part of the overall school connectivity strategy, to measure data and real time progress of learning outcomes,*[63] *as well as the real time needs of students and teachers. Real time monitoring is a powerful evidence for multiple stakeholders to* ***advocate for increased and meaningful connectivity*** *around the world.*

Real time monitoring *might also help governments* ***optimize their education systems*** *by allowing school actors (teachers, students) and community (parents, mediators) to monitor schools' infrastructure reality, making comparisons, identifying, gaps and empowering them to act as transforming agents of their present and future possibilities.*

Data analysis *allows policymakers to assess and monitor policies' effectiveness and anticipate outcomes. Data analytics and AI-based systems can benefit from real-time data to work on predictive models that allow a better understanding of school and policy settings.*

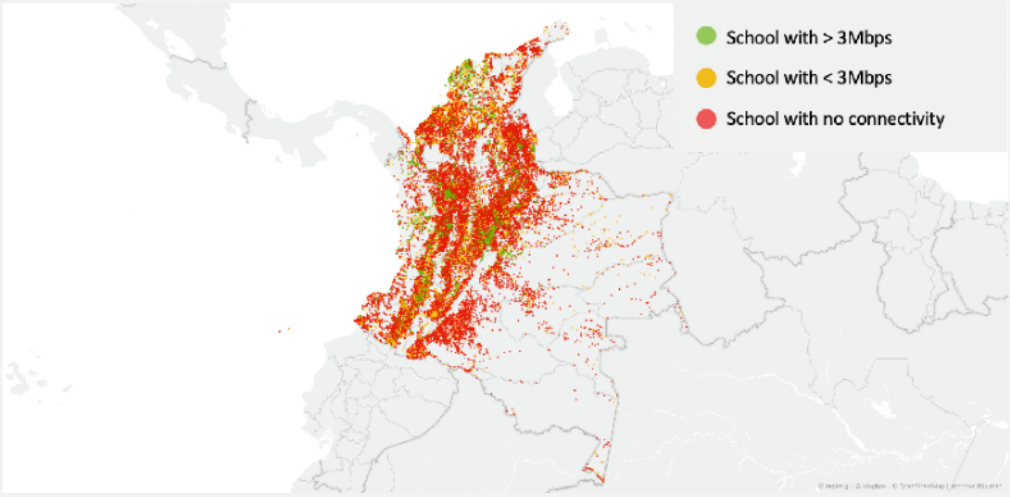
[63] Radhika Iyengar, Sarah Muffly, Charles Akomaning-Mensah, Alia Karim, Prabhas Pokharel, Sarayu Adeni. Columbia University. (2016). Using Real-time Data and Corrective Teacher-feedback as a Mechanism to Improve Children's Reading Skills.

Box 4. Giga. Mapping Schools Location and their Connectivity.

Since its launch in 2019, **Giga** has mapped[1] connectivity availability and speeds for **800,000** schools in **25 countries** and built an open data product to help governments and partners eliminate the digital divide globally.

This is been done through a variety of approaches including: collecting existing data, crowd-sourcing, Artificial Intelligence (AI), and Machine Learning (ML). The map is hosted on an open source data platform, and together with ITU broadband mapping data it constitutes the foundation for Giga, to connect every school to the Internet by year 2030. Giga's platform has also developed a real time visualization of every school's Internet connectivity. This real-time map brings together, and showcases a wide range of data including: school location, geographic coordinates and other key attributes, as well as information on school Internet connectivity requirements, both in terms of speed (Mbs) and type. Giga also has developed a framework for data sharing and established core principles for data collection and validation. Giga's mapping platform is helping identify where the gaps are, understand the level of connectivity that exists at each school, and do its best to channel partners and resources to help. In Colombia for example, Giga used Artificial Intelligence techniques to automatically map schools from satellite imagery and provide the government with the location of 7,000 schools that were not part of their official datasets.

Colombia. School Connectivity Map. Giga Mapping.



[1] UNICEF. Office of Innovation. (2018). School Mapping. To map every school in the world and show their connectivity real-time.

1.2 Frameworks and principles for collecting, validating, sharing, and governing data

*Using **reliable data** on where schools are, which schools need broadband connectivity (and how much), and **how many children and their communities are impacted**, **helps governments** identify gaps, better design national tenders, and national/regional bids for school connectivity programs and mobilize the necessary funds to get them connected.[64]]*

Data is at the core of any school connectivity program. In order for it to be relevant and useful, it must be: accurate, inclusive, current, of good quality and properly maintained. Moreover,

[64] Nevertheless, in order to achieve the SDGs in education, parallel efforts will still need to be made to school the millions of children who are currently not part of any education system.

this data must be safe, and it must be handled with strict protocols that guarantee its safety at all times, as it concerns children and youth, vulnerable populations that must be protected.

The development of solid frameworks on data sharing, as well as key principles for collecting and validating data are of utmost importance. These frameworks not only help safeguard the data of children and youth, but also help governments incorporate sustainability and accountability into their connectivity programs and build optimized processes for decision-making.

Data Collection and Validation

When **collecting** and **validating** data, some fundamental principles must be observed:

1. Determine whether there is already data available, and if so, the mechanisms through which it were gathered, it's quality and whether it is current or not.
2. Identify relevant regulation and administrative procedures that may affect data collection activity and communicate those within the team(s) that will work on data collection.
3. Ensure data quality.
4. Transparency is key to building trust, especially when children and school information are at play.
5. Establish mechanisms to safeguard data and protect the safety of children. This implies working with technical teams to develop secure backups, malware, antivirus software and firewalls protection systems.
6. Use technology (e.g. crowdsourcing, satellite imagery, drones with radio frequency sensors, block chain, etc.) to collect, protect, and validate data on school location and school coordinates, as well as on ancillary services such as electricity.
7. Data collected must be protected. As highlighted by the UN Secretary General's High-Level Panel on Digital Cooperation, "effective personal data protection and the protection of the right to privacy in line with internationally agreed standards are imperative".[65] Frameworks for data privacy, data sharing, and data protection must therefore be in place when launching any plan aimed at connecting schools online.

Data Sharing

The **MAP** pillar is guided by the core belief that data is a public good. In line with UNICEF's Strategic Framework for Data for Children, smart demand, supply and use of data drives better results for children. Data has the potential to improve access to critical services and resources for children and youth and their communities. In many cases, these services are found in and provided by schools.

When designing school connectivity programs, solid frameworks with clear principles for data sharing must be established. The framework introduced below (used by the Giga Initiative) is centered around three core principles:

[65] United Nations. (2020). Report of the Secretary-General. Roadmap for Digital Cooperation.

1. ***Public data gathered with public money creates public goods***. *Digital cooperation is a key enabler for school connectivity. It is reflected in the priorities of many organizations and recommended by the UN Secretary General's High-Level Panel on Digital Cooperation.*[66]

2. ***School location data is a public good***. *The ability to know where education and other foundational resources can be found is a public good, similar to any health center or government building. In most places where data exists, school locations are already shared publicly on sites like Google Maps, 2GIS, and OpenStreetMaps.*[67]

3. ***Child Online Protection should always be prioritized***. *Adherence to Child Data Protection Policies and Principles of Responsible Data for Children is of utmost importance and relevance. Mapping initiatives should aim to provide information that can have a positive impact without putting children at risk.*

Data sharing frameworks *must differentiate between raw vs. processed connectivity data.* ***School demographic data*** *for example, should always be treated as* ***sensitive***.

Data Protection for Children

There are unique risks and responsibilities when using data about and for children. The goal to improve outcomes for children is inseparable from the need to ensure the effective and positive impact of the data collected, stored, analyzed and shared.

In line with the UN Privacy Policy Group's Principles on Personal Data Protection and Privacy, as well as UNICEF's Personal Data Protection Policies for Children, only school location should be made public. This means that all school demographic data (e.g. number of students, age of students, gender of students) should be kept strictly sensitive. Furthermore, any data that is not purpose-driven, including individualized student data (e.g. names, contact information, address, family information) should not be collected.

Recognizing that there are situations where even a school location might be too sensitive to share, given context-specific security issues, risk assessments should be conducted to evaluate whether data sharing in a country, or region of a country, is of particular concern. If a risk is identified, a baseline aggregation level of data that can be publicly shared for that country (or region), or set of data, should be determined in partnership with the country government.

Data Sharing for Connectivity Data

Connectivity data *is critical to the mission of connecting every school to the Internet; this data is essential in order to determine where and how connectivity must be extended.*

In this context, connectivity data is inclusive of both infrastructure data (e.g. mobile coverage, fiber networks, electricity coverage) and school connection data (e.g. type of internet

[66] Digital Cooperation. (2019). The Age of Digital Interdependence. Report of the UN Secretary-General's High-Level Panel on Digital Cooperation.
[67] UNICEF. (2018). UNICEF school mapping using the OpenStreetMap Platform.

connectivity, bandwidth, latency), and each has a specific purpose. Infrastructure data is necessary for determining how unconnected schools can best be connected and for developing cost estimates that drive fundraising and investment. On the other hand, school connection data helps to develop an accurate, live map of Internet quality in connected schools that ensures reliable delivery of services and justifies ongoing investment.

When collaborating with providers and operators to map school connectivity, a dynamic approach is often needed to share connectivity data and infrastructure maps.

Beyond these minimum requirements, it is also important to work with partners who share data to define specific licensing that will make that partnership possible. Open standards for connectivity and infrastructure data are goals to be achieved both inside and outside of the context of schools.

The governance of data is also an important component of data sharing. It refers to those guidelines, rules, principles and policies that define how data is used, authorized, accessed, and managed. Having a data governance framework in place also helps bring in control and accountability to the entire data management cycle, as well as transparency, and integrity to school connectivity programs.

1.3 Conclusions

Mapping schools and their **connectivity** is a **core building block** for any strategy or connectivity plan; knowing where schools are and what they need, as well as preparing the ICT landscape should be the first steps towards school connectivity. **Accurate data** about schools location and its appropriate management is critical to achieving the Sustainable Development Goals, in particular those related to: high-quality education and life-long learning, equal access to opportunity, and eventually, poverty reduction, peace and the end of violence.

Accurate Mapping of school locations and their connectivity can help governments improve their overall education system and development goals by:

- Helping estimate data about the number of children out of school, and in conjunction with other elements, help identify factors that impact learning outcomes.
- Having a publicly available baseline dataset can help to ensure that equity is at the core of national connectivity programs and that necessary resources such as access to information and opportunities also reach the most vulnerable.
- Aggregating demand, thereby providing governments with the tools they need to build a more solid business case for investing in un-served and underserved areas.
- Better estimating the costs and requirements of extending broadband connectivity to every school and classrooms through the overlaying of school connectivity data with other datasets such as topography, electricity or infrastructure. This helps governments enable the development of appropriate financial models thereby unlocking the corresponding sources of funding.
- Using comprehensive datasets around educational facilities to inform programs across different sectors (i.e. health, education, emergency preparedness and response), improving planning and resource allocation for governments and international organizations.[68]
- Using data better to coordinate delivery and response efforts during national or global emergency crises such as forced displacement or the COVID-19 pandemic: better estimations

[68] Earth Institute at Columbia University in collaboration with Ericsson. (2016). How Information and Communications Technology Can Achieve The Sustainable Development Goals.

of the number of children impacted and their educational needs; broader understanding on how to provide critical information and other supplies to schools and communities; better mapping the levels of vulnerability of the communities surrounding schools.

- Using reliable data on the number of schools, children and communities impacted to identify gaps, better design national tenders or bids for school connectivity programs, and mobilize the necessary funds to get all schools connected.
- Using reliable research and survey data to better understand existing digital inequalities in schools, providing feedback to policymakers to incorporate changes in ongoing policies or other actions that may be formulated.
- Bridging digital gaps and working towards the attainment of the sustainable development goal SDG4.

Real time monitoring is a means to hold providers accountable in the fulfillment of their contractual obligations regarding connectivity levels, by allowing decision makers to **monitor progress** in the implementation of their connectivity programs. This helps reduce inefficiencies, and increase transparency. Real time monitoring might also help governments **optimize their education systems** by improving the measurement of data around Internet connectivity, schools, and education services as a whole, including learning outcomes, as well as the real time needs of students and teachers. Real time monitoring is a powerful evidence for multiple stakeholders to **advocate for increased and meaningful connectivity** around the world.

Mapping schools and their connectivity is a major but necessary undertaking for any country, which requires the collaboration of multiple stakeholders and the development of consistent and thorough frameworks and principles for **collecting**, **validating**, **maintaining**, **safeguarding**, **sharing** and **governing data.** Data sharing frameworks must allow the handling of school location as public information and school demographic data as sensitive information; prioritize data protection for children, and allow public data gathered with public money to create public goods.

Connectivity and access to information can pave the way to provide other essential services such as health to children and it can also play a very important role in the creation of opportunities that uplift entire communities. Schools are and will continue to be a very important unit for **aggregating demand** for connectivity and **for empowering the communities** that surround them. Connecting schools to the Internet has a broader impact and it should not be seen as a mere "education" related effort.

1.4 Case Studies

This section presents four case studies that illustrate successful examples of:

- Country led efforts to map school connectivity using some of the key methods, technologies and principles outlined in this chapter.
- Use of real-time connectivity data to assist in efforts for mapping out of school children as well as to identify factors that impact learning outcomes.
- Effective combination of mapping strategies with broadband infrastructure mapping.
- Use of real-time data collection principles to monitor progress in educational attainment.

1.4.1 Kyrgyzstan

Principle Addressed
Overall mapping methodology.

Project Name
Giga Mapping.

Location
Kyrgyzstan.

Date
2018 – ongoing.

Partners
- Ministry of Education, Kyrgyzstan
- Giga

Situation/Challenge
Kyrgyzstan is a mountainous land locked country in Central Asia, which borders Kazakhstan, Uzbekistan, Tajikistan and China. With a population of approximately 6.5 million, an estimated 32 per cent are under the age of 14.[69] In early 2019, President Jeenbekov declared 2019 the Year of Regional Development and Digitalization of Kyrgyzstan,[70] with the development of the Digital Kyrgyzstan 2019 – 2023 roadmap to ensure the digital transformation of the country. The President hopes to make Kyrgyzstan the top country in the region in terms of digitization, yet in 2017 it was estimated that only 38 per cent of adults in the country were using the Internet.[71]

Aim of Project
The aim of the project was to map the connectivity status of all 2,137 public schools in the country.

Project Details
UNICEF worked together with the Ministry of Education to collect school location and school connectivity data - which schools had Internet and what was the speed - across the country. The data, mostly obtained through school principals, is being integrated within the country's Educational Management Information System (EMIS) to ensure its sustainability over time. Currently, the Giga team is working with the government to monitor the quality of the Internet in schools in real-time in order to have a live map of school connectivity. The government will use the live map to keep improving connectivity services in schools.

Results
The mapping exercise permitted the Prime Minister's Office to see which public schools in the country were not connected to the Internet. Following this exercise, the Prime Minister of Kyrgyzstan committed by the end of 2019 to connect the 691 schools that had been identified as unconnected.

Following the mapping exercise, the Kyzyl October school, which is located in the mountain locked village of Kotur-Suu in central Kyrgyzstan, was identified as one of 35 schools which are located in mountainous areas which make connection through fiber-optic and wireless communication lines difficult. The State Committee of Information and Communications Technology (ICT) and the Ministry of Education and Science of Kyrgyzstan partnered with OneWeb and UNICEF to connect the school via low-orbit satellite.

The Prime Minister's Office also gave a US$2m loan to Kyrgyz Telecom to extend connectivity to 307 schools.

69 UNESCO. (2018). Kyrgyzstan.
70 Times of Central Asia. (2019). Kyrgyzstan aims to be in the forefront of digitalization in Central Asia.
71 International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).

Figure 2. Kyrgyzstan School Connectivity Before Giga Mapping.

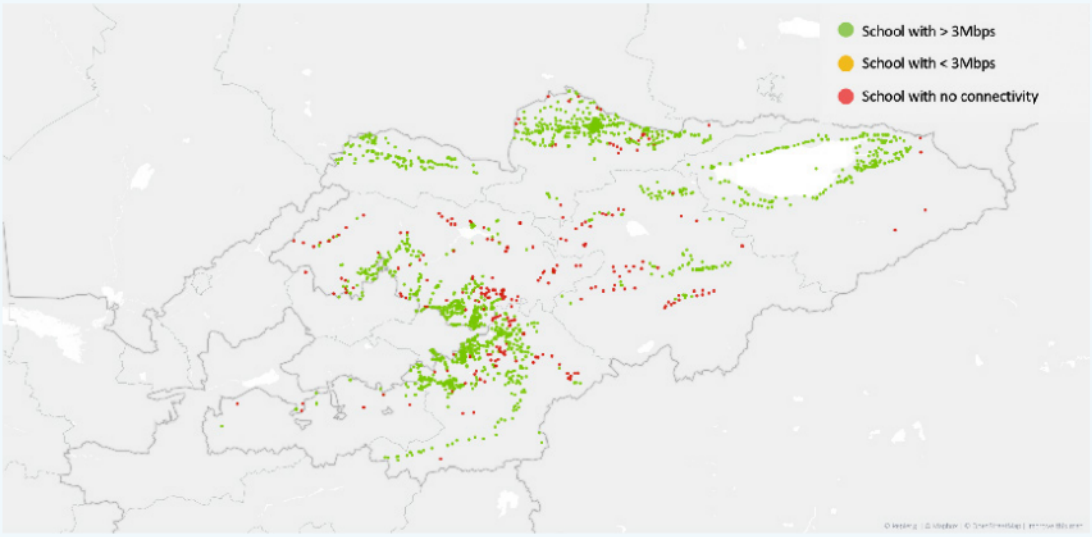
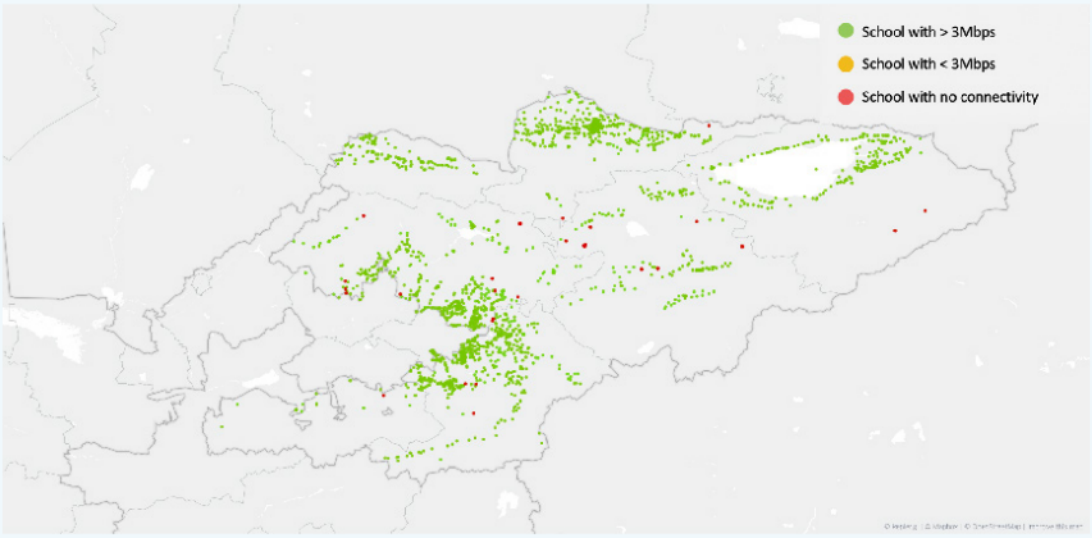


Figure 3. Kyrgyzstan School Connectivity Following Giga Mapping and Improvement Measures.



Lessons Learned

By opening up and exposing service fees from different players in the market, the Ministry of Education was able to negotiate and secure prices that were almost half of those previously (from $50/month to $28.5/month) and almost double speeds (from 2Mbps to 4Mbps). This allowed the government to save an estimated 40 per cent of its annual education connectivity budget, approximately USD 200,000 of savings, while at the same time allowing schools to receive better services.

Whilst all disconnected schools have now been connected, there were some schools that were found to have been connected twice (through two different providers), as well as an additional 30 schools that were not yet connected but will be connected via the government for 2020. There is still work to be done to improve the quality of Internet in schools, and ensure long-term continuity of the program. Areas that will need focus are:

1. Improvements in connectivity – continued monitoring of Internet speeds to allow for improvements in connectivity.
2. Infrastructure considerations – related to connection of schools in hard to reach areas such as those schools in mountainous regions.
3. E-learning platforms – the Ministry of Education and Science will need to ensure that relevant e-learning platforms are integrated into the national curriculum.
4. Digital content – the Ministry of Education and Science will need to ensure that there is an appropriate collaboration space for teachers and Information Technology (IT) specialists to develop new digital learning content on a regular basis.

1.4.2 Brazil

Principle Addressed

Real time monitoring of public schools' connectivity.

Project Name

Connected Education Internet Measurement System.

Location

Brazil.

Date

2017 – ongoing.

Partners

- Brazilian Network Information Centre (Nic.br)
- Brazilian Ministry of Education (MEC)

Cost

This system was funded by the Brazilian Network Information Center (NIC.br)[72]through its Center for Studies and Research in Network Technology and Operations (Ceptro.br), in partnership with the Regional Center for Studies on the Development of the Information Society (Cetic.br). In addition, Lemann Foundation[73]provided in-kind contribution by conducting the implementation of a pilot project and by training educators and educational managers to use the resources.

Situation/Challenge

Whilst 70 per cent of schools in Brazil have Internet access, 58 per cent are limited to speeds of 2 mbps.[74] Of the 155,026[75] primary and secondary schools in Brazil, 86 per cent are public schools. Of these, 29 per cent of primary schools and 61 per cent of secondary schools have Internet access available for students.[76] Despite the growth in fiber optic connections, with 26 per cent of urban schools connected in that way, radio is still necessary for connection in 19 per cent of rural schools,[77] particularly those in the Amazon remote regions. The main obstacle to rural connectivity remains the fact that it is difficult to ensure high quality connectivity without the use of fiber, particularly as the use of satellite connectivity is still rare.

Brazil still faces challenges in implementing policies that foster the access to, and the use of, digital technologies in public schools, as well as measuring the effectiveness of these policies in the teaching and learning processes. Investing in ICT projects in education is a key strategy that has been adopted by the Brazilian Ministry of Education to face existing connectivity challenges and to bridge the digital gap regarding access to the Internet in public schools, as well as to promote the development of digital skills. However, the size of the primary and secondary school system represents a major challenge: Brazil has more than 34 million students and almost 2 million teachers.[78]

Aim of Project

To monitor the Internet quality at public schools to ensure that schools are receiving the recommended speed defined by the The National Innovation Policy Connected Education (PIEC),[79] and to provide policymakers and education actors with real time data on the quality of Internet connection offered by ISPs. The project aims to support the universalization of high-speed Internet access and encourage the pedagogical use of digital technologies in basic education policy.

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72 The Brazilian Network Information Center (NIC.br) is the executive arm of the Brazilian Internet Steering Committee (CGI.br) and its mission includes: registering and maintaining <.br> domain names, as well as allocating Autonomous System Numbers (ASN) and IPv4 or IPv6 addresses in Brazil; handling and responding to computer security incidents involving networks connected to the Brazilian Internet; projects that support and improve the network infrastructure in the country; producing and publishing indicators, statistics and strategic information on the development of the Internet in Brazil; promoting studies and recommending procedures, regulations, and technical and operational standards that will improve network and Internet service security. For more information on NIC.br: https://www.nic.br/who-we-are/

73 The Lemann Foundation strives to make Brazil a more just and equitable place by guaranteeing access to high-quality public education for Brazilians of all backgrounds while supporting the development of leaders committed to the social transformation of Brazil. For more information about the Lemman Foundation: https://fundacaolemann.org.br/en

74 "Connectivity in Brazilian public schools: current overview and future perspectives" conference organized by NIC.br. 4-6 May 2020.

75 The National Institute of Educational Studies and Research Anísio Teixeira, (INEP). Censo da Educação Básica 2019: Notas Estatísticas. (2019).

76 The National Institute of Educational Studies and Research Anísio Teixeira, (INEP). Censo da Educação Básica 2019: Notas Estatísticas. (2019).

77 "Connectivity in Brazilian public schools: current overview and future perspectives" conference organized by NIC.br. 4-6 May 2020.

78 The National Institute of Educational Studies and Research Anísio Teixeira, (INEP). Censo da Educação Básica 2019: Notas Estatísticas. (2019).

79 The National Innovation Policy Connected Education (PIEC) was launched in November 2017 by the Brazilian Ministry of Education and is aimed at fostering the pedagogical adoption of ICTs in Brazilian schools.

Project Details

The Connected Education Internet Measurement System was built upon the SIMET[80] system developed by Ceptro.br, and works both as a measurement and a data collection tool. The system, also called a measurement agent, can be installed simultaneously in several computers, including those used by students for pedagogical activities. The measurement agent allows evaluation of the quality of connection by focusing on four main metrics: i) download and upload speed; ii) Round Trip Time (RTT or bidirectional latency); iii) packet loss; and iv) jitter, which is the variation of latency. The system performs automatic measurements and periodically updates a data visualization portal[81] allowing policymakers, the educational community, researchers and society in general to access a wide range of datasets. Live data is refreshed every 30 minutes. In addition to the visualizations of monitoring data, the platform allows the georeferencing of participating schools, cross-referencing information from structured administrative datasets from the INEP School Census.

Results

As of July 2020 the measurement agent had been installed in more than 22,000 public schools in 3,553 out of 5,572 municipalities, and since November 2018 there have been in the region of 8.1 million unique measurements captured.[82]

Data collected by the system provides a complete picture of schools' connectivity for policymakers and educators at different administrative levels – federal, state or municipal. The data reveals existing inequalities of Internet access across and within Brazilian states.

The cross-reference of the connectivity data from the Connected Education Internet Measurement System with the data provided by the National School Census from the Instituto Nacional de Estudos e Pesquisas Educacionais (INEP), allows for further analysis on the spread of broadband. It is possible, for example, to relate the Internet quality variables to the variables of the number of students enrolled in schools, the student-computer ratio, the location of the school (rural or urban area) and jurisdiction (municipal, state or federal).

The concept of quality of Internet connection is traditionally related to the characteristics of the network, which can be summarized by speed, upload and download, and in measures of availability, such as latency and packet loss. However, it is also necessary to consider user needs and perception of quality. In this regard, future enhancements to the system could include functionalities that allow policymakers to establish relationships between connectivity data and pedagogical activities mediated by ICTs.

80 For more information on the system please visit https://simet.nic.br/projetos/ (content only in Portuguese).
81 For more information on the Connected Education Internet Measurement System please visit http://medidor.educacaoconectada.mec.gov.br/ (content only in Portuguese).
82 Information provided to ITU by NIC.br. 27 Jul. 2020.

Lessons Learned

1. *Pilot project.* The successful implementation was largely due to the fact that the pilot project enabled the identification of existing technological realities in the selected schools[83] that could hinder the installation of the system, while also allowing a better understanding of the difficulties faced by school principals in conducting technological-based projects.
2. *Training materials.* The results of the pilot led to improvements being made to the system, and allowed for mapping of the difficulties faced by schools. This led to the building of training courses, manuals, support videos and FAQ that proved very useful for schools.
3. *Certification process and technology neutrality.* It was fundamental to build a solid certification process with a national institution to certify both the application and the firmware of the Connected Education Measurement Agent for when it is introduced into routers using the most common operational systems (Windows and Linux systems).
4. *Communication strategy.* In a continental country like Brazil, with a multi- administrative sphere educational system, effective communication was a key success factor for the deployment of the system in more than 22,000 thousand schools. School principal, teachers, IT staff need to be engaged in the process and contribute to demonstrate its relevance to the school community.
5. *Value of monitoring data.* Real time data allows school managers to compare contractual and actual speeds and flag discrepancies. However, measuring Internet access is not enough to understand how the Internet is being used, and if it is being used for educational activities rather than just for administrative tasks. It is useful to refine the data to have a better understanding of how connectivity is being used. According to data from the ICT in Education Survey, carried out by Cetic.br in 2019, while 96% of schools located in urban areas had Internet access in areas of administrative use, only 63% had access to the Internet network in the classroom.
6. *Accuracy of information.* Whilst ISP reporting is enforced through the Brazilian Telecom Regulator (ANATEL), the information provided is not always accurate, for example ISP's may under report their network to avoid having to pay higher taxes.
7. *Purchasing power.* Allocating resources to schools for purchasing does not necessarily result in an increase in the use of technology or faster connectivity speeds, as for example schools were not aware on how to follow up on requests for additional connectivity.
8. *Contract negotiations.* Whilst schools are able to secure their own connectivity contracts, with schools and municipalities negotiating prices directly with ISPs, it is recommended that schools group together to obtain better prices.
9. *Offline content.* COVID-19 highlighted the need for offline content, with Brazil's National Common Core Curriculum providing an advantage for cloud distribution of content.

1.4.3 Sierra Leone

Principle Addressed
Combination of mapping tools and ITU broadband maps.

Project Name
Free Quality School Education initiative.

Location
Sierra Leone.

Date
2019 – ongoing.

[83] A random sample of 200 schools in the city of Manaus, consisting of a mix of both urban and rural schools.

Partners

- Sierra Leone's Directorate of Science, Technology and Innovation (DSTI)
- UNICEF
- ITU
- Global System for Mobile Communications Association (GSMA)

Situation/Challenge

Since independence in 1961, Sierra Leone has experienced challenging periods of internal conflict, military intervention, disease outbreaks and natural disasters and currently ranks 179th (out of 188) in the Human Development Index.[84] Of the estimated 7.6 million population,[85] the ITU estimates that only 9 per cent[86] of individuals in Sierra Leone are using the Internet, whilst adult literacy rates are only at 48 per cent.[87]

As part of the country's Medium Term National Development Plan 2019-2023 which aims to improve people's lives through education, inclusive growth and building a resilient economy, the Government of Sierra Leone has committed to use technology and innovation to support the delivery of the plan.

Aim of Project

The 'Free Quality School Education Initiative' seeks to provide free education to children, and aims to use data science to help ensure that every child will have access to free education.

Project Details

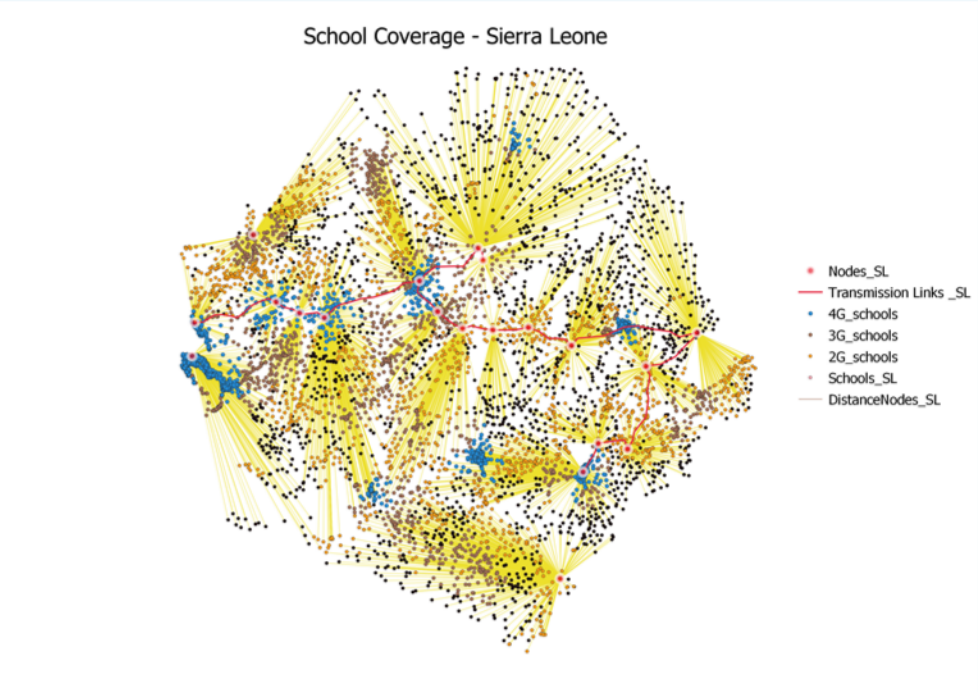
As part of the Free Quality School Education Initiative a data system is being developed to provide the government with up-to-date information on schools, and students. The interactive tool will help the government in its decision making process in what it pertains to education and school connectivity. The data dashboards and customized interfaces will also include the mapping of all schools and their connectivity, whilst also enabling the government to identify those children that are currently out of school.

Results

To date the connectivity of 10,790 schools has been mapped, with school location and connectivity data provided by the Directorate of Science, Technology and Innovation (DSTI) through collection via the Ministry of Education's annual digital school census. Whilst 80 per cent of schools have been shown to be within 3G or 4G coverage,[88] only 205 were shown to be connected to the Internet. This means that an estimated 112,000 students live in areas without mobile coverage or Internet connectivity.

84 UNDP. (2018). Sierra Leone Annual Report.
85 UNDP. (2018). Sierra Leone Annual Report.
86 International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).
87 UNDP. (2018). Sierra Leone Annual Report.
88 Mobile coverage maps were provided by Orange, Africel, the GSMA and others.

Figure 4. Distance to the Nearest Transmission Network Node (yellow lines).



The transmission network[89] data from the ITU Broadband maps[90] have been used to identify the distance from a school to the nearest fiber Node to estimate the cost of extending connectivity to the disconnected schools. In a transmission network, a node is an access (entry or exit) point, i.e. transmission equipment is installed at each node, which can provide access into the network.

Lessons Learned

Collaborating on mapping resources improved the data quality and analyses power to get a more complete picture of connecvitivty gaps and estimate the amount of effort needed to bring Internet access to all schools in Sierra Leone. Mapping schools is a comprehensive effort that caapitalizes on the value of data, connectivity, and effective policy that supports learning, teaching and human capital development. At the moment of writing this report the collaboration with Sierra Leone is still ongoing. Further lessons are expected to come in the near future.

[89] The essential underpinning of a broadband access network is a core transmission backbone network, connecting high-speed networks such as 3G/4G towers and international Internet links.

[90] International Telecommunication Union, (ITU). (2020). ITU Broadband Maps: ICT Infrastructure deployment, gaps, and opportunity analysis.

1.4.4 Ghana and Mali

Principle Addressed
Real time data collection.

Project Name
Real-time Data for Real-time Use: Case Studies from Ghana and Mali.[91]

Location
Ghana and Mali.

Date
2015.

Partners
- Millennium Villages Project
- Sustainable Engineering Lab

Situation/Challenge
Whilst household surveys are useful in measuring the impact of education strategies and policies adopted in developing countries, they also have a number of associated challenges such as the time involved in collecting data, the validity of data (depending on how regularly it is collected) and the usefulness of the results at a district or school level (once the data has been aggregated).

Aim of Project
To collect real-time data that can be analyzed to provide useful feedback to schools and district education offices on a monthly basis.

Project Details
The project used an android phone based data collection system at the Millennium Villages Project site in Tiby, Mali and in Bonsaaso, Ghana, to collect the date in real-time. The data was then stored in a data collection, management and utilization system for analysis before being passed back to schools and district education offices.

Results
In Tiby, analysis of data combined with geographical information highlighted a number of interesting issues including distances of schools from towns in relation to student attendance as well as higher teacher absenteeism as a result of schools only running in the morning on Wednesdays and Thursdays. This information allowed for steps to be taken to improve upon both student and teacher attendance.

The monthly data at from Bonsaaso showed that those schools, which were lacking full time teachers, were also those schools where students tended to lack basic reading skills. When this information was combined with geographical information for the district the analysis showed that the area where these schools were located tended to lack basic infrastructure meaning that teachers were more reluctant to accept postings.

[91] International Education News. (2015). Real-time Data for Real-time Use: Case Studies from Ghana and Mali.

Lessons Learned

Frequently collected data with frequent feedback allows the data collected to be more useful.

The data is more impactful if those who collect the data are also those who are in a position to take appropriate action having seen the results of the data. The closer they are to the issues, the better the data use is going to be.

As well as technology being useful in learning and as a teaching aid, technology can also be useful as a means to improve educational planning. Different data users (policymakers, district officials, school members) often like to see different indicators. Therefore data displays need to be created at various levels.

Efficient adoption of technology-based solutions for issues of data collection depends on many factors. Political will as well as local capacity to collect frequent data and disseminate the results is key. Stakeholder buy-in from a multi-sectorial perspective can help to gain insights from already existing practices from other sectors such as health. A democratic process that weighs the different data needs at the national, state and district levels is also critical in maximizing data use. This is important since different stakeholders at various levels may have very different data uses.

2. CONNECT the schools

As it has been mentioned in the previous chapter, in addition of knowing the geographical locations of schools, it is also important to understand the reasons why schools are not connected in the first place. This means: identifying the areas where there is limited or no connectivity service, the reasons why a school has no access, as well as the potential options to extend service. In addition to the already highlighted causes that might affect a school's lack of/poor connectivity (both from the supply and demand sides), other challenges faced by governments when connecting schools to the Internet include:

- Identifying gaps in network infrastructure coverage, as there is no systematic, publicly available, universal data set of global connectivity infrastructure.
- Extensive number of technologies providing digital communications and a lack of aggregated information showing the coverage areas served by those technologies, contrasted against the geographic locations of schools.
- Electrification. Many schools may not be connected to a reliable source and even if they are, ministries of education might have little or no control over Internet connectivity in schools, which depends on national telecommunications infrastructure.[92]
- Unwillingness of providers to operate in certain areas, which are of difficult geographic terrain, have low density of population, or are affected by conflict.
- Defining what it means to be "connected" and what are the connectivity efforts required to get all schools online; these can differ among countries and can be highly influenced by their geographic constraints (e.g. landlocked countries or island states).
- Defining what is the ultimate goal to be achieved with connectivity and how ambitious the school connectivity plan is.

Once schools have been mapped, and their connectivity requirements have been identified, the next step is getting them online. Here it is important to analyze which schools will be connected first and what would be the criteria to follow for that prioritization. This can happen either by a scheme where governments (ministries) take the lead according to their school connectivity plan (top down approach); or by a model where the schools themselves could drive that effort (bottom up approach) because there is no country connectivity plan available, or implementation is slow due to funding; a third alternative is a (hybrid approach), where connectivity programs are funded by the government but schools have to apply for funding.[93]

In addition, it is also important to determine what are the best possible technical solutions that will provide schools with the required connectivity, and countries with safe, secure, reliable, and fit for purpose infrastructure to support future digital developments. Adequate and cost-effective infrastructure and access to resources are a critical component of any strategy or government plan seeking to connect students and schools to the Internet. But having access to broadband is as important as being able to afford it. The Broadband Commission advocates for **affordable connectivity** and entry-level broadband services in developing countries that are at less than 2 per cent of monthly Gross National Income (GNI) per capita. While affordability has improved significantly since the Broadband Commission set its initial target in 2011, costs still remain high in many countries.[94] In some instances, Governments' limited financial resources per student, as well as overall poverty and systemic shocks such as the current COVID-19

[92] International Telecommunication Union, (ITU). (2014). Partnership on Measuring ICT for Development. Final WSIS Targets Review. Achievements, Challenges, and the Way Forward.
[93] International Telecommunication Union, (ITU). (2013). Connect a School, Connect a Community.
[94] ITU/UNESCO Broadband Commission for Sustainable Development. (2019). The State of Broadband: Broadband as a Foundation for Sustainable Development.

pandemic, also impact affordability and prevent many children and youth from accessing the Internet at school and from home.

Moreover, understanding the regulations and policy frameworks currently in place, the business models for deploying technologies, as well as the connectivity requirements for present and future needs (five years out) is also essential for connecting schools and for determining the best possible solutions for last mile connectivity.

The objectives of the "**CONNECT**" pillar are to:

- Determine the most affordable and suitable connectivity solutions (e.g. technologies, regulations and business solutions) to connect schools based on their context.
- Cluster mapped schools according to their connectivity levels and technology requirements (e.g. last mile, backhaul).
- Provide tools for governments to oversee implementation of the connectivity solution by the service provider against Key Performance Indicators (KPIs) such as network and data security, and data rate among others.
- Help assess the school readiness to connectivity.

This chapter summarizes key learnings and proposals coming out of the advisory process provided by the Broadband Commission Working Group on School Connectivity to the Giga Initiative on the **CONNECT** pillar. It reviews some of the technical implications of schools' connectivity requirements, as well as the technologies, policies and business models that might help address them.

The **CONNECT** pillar is anchored on the ITU's forthcoming publication: Last Mile Connectivity (LMC) Solutions Guide, which has been designed for governments, service providers, communities, civil society and technical organizations to address the lack of telecommunications service delivery (voice and data communications) in developing countries around the world. This chapter also introduces a methodology for connecting schools (once they have been mapped), based on the principles highlighted in the LMC Solutions Guide. The methodology has been adopted by the Giga Initiative, and is intended to help governments come closer in their goal of connecting schools to the Internet, and to provide schools with access to online learning tools and digital relevant pedagogies that help improve the quality of education.

The final section of the chapter is dedicated to case studies documenting good practices for connectivity around the world, which have been developed in accordance to some of the principles highlighted in the **CONNECT** pillar.

The Broadband Commission Working Group on School Connectivity recognizes the impact that externalities such as: electricity, access to basic infrastructure, hardware and devices, market conditions, and skilled personnel have to school connectivity. Understanding and acting upon these externalities is fundamental to the implementation, success, and sustainability of any connectivity program. These externalities require further in depth analysis and study, and as such, they were not part of the scope of the work developed by the Working Group. Their examination is hence not included in this report.

2.1 Methodology and principles for connecting schools

Online connectivity provides learners, teachers and administrators with access to new resources and pedagogical tools; it also provides them with state of the art knowledge and instruction methods, as well as with new trends in administrative processes, and teacher training. Connected schools are also neuralgic to entire communities, as they can (outside regular school hours) act as knowledge and entrepreneurship hubs to entire populations including marginalized groups.

Selecting the appropriate interventions that will bring connectivity to schools needs to be accompanied by a thorough process. In the past year, the Broadband Commission Working Group on School Connectivity has provided advice on the methodology developed by the ITU for Last Mile Connectivity, and adopted by Giga in their **CONNECT** pillar. The methodology is structured around the following tiers:

1. ***Reviewing the already existing options for connectivity***
2. ***Selecting affordable, financially viable and sustainable solutions***
3. ***Implementing interventions***

1. *Reviewing the already existing options for connectivity*

> *After the mapping of schools has taken place, all existing solutions and interventions for connectivity must be analyzed. In here it is key to look at: the types of interventions currently available, the schools' connectivity requirements, affordable business models, as well as technology and regulatory frameworks.*

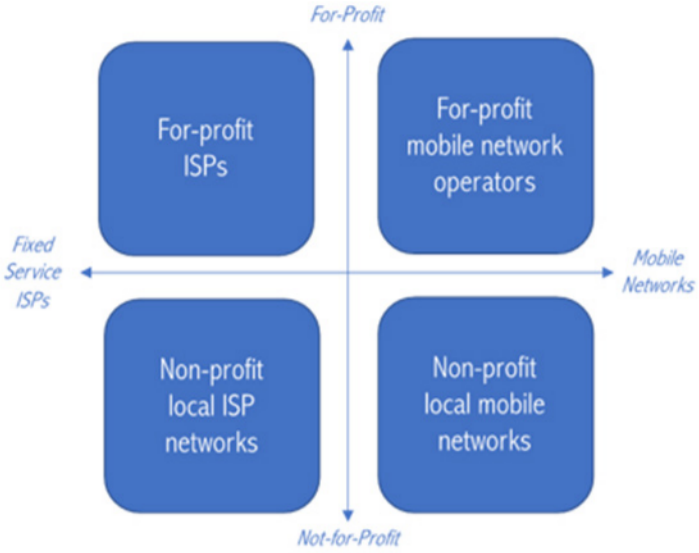
1.1 Types of Interventions currently available

For the past year, the ITU has been analyzing and categorizing about 112 different interventions globally. This analysis has demonstrated that interventions primarily differ along two different axes:

- The **type of network service** (as defined by the primary access network technology utilized), and
- The **focus of the entity of profit generation**.

In the first axes (**type of network service**), interventions focused either on *Mobile network deployments* providing various mobile wireless services (such as cellular or other wireless) including voice and data; or *general Internet Service Providers* (ISPs) who utilized a range of different technologies to provide data focused service. In the second axes (**focus of the entity of profit generation**), interventions are categorized as *not-for-profit* or *for-profit*.

Figure 5. Axes for Categorization of Technology Interventions.[95]



In the case of **For Profit** interventions, both **Mobile Operator Networks (MNOs)** and **Internet Service Providers (ISPs)** operate through licenses; manage CapEx/revenue sharing models, network as a service, or energy and connectivity business models. Both also use a mix of usage based services for voice and data and other paid services as revenue models, and have little to none subsidies (except if benefiting from Universal Services Funds (USFs) to support deployment in marginalized areas). With the exception of spectrum regulation (which is exclusive to MNOs), and Satellite landing rights (exclusive to ISPs), the most common regulatory concerns of **For Profit** interventions include: radio certifications, Telco franchises, rights of way and pole attachment, as well as national, regional and local business licenses.

In the case of **Not for Profit** interventions, both **local mobile** and **local ISP networks** provide services through small networks, usually community operated through collaboration business models, and capture revenue through a mix of paid or low cost services and free access. Both receive partial or full recurring subsidies, and their main regulatory concerns are mostly related to radio certifications, telecommunication franchises, rights of way and pole attachment, local business licenses, and licensed spectrum (for local mobile networks).

1.2 Connectivity Requirements and Usage

When reviewing available options for connectivity, in addition to the analysis of available interventions, it is also important to look at the school's **connectivity requirements** and the intended **usage** of technology (present and future – five years out). Understanding the needs and the usage of connectivity from the user's perspective is key and has to be done before defining the solutions that can address those needs.

[95] Last Mile Connectivity (LMC) Solutions Guide. International Telecommunication Union (ITU), 2020. Forthcoming publication.

A proper analysis of a school's connectivity requirements must consider the needs of teachers, learners, administrators and parents alike.

Governments and bodies seeking to connect schools to the Internet need to evaluate among other factors:

- The actual (and future) need of the school for real time access to data (e.g. real-time video applications, gaming, and online collaboration tools).
- The school needs in regards to bandwidth, latency, and network speed requirements, versus the quality of connectivity that is expected, as well as the distance to backbone.[96]
- The required equipment and devices to ensure access to the Internet at schools and at home (computers, laptops, tablets, personal phones).
- The number and types of activities that will be conducted online and their frequency.
- Expectations of the school in terms of data and content sharing.
- How schools expect to tackle issues such as the "homework gap" and how online learning from home is incorporated in a safe and secure manner. The COVID-19 pandemic exposed the importance for learners to be able to connect from home; any forward-looking school connectivity program must also consider this issue.
- Security protocols to safeguard data and protect children from online dangers and abuse.

These are just some of the elements that need to be taken into consideration, in order to develop a structured plan that not only matches connectivity requirements with the appropriate transfer rates, speeds, and latencies, but also with an engaging learning experience.

*Understanding the **school's readiness** and that of the **country's educational system** is primal to integrating connectivity. School readiness refers not only to technology and infrastructure, but also to the human and regulatory aspects (educators' adoption readiness, regulation, government support, and data privacy policies). It also refers to the readiness of the community to which the school belongs: parents and children's basic knowledge and awareness of the Internet, its benefits and risks.*

Governments must also evaluate the risks of adopting technology and understand the ecosystem of the communities surrounding the school. Communities and traditional leaders play a significant role in accelerating or delaying adoption. Last but not least, measuring the **usage** of connectivity must also consider the "aspirational" factor. Schools need to be ambitious and identify the viability and impact of future scenarios that include better and faster connectivity. The connectivity plan also needs to extend value into the future and allow the school to incorporate new technologies entering the educational space such as the Internet of Things (IoT), augmented and virtual reality, robotics, Science, Technology, Engineering and Mathematics (STEM) experiences, coding and many more wherever possible.

[96] In some countries, primary and secondary schools can also get connected to the Internet by using the backbones of National Education and Research Network (NRENs).



© UNHCR/Sebastian Rich
As part of the UNHCR & Vodafone Foundation's Instant Network Schools Programme, refugee students attending the Angelina Jolie Primary School in Kakuma camp learn computer coding. The training is also supported by the iamtheCODE movement that aims to train 1 million women and girls by 2030.

1.3 Business Models

Once the available interventions have been analyzed and the school connectivity requirements have been documented, it is worth looking at different business models that could provide affordable connectivity especially in the last mile (which is typically where the most difficult challenges for connecting schools reside). A review of regulations and policies favoring the emergence of innovative business models such as: clustering connectivity demands, franchising, community networks, connectivity as a service, and spectrum reuse, must be done in parallel.

The following are some examples of business models that provide certain level of service in the local access last mile network:

- Integrated International Operator: owns national transmission infrastructure, backhaul and last mile access network infrastructure, and may provide retail services.
- Integrated Local Operator: owns the regional backhaul infrastructure and last mile access network, and provides retail services.
- Infrastructure as a Service Operator: owns passive network infrastructure but does not operate active network equipment, nor provides network service.
- Connectivity as a Service Operator: owns active network infrastructure in the last-mile access network but does not provide own branded retail service.
- Last Mile Connectivity Integrated Operator: owns last-mile local access network infrastructure and provides its own branded retail services.
- Last Mile Connectivity Service Operator: Does not own any network infrastructure but provides its own branded services.



© UNICEF/UNI232329/Noorani
Hassan Saleh Musa, class teacher, assists a girl child with her tablet, at the UNICEF supported Debate e-Learning Centre in a village on the outskirts of Kassala in Eastern Sudan.

When evaluating business models that could help increase school connectivity, is always useful to consider different mechanisms to target remote and hard to reach areas by looking at ***aggregating demand*** *and by* ***clustering schools*** *according to socio-economic indicators, proximity to backhaul, urban vs. rural, and Ministries of Education related criteria. Governments must see schools as* ***anchors*** *of the surrounding communities.*

Sustainability is a key issue for investments aimed at providing connectivity. Most initiatives focus their efforts only in financing Capital Expenditure (CapEx) but the major challenge is to build Operational Expenditure (OpEx) business models. There is a need for research, data and evidence showing how different methods of demand aggregation and OpEx business models can work and empower local businesses to innovate and provide last-mile connectivity.

Another recommendation is to explore Business-to-Business models (in parallel to Business to Consumer models) and also hybrid business models instead of purely consumer-based subscription models. Taking advantage of the fact that education can be funded even as a loss, another alternative is to present the issue of school connectivity as an education issue, rather than an ICT issue.

Another approach is to see schools as an anchor **for connecting and uplifting the communities** that surround them. For this, governments should:

- Look at business models that use demand aggregation as a driving factor that pays for investments in connectivity.
- Find what is around the schools, and what are other opportunities for using the school connectivity (e.g. hospitals, markets, health centers, public services).
- Explore the cultural export that connectivity can provide to connected communities.

- Combine school's use of connectivity with other usage (e.g. Wi-Fi Cafés).
- Show the impact and the economic value of school connectivity.
- Consider possibilities for schools to sell excess of capacity to local communities.

By doing this, a stronger case can be made for investing in school connectivity, as the extra connecting capacity could be used and even sold/rented out to local markets, hospitals, farmers and entrepreneurs.

1.4 Technologies and Regulation

> *When it comes to connecting schools to the Internet,* ***there is no one fit all technology****. Connectivity models and interventions must be* ***technology agnostic*** *and respond to specific needs of the target populations. There are many technologies that can support governments' connectivity plans and their efforts for getting schools connected to the Internet. Different technologies can be used depending on the context, the specific connectivity needs and the intended usage. In many instances it might even be required to mix different types of technologies in order to grant connectivity.* ***The end result should be to provide schools with affordable, fast and high quality connectivity, a goal that should be technology independent****.*

For further details on this topic, the Broadband Commission Working Group refers the reader to the ITU's Last Mile Connectivity Solutions guide, which provides a comprehensive repository of the available technologies that can be evaluated for adoption in accordance to specific school settings.

In addition to the available technologies, it is also important to understand which regulations and policies would enable the use of those technologies to provide affordable connectivity. In many countries, the Telecommunications sector tends to be highly regulated, which in turn impacts school connectivity as market restrictions result in less competition, higher prices, poor quality of service and fewer connectivity options. Regulations to the Telecommunications sector can bring both positive and negative repercussions for school connectivity: there may be regulatory restrictions that inhibit schools' connectivity options (e.g. requirement to use only licensed operators or the inability to use certain radio spectrum frequencies); and other regulatory tools that aim at expanding Internet access in rural or remote areas, which can benefit schools by making infrastructure more available.[97] Spectrum for example, is typically an issue for wireless technologies. Nonetheless, in rural areas, spectrum is often available; the problem is rather its reusability. Regulators could/should allow the re-usage of available spectrum in rural areas for school connectivity. Understanding spectrum, license processes and USF usage, should take place before implementing interventions for connectivity as they can either act as road blockers or boosters for increasing access. Regulations and policies should also enable novel innovations, community networks and traditional providers.

[97] International Telecommunication Union, (ITU). (2013). Connect a School, Connect a Community.

2. *Selecting affordable, financially viable and sustainable solutions*

> *Identifying the most feasible and affordable connectivity solution should be an iterative process requiring identification and refinement of the options made within the principles of* ***Affordability***, ***Usage***, ***Financial Viability***, ***Structure*** *and* ***Sustainability***.

After schools have been mapped and clustered, and the already existing options for connectivity have been analyzed, the next step is to identify and select those solutions that better address the connectivity needs of the schools and the local context they find themselves in. In order to achieve this, an iterative process is recommended. This process should include the identification and refinement of technology options made within core dimensions that serve as binding constraints and that can provide direction for any possible solution set. These dimensions are:

- **Affordability:** ensuring that connectivity service user pricing falls within affordability thresholds (e.g. entry-level broadband services in developing countries that are at less than 2 per cent of monthly Gross National Income (GNI) per capita for 1 Gigabyte (GB) of mobile broadband data).[98]
- **Usage**: identifying the applications and services that need to be available, and the level of Quality of Service (QoS), that those applications and services require.
- **Finance Viability**: This includes measuring the economic viability for private investment of the connectivity service, based on estimates of Average Revenue Per User (ARPU), availability of backhaul/middle mile connectivity, options for different local access technologies and the potential QoS level. In the case of schools connectivity projects (as these often are associated with high socio-economic pay offs even with limited financial viability), this principle is more focused towards "efficiency" or choosing the right technology option/business model to connect schools.
- **Structure**: Articulation of the business model of the service delivery, and identifying any regulatory constraints on the model and technologies utilized.
- **Sustainability**: An understanding of the revenue model of the service, and any potential subsidy (one-time, and/or recurring) if necessary.

[98] ITU/UNESCO Broadband Commission for Sustainable Development. (2018). 2025 Targets: "Connecting the Other Half". Target 2. A key aspect of designing potential solutions begins with identifying what price levels of service would constitute as affordable, especially for schools. More details in chapter 2.3 FINANCE School Connectivity.

Figure 6. Dimensions and Iterative Approach for Selecting Technology Solutions for School Connectivity.[99]

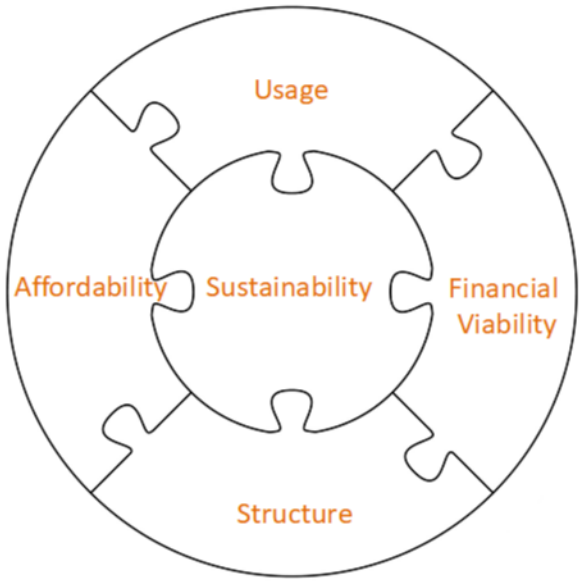


Illustration 69246078 © Patrick Marcel Pelz | Dreamstime.com.

3. *Implementing interventions*

Once the possible solutions have been identified and selected with the iterative approach discussed above, the next step is implementing interventions. There are three types of interventions to increase universal coverage and service for Internet connectivity:

- Policy and regulatory interventions that expand economically feasible service provision.
- Interventions that require one time financing or limited subsidy to de-risk private investment, and
- Interventions requiring recurring public financing support (as service provision is not economically feasible because the market offers insufficient return on private capital investment).

More specific details on the possible economic models for financing school connectivity are described in chapter **3. FINANCE School Connectivity**.

> *Implementing interventions must be done considering present and future usage needs for all stakeholders (students, teachers, administrators, community), and understanding the school and community readiness and that of the education system (learning programs, teacher skills, training needs, percent of computers at schools and homes, child online protection and safeguarding).*

Implementing interventions must also go hand in hand with tools that facilitate the decision-making processes. The Broadband Commission Working Group on School Connectivity

[99] International Telecommunication Union, (ITU). (2020). Last Mile Connectivity (LMC) Solutions Guide. Forthcoming publication.

recommends using the ITU Last Mile Connectivity (LMC) Toolkit as one of the possible tools for this purpose. Further details on the LMC Toolkit and Solutions Guide are covered in the following section.

2.2 Tools for Implementation – ITU's Last Mile Connectivity (LMC) Toolkit

ITU's Last Mile Connectivity (LMC) Toolkit is one of the possible aids that could help assist decision-making processes when selecting and implementing interventions for connectivity. It helps achieve this goal, by creating a platform for information sharing and coordination among last mile connectivity projects that increases last mile connectivity networks. The Toolkit is comprised of: a Last Mile Connectivity (LMC) Solution Guide, interactive software tools, capacity building material and guidelines for assisting implementation.

The Last Mile Connectivity (LMC) Solutions Guide was conceptualized by the ITU as an effort to provide governments, service providers, communities, civil society and technical organizations with a tool to address the lack of telecommunications service delivery (voice and data communications) in developing countries around the world. The solutions presented in the guide can also be used in underserved and unconnected geographies in higher income countries.

The focus of the guide is to identify specific solutions for localities known as "un-served" and "underserved" in terms of telecommunications service, which currently do not benefit from connectivity.

The LMC Solutions Guide has two areas of focus:

1. A focus on **solutions** that can **currently be deployed for affordable communication service to unconnected communities** in developing countries (low-income countries, Least Developed Countries (LDCs), and Middle Income Countries (MICs), as well as a Landlocked Developing Countries (LLDCs), and Small Island Developing States (SIDS)).
2. A focus on the **conditions**, **constraints** and **solutions facing individual localities**, and the solutions helping connect communities with affordable service.

The Solution Guide is divided into four main blocks, which contains the recommended principles for increasing connectivity in the last mile. These principles were already explained in the previous section as part of the Methodology for connecting schools: Identifying unconnected communities; Reviewing the already existing options for connectivity; Selecting affordable, financially viable and sustainable solutions, and Implementing interventions.

For further details and a more comprehensive view on the LMC Solutions Guide, please visit: Last Mile Connectivity (LMC) Solutions Guide. In addition to the LMC Solutions Guide, the Toolkit also includes interactive software tools, capacity building material and guidelines for assisting implementation.

Box 5. Giga. Connectivity Tools.

The Giga Initiative together with ITU are also working on a Broadband Diagnostic Toolkit (BDT), which comprises a set of methodologies, software tools and parameters that allows decision makers, network designers or infrastructure owners to support their decisions about connecting the unconnected.

From the architecture point of view, the BDT is divided into three layers: Methodology, Software & Parameters. The Methodology layer includes two methodologies for technologies selection and cost estimation:

1. For connecting schools to broadband transport backbones;
2. For building local area networks (LAN) in schools.

1. Methodology for technologies selection and cost estimation for connecting localities or schools to broadband transport backbones

The Methodology considers an object as a Switching Node (SN), organized in locality for connecting an access network (last mile) to a broadband transport backbone or a switching node of educational institution (school), for connecting all educational institutions of a locality.

The initial data for simulating are object parameters (geographical location; number of subscribers by groups, etc.), as well as parameters that determine the current state of technology development, the telecommunications equipment market and the country's or regional's economy. Access technologies parameters might incorporate transmission delay, nominal bitrate, transmission medium, equipment characteristics, etc.

The proposed approach is intended to initially determine the required characteristics of the transmission channel and the possible technologies for establishing the necessary channel, and then calculate the quantitative and economic indicators to select the most economically feasible solution.

2. Methodology for technologies selection and cost estimation for building local area networks (LAN) in schools

The methodology allows for selecting a technology solution, and estimating the cost for building local area networks in schools. It operates by school specific data (school complex length; number of buildings in school complex; average number of floors in a building; school complex width etc.), technology specific data (the labor norms for installation and commissioning of equipment and materials, equipment performance, etc.), country/region specific data (mean cost of Ethernet switch, mean cost of Wi Fi access point[1], mean cost of cable, labor costs etc.).

The results of the calculations are provided in the form of necessary CapEx and OpEx that allows calculating the total cost of ownership for different variants and choose the best one from the economical point of view.

[1] Distribution of access points inside schools is an important issue; in some places, schools might have Internet access but no connection in regular classrooms. For example, in Brazil, according to the Center of Innovation for Brazilian Education (CIEB), 96% of urban schools declare having Internet connection for administrative tasks, but less than 19% have connections (Wi-Fi or cable) in regular classrooms.

2.3 Conclusions

Online connectivity provides learners, teachers and administrators with access to new resources and pedagogical tools, state of the art knowledge and instruction methods, as well as new trends in administrative processes, and teacher training. After the mapping of schools has taken place, all existing solutions and interventions for connectivity must be analyzed. Here it is key to have a methodology that reviews and understands: the types of interventions currently available and the schools' connectivity requirements; the intended usage of the technology; affordable business models, as well as technology and regulatory frameworks.

When evaluating business models that could help increase school connectivity, it is always useful to consider different mechanisms to target remote and hard to reach areas by looking at **aggregating demand** and by **clustering schools** according to socio-economic indicators, proximity to backhaul, urban vs. rural, and Ministries of Education related criteria.

The selection of affordable, financially viable and sustainable solutions must be done through an iterative process based on the principles of ***Affordability***, ***Usage***, ***Financial Viability***, ***Structure*** and ***Sustainability***. Interventions must also be selected considering the present and future usage needs for all stakeholders (students, teachers, administrators), and understanding the school and community readiness and that of the education system. Strengthening existing electrical infrastructure and addressing other externalities such as: access to hardware and devices (at school and from home), market conditions, and skilled personnel is also a critical success factor of any school connectivity program. School location and basic indicators of infrastructure needs to be shared across ministries (cross-sectorial data share). This will ensure that integrated solutions will reach the schools in terms of health, Water, Sanitation and Hygiene (WASH), nutrition and others.

Business models for school connectivity should also help increase connectivity in the last mile and in the most challenging contexts, by using the principles of **demand aggregation** and **school clustering**. Governments should see **schools as anchors** for the development of the surrounding communities as they can also (outside regular school hours) act as knowledge and entrepreneurship hubs to entire populations including marginalized groups.

Connectivity models and interventions must be **technology agnostic** and respond to specific needs of the target populations. They also must allow for expansion of economically feasible service provision and cater for one-time financing or limited subsidy interventions that **de-risk private investment**.

Enabling policies and regulatory frameworks should adopt flexible "light-touch", multi-sectorial, forward-looking, neutral and transparent policy and regulatory approaches. These should foster competitive and investment friendly environments, and provide incentive regulations for infrastructure, service and applications development while achieving social goals. School connectivity and the effective management and use of real-time data, can help make and accelerate policy decisions to achieve the SDGs.

The COVID-19 pandemic forced many people to work and learn from home, bringing a lot of attention to the importance of broadband and out of school connectivity. An ambitious (yet realistic) vision of school connectivity should include safe "**out of school**" access to the Internet and should be supported by the appropriate technologies that enable high quality learning. An active involvement of the different key stakeholders, a strong commitment from the government, as well as the local community (including teachers and students), is key for

any effort oriented towards mapping and connecting schools. Recognizing that there is no one-way to connect schools and that all relevant options, technologies and approaches are valid is also a critical element for success.

2.4 Case Studies

This section presents four case studies that illustrate successful examples of:

- National school connectivity plans piloting different technologies to connect rural schools.
- Practices addressing some of the core principles highlighted in the **CONNECT** pillar when implementing connectivity plans.

2.4.1 Nicaragua

Principle Addressed National School Connectivity Plan and piloting differing technologies to connect rural schools.
Project Name Nicaragua's National School Connectivity Plan (Connect a School Connect a Community).
Location Nicaragua.
Date 2010.
Partners • ITU • Institute for Telecommunications and Posts (TELCOR) • Intel
Cost Of the 100 computers distributed, 60 were provided free of charge by the ITU and 40 were donated by Intel Corporation. The Claro-Enitel Corporation offered free Internet connectivity to each of the five schools for the first year.
Situation/Challenge In 2010, an estimated 10 per cent[100] of the population in Nicaragua was using the Internet.
Aim of Project The aim was to connect Nicaragua's rural public schools with ICT access so that schools could serve as community ICT centers for rural, marginal and isolated areas.

[100] International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).

Project Details

Given the 8,154 public schools in Nicaragua, the first step was to create a national plan for connectivity to schools. The ITU committed to cooperate in the drafting of a national school connectivity plan for the country and to conduct a pilot project, which would connect five public schools using different network technologies.

Following a review of policies and regulations in the Nicaraguan telecommunications sector a staged plan was put in place for national school connectivity, which included proposed polices to:

- Eliminate value-added tax for Internet services for schools.
- Setting preferential rates for the educational sector.
- Imposing conditions, such as provision of Internet services to schools at preferential rates, on companies before granting or renewing spectrum.
- Auctioning unused spectrum on condition that the licenses provides free connectivity to schools for the duration of the license.
- Using the proceeds of the Telecommunications Investment Fund (FITEL) to provide Internet services to schools and to finance the purchase of equipment.

For the pilot, children at five remote schools were provided with computers, electricity and Internet access. Internet access was provided via 3G connection, canopy antenna, and Very Small Aperture Terminal (VSAT) technology. In some instances electricity also had to be installed and this was achieved with the aid of solar panels. Each school was equipped with 20 computers and 98 rural schoolteachers were trained in ICT, with each school receiving per week four hours of training on site and four hours online for five weeks.

Results

A total of 921 students, 98 teachers and 2923 people in the communities where the five schools were located, benefitted from the project. In addition the country benefitted from the development of a national school connectivity plan, which could be used to continue the task of connecting schools.

Lessons Learned

As a result of developing the national school connectivity plan, major challenges such as financing, improved collaboration between public and private sector, cultural adaptation to technology, and the importance of capacity building were identified.

In addition, the implementation of the pilots highlighted the use of different technologies for urban and rural areas in future projects, the need to decentralize technical and teaching assistance at the local level, and the requirement for public sector institutions to work in a more integrated fashion.

2.4.2 Suriname

Principle Addressed

National School Connectivity Plan applying principles of the CONNECT pillar.

Project Name

Suriname National School Connectivity Plan (Connect a School Connect a Community).

Location

Suriname.

Date

December 2011 – December 2012.

Partners

- Telecommunication Authority Suriname (TAS)
- ITU

Cost

- CHF 100,000 Regional Initiative Seed Funds (Americas) from ITU
- In-kind contributions from both ITU and TAS

Situation/Challenge

Broadband is not widely available in Suriname, which has one of the lowest broadband penetration rates in the Caribbean,[101]this despite some developments in terms of infrastructure roll-out, e.g. the use of two-way satellite transfer systems (VSAT) to provide access to the Internet in even the least accessible areas. Broadband services are mostly limited to Greater Paramaribo and the main population centers in the coastal strip. According to the Ministry of Education in Suriname, in 2011 less than 3.5 per cent of primary schools in the country had a broadband connection and computer room, and generally only 32 per cent of individuals were using the Internet. Prior to the project, there was no single strategy for connecting schools. Whilst computers and connectivity were readily available in urban areas, this was not true in rural areas. Some of the challenges faced were lack of coordination between public and private sector, inadequate training, lack of local content, outdated legal and regulatory frameworks, and cost.

Aim of Project

1. To assist the government of Suriname in developing a proposal for a National School Connectivity Plan.
2. To promote broadband Internet connectivity for at least two schools in remote or rural areas.
3. To furnish at least one classroom per school with computers and educational ICT equipment and materials.
4. Provide training to teachers.

Project Details

The project aimed to work with the Government of Suriname through the Telecommunication Authority Suriname (TAS) to develop a proposal for a National School Connectivity Plan.

At the end of the project a number of follow on actions were identified:

- Establish a *National School and Community Connectivity Coordination Committee* housed within TAS with participation of TAS, the Ministry of Transport, Communications, and Tourism, the Ministry of Education, and the Ministry of Labor, Technology and Environment to coordinate government initiatives relating to school and community connectivity and ensure consistency and coherence with other policy elements such as education, health and government administration.
- Create a *School Connectivity Forum for Collaboration and Dialogue* on the development of school connectivity initiatives chaired TAS with the participation of government (TAS, the Ministry of Transport, Communications, and Tourism, the Ministry of Education, and the Ministry of Labor, Technology and Environment), parliament, industry and regional and local authorities, donor agencies and other relevant stakeholders.
- Establish a co-chairmanship between TAS and the Ministry of Education of both Fora, with TAS coordinating connectivity issues and ensuring that initiatives are accommodated within regulatory and competitive framework for ICTs, and the Ministry of Education being responsible for education-specific issues such as teacher training, curriculum development, etc.
- Establish clear responsibilities and mandate of participating government entities and agencies.
- Identify coordination mechanisms for content-related input from stakeholders.

[101] B.Claire Downes-Haynes. CANTO. (2016). Consolidation of Summary of Findings and Recommendations of the Four Components of BIIPAC.

Results

Four schools were connected to the Internet and equipped with a computer lab, which also included a printer and scanner. Training was also provided to teachers and managers of the computer labs, also referred to as community ICT centers, as well as to those members of the community who wished to use the centers for their day-to-day social and economic activities. With the assistance of the ITU a draft Suriname National School Connectivity Plan was developed, and in May 2013 the plan was launched.[102]Following the project, TAS is looking at updating some of the existing telecommunications laws, to accommodate competition and convergence through the introduction of regulatory provisions relating to, for example, flexible technology neutral licensing, flexible spectrum policies, universal access and service provisions accommodating convergence, infrastructure sharing, co-location provisions, etc. TAS is also analyzing the best ways to finance school connectivity. One such measure being considered is Universal Access and Service Financing, with a potential focus on how projects, such as free connectivity, can be funded through operator's existing corporate responsibility programs.

Lessons Learned

Members of the community were charged a fee to use the service, thus contributing to the sustainability of the ICT community centers.

School connectivity does not come cheap and it is important to define Total Cost of Ownership as well as mechanisms to ensure sustainability of projects. This includes ensuring that education sector and ICT sector budgets are carefully allocated and managed to ensure the efficient deployment of ICT for use in the education sector. Linked to this, is the fact that resources are generally limited, and therefore some choices need to be made in the allocation of resources, i.e. where to 'put the money'. If scarce public resources must be allocated, the best value for the money is generally sought. The question is how to measure 'value' and 'money'.

Core indicators measure the inputs and outcomes of a program or project and are essential in the evaluation of Information and Communications Technology for Education (ICT4E) initiatives. In order to measure true use of resources, actual consumption of the resources must also be taken into consideration (e.g. number of connections, equipment, etc.) and the cost thereof.

The policy objectives such as better grades, and fewer dropouts, for example, must also be considered. These outcomes are usually brought about by a series of direct and measurable outputs, such as number of students, and number of teachers trained among others.

Finally, it is important to ensure promotion and awareness of initiatives. Policy-makers, school administrators, parents and students need to be acquainted with the multi-faceted opportunities, challenges and constraints of integrating ICT into education.

[102] Telecommunications Authority Suriname (TAS). (2012). Launch of the "National School Connectivity Plan".

2.4.3 Turkey

Principle Addressed
National School Connectivity Plan.

Project Name
FATiH Project.

Location
Turkey.

Date
2010 – ongoing.

Partners
- Ministry of National Education of Turkey (MoNE)

Situation/Challenge
In 2007, only 29 per cent of 25 – 64 year olds in Turkey had achieved an upper secondary level education.[103] Turkey is one of the countries in the OECD with the highest proportion of its population under 15 years of age.[104] In order to ensure that more young people complete their education the Turkish Government introduced a number of policy measures under *the Strategic Plan for the Ministry of National Education* (2010-2014) and the *Tenth Development Plan* (2014-2018).[105] This included legislation to increase the number of compulsory school years from 8 to 12 years in 2012.[106] In addition, as part of the *Tenth Development Plan*, and under the *Information Society and Action Plan (ISAP)*, the government has committed to improve the educational ICT infrastructure and progress towards a more digital society.

Aim of Project
The purpose of the project is to provide equal opportunities in education and improve technology in schools through the use of information communication technology (ICT) by:[107]
- Providing equipment and software.
- Providing educational e-content and management of e-content.
- Ensuring effective use of ICT in teaching programs.
- Providing training to teachers.
- Monitoring ICT usage.

103 OECD. (2009). Education at a Glance 2009 - Survey.
104 OECD. (2020). Education Policy Outlook: Turkey.
105 OECD. (2013). Education Policy Outlook: Turkey.
106 OECD. (2013). Education Policy Outlook: Turkey.
107 FATiH Project. Our Vision & Mission.

Project Details

Specifically the project aims to provide:[108]

- Every school with Virtual Private Network (VPN) broadband Internet access, infrastructure and high-speed access.
- Every classroom with an interactive whiteboard and wired/wireless Internet access.
- Every teacher with Education Information Network (EBA) applications, access to EBA market, cloud account and ability to share course notes.
- Every student access to EBA market, cloud account, digital identity, ability to share homework and individual learning materials.

The EBA was set-up to support the use of ICT materials and ensure that technology is successfully integrated into the education system, as well as being designed for use both at school and at home.[109] The content for EBA is produced by experts in the field (both in Turkey and Internationally) and provided in different formats to ensure relevance for students with different learning styles.[110]

The FATiH project was initially planned to run for 5 years, with Phase 1 focused on high schools, Phase 2 on vocational schools and Phase 3 on primary and pre-schools.[111] All schools were equipped with interactive whiteboards, and tables were distributed to students in secondary schools[112]. The target was 450,000 interactive whiteboards installed and 11 million tablets distributed.[113] Teachers were also provided with training on the use of ICT in education, as well as training on the tools introduced with FATiH.[114]

With regards to infrastructure and connectivity to schools and classrooms, phase 1 aimed to connect 3362 schools, while phase 2 aimed to connect a further 9052 schools. The project looks to install network infrastructure, in the form of routers, switches, and access points, to the principal school buildings, the main buildings, workshops and labs.[115]

Results

Currently there are 47,158 schools, which are included in the FATiH project.[116] By 2015 over 700,000 tablets had been distributed to students in 81 cities and over 200,000 interactive whiteboards had been installed.[117] By 2019 these figures had increased to over 1.4 million tablets distributed and over 430,000 interactive whiteboards installed.[118]

A total of 3,100 schools from phase 1 and 10,500 schools in phase 2 have been connected to the Internet.[119]

108 FATiH Project. Our Vision & Mission.
109 Abtar Darshan Singh, Shriram Raghunathan, Edward Robeck, Bibhya Sharma. IGI Global. (2018). Cases on Smart Learning Environments.
110 Abtar Darshan Singh, Shriram Raghunathan, Edward Robeck, Bibhya Sharma. IGI Global. (2018). Cases on Smart Learning Environments.
111 Nuh Yavuzalp, Melih Derya Gürer, Orhan Curaoğlu, Soner Durmuş, Sedat Akayoğlu, Mehmet Bahar, Fahri Kiliç and Erkan Tekinarslan. International Journal of Research in E-Learning. Vol 1. (1). (2015). FATIH Project in Turkey: A Case Analysis.
112 ERG. (2013). Turkey's Fatih Project: A plan to conquer the dıgıtal dıvıde or a technologıcal leap of faith?.
113 OECD. (2019). Education Policy Outlook 2019: Working Together to Help Students Achieve their Potential. Turkey.
114 ERG. (2013). Turkey's Fatih Project: A plan to conquer the dıgıtal dıvıde or a technologıcal leap of faith?.
115 FATiH Project. Infrastructure and Access Services.
116 FATiH Project. FATiH Project.
117 OECD. (2019). Education Policy Outlook 2019: Working Together to Help Students Achieve their Potential. Turkey.
118 OECD. (2019). Education Policy Outlook 2019: Working Together to Help Students Achieve their Potential. Turkey.
119 FATiH Project. Infrastructure and Access Services.

Lessons Learned
The original design for the EBA platform was criticized for content quality, and the fact that it's hardware and software was not easily adaptable or take advantage of technological developments. Improvements were made, particularly through the use of feasibility and cost-effectiveness studies to ensure that the most sustainable and flexible solutions were selected.[120]

2.4.4 Brazil- Amazonia

Project Name
Amazonia Connected.

Principle Addressed
National school connectivity plans piloting different technologies to connect rural schools.

Location
Amazon Rivers, Brazil.

Date
2015 – ongoing.

Partners
- Brazilian Ministry of Communications (MC)
- Brazilian Ministry of Defense (MD)
- Brazilian National Research and Education Network (RNP)
- Brazilian Ministry of Science, Technology and Innovation (MCTI)

Situation/Challenge[121]
The South American Amazon region covers nine countries and includes about half the area of Brazil. The region is sparsely populated, and the provision of connectivity is challenging given the dense vegetation of the Amazon rain forest. However, the population in this region, while sparsely populated, is mainly concentrated along the rivers, with the towns of Manaus and Belém having populations of more that 2 million people. The main rivers in this area are navigable by ocean going vessels, which are able to reach as far as Iquitos in Peru (a distance of some 3,700 km from the Atlantic Ocean).

Aim of Project
The project aimed to improve connectivity in the Amazon region by improving the availability of broadband and general communications,[122] and to do so by making use of the Amazon rivers to lay fiber optic cables to provide backbone connectivity.[123]

120 World Bank. (2020). International Bank for Reconstruction and Development Project Appraisal Document on a Proposed Loan to the Republic of Turkey for a Safe Schooling and Distance Education Project.
121 Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
122 Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
123 Eduardo Grizendi, Michael Stanton. EUNIS. (2016). Bridging the Digital Divide in Tropical South America.

Project Details

The project worked on the premise that using the Amazon rivers to lay fiber optic cables would be a cheaper and more effective method of connecting the region than through the use of satellites.[124] The project looked to lay fiber optic cables in the Amazon River, Negro River, Branco River, Soimões River, and Madeira River and along the Atlantic coastal waters.[125] It is estimated that the project, once completed, would serve an estimated 7.6 million people living near to the proposed routes.[126] Prior to the start of the project, a small pilot connecting two Brazilian army units (about 7km apart) was connected through sub fluvial cables. Following the success of this small pilot, work began on the first phase of the project, which aimed to provide broadband connection from Coari to Tefé with cables laid along the riverbed using barges between March – April 2016.[127]

The second phase of the project extended the fiber optic cables in the Solimões and Negro Rivers, with the plan to connect Coari to Manacapura, Iranduba, Manaus and Novo Airão.[128]

Results

The first cable was laid in the Solimões River in 2016 from Coari to Tefé, a distance of some 240 km. This was extended a further 500 km in 2017 to link Coari to Manaus, and then along the Rio Negro from Manaus to Novo Airão.[129]

So far, 15 schools and 11 higher education institutions have access to the Internet as a result of this project, with a plan to connect a further 25 schools in the next phase.[130]

In 2019 it was announced that the project Amazonia Connected 2020 would further extend the existing cabling to connect 650 km along the Amazon River from Macapá to Alenquer (a further 650 km).[131]This plan also includes investment by the Ministry of Education to connect 178 public schools in 5 municipalities.[132]

Lessons Learned

During the course of laying the sub fluvial cables it came to light that the same technology was used for the purposes of laying cables for electrical telegraphy from Belém to Manaus in 1895 - 96, showing that there are still lessons to be learned from previous projects, even given the advances in technology.[133]

In this instance, submarine cable technology was much more suited to providing broadband connectivity than other technologies due to the dense tropical forest, low population densities, and poor access by roads, and should be considered for other tropical areas of the world where there are large rivers and dense forests.[134]

[124] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[125] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[126] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[127] Eduardo Grizendi, Michael Stanton. EUNIS. (2016). Bridging the Digital Divide in Tropical South America.
[128] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[129] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[130] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[131] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[132] Information provided to ITU by Brazilian National Research and Education Network (RNP). 23 Jun. 2020.
[133] Eduardo Grizendi, Michael Stanton. EUNIS. (2016). Bridging the Digital Divide in Tropical South America.
[134] Eduardo Grizendi, Michael Stanton. EUNIS. (2016). Bridging the Digital Divide in Tropical South America.

3. FINANCE School Connectivity

Current financing models for the deployment of broadband networks are not delivering affordable connectivity solutions to schools. Finding cost effective ways that grant useful, uninterrupted and relevant connectivity for students, teachers, and school administrators still remains a challenge, and so is finding attractive and innovative mechanisms that encourage operators to invest in last mile connectivity in both developed and developing regions. Deploying new technologies (especially in hard to reach areas) thus remains an expensive endeavor as it does not only include costs of infrastructure and labor, but also regulatory expenses such as spectrum licenses and operating expenses like electricity and power supply. This is why costs of financing school connectivity are typically high (especially in remote and hard to reach areas); this compounded with unreasonably high return rates expectations (based on too high perceived risks) become a huge hurdle for investors.

Finding solutions to address school connectivity challenges depends on understanding the reasons why schools are not connected, as well as on the "**opportunities**" that could be used to maximize investment. Careful identification and assessment of **opportunities** can help reduce cost or increase value so that there is a business case for investment. Moreover, understanding the impact these **opportunities** have in lowering costs and enhancing returns can help create attractive packages for funders and donors. It might even contribute to **de-risk investments** in technology.

To address the affordability of Finance for school connectivity, it is essential to look at four key elements:

1. The need to resolve **information gaps**: when there is lack of information then there is a perceived risk.
2. The need to **improve conditions for investment** through activities like tax reductions, dynamic use of spectrum and infrastructure sharing.
3. The need to make **bids more appealing** through aggregation of demand and advance commitments.
4. The need to expand the **value of connectivity** – through sustainable business models including communities and businesses surrounding the schools.

Alongside affordable finance it is also equally important to ensure that the most cost effective technologies for the geographical, demographical and topological situation are being used. As discussed in the **CONNECT** chapter, combining affordable technology with affordable finance leads to lower and more sustainable entry points.

Another issue to highlight is the longevity of business models: Fiber- long, 3G/4G Medium to Long and Wireless Medium to short. This creates confusion to finance models when trying to forecast risk, Discounted Cash Flow (DCF), Net Present Value (NPV), and Depreciation, causing a mixed model which is hard to separate and finance as one project. When assessing models and bids, it is important to apply different expectations and models to different technologies.

The objectives of the **FINANCE** pillar are to:

- Use the principles of "demand aggregation", lowering cost of infrastructure (through sharing, new technologies and spectrum policies), and the information gathered through the **MAP** and **CONNECT** pillars, to divert funding sources and strengthen the case for investment in school connectivity.
- Provide a methodology to finance school connectivity based on the principles of demand aggregation, a structured approach to costs, and careful analysis of available sources of funding, financial viability and economic sustainability.
- Provide an overview of cost-effective, affordable and sustainable financing models for school connectivity, which generate returns to different stakeholders groups.
- Identify potential **opportunities** that could be used to reduce cost or increase value, resolve information gaps, improve conditions for investment, and expand the value of connectivity.
- Provide an overview of the risks associated with connectivity infrastructure projects, as well as some of the potential instruments and policies that could help share or mitigate those risks in order to attract investors.

This chapter summarizes the learnings, proposals and financial models coming out of the advisory process provided by the Broadband Commission Working Group on School Connectivity to the Giga Initiative on the **FINANCE** pillar. It introduces the approach of "aggregating demand" through the lenses of the Giga initiative, and explains how the approach evolved from the concept of "organizing common bids or clustering connectivity demands" to "facilitating access to finance school connectivity". Although ICT devices, tools, and equipment are important items to consider when developing cost structures for school connectivity plans, the models presented in the **FINANCE** pillar do not take into account these costs. The advisory process provided to Giga by the Broadband Commission Working Group on School Connectivity focused only on the connectivity infrastructure and post-connectivity services piece, which are considered to be the hardest to fund today. To address this issue, Giga envisions leveraging partnerships with other organizations like UNESCO, the World Bank, and national governments that are more active in the device procurement space. The financial returns model presented in this chapter also does not include specific details on debt and equity terms (e.g. interest rate, coupon rate, cost of money, etc.) as those will heavily depend on negotiations; nor will it give a final, accurate Internal Rate of Return (IRR%) for investors, as these are heavily dependent on deal terms and more precise data. The structure however, will allow for a more accurate answer to these questions in the near future.

3.1 Methodology and financial model for school connectivity

1. Aggregating demand

> ***Aggregating demand*** *can help tackle costs, generates economic returns and brings further investments by clustering attractive opportunities for investment thus creating "clusters of connectivity demands", which could reduce information asymmetries, fragmented offerings and models, and ultimately lower the costs of deploying or expanding connectivity.*

The conceptualization of the approach on "aggregating demand" comes from a previous analysis done in 2018 by the Digital Impact Alliance (DIAL),[135] which explored the analogies and differences in applying the model of the Global Alliance for Vaccines and Immunizations (GAVI) and current challenges to bridge the digital divide.[136] Some of the issues and challenges analyzed include:

- Financing for the provision of broadband services in developing countries.
- Return on investment for digital solutions.
- Role public policies on data can play in reducing the cost of services provision.
- Fragmentation (or extending digital solutions for specific verticals).
- De-risking investment in technology and the role of public funding.
- Assessment of investment levels (for deployment, as well as for building capacity and sustainability).
- Governance and business models.

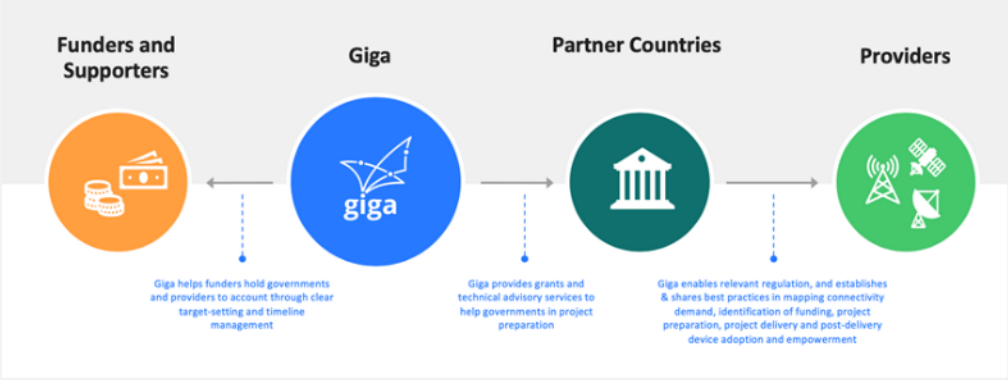
[135] Digital Impact Alliance.
[136] Digital Impact Alliance. (2018). Financing Digital Markets: What Vaccines Can Tell Us About Scaling Digital Technologies in Low-and Middle-Income Countries.

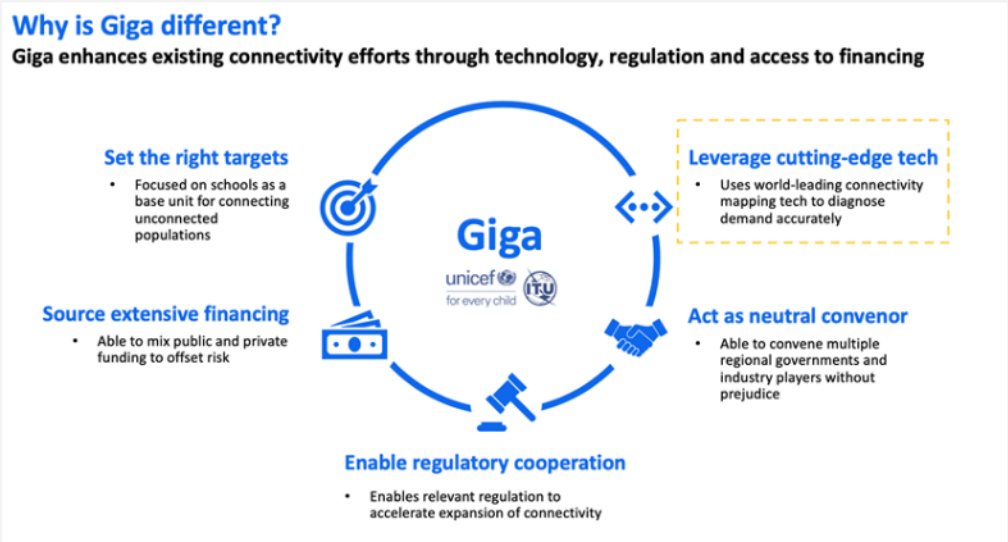
Box 6. Giga. From Aggregating Demand, to Facilitating Access to Financing School Connectivity.

The initial concept of Giga was articulated around the idea of "aggregating demand" and organizing a common bid/or the clustering of connectivity demands, that could bring down the costs of deploying or expanding connectivity.

The concept builds on the lessons learned from GAVI, the Vaccine Alliance, which managed to transform the delivery of vaccines in developing countries through the aggregation of demand. Using this initial analogy, Giga would use the information gathered through the **MAP** pillar to organize "clusters of connectivity demands", for use in the technical specifications, to deliver the solutions for school connectivity identified in the **CONNECT** pillar.

Building from this initial concept, Giga brought the lessons learned from previous analysis conducted in 2018 by the Digital Impact Alliance (DIAL)[1]. Giga acts as a convener between funding opportunities and connectivity projects for schools in disconnected areas and, ultimately, their surrounding communities; to facilitate funding opportunities, Giga provides critical information necessary to structure multi-stakeholder projects, and identifies the magnitude of interventions needed to bring each actor to the table.





[1] Digital Impact Alliance. (2018). *Financing Digital Markets: What Vaccines Can Tell Us About Scaling Digital Technologies in Low-and Middle-Income Countries.*

Box 7. Giga. Stakeholder Groups for Financing School Connectivity.

Through the FINANCE pillar, Giga aims at providing services to three key stakeholder groups: **Funders and supporters**, **Countries**, and **Providers**. The aim is to support these groups in the following way:

1. **Funders and Supporters:** by helping hold governments and providers to account through clear target setting and timeline management. Giga has received statements of interest from a variety of country donors, development banks, sovereign wealth funds, private sector operators and donors, including but not limited to Norway, Finland, Denmark, and the United States Agency for International Development (USAID).
2. **Countries:** by providing grants (subject to funding availability) and technical advisory services to help governments in project preparation. During its first year, Giga will focus on 13 countries: four in Sub-Saharan Africa: Rwanda, Kenya, Niger, Sierra Leone; three in Asia: Kazakhstan, Kyrgyzstan, and Uzbekistan; and six in Latin America and the Caribbean: El Salvador, Honduras, Dominica, St. Lucia, and St. Vincent and the Grenadines and Granada.
3. **Providers:** by enabling relevant regulation and by establishing best practices in mapping connectivity demand, appropriate funding, project preparation, project delivery and post-delivery device adoption and empowerment.

The combination of these solutions allow Giga to act as an impartial and technology-neutral broker for connectivity opportunities, articulating the economic case for school connectivity, providing transparency to funding availability, and setting best practices across countries.

Aggregating demand may be difficult across countries that do not belong to the same geography, since investors tend to apply a regional/national focus in their decisions.

*When possible, aggregating demand can provide an opportunity to combine **different levels of risks** in the same "package", facilitating access to finance to those countries/ locations that may be perceived as higher risks and making the overall package more interesting to investors.*

This would also allow "less attractive" investments to have the opportunity to mobilize funding, otherwise, the amount of grant money required might be quite significant, which in turns make school connectivity projects more costly. In addition to geography, demand aggregation can also be done by technology (e.g. software services) and by type of infrastructure. Depending on the approach taken, the interest from investors may differ.

As highlighted earlier in the **CONNECT** pillar, governments should look at business models that use the demand aggregation of schools to explore other opportunities for using school connectivity to the benefit of local hospitals, markets, health centers, public services, and the community at large.

The COVID-19 crisis exposed the issue of education not being confined exclusively to schools as physical venues. However, ***schools are (and should continue to be) an important element of demand aggregation****. They are physical places to which students can relate to and benefit from a safe and secure space to learn. Moreover, they are also neuralgic cells, which can act as an* ***anchor*** *for connecting and uplifting the communities that surround them, and making a more attractive case for investment in un-served and underserved areas.*

2. Costs Structure for School Connectivity, Funding, and Expected Returns

The costs associated with school connectivity are substantial and represent a significant economic burden to the education community. As highlighted in the ITU Connect a School, Connect a Community report,[137] initial economic costs for connecting schools are largely based on the telecommunications costs for providing connectivity, the hardware costs associated (computers, learning devices, mobile devices, network infrastructure, file services, wireless local area networks, etc.) and the Total Cost of Ownership. Total Cost of Ownership includes costs of deploying infrastructure platforms, which go beyond the costs of computers and connectivity: cost of accessing electricity in places where there is no electricity grid; the cost of security and electricity; cost of replacing equipment; hardware and software peripherals; maintenance costs; content and applications related costs; user training and support; technical support, as well as monitoring and evaluation related costs.

Every school around the world is different, and so are their demands and needs for connectivity. Keeping schools connected to the Internet in ways that are useful not only to learners, but also to teachers, administrator and parents, differ from place to place as it does the approach on how to pay for these costs.

Costs for school connectivity can be categorized into two main groups: those related to Connectivity Infrastructure and those related to Community Empowerment. Hereunder some examples of the types of costs covered within each category.

Connectivity Infrastructure related costs:

- Includes the capital expenditure on build out costs for infrastructure for power, middle and last mile connectivity.
- It also includes the annual operational costs to cover not only initial connectivity, but also the costs of expanding and sustaining Internet access including maintenance, labor, electricity, and security among others.

Community Empowerment related costs:

- Includes seed and early stage funding for new social enterprises and community businesses that leverage connectivity, e.g. financial payment platforms, tele-health and tele-learning providers, to mention some.

While it is true that connectivity costs can be significant, it is also true that multiple sources of funding are available. Funds for financing school connectivity can come from governments,

[137] International Telecommunication Union, (ITU). (2013). Connect a School, Connect a Community.

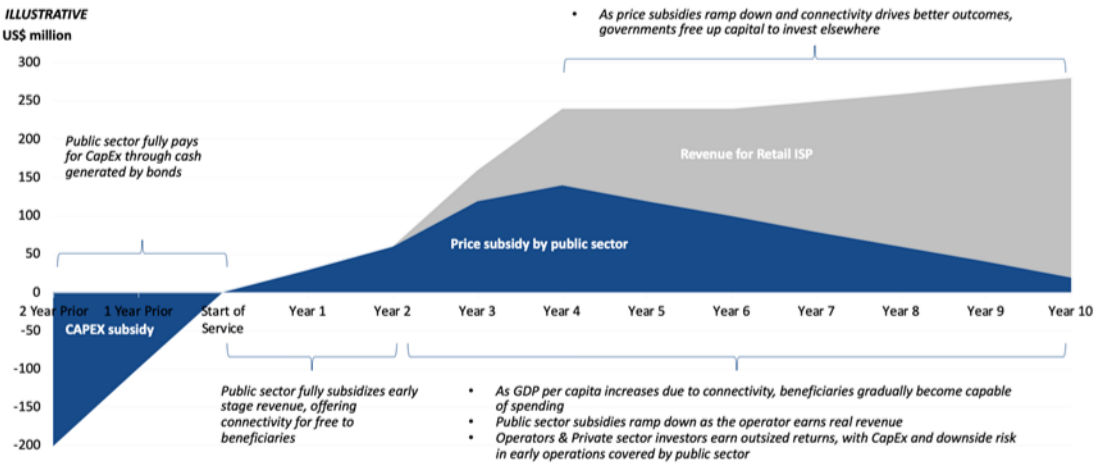
private operators, multilateral organizations and donors, the private sector at large, and Non-Governmental Organizations (NGOs).

Connectivity infrastructure costs can ideally be funded by a combination of efforts from the public and private sectors. This includes government funding, which is likely to come from a variety of sources, ranging from connectivity infrastructure funding through Universal Service Funds (USFs), to education infrastructure funding through education sector plans. Funding for connectivity infrastructure costs can also come through loans and grants from foreign donor governments, grants from bilateral donors and foundations, standard interest loans and project preparation facilities from development banks, and equity/debt from private investors. Pooling funding from these various sources facilitates the broader goal of making an economic case for connectivity *specifically* in educational contexts. Governments should allow for the participation of multiple stakeholders in the funding of school connectivity plans through the establishment of partnerships, and encourage better coordination across several entities including Ministries of Technology, Education, Innovation and Science, as well as with telecom operators. This is a major challenge that requires Governance, and well-defined responsibilities and accountabilities.

Public funders, including governments and development banks are expected to fully fund CapEx for last mile connectivity and power infrastructure build out; partially fund annual operational costs such as maintenance and labour, and partially price subsidise users. Private funders (e.g. private companies, MNOs, institutional funds and ultra-high-net-worth individuals) are expected to partially fund annual operational costs, and partially price subsidize users with a cap on subsidy amount to ensure public funders cover the majority of subsidies. As a result of this funding structure, public investors are expected to pay off necessary debt interest with low to zero returns.

> *Leveraging **public sector funding** to subsidize the creation of fast-growing connectivity markets enables private investors to achieve outsized returns comparable to those of typical private sector infrastructure financing projects.*

Figure 7. Business Model for the Return on Investment (ROI) of School Connectivity.



Community Empowerment related costs could ideally be funded by traditional private sector venture capital and/or small-scale growth equity funds. In some instances, these may be impact investment funds, enclosed within development institutions or NGOs. Venture Capital funds are expected to contribute small to medium cheque sizes (e.g. US$ 100K- US$ 500K) into local social enterprises and community businesses, with an emphasis on companies that leverage connectivity to provide services that kick start local economies. For example, financial payments, e-Commerce, remote learning and healthcare platforms can all encourage local households to adopt connectivity and Internet-based transactions, lowering living costs and enhancing development outcomes. These types of funds are expected to generate high-risk, high-return profiles similar to typical early stage venture capital investments.

Table 2. Summary - Cost Structure for School Connectivity, Funding and Expected Returns.

Cost Category	Costs	Possible Sources of Funding	Possible Financing Mechanisms	Expected Returns
Connectivity Infrastructure	1. CapEx on build out costs for infrastructure for power, middle and last mile connectivity 2. OpEx in maintenance, labor, electricity and security	**MIXED: Public and Private Funding:** • Public: Government funding (including USFs and education infrastructure funding through education sector plans); grants and Loans from foreign donor governments, bilateral donors and foundations; standard interest loans and project preparation facilities from development banks and Development Finance Institutions (DFIs) • Private: Equity/ debt	**Public Financing:** • Fully fund CapEx for middle and last mile connectivity and power infrastructure build out • Partially fund annual operational costs • Partially price subsidies users • Private Financing: • Partially fund annual operational costs • Partially price subsidizes users with cap to subsidy amount	**Public Investors:** Usually fixed/low financial returns coming from license fees from retail ISPs or tax revenue through GDP growth driven by connectivity **Private Investors:** Attractive returns comparable to typical private sector infrastructure financing projects either from license fees from retail ISPs or enhanced returns through CapEx subsidies from other sources
Community Empowerment	Seed and early stage funding for new social enterprises and community businesses that leverage connectivity	**Private Funding:** • Venture capital and/or small scale growth equity funds • Private Sector + Development institutions or NGOs through impact investment funds	**Private Financing:** • Contribute small to medium cheque sizes (e.g. $100K-$500K) into local social enterprises and community businesses that leverage connectivity	**Private Investors:** Will earn high-risk, high-return profiles similar to typical early stage venture capital investments

3. Opportunities to enhance impact

The concept of **"opportunities"** in the FINANCE pillar refers to additional products ranging from regulatory reform, demand aggregation, infrastructure sharing and other tools that can be used to enhance impact in the process of sourcing, financing, implementing, and sustaining connectivity projects.

The table below illustrates some of the "**opportunities"** that have been discussed in the working sessions of the Broadband Commission Working Group on School Connectivity. They are grouped in four categories according to the goal/challenge they aim to address:

- Resolve information gaps
- Improve conditions for investment
- Make bids more appealing, and
- Expand the value of connectivity

Table 3. Opportunities, Impact and Outcomes.

GOAL	OPPORTUNITY	IMPACT	OUTCOME
Resolve information Gaps	Data and information	Decreases Cost, Increases Investment Value	Accurate data about expansion opportunities de-risk investments by appropriately sizing and locating the market, and highlighting areas of outsized opportunity
Improve Conditions for Investment	Tax reductions, waivers	Decreases Cost	Has potential to decrease costs for most stakeholders, influencing decisions to invest in connectivity and/or purchase data
	Spectrum licensing (fees, reframing)	Decreases Cost (to providers)	Decreases costs (CapEx, OpEx) and reduces barriers to entry for smaller providers that can increase competition and lower prices
	Infrastructure sharing (active and passive)	Decreases Cost (to providers)	Decreases CapEx costs
Make Bids More Appealing	Risk mitigation instruments	Decreases Cost (to debtors)	Reduces risk by insuring or guaranteeing against risk-trigger events
	Big upfront public funding (e.g. $1b)	Decreases Cost	Decreases costs and reduces risk, in part by signaling a broader public commitment
	Demand aggregation / pooling	Increases Investment Value	De-risks the investment in CapEx
	Advanced market commitment	Increases Investment Value	De-risks the investment in CapEx
Expand Value of Connectivity	Decentralized financing / hub and spoke economic model (i.e., block chain)	Increases Investment Value	Potential to increase economic growth and "unknown return"
	Real-time connectivity monitoring	Increases Investment Value	Improves the efficacy of connectivity to increase education outcomes, economic growth, government investment return by ensuring there is successful delivery of access

4. Political and Regulatory Risk Mitigation Instruments

Having modern and efficient infrastructure is a pre-condition to ensure the long- term success of connectivity plans. As it has been discussed earlier, the required level of investment for infrastructure related projects is quite significant and so, it cannot be raised in isolation by the public sector. Private sector intervention and funding is needed to fill the gap; however, private investors tend to be careful in these types of investments due to the long-term nature of the projects, which tend to outlast political cycles, and the political and regulatory risks impacting their potential costs and revenue schemes.

Infrastructure projects face a variety of challenging risks that spread throughout the different phases of a project: ***planning, design and construction*** (activities prior to the commissioning of an asset); ***operation*** (operation and maintenance of the infrastructure asset) and ***termination*** (decommissioning or end-of-contract related activities).[138]

Some of the risk factors can be categorized as follows:

- **Business Risk Factors** (related to physical conditions, demand side, project's business partners and own performance).
- **Sovereign Risk** (related to chances of national governments treasury or central banks defaulting on sovereign debt).
- **Regulatory Risks** (affecting the specific infrastructure project, the industry sector or the entire economy).
- **Macro and Socio-economic Environment Risks** (economic crises, exchange rate and interest rate volatility, inflation, ageing society, xenophobia, etc.).
- **Force Majeure Risks** (war, terrorism, civil disturbance, labor strike/industrial action, and natural disasters).

During the ***planning, design and construction phases***, an infrastructure project might be subject to risks such as: cancellation or change of scope (typically coming from changes in government leadership); risks associated with permits, which might be delayed and influenced by the outcomes of environmental and social-impact studies; and risks associated with the community acceptance of the project. During the ***operation phase***, the risk of expropriation is a fundamental political risk for private infrastructure owners; others include the risk of breach of contract, and risks coming from the operating regulation of the infrastructure asset. Some of the risks impacting the ***termination phase*** of infrastructure related projects include: risks related the duration or renewal of the concession, risks related to the transfer of the asset or it's decommissioning. Additional risks that affect an entire sector or the economic conditions of a country or region as a whole include: risks coming from industry regulation or taxation changes, risks associated with currency transfers and convertibility, judicial risks and risks of corruption and market disruption.

Through the **FINANCE** pillar, the Broadband Commission Working Group on School Connectivity has provided advice on some instruments for political and regulatory risk mitigation in ICT connectivity that are easy to deploy and execute. At the moment of writing this report, the development of these instruments was still in its preliminary phase. For illustration purposes, some of the key ideas around those discussions are summarized in the table below.

[138] World Economic Forum. (2015). Strategic Infrastructure. Mitigation of Political & Regulatory Risk in Infrastructure Projects.

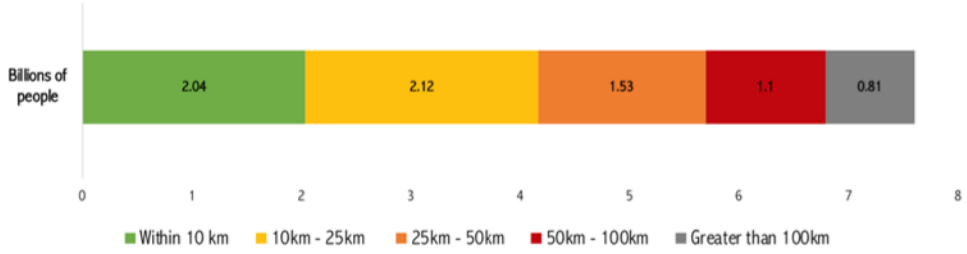
The development of *proactive* ***risk mitigation measures****, including and in particular* ***political and regulatory*** *risk mitigation will be essential to attract investors.*

Table 4. Some Examples of Political and Regulatory Risk Mitigation Instruments.

Instruments	How it works	Typically offered by
INSURANCE	Insurance policy with long lock-in periods (e.g. 15 years), paying out for risk trigger events Typically insured against well-defined trigger events e.g. Expropriation, Breach of Contract May include 'First-Loss' policies	Multilateral organizations: • Political/regulatory risk insurance providers, e.g. World Bank Multilateral Investment Guarantee Agency (MIGA) • Development banks, e.g. World Bank, African Development Bank (AfDB), Asian Development Bank (ADB) Private insurers: • Private insurance and Reinsurance companies National providers: • Export credit agencies • Governmental donors and development agencies, e.g. the Overseas Private Investment Corporation (OPIC USA)
RISK GUARANTEES	Guarantor repays loan partially or in full to debtor, in case of borrower default Typically offered on a project-by-project basis, mostly to developing countries May include 'First Loss' policies	
HEDGING & DERIVATIVES	Influences cost of debt and the breakage costs in termination compensation Hedge counterparties (e.g. a bank) formalizes the sharing of security and arrangements on default, with limited recourse • Interest rate swaps – to manage exchange rates to convert variable rate debt to fixed rate debt • Currency swaps – to manage FX movements • Commodity derivatives – to fix commodity prices	International financial institutions (e.g. the International Bank for Reconstruction and Development (IBRD))

5. Financing School Connectivity in the Last Mile

Figure 8. Population within Reach of Fiber. March, 2019.[139]



Note: Not cumulative; figure depicts population within category not inclusive of lower thresholds
Source: International Telecommunication Union (ITU)

Fiber optical cable networks provide high-speed data connectivity, but they typically do not reach populations outside of urban and suburban areas. As depicted in the figure above, around the world, only 2 billion people are within ten kilometers of current fiber optic cable networks; this suggests that the vast majority of the world's population still does not have even the potential access to fiber networks because of a lack of geographic proximity.[140] Middle and last mile networks are built to complement international and national networks. The term "Last Mile" is often used to describe the infrastructure carrying signals from the "Middle Mile", along the relatively short distance "Last Mile" to and from the home or business. As it was highlighted earlier in the **CONNECT** pillar, in this report, the term "Last Mile" identifies those localities that are currently un-served and underserved in terms of telecommunications services, and which do not benefit from connectivity and the link to the global network of voice and data communications.

> *Financing connectivity should be **technology agnostic** and establish a model that awards business to the most appropriate solutions based on specific connectivity requirements. Identifying the most feasible and affordable connectivity solution should be an iterative process requiring identification and refinement of the options made within the principles of **Affordability**, **Usage**, **Financial Viability**, **Structure** and **Sustainability**.*

As discussed in the **CONNECT** chapter, **financial viability** includes measuring the economic viability for private investment of the connectivity service, based on estimates of Average Revenue Per User (ARPU), availability of backhaul/middle mile connectivity, options for different local access technologies and the potential Quality of Service (QoS) level.

It is worth stressing that financial viability of establishing service (taken from the point of view of the investor into the project, whether it is a commercial investment or subsidized deployment) is different from gauging the affordability of the service provided (taken from the point of view of individuals in the prospective under-served community). While financial viability is dependent on revenue generation, presumably coming from paying consumers (and impacted

[139] International Telecommunication Union, (ITU). (2019).
[140] International Telecommunication Union, (ITU). (2020). Last Mile Connectivity (LMC) Solutions Guide. Forthcoming publication.

by geographic and technical considerations, as well as regulatory requirements and policies[141]), viability is not a function of whether these customers are higher or lower income, or if they are business and organizations instead of users. What matters for viability is that the revenue generation can cover the costs of deployment. In the case of schools connectivity projects (as these often are associated with high socio-economic pay offs even with limited financial viability), this principle is more focused towards "efficiency" or choosing the right technology option/business model to connect schools.

Affordability, particularly measure of broadband affordability that focuses on 2 per cent of monthly GNI per capita, on the other hand is focused at the consumer population. So whereas a deployment may be financially viable from the perspective of a service provider by providing connectivity service to higher income consumers (or businesses), that particular deployment would not be serving an affordability goal. A key aspect of designing potential solutions begins with identifying what price levels of service would constitute as affordable.

One approach would be to identify affordability thresholds of 2 per cent of month GDP per capita (GDP pc), as well as 5 per cent for sensitivity analysis, using national averages. A more granular approach would consider regional or local average income levels that can be obtained from statistical agencies with-in the country of focus. These affordability figures would then serve as guidepost for determining which types of service would be deemed affordable, keeping in mind that the 2 per cent of monthly GDP pc is for 1 GB of mobile data.

> ***Affordable*** *and* ***economically sustainable financial models*** *for last mile connectivity must engage the community who would be the customers of the new service, in a participatory, multi-stakeholder process.*

When estimating the cost of deploying infrastructure it is not always a question of new network built. Building new towers in rural locations is expensive whereas sharing the costs of network deployment to the extent possible for the last mile could positively impact the financial viability and affordability of models. Another possibility would be open access networks.

In addition to viability and affordability, financial models for school connectivity also need to be economically sustainable. Economic **sustainability** in this context goes beyond revenue modeling and takes into account the longer-term viability of the intervention, thereby ensuring that operating expenditures as well as future growth and upgrades are taken into account. Sustainability also depends on the existence of capacity building, as well as content and services delivery mechanisms and the possibility to create a balance between financial, social, organizational, and policy related interests.

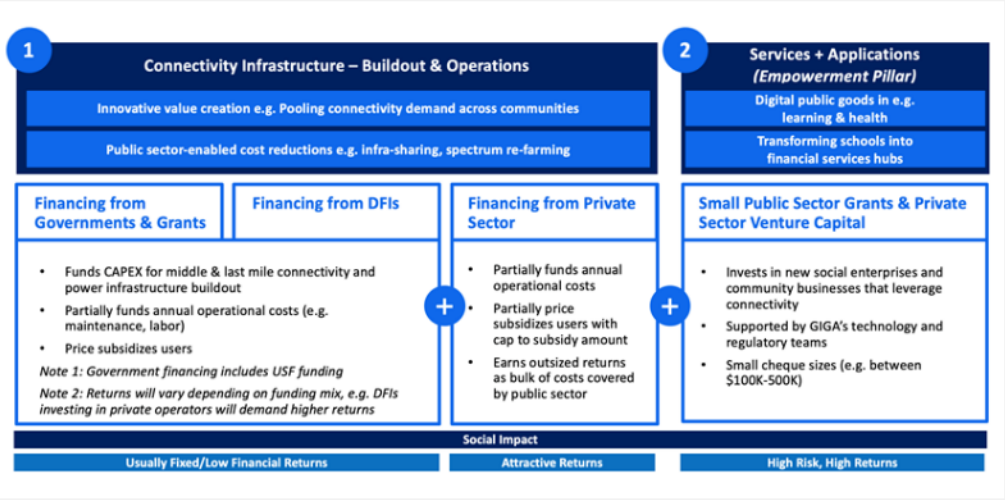
[141] Some examples of regulatory policies include: ISP licensing, Spectrum use, Universal Access and Service Funds, Universal Service Obligations, and Tariff arrangements.

Box 8. Giga. Financial Services Model.

When countries engage with Giga, UNICEF and ITU intend to support them in the development of school connectivity end-to-end: from aligning the vision of the project, designing the necessary governance, financing and technology choices, building bid packages, to implementation and long-term performance monitoring.

Giga intends to provide services that support country governments to develop their case for investment through data transparency, regulatory reform, and public financing. On the other hand, Giga packages and develops investment opportunities in coordination with private funders and implementation companies to form a successful bid.

To generate financial returns for funders and supporters, Giga aims to leverage public sector funding to subsidize the creation of fast-growing connectivity markets, allowing private sector funders to achieve outsized returns.



Giga envisions private sector financing to be available through a variety of instruments. Here below an illustration, which at the moment of writing this report was still in its conceptualization phase.

Potential Instruments	How it works	Return profile
Multilateral Connectivity Bonds	• Giga establishes a consortium of country donors to make long-term financial pledges towards connectivity improvement • A development bank acts as treasurer to convert long-term pledges into bonds, regularly vetted by rating agencies • Investors purchase bonds with regular repayments funded by above pledges	• Low Risk, Moderate Returns • Similar to IFFim 'vaccine bonds' established by GAVI
National Digital Impact Bond	• Giga facilitates a recipient country to convert its USF funding into an Impact Bond, with risk guaranteed by additional donor pledges	• Low Risk, Moderate Returns • Similar to IDB digital impact bond in Honduras
Connectivity Infrastructure Securities	• Giga partners with national governments, public sector banks and operators to convert illiquid connectivity infrastructure into tradeable securities • Giga supports credit enhancement of such securities with donor grants, government funding, debt layering etc. • Investors repaid through infrastructure license fees to retail ISPs	• Moderate Risk, Moderate Returns • Dependent on de-risking effectiveness
Equity in Operators	• Giga identifies operators who will build and operate connectivity infrastructure in the target country • Investors purchase public or private equity in these partners, with standard returns and exit options (e.g. dividends, M&A, IPO... etc.)	• Low Risk, Moderate Returns • Stable cashflows especially where operators have strong market position
Venture Capital Investing	• Giga creates Venture fund investing in social enterprises and community businesses leveraging connectivity in recipient countries • Investors access exclusive Seed and Series-A stage funding opportunities	• High Risk, High Returns • Similar to typical early-stage VC investing

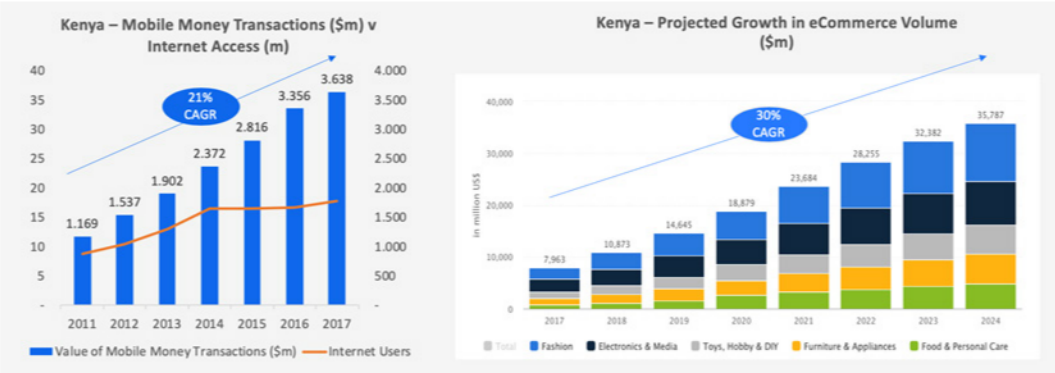
Furthermore, to model returns more concretely on a country-by-country basis for different investor types, Giga is constructing return models covering various connectivity solutions, costs and investment value creation possibilities.

3.2 Why investing in school connectivity

As it has been highlighted throughout this chapter, from the economic point of view, investing in school connectivity creates specific sources of revenue for different stakeholders. Through government bulk purchases of connectivity from wholesale operators, prices are compressed by pooling demand in communities, and revenue is generated from license fees for access to connectivity paid by retail operators. Moreover, and as it has been discussed already, using schools as anchors and units for aggregating demand, extends the benefits of connectivity to the surrounding communities. As GDP per capita increases due to connectivity, community members become capable of spending, and tax revenue can be collected from this connectivity-driven GDP growth.

Investing in connectivity fosters economic growth and consumer spending power. Building infrastructure generates direct benefits coming from increase in employment and economic product through the purchase of raw materials to build network infrastructure. Starting with schools, and continuing with newly connected communities, the Internet can be used not only for learning, but also for expansion of community driven businesses that strengthen local ecosystems. Access to connectivity, creates ancillary, fast-growing markets and online transactions, bringing consumer spending to an exponentially growing e-Commerce secstor.

Figure 9. Kenya's Example - Value of Mobile Money Transactions and Projected Growth in e-Commerce.[142]



Furthermore, investing in school connectivity might also have an impact in education outcomes, and in the overall empowerment of individuals. Education and connectivity widen the opportunities of young people and improve the outlook of those attending school. Investing in school connectivity can also have a spill over effect and accelerate the creation of further socio-economic opportunities that uplift entire communities.

142 IMF. (2020). Financial Access Survey. Statista. Keyna eCommerce Market Estimates.

3.3 Conclusions

Finding solutions to address school connectivity challenges depends on understanding the reasons on why schools are not connected in the first place, as well as on the "**opportunities**" that could be used to maximize investment. Careful identification and assessment of "**opportunities"** can help reduce cost or increase value so that there is a business case for investment. Understanding the impact of "**opportunities"** in lowering costs and enhancing returns can help create attractive packages for funders and donors. It might even contribute to **de-risk investments** in technology.

Although the costs and risks of investing in school connectivity and increased broadband access are significant, the cost and risks of inaction are way higher. School connectivity has the potential to bring in long term returns through **economic growth** coming from more skilled and knowledgeable populations that create stronger digital economies with higher consuming spending power. Ensuring affordability of access to reliable, fast and secure networks (as well as to devices and equipment) is of utmost importance to guarantee long-term success in any school connectivity plan.

Aggregating demand can help tackle costs, generates economic returns, and brings further investment by:

- Helping organize the **clustering** of demand for attractive investment opportunities, which reduce information asymmetries, fragmented offerings and models, and lowers costs of deploying or expanding connectivity.
- Providing an opportunity to combine **different levels of risks** in the same "package", facilitating access to finance to those countries/locations that may be perceived as higher risks and making the overall package more interesting to investors.
- Using schools as **anchor** for aggregating demand of larger communities, making a more attractive case for investment in un-served and underserved areas.

When building a **case for investment** in school connectivity projects, governments must think of models that target the interests and needs of several stakeholders according to key principles that ensure inclusiveness and openness. This can be achieved by:

- Using principles for **data transparency**, **regulatory reform** and **public financing** to help establish the "case for investment".
- Leveraging **public sector funding** to subsidize the creation of fast-growing connectivity markets, that allow private sector funders to achieve outsized returns.
- Developing **cost models from the bottom up** (by using school location and user profiles to determine school bandwidth needs, the appropriate last mile technology solutions and the costs to procure and maintain that technology), which help develop targeted and more structured investment and business models.
- Introducing concepts such as cost sharing of **network deployment** to the extent possible for the last mile; this helps strengthen the business case and ensures inclusion of un-served and underserved populations.
- **Combining private and public funding** and establishing **partnerships** to cover connectivity infrastructure, build out, and operation costs to offer a more holistic approach to financing of school connectivity.
- Using **private venture capital** to cover community empowerment related costs that could contribute to the development of local entrepreneurship ecosystems.
- **Projecting revenue from the economic growth** and Internal Rate of Return (IRR%) from connected communities.

- Using **best practices** in **accountability** and **governance** to help assess the level of investment needed for deploying solutions, building capacity, and ensuring economic sustainability.

Financing connectivity should be **technology agnostic** and establish a model that awards business to the most appropriate solutions based on specific connectivity requirements. Identifying the most feasible and affordable connectivity solution should be an iterative process requiring identification and refinement of the options made within the principles of **Affordability**, **Usage**, **Financial Viability**, **Structure** and **Sustainability**. Open competition and infrastructure sharing can help in that endeavor. Developing a **holistic approach** enables the overall sustainability of connectivity plans; a holistic approach includes boosting the demand side, ensuring access to relevant content and services (including government services), and building capacity to teach the skills needed to go online and be able to use those tools. Any government support for broadband networks aiming for a holistic approach should ensure that these issues have been addressed, to increase uptake and usage, which in turn will help to promote further investment.

Regulatory frameworks that stimulate competition by lowering access practices as well as innovative ways for reaching out to un-served and underserved populations are also important, especially for the achievement of the 2025 Broadband Commission targets and the Sustainable Development Goals. Proactive **risk mitigation measures**, including and in particular political and regulatory risk mitigation will be essential to attract investors.

3.4 Case Studies

3.4.1 Malawi

Principle Addressed Using Demand Aggregation and Internet Pre-purchase to Crowd-in Private Sector Investment.
Project Name Regional Communications Infrastructure Program 3 Malawi (RCIPMW).[143]
Location Malawi.
Date 2009-2016.
Partners • The World Bank • The Public Private Partnership Commission of Malawi (PIU)
Cost RCIPMW – USD 14.5M for the Connectivity component (of total USD 19.9M for the RCIPMW project).

[143] Information provided to ITU by The World Bank. 17 Aug. 2020.

Situation/Challenge

Malawi significantly lagged its peers in the development of its market for telecommunications and other digital services. The country was ranked 168th out of 175 countries in the ITU's Information and Communication Technology Development Index (IDI) in 2016. Mobile penetration remained low, with subscriptions standing at 37 per cent of the population and only 7 per cent of households reported having access to the Internet in 2014. Affordability was cited as the top barrier to Internet access as the retail price of an entry level mobile broadband package (500 Megabytes (MB) per month of data) was equivalent to 24.4 per cent of GNI per capita, while a fixed connection exceeds 111 per cent. There was a large divide between urban and rural areas for connectivity. Backbone and access network infrastructure were lacking or deficient in most rural areas and secondary cities, limiting the opportunity to deliver high quality ICT services, even for those willing to pay a premium price. In addition, there was no coherent government connectivity network for its services.

Aim of Project

The main objective of the RCIPMW were:

1. To contribute to lower prices for international capacity, extend the geographic reach of broadband networks within Malawi.
2. Improve the competitiveness of the telecommunications market in Malawi.

Project Details

The World Bank's Regional Communications Infrastructure Program (RCIP) has brought enhanced international connectivity to ten countries in Eastern and Southern Africa since its inception in 2007. Each country program shared a common objective of leveraging private sector investment and growth to drive down the price of connectivity. While mechanisms to achieve the objective have varied between countries, the approach taken under RCIPMW was to aggregate government bandwidth demand into a single competitive tender.

The Project addressed the connectivity challenges through two critical sub-components: (i) regional connectivity, and (ii) last mile connectivity. The government purchased 10‑year Indefeasible Rights of Use (IRU) for a large volume of international bandwidth and related services for government use. The contract obliged the vendor to make available the same price offered to government available to ISPs and mobile operators on a wholesale, open‑access, and non-discriminatory basis. In addition to providing low-cost international bandwidth, the project financed last mile connectivity to selected public institutions and points of presence within Malawi, provided by private operators and ISPs operating within the country. While the project financed ongoing Internet subscription to the institutions, the service providers were encouraged to sell Internet services to other people in the vicinity of the target institution through Wi-Fi networks. This increases the revenue that the service provider can generate from the installation and therefore is likely to make it more financially sustainable.

Results

Under RCIPMW, 145 public institutions, including 100 secondary schools, have been provided with connectivity. The government purchased a large volume of international bandwidth and related services over a 10-year period through a competitive bidding process. To supply these services, SimbaNet constructed a nearly 900 km network of overhead fiber optic cable, with eight landing points plus a Virtual Landing Point (VLP) in Lilongwe. The network connects internationally via Tanzania (with a cable landing station in Dar es Salaam) and via Zambia.

Telecoms operators and Internet service providers (ISPs) are able to connect to the SimbaNet network on an open access basis and are also enjoying greatly reduced costs for wholesale bandwidth. The contract therefore provides an anchor tenant to attract private sector investment. This has enabled them to launch new services, with a reduced cost structure, which should in turn enable retail price reductions provided that there is sufficient competition in this market segment.

Meanwhile, with large remaining institutions still lacking connectivity to the network especially those outside Lilongwe, a successive project, the Digital Malawi Program Phase 1 Project, applies the same mechanism to connect all priority public institutions throughout the country. Target institutions include government offices, public services centers ('one stop shops'), primary and secondary schools, and health centers.

Lessons Learned

The "Malawi model" brought multiple benefits. It capitalizes on economies of scale to significantly lower the unit connectivity costs of government by aggregating demand under a single, low price contract. Serving government institutions also incentivizes private sector investment in new network (backbone and access network) infrastructure in areas throughout the country where it does not yet currently exist. In addition, the government's risk is lower than it would have been if a more direct investment had been used since it leverages significant private sector financing and lowers the government's up-front capital costs for infrastructure investment. The government also does not need to retain technical expertise to operate a network, thus eliminating ongoing operating, maintenance and upgrade costs. Furthermore, it significantly lowers the barriers and costs for the private sector to offer services in currently underserved areas by utilizing the same shared infrastructure.

3.4.2 Caribbean Regional Communications Infrastructure Program (CARCIPP)

Principle Addressed
Combining private and public funding and establishing partnerships.

Project Name
Caribbean Regional Communications Infrastructure Program (CARCIP).[144]

Location
OECS – Grenada, Saint Lucia, Saint Vincent and the Grenadines.

Date
2012-2020 (December).

Partners
- The World Bank
- Government of Grenada
- Government of Saint Lucia.
- Government of Saint Vincent and the Grenadines
- Caribbean Telecommunications Union (CTU)
- Eastern Caribbean Telecommunications Authority (ECTEL)
- Private sector telecommunications operator

Situation/Challenge
When CARCIP was initiated (2012), telecommunications in the three countries were plagued by low bandwidth, high prices, and poor service quality due to a reliance on legacy copper networks. There were also several large coverage gaps. Governments were often paying high prices for obsolete services and equipment, and citizens had to deal with substandard services and limited access to global networks. Schools in the three countries had serious network capacity problems. Many had limited Internet connection to support up to a thousand students. Weak connections made the service so slow that it was generally unusable.

Aim of Project
Project Development Objective (PDO) is to increase access to regional broadband networks and advance the development of an ICT-enabled services industry in the Caribbean Region.

[144] Information provided to ITU by The World Bank. 17 Aug. 2020.

Project Details

The basis of the project is a Public Private Partnership (PPP) to Design, Build, Operate, Finance, and Transfer (DFBOT) Broadband Internet Services for government administration buildings (Government Wide Area Network - GWAN), schools, community centres and other locations. The innovative contracting process and resulting PPP structure is a first for digital infrastructure in the region. It is also the first of this magnitude, requiring approximately US$45 million from governments and private partners. This is possibly the first joint tender by three countries for such wide-ranging infrastructure, including both new construction, then transferred upfront to the governments, and service provision over a 15-year service period. The unique contracting approach allowed all three governments to obtain substantial economies of scale, allowing lower pricing and better quality of service than if they had purchased the networks separately. In addition, Governments will own the GWAN networks upon completion and have guaranteed access to large amounts of capacity.

The Governments requested revisions to on-island capacity and connectivity services to support their EduNet initiative. The main objective for EduNet is to connect primary and secondary schools and establish a National Research and Educational Network (NREN) to create an ICT environment in the education system that encourages creativity, innovation, critical thinking, communication, research and decision-making.

EduNet capacity from each school will be routed directly to the Ministry of Education (or other centralized location where Educational Content and Management Systems are housed). If at the Ministry of Education, a 10Gbps will be required from this site. Internet capacity from each school will be served through a centralized Dedicated Internet Access pipe (off-island) of 1.5Gbps. The private operator agreed to deliver a full fiber based 1Gbps line speed to all Primary & Secondary schools. The 1Gbps bandwidth will be available for EduNet and Internet services. EduNet capacities will be reserved and routed directly to the Ministry of Education. The remaining capacity will be available on demand from any of the individual schools for Internet services.

Results

Through an international public tender the three countries signed contracts with a private operator for the construction of new GWANs, educational networks for schools, libraries, and community centers; and a new submarine cable. Fiber optic connectivity to outlying small islands (e.g. Grenadines islands) will introduce modern telecommunications services for the first time, enabling affordable Internet services.

More than 500 government buildings will be connected (government administration, health clinics, police stations, post offices, and community centers), advanced data centers will be installed, and approximately 350 primary and secondary schools will have access to fiber based high-speed Internet. Security will be ensured, as contracts include technology updates.

Building the digital economy is not just about providing connectivity. CARCIP focused first on creating an updated policy and regulatory environment managed by the CTU and the regional regulatory authority, Eastern Caribbean Telecommunications Authority (ECTEL). The program also includes skills development for women and youth employability and digital entrepreneurship.

Lessons Learned

This approach provided significant gains but included risks: the three governments had no experience with PPPs, or with complex digital infrastructure contracts. So how was it put together? There are five key success factors:

1. Vision and passion to make this very complex project happen.
2. Support from institutions like the World Bank to deal with crisis moments and complex administrative procedures.
3. Partnership to address both technical and PPP sides of the project.
4. Win – Win approach to onboard all parties.
5. Patience, patience and patience exhibited by all participants.

Section B. EMPOWERING LEARNERS

Increasing connectivity alone will not help in the ultimate goal of **granting universal access to higher quality and inclusive education**. *Granting universal access* implies making sure that the benefits of education and technology are accessible to every one; this means, also to girls and to children and youth belonging to minorities, indigenous and marginalized groups, refugees and displaced learners, as well as children with disabilities.

Despite all efforts, all these groups still continue to be left behind in ICT. Today, women and girls are 25 per cent less likely than men to know how to leverage digital technology for basic purposes.[145] According to the Equals.org partnership, women represent just 6 percent of software developers; overall, the proportion of all women using the Internet globally is 48 per cent against 58 per cent of all men.[146]

Refugees and displaced learners also face tough challenges as individualized access to connectivity is at times hindered by legal and regulatory barriers requiring for example credentialed proof-of –identity documents to register for Subscriber Identification Module (SIM) cards or to enroll in some online learning programs.[147] Lack of access to connectivity continues to push refugees and displaced learners farther behind in acquiring the necessary digital skills and competencies not only to communicate with those outside their region and country of asylum, but also to take advantage of educational and livelihood opportunities that could empower them to protect their rights, including the right to education.



© UNICEF/UN051304/Herwig
Two adolescent girls use cellphones outside a solar kiosk in the Za'atari camp for Syrian refugees, in Mafraq Governorate, near the Syrian border.

145 UNESCO. (2019). I'd blush if I could.
146 International Telecommunication Union, (ITU). (2019). Measuring Digital Development. Facts and Figures.
147 UNHCR. (2019). Connectivity for Refugees. Displaced and Disconnected.

Children with disabilities are another group confronted with multiple forms of discrimination, which excludes them from society and school. Lack of access to school and the inability of education systems to ensure quality education for children with disabilities are two of the major challenges to overcome. The Broadband Commission, ITU, UNESCO and UNICEF encourage the development and implementation of inclusive education policies and practices to ensure equal education opportunities for people with disabilities. Despite some progress, it is however clear that more efforts needs to be made if we are to achieve the goals of granting universal access to higher quality and inclusive education for all youth and children.

Quality education for all requires secure and friendly environments, qualified and motivated teachers, as well as safe access to quality content and digital solutions. These solutions should empower children and provide them with the appropriate skills they need to thrive in society and to make an impact to their communities. Quality education also requires that learning outcomes are monitored and fed back into instruction. This involves again, looking at content, data, as well as instruction and assessment methods that leverage the power of connectivity, and the role and skills of teachers.

> *The success of school connectivity programs requires a* ***comprehensive approach****; it equally depends in addressing supply side related challenges (e.g. access to infrastructure, affordability, regulation, and available technologies that are safe for children), as well as in addressing demand driven factors like: digital skills and literacy barriers; open, relevant and localized educational content; lack of awareness of the importance of connectivity; fear of adoption, as well as socio-cultural norms that exclude minorities and girls.*

Additional systemic factors impacting connectivity and quality education include: understating the importance of real time data in evaluating learning outcomes; lack of knowledge on how to best incorporate hybrid[148] and personalized learning; schools' low readiness to distance learning solutions, and an overall failure to recognize the importance of out of school connectivity. All of these challenges have also been difficult to overcome even in those places where access to infrastructure and reliable connectivity is granted.

Moreover, understating the relevance of building capacity and strengthening the skills of educators and school leaders has been and continues to be a major pitfall. The human factor is one of the key ingredients for making connectivity work for learning but unfortunately is quite often not prioritized.

[148] Hybrid learning can be defined as a learning approach that combines both remote learning and in-person learning to improve student experience and ensure learning continuity. It is of particular relevance during COVID-19 school partial re-openings and in preparation for potential virus resurgence. UNESCO.



© UNICEF/UNUN0143506
Teacher Albert Matakone uses a computer tablet as a reference as he teaches children about the human digestive system at a school in Baigai, northern Cameroon.

> *Educators are **powerful change agents** who can deliver the educational response needed to achieve the SDGs. Their knowledge and competencies are essential for restructuring educational processes and educational institutions towards sustainability.*[149]

In many places, teachers have none or very low levels of digital literacy, little understanding of online harms and risks to children and how to mitigate them, and little confidence on the use of technology for pedagogical purposes. Teacher training in the use of ICT allows teachers not only to acquire new skills and competences, but also to overcome fears of using technology.

> *Education systems all over the world need to regularly **update and reform** teacher preparation and professional development programs to ensure that all teachers can harness technology for education.*

There is a worldwide shortage of well-trained teachers. According to UNESCO's Institute for Statistics (UIS), 69 million teachers must be recruited to achieve the goals of universal primary and secondary education by 2030.[150] Teachers are fundamental to the success of any education system, but more importantly they are fundamental to the empowerment of learners. Teachers act as role models and can give children purpose and inspiration. They can also help ensure that the benefits of technology and education are absorbed and put to the service of entire communities. Although the issue of teachers is not a focus area of this report, the Working Group

149 UNESCO. (2017). Education for Sustainable Development Goals. Learning Objectives. Education 2030.
150 UNESCO. (2019). Teachers.

on School Connectivity recognizes the critical role they have in empowering learners, and in the deployment and long-term success of any school connectivity plan. It therefore advocates and recommends that governments give more funding and attention to the development of teachers' competencies.

> *Education and connectivity must serve a* ***greater purpose than merely getting schools online****: they must empower learners and help them develop the self-discipline and self-responsibility required to move forward in life, and the resilience and confidence needed to face life challenges.*

In the particular case of girls, minorities and children with disabilities, empower is also about helping them develop a wider awareness of themselves, and to gain confidence and self-esteem so they are in a better position to define and act upon their dreams and ambitions. Education and connectivity should help form rounded and confident individuals who are fully aware of their potential, and who are empowered to live their lives with purpose, and to use their innate and acquired talents not only to their self-fulfillment, but also to the development of more prosperous, equitable and inclusive societies.



© UNICEF/UN0213046/Noorani
A female teacher helps children use computers in a library at Boufaroua Primary School on the outskirts of Sbeitla in Tunisia.

The objectives of the **EMPOWER** pillar are:

- To come full circle in the suggested methodology for school connectivity thereby complementing the approach discussed in the **MAP**, **CONNECT** and **FINANCE** pillars.
- To introduce core principles and an approach for **identifying**, **assessing**, **supporting and deploying** high quality, meaningful, safe and appropriate learning content, solutions and platforms in safe school environments or via remote learning.
- To facilitate the use of digital technologies and content that guarantee **inclusiveness** and that enable **local ownership** and decision making, while generating value for the countries developing and deploying these solutions.
- To act as a **knowledge hub** for frameworks and tools for content and protection including:
    - **Vetting and assessment criteria** for digital solutions and content, specifically related to outcomes, impact and adaptability to local context.
    - **Operationalization and deployment** of solutions and content in different country contexts.
    - **Child Online Protection**.

The **EMPOWER** pillar seeks to bring valuable solutions and content once connectivity has been established - namely on articulating the link to quality, safe and inclusive learning, ensuring schools provide the right skills for employability, and ensuring every young person has safe access to information, opportunity, and choice.

This chapter summarizes the key reflections, learning and proposals coming out of the advisory process provided by the Broadband Commission Working Group on School Connectivity to the Giga and UNESCO's e-school Initiatives on the **EMPOWER** pillar. The chapter focuses on the main topics driving the discussions with the Broadband Commission Working Group on School Connectivity, which were grouped around three areas: Vetting and assessing criteria for digital solutions and content; operationalization and deployment of digital solutions and content; and Child Online Protection. The final section of the chapter is dedicated to case studies that address some of the core principles highlighted in the **EMPOWER** pillar.

Box 9. Digital Public Goods and the Digital Public Goods Alliance.

Following the recommendation 1B of the UN Secretary General's High-Level Panel on Digital Cooperation,[1] the Broadband Commission Working Group on School Connectivity has also provided advice regarding the identification, assessment, support, and deployment of Digital Public Goods to articulate the link to quality and inclusive learning. Digital Public Goods (DPGs), are defined by the Digital Pubic Goods Alliance[2] as open source software, open data, open AI models, open standards and open content that adhere to privacy and other applicable best practices, do no harm and are of high relevance for attainment of the Sustainable Development Goals (SDGs).[3] Some examples of Digital Public Goods include: open source software and applications for education in local languages; open educational resources aligned to state curriculum standards tailored to meet student and teacher needs; open source applications to support learning of children with disabilities; Open Educational Resources (OERs) to provide access to localized courseware; open access libraries to scientific literature and many others.[1]

The Digital Public Goods Alliance focuses in particular on making solutions and content pubic as a strategy for increasing access. It also seeks to convene a network of partners from different sectors that will contribute to the identification, support, scale-up, and proper use of digital public goods, and the software, data, content and algorithms that drive them, in order to advance humanity. Incubated by UNICEF and Norway, the Alliance relies on engagement and leadership from key "pathfinder" countries, private sector technology experts, implementing organizations and innovation groups across the UN system.

[1] Recommendation 1B: Digital Public Goods. "We recommend that a broad, multi-stakeholder alliance, involving the UN, create a platform for sharing digital public goods, engaging talent and pooling data sets, in a manner that respects data privacy, in areas related to attaining the SDGs". UN. (2019). Secretary General, High-Level Panel on Digital Cooperation.

[2] Digital Public Goods Alliance.

[3] Definition taken from the Digital Public Goods Alliance. In line with Stakeholder Group for Recommendation 1B of the UN Secretary General High-Level Panel on Digital Cooperation.

[4] For a full set of examples, visit the DPG Alliance website nomination site: https://digitalpublicgoods.net/explore/

Additional empowerment elements that complement implementation and deployment of holistic school connectivity models such as: curriculum integration, assessment, capacity building, teacher training, and monitoring and evaluation will not be discussed in detail this chapter. Although the Working Group recognizes the importance of these elements for the long-term success and sustainability of any connectivity strategy, this was not a focus area of last year's work and therefore it is not included in the report.

4. EMPOWER Learners

4.1 High quality content, solutions and platforms for empowering learners and teachers

Successful incorporation of technology into educational programs is notably driven by the availability of high quality, appropriate and relevant content; by solutions and platforms that group and deliver that content, and by Open Educational Resources (OERs).[151]

For the purposes of this report, high quality, meaningful, inclusive and relevant content refers to: resources, tools, and applications, learning material, solutions, platforms and OERs that meet the needs of the learner alongside with those of teachers and instructors, who also play an essential role in the achievement of learning outcomes. This type of content, solutions, applications and platforms, should have the following characteristics:

- *Should be developed by taking into account the **local context** and language of the school and the surrounding community.*
- *Should be **ambitious** in order to provide learners with knowledge, skills, values, and attitudes that allow them to reach their highest potential, to protect themselves, and to thrive in society.*
- *Should prepare learners for a faster, more connected, and uncertain world by equipping them with **core competencies** in: communication, collaboration, critical thinking, creativity, problem solving, and appreciation of diversity, environmental consciousness, and learning to learn techniques.*
- *Must be **inclusive**, thereby addressing the needs of girls, children and youth belonging to minorities, indigenous and marginalized groups, refugees and forcibly displaced populations, as well as children with disabilities.*
- *Must be **suitable** and **safe**, and must be developed and delivered according to principles that guarantee the **online protection of children** at all times.*
- *Must be deemed **most appropriate by teachers** in order to advance the learning of their students. Efforts should be made to give teachers a wide selection of content; schools should work to obtain content recommended by teachers and, whenever possible, give teachers the ability to tailor content or make their own.*
- *Should be built on the basis of **open copyrights** and **open source** codes and under **open ecosystem principles**, so users are not thrust into others' walled gardens.*
- *Must be made available online to **every child** and young person in the world and facilitate local ownership and decision making, while generating value for the **local ecosystems** creating and deploying these solutions.*
- *The school closures generated through the pandemic highlighted the fact that a great percentage of children and young people among vulnerable populations in the developing world have no access or limited access to the Internet. Learning content should be made accessible online **in formats that are also suitable to low connectivity contexts**, and alternative analogue platforms if necessary.*

[151] Open Educational Resources (OER) are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. OER form part of 'Open Solutions', alongside Free and Open Source Software (FOSS), Open Access (OA), Open Data (OD) and crowdsourcing platforms. UNESCO.



© UNICEF/UNI319836/Kanobana
Igihozo Kevin, 11, studies at home in Rwanda due to coronavirus-related school closures, listening to his Primary 5 lessons on the radio every day.

4.2 Approach for identifying and deploying high-quality content, solutions and platforms

In the post-COVID-19 world, the need for connectivity for all is even clearer – and that need is not simply for data but for what that data contains. An entire global population will need to work – and to work in new ways – to provide for their families and communities. That means new skills, new ways of collaborating, globally, and new ways of getting paid.

This past year, the Working Group on School Connectivity has provided guidance on key themes related to the identification, assessment, support and deployment of high quality content and solutions to support learning and skills development. In this section, the Working Group on School Connectivity introduces a four steps approach for identifying and deploying those solutions, and shares the key outcomes and recommendations coming out of the consultation sessions with the Giga and UNESCO e-Schools Initiatives.

1. Identify and Assess

The first step in the approach includes the identification of suitable, relevant, safe and high-quality content and solutions that empower learners. During the advisory process, a number of initiatives around the world were analyzed compiling many of the principles discussed above and specifically: solutions based on impact on education outcomes; solutions developed within principles of sustainability, scalability and licensing models, as well as adaptability of content and digital literacy.

Some examples of the solutions analyzed include:

- Open source software for immediate use and scale (COVID-19 response for Tele-education, Tele-health and Financial Services).
- Solutions that address challenges in the learning and skills development space.
- Solutions and content vetted by the DPG Alliance.
- Solutions that explore new technologies, methods and nominations of open source, software, content, data and models to digitalpublicgoods.net

Once high quality content and solutions have been identified, a process must be initiated for **assessing** those resources and for providing technical and financial support to scale them. Some of the dimensions that could be considered when assessing high quality content and solutions include:

- Ensuring "**product quality and openness**": to what extent it adds value and improves learning of specific subjects; whether it respects security and privacy, which types of open licenses it uses, etc.
- **Usability** of the content or solutions and how they will be used in real life contexts; how is it possible to integrate those in the education processes; how to build teachers capacities around it; how to monitor and evaluate its use, and how to adapt it to local contexts.
- **Inclusion** to local Edtech providers who can adopt, curate, support and build on top of it. This third dimension is critical to ensure that content and solutions will be owned, maintained and adapted by the local publishing ecosystem to ensure cultural appropriateness and relevance to local contexts.

Moreover, selection processes and the solutions themselves must reflect and represent the interests of countries and local communities and should be based on principles for real-time assessment and monitoring.

Vetting Criteria

In order to properly assess the value, suitability and viability of learning content and solutions, a set of vetting criteria needs to be applied.

> ***Vetting criteria*** *must be put in place for examining digital solutions and content, specifically related to educational outcomes, impact and adaptability to local context. Vetting, assessment, and monitoring of content and solutions should also be real time and include principles and practices for Child Online Protection. Moreover, vetting criteria should be applied to both: educational content and cultural consumptions.*

This involves data, but also analyzing formats, communication practices and engagement, which includes data collection and interpretation. Multilingual and multi-platform ecosystems must also be considered when applying vetting criteria.

Since almost half of the population has no access to the Internet, there is still a large dependency on radio and TV content for pedagogical continuity; ***vetting criteria should also be applied to the content delivered through these channels****.*



© UNICEF/UNI314054/Klincarov
Skopje, 25 March 2020: Twins Maksim (5) and Jan (5) practice yoga for children as they follow the TV-classroom programme broadcast on national television.

Some specific considerations for vetting criteria include:

- **Subject specific criteria** for assessing solutions through communities of practice. For example, for early grade reading:
  - Project complies with established standards and best practices for literacy and early grade reading resources.
  - Project addresses risks related to content quality and appropriateness.
- **Technical criteria** for assessing solutions through communities of practice:
  - Includes technical criteria that meets Child Online Safety standards i.e. Safety by Design Framework[152].
  - Licenses and copyright, utility and impact, product design, product quality. Do No Harm, Best Practices, Financial Sustainability.

[152] Australian Government. eSafety Commissioner. (2019). Safety by Design.

The Working Group emphasizes in particular the need for vetting criteria that allow to take into account local ownership and the principles for digital development on: user-centered and data driven design, understanding local ecosystems, scalability, sustainability, reusability, privacy and security, safety, collaboration, as well as open standards, open access, and open licensing.[153]

2. Increase Access

> *In order to **increase access** to vetted and secure content, it is important to determine value added business models that can be applicable for the learning content and solutions selected. These must be developed in accordance to the context of the country where those solutions and content will be deployed and used. This also implies localization and translation efforts, and ensuring that vetted solutions adhere to cyber-security practices, and the principles of intellectual property, data privacy, data ownership, and Child Online Protection.*

These resources should be collected and made accessible to the entire world through an open repository (e.g. digitalpublicgoods.net). Community-based models of digital access led by community organizations and micro social enterprises should also be considered. Technical standards and protocols on opening access to data sets can also help ensure that more quality content becomes available.

> *Teachers are another element to help increase access. The way in which they interact with open educational resources and digital content; how they incorporate new pedagogical practices for interactive learning, and whether they have the appropriate skills set to do that, highly impacts adoption and usage of digital content in the classroom.*

Not knowing how to effectively integrate online tools and content into teaching can limit the positive impact technology has on learning. [154] In order to increase access to high quality, vetted educational content and resources, the digital knowledge needs, and gaps of teachers and learners must be addressed in advance.

UNESCO's ICT Competency Framework for Teachers (ICT-CFT) is one example of the possible mechanisms that can help governments develop more comprehensive teacher ICT competency policies and standards and integrate these in overarching ICT in education plans.[155] UNESCO's experience rolling out this framework in many countries has shown however that teachers' use of ICT is mostly at the "knowledge acquisition" (former "technology literacy") level. The use of technology at the "knowledge deepening" or "knowledge creation" levels is still very limited. This of course also has implications for integration and creation of content that can be localized for the specific needs of the teacher and learner population it intends to serve.

[153] Digital Public Alliance and Principles for Digital Development.
[154] According to the Center of Innovation for Brazilian Education, CIEB, in Brazil, data from fifty thousand teachers who have used the Self-Assessment on Digital Skills Tool (https://guiaedutec.com.br/educador)), show that they still do not know hot to integrate online tools in their teaching.
[155] UNESCO (2019). ICT Competency Framework for Teachers.



© UNESCO
Champion teachers engage in discussions to prepare the lesson plans for the e-schools.

As part of its COVID-19 education response, UNESCO has also developed some strategies, webinars and tools to help educators improve their online teaching practices[156]. Moreover, platforms such as: **e-learning Industry** and **Edmodo**, just to mention some, also offer interesting resources to help teachers use connectivity to create interactive and high quality learning, and to engage students remotely. **Khan Academy**, and the **Ideasgym Academy**, are other examples of online platforms providing access to lessons, as well as training and support to teachers, learners and parents, mainly on STEM (Science, Technology, Engineering and Mathematics). Multiple free online courses and resources delivered through Massive Open Online Courses (MOOCs) also offer possibilities for teachers to get trained on how effectively and innovatively deliver classes online and how to integrate online tools into teaching.

Another key area for increasing access to high-quality content and solutions has to do with safety and security. Safety of online learning platforms, applications and solutions is of utmost importance and has to be granted in order to safeguard the vulnerability of children and youth. The COVID-19 pandemic, social distancing measures and the widespread school closures, have made online platforms and communities essential.

156 UNESCO. (2020). COVID-19 Education Response. Issue Note No. 2.1: Distance learning strategies in response to COVID-19 school closures; Distance learning strategies – What do we know about effectiveness? – Synthesis report.



© UNICEF/UNI320751/Soares
A girl shows off the online platform on which children and parents in Timor-Leste can access a range of audio-visual material to help students continue learning during ongoing school closures.

The pandemic has introduced younger children to social networking tools that may not be designed for them and for which they may have none or limited preparation.[157] Increased Internet access can put children at greater risk of online dangers such as sexual abuse, exploitation and cyber bulling, and their exposure to harmful content. Increasing access also means having safer and more controlled environments (whether at school or at home) that allow for secure and empowering learning experiences. The Working Group on School Connectivity adopted the issue of Child Online Protection as one of the key areas for discussion this past year, and one of the building blocks of the **EMPOWER** pillar. The key reflections, recommendations and links to frameworks and tools on this subject are consolidated further down in chapter **4.3 Child Online Protection**.

3. Deploy and Use

Deploying and effectively using learning content and solutions come with some challenges. There are many factors that affect or could affect the scale up of digital public goods related to improving learning outcomes and job skills. Through the advisory process provided by the Working Group to the **EMPOWER** pillar, some of those factors were classified as follows:

[157] End Violence Against Children, UNICEF, ITU, UNODC, WHO, UNESCO, WPGA, World Childhood Foundation. (2020). Technical Note: COVID-19 and its implications for protecting children online.

Table 5. Supply and Demand Factors Affecting Scale Up of High-Quality Learning Content and Solutions.

Supply related factors	Demand related factors
1. Design for replicability and scale	1. Lack of understanding why open source matters, which is often associated to a lack of demand for open source learning content
2. Interoperability of systems	2. Poor understanding of the different types of licensing models, their benefits and outputs
3. Reusability of infrastructure	3. Poor teachers' knowledge on how to use/ reuse content
4. Suitable design that allows for contextualization	4. Lack of data on vendor lock-in
5. Licensing	5. Impact measurement: going beyond the measurement of skills and learning impact. Measuring the specific impact of a given technology; evidence of impact vs. use and outcomes
6. Transparency – setting minimum standards at 'right' level – neither too stringent nor too loose	
7. Evidence of impact	
8. Local translation and customization	
9. Significant scale up investment	

In addition, the readiness of the school environment and the context for the implementation are also key to the deployment process. School readiness refers not only to the technological aspect (connectivity, infrastructure, digital distribution channels for vetted content, hardware availability, etc.), but also the human and regulatory aspect (educators' adoption readiness, regulation, government support, and data privacy policies). It also refers to the readiness of the community to which the school belongs: parents' and children's basic knowledge and awareness of the Internet, its benefits and risks.

> ***Planning and allocating resources and partners*** *that could provide support in local adoption, rollout and piloting activities, must be accounted for, as well as support for increasing usage of vetted content. Community approaches that leverage teacher engagement to produce and publish content helps increase adoption and enrich platforms while creating ownership, and increasing visibility.*

Moreover, mechanisms for capacity building (e.g. configuration and training of the content solution), as well as systems for measuring results and for ensuring accountability must also be designed and tested before deployment and use of online content solutions. Connections to partners and resources for capacity building and financing of local entrepreneurship ecosystems must also be designed in this step.

Most importantly, and as already discussed, additional mechanisms must be put in place to ensure children are protected online while accessing and working with content. This will ensure that deployment and uptake of digital learning content and solutions is done in a safe

environment that protects children and their rights to learn without fear of being subject to abuse and exploitation.

4.3 Child Online Protection (COP)

The COVID-19 crisis showed how important digital networks and services are to health, safety and education systems, and to the survival of economies. Following the spread of COVID-19, more aspects of people's daily lives are moving online: Internet usage has gone up 50 per cent in some parts of the world,[158] and many sectors such as education saw an overnight shift to digitalization. Many children's learning experiences are being reshaped by the introduction of online learning, and digital content and platforms and their social traits put to test through an increased participation in online games, social media and video so they can keep connected to their friends and extended family while in isolation.

Currently more than 200,000 children go online every day; 800 million are actively using social media, and at any given time, an estimated 750,000 individuals are looking to connect with children for sexual purposes online.[159] Although the goal is to connect every school and every child to the Internet and to provide them with access to information, opportunity and choice, this access needs to take place in a safe and secure way that protects children from online dangers.

Although there is a tendency to regard children and the younger generation as more tech-savvy, it should be recognized that "savviness" can mean different skill-sets in different contexts and does not necessarily imply ability to detect and avoid cyber threats.

> *On the other hand, children are more acceptive of new tools and technology and therefore they should be actively encouraged to adopt and use the tools that empower them and help to avoid risks in the online space.*

In the Broadband Commission's **Agenda for Action for Faster and Better Recovery**,[160] Commissioners and their organizations are urgently collaborating to compile and disseminate a repository of tangible actions that might help overcome the effects of the pandemic. The Agenda is based on three pillars: resilient connectivity, affordable access, and **safe use of online services for informed and educated societies**. The Broadband Commission advocates for safe use of online services by all, especially **children** respecting the right to privacy, and promoting trust and security in the use of data. It also champions the enablement of safe digital content sharing to support e-education, e-health, digital agriculture, e-financial services and mobile payments, and e-government platforms; the empowerment of youth, and ensuring and promoting child safety online. Additionally, it includes the commitment to make available their broadcasting capacity for educational and health purposes and provide online training and safe digital tools to parents and teachers to keep children safer online. Likewise, it promotes the use of broadband to provide distance-learning programs for all ages, and empower people with quality journalism and evidence-based and scientific information about COVID-19.

158 World Economic Forum. (2020). Will the coronavirus break the Internet?.
159 End Violence Against Children.
160 ITU/UNESCO Broadband Commission for Sustainable Development. (2020). COVID-19 CRISIS. Broadband Commission Agenda for Action for Faster and Better Recovery.

The Broadband Commission Working Group on School Connectivity considers Child Online Protection a **top priority**. It is a very important and sensitive element that must be present in the design and deployment of any strategy for school connectivity. Given its importance, during this past year the Working Group dedicated special sessions for discussing the topic at length, and for reviewing and analyzing some of the world wide approaches, frameworks and tools available to address the issue.

This section compiles key insights and possible recommendations for concrete and practical actions that could be implemented in the short and medium term by governments, private sector, schools and other actors, to protect children online and to help them protect themselves in terms of acquiring digital skills particularly in the context of COVID-19. It also collects a list of global efforts, good practices, tools and top resources, which were analyzed during the advisory process for School Connectivity. The Working Group considers these resources could serve as reference for governments, the private sector, non-profits, schools, parents, and the community at large when designing and deploying high-quality online learning content, solutions and platforms.

Key Insights:

- The transition of schools to online learning has also increased the cyber risks for children. Risks faced by children online are becoming increasingly diverse. With both children and sexual offenders confined at home and spending more time online, law enforcement authorities and reporting hotlines have seen a striking increase in the amount of Child Sexual Abuse Material (CSAM)[161] being shared online.
- Digital devices and platforms, including educational platforms, often lack adequate child safety features.
- "Digital Security" applies to a combination of offline and online activities (for instance, a child might record a video or take photos offline and later install an app from the Internet while accepting the terms and conditions that allow the app to access the device's storage, leading to the risk of potential image theft and abuse).
- Not enough attention is given to developing online safety knowledge and skills among children, parents, and educators. There is an important role to be played by schools, the private sector, the media, the digital platforms, and regulators.[162]
- The approach to addressing Child Online Safety (COS) should involve different stakeholders and place the child at the center. It should also consider the risks that the children get exposed to "offline" but that project into the "online" space or manifest once the children get "connected."

[161] Europol. (2020). Exploiting isolation: Offenders and victims of online child sexual abuse during the COVID-19 pandemic; WePROTECT Global Alliance. (2020). Intelligence Report on Impact of COVID-19 on online Child Sexual Exploitation and Abuse.

[162] In Poland for example, the Office of Electronic Communications (UKE) runs an educational campaign #keepCTRL: https://www.uke.gov.pl/en/newsroom/click-sensibly-keepctrl-new-uke-educational-campaign



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In Gamboa, Colon Province, Panama, Mila, 11, logs onto her tablet.

Some concrete areas where action/support is needed:

1) *Empowering children with information and tools for online safety (incl. raising awareness about how to report and respond to harmful content and abuse).*
2) *Parenting guidance and advice (including improving parent's digital literacy).*
3) *Creating safe online learning experiences for students.*
4) *Making online platforms safe and accessible for children (including through collaboration with industry and regulators).*
5) *Strengthening national preparedness and response (incl. through legislative action).*

Recommendations:

- Safety by Design.
  - More collaboration needs to take place between governments and the tech industry to integrate safety into their products.
  - Design a unified, practical and actionable industry-ask relying on Safety by Design Principles.
  - Adapt Safety by Design Principles to online education and learning platforms.
- Mandatory education in Child Online Safety (COS) for students, teachers and caregivers.
- Mandatory detection and reporting of CSAM on educational platforms.
- Consolidate lessons learned from the COVID-19 crisis:
  - Online safety should be a shared but explicit responsibility of the government, the industry, and service providers, and not that of the children themselves. There is a

need for stronger collaboration among these stakeholders to disseminate and enforce many of the tools already available for COP.

- The private sector should make available broadcasting capacity for Child Online Protection. It should also provide safe, secured and transparent platforms for education and digital tools for children, parents and teachers, and provide access to reporting mechanisms.
- Governments should provide COS guidelines & consult all relevant stakeholders or widely disseminate the existing COS guidelines.
- Children themselves should always be included in policymaking processes & tools development on COS. [163]
- COVID-19 exposed many children to digital learning over an instant. Going forward, children and their communities should be better prepared for interacting and learning online. There is a need to raise awareness among communities about the importance of COP even before connectivity arrives. As the required infrastructure might take time to be deployed, it is important to provide communities with tools regarding digital skills and basic knowledge on online safety so children are ready when connectivity is established.

- Government legislative and/or political action is an important step towards strengthening the response to cyber threats to children. Child Online Protection policies should be made a government goal. Every country should include Child Online Protection in their National Broadband or digital connectivity plan.
- Encourage/promote the development at national level of an appropriate regulatory framework and environment for data protection and privacy: ethical standards, use, share and store of data, respect and enforcement in the learning environment.
- When rolling out toolkits on COP, there should also be an accompanying service that works directly with the stakeholders (e.g. schools) to help implement the recommendations proposed by the toolkit.[164]
- The subject of digital security should be embedded into digital literacy education. The former cannot be considered a standalone topic, because children need to understand how the digital world works in order to understand what risks they are exposed to and why do these risks emerge.
- Industry and governments could work on developing regulations and standards for a proper presentation of terms and conditions for digital products and services (applications, games, websites, programs, devices, etc.) to guarantee they can be read and understood by children and parents and that they clearly state the risks associated with the use of those products and services concerned.
- The Broadband Commission Working Group on School Connectivity calls to support the **Agenda for Action**.[165] Furthermore, to sign the Broadband Commission's Universal **Child Online Safety (COS) declaration**.[166]

[163] The Inter-Agency working group on violence against children strongly recommends providing opportunities for children's views to be heard and taken into account through consultation and dialogue. Other examples of global efforts calling for the inclusion of children's perspectives in the debates around Internet governance and children's safe Internet use include among others: UNICEF Office of Research –Innocenti and the partnership between UNICEF and ITU, GPEVAC, UNESCO, UNODC, WePROTECT Global Alliance, WHO and World Childhood Foundation USA.

[164] In Australia, a program called the 'Trusted eSafety Provider' program exists, in which eSafety endorses providers to go into schools to support their online safety efforts and deliver online safety education.

[165] ITU/UNESCO Broadband Commission for Sustainable Development. (2020). COVID-19 CRISIS. Broadband Commission Agenda for Action for Faster and Better Recovery.

[166] ITU/UNESCO Broadband Commission for Sustainable Development. (2010). Child Online Safety Universal Declaration.

- The Broadband Commission Working Group on School Connectivity also calls to help implement the **ITU Child Online Protection Guidelines for policymakers, industry, parents & educators and Children themselves**.[167]

The table below highlights resources that the Working Group considered during its discussions and advisory process, which could serve as reference for governments, the private sector, non-profits and other organizations when developing and deploying high-quality online learning content, solutions and platforms that adhere to COP principles.

Table 6. Resources on Child Online Protection.[168]

#	Resource/Tool/ Framework Analyzed	Authority	Link
1	Broadband Commission Agenda for Action: for faster and better recovery	Broadband Commission	https://www.broadbandcommission.org/COVID19/Pages/default.aspx
2	Child Online Safety Universal Declaration	Broadband Commission	https://childonlinesafety.org/
3	Child Online Safety: Minimizing the Risk of Violence, Abuse and Exploitation Online	Broadband Commission	English: https://www.broadbandcommission.org/Documents/working-groups/ChildOnlineSafety_Report.pdf Spanish: https://www.broadbandcommission.org/Documents/Broadband%20Commission%20Report%20AW_ES_single%20page.pdf Arabic: https://www.broadbandcommission.org/Documents/reports/2020/Child_Online_Safety_ar.pdf Portuguese: https://www.broadbandcommission.org/Documents/working-groups/ChildOnlineSafety_ReportPortuguese.pdf
4	Broadband Commission Working Group on Child Safety Online	Broadband Commission	https://www.broadbandcommission.org/workinggroups/Pages/WG1-2018.aspx
5	Protecting Children during the COVID-19 Outbreak	End Violence Against Children	https://www.end-violence.org/protecting-children-during-covid-19-outbreak

[167] International Telecommunication Union, (ITU). (2020). Child Online Protection.
[168] This table compiles only those resources, frameworks and tools that were presented, analyzed and discussed during the Working Group sessions on the EMPOWER pillar.

#	Resource/Tool/ Framework Analyzed	Authority	Link
6	COVID-19 and its Implications for Protecting Children Online and accompanying Resource Pack	End Violence Against Children, UNICEF, ITU, UNODC, WHO, UNESCO, WePROTECT Global Alliance, World Childhood Foundation	Technical Note : https://www.end-violence.org/sites/default/files/paragraphs/download/COVID-19%20and%20its%20implications%20for%20protecting%20children%20online_Final%20%28003%29_0.pdf Resource Pack : https://www.end-violence.org/sites/default/files/2020-07/COVID19%20Online%20Technical%20note%20resource%20pack_PUBLISHED.pdf
7	Safe to Learn Coalition	End Violence Against Children	https://www.end-violence.org/safe-to-learn
8	Several resources, tools and practices on Child Online Protection	End Violence Against Children	https://www.end-violence.org/safe-online
9	Keeping children safe online during the COVID-19 pandemic	e-Safety Commissioner Australia	https://www.esafety.gov.au/key-issues/covid-19/international-advice-for-parents
10	Safer online environments in schools: Resources and toolkit for parents and educators	e-Safety Government of Australia	https://www.esafety.gov.au/ https://www.esafety.gov.au/educators/toolkit-schools
11	Safety by Design overview	e-Safety Commissioner Australia	https://www.esafety.gov.au/key-issues/safety-by-design https://www.esafety.gov.au/sites/default/files/2019-10/SBD%20-%20Overview%20May19.pdf
12	Child Online Protection Guidelines for policymakers, industry, parents, educators and children (2020)	ITU	https://www.itu-cop-guidelines.com/
13	Guidelines for Children on Child Online Protection (2016)	ITU	https://www.itu.int/en/cop/Documents/S-GEN-COP.CHILD-2016-PDF-E%5B1%5D.pdf
14	Guidelines for Children on Child Online Protection (2020)	ITU	https://www.itu-cop-guidelines.com/children
15	Guidelines for Parents, Guardians and Educators on Child Online Protection (2020)	ITU	https://www.itu-cop-guidelines.com/parentsandeducators
16	Guidelines for Policy Makers on Child Online Protection (2020)	ITU	https://www.itu-cop-guidelines.com/policymakers
17	Guidelines for Industry on Child Online Protection (2020)	ITU	https://www.itu-cop-guidelines.com/industry

#	Resource/Tool/ Framework Analyzed	Authority	Link
18	The Child Online Protection Initiative	ITU	https://www.itu.int/en/ITU-D/Cybersecurity/Pages/COP.aspx
19	Several resources on Child Internet Safety	UK Council for Child Internet Safety (UKCCIS)	https://www.gov.uk/government/groups/uk-council-for-child-internet-safety-ukccis
20	Safe to Learn during COVID-19: New recommendations released	UNESCO	https://en.unesco.org/news/safe-learn-during-covid-19-new-recommendations-released
21	COVID-19 and its implications for protecting children online	UNICEF	https://www.unicef.org/documents/covid-19-and-implications-protecting-children-online
22	Guidelines for Industry on Child Online Protection	UNICEF and ITU	https://www.unicef.org/media/66616/file/Industry-Guidelines-for-Online-ChildProtection.pdf
23	Campaign to End Violence against Children	UNICEF	https://www.unicef.org/end-violence
24	Toolkit Free App on Child Sexual Abuse and Exploitation Off/Online	World Childhood Foundation USA	http://www.socapp.org/
25	Resources on Child Online Safety and reporting mechanisms	World Childhood Foundation USA	https://www.childhood-usa.org/resources
26	Parenting tips on keeping children safe online during COVID-19:	WHO	https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/healthy-parenting https://www.who.int/publications/m/item/covid-19-parenting-keeping-children-safe-online
27	COVID-19: 24/7 PARENTING Proven parenting tips and activities for all ages in worldwide languages	Parenting for Lifelong Health; WHO; UNICEF; UNODC; End Violence; the Internet of Good Things; USAID; CDC; World Without Orphans; the World Childhood Foundation USA, the Internet of Good Things and Clowns Without Borders South Africa	https://www.covid19parenting.com/#/home

Box 10. Giga. Empowering Learners through Country Activities.

Giga aims to support countries in the deployment and scaling of learning content and solutions through a specific set of activities. These activities are designed to: Resolve information gaps; Improve conditions for Investment, Launch National "Common Bids/or clustering of connectivity demands" and Create Sustainable Structures.

Giga itself will not be investing in learning related solutions, nor will it support the scale of such solutions once connectivity is established. Giga will rather work with partners who can "come in" and provide their expertise in the development and scaling of Digital Public Goods (DPGs). These partners include, but are not limited to: UNICEF's Education Strategy (and its related teams at country level), the Digital Public Goods Alliance, and UNESCO's e-schools initiative.

Country Activities to Resolve Information Gaps:

- Engage with Ministries of Education to assess: digital learning needs, as well as existing solutions and gaps; local ecosystems and their capacity; policies, and frameworks on Child Online Safety.
- Identify local businesses and stakeholders that can develop and scale digital solutions once connectivity is established.
- Facilitate timely connections to partners to access vetted digital solutions.
- Reference existing expertise and support the **safe** (i.e. **Child Online Protection**) scaling of connectivity and digital solutions.

Country Activities to Improve Conditions for Investment:

- Include country resourcing needs/investment opportunities related to the local development and scaling of DPGs in any financing requests/bids that Giga facilitates or directly fundraises for.
- Incorporate investment returns and opportunities that the development and scaling of digital solutions bring to Giga's investors and funders (e.g. increased access to financial services that increase revenues for MNOs).
- Facilitate connections to venture capital and other investors for developing and scaling digital solutions.

Country Activities to Launch National "Common Bids/or clustering of connectivity demands":

- Integrate technical assessment criteria for digital solutions that are in line with Giga's principles for "EMPOWER" (e.g. open source, interoperability, local and public ownership, sustainability).
- Identify DPGs that could meet the needs outlined in the Bid.
- Advise on local scaling, hosting, platform integration and business models for deploying those solutions selected through procurement processes.

Country Activities to Create Sustainable Structures:

- Provide access to resources, capacity building and financing to support local entrepreneurship ecosystems and business models that develop and scale local digital solutions.
- Provide access to platforms that monitor real time use and quality of solutions (e.g. Real time monitoring, DPG storefront).
- Provide access to platforms that incentivize maintenance and contributions to local solutions (tokenization, crypto fund).

Giga will also facilitate access to solutions and will provide guidance in country engagements focusing on:

- The creation of local entrepreneurship ecosystems that allow the development and scaling of digital solutions, and business models that generate value for local stakeholders.
- Solutions that enable vendor-independence, reusability, interoperability, adaptability and distribution. This means, solutions that are open source software, open data, open AI models, open standards and open content that adhere to privacy and other applicable best practices, do no harm.
- The integration of policy frameworks and tools that support safe access to digital solutions.

Box 11. UNESCO's Model for Technology-Enabled Schools.

In light that the world may enter an increasingly crisis-prone and pandemic-prone age over the coming decades, there is an urgent need for all countries to mix varied technologies to build more inclusive, and more crisis-resilient school systems in the context of achieving SDG4[1]by 2030.

In response to this need, UNESCO has been developing a guiding framework for leveraging technology to enable schools to ensure continuity and quality of learning for all. The **UNESCO's model for technology-enabled schools** aims to:

- **Provide a step-by-step guidance** on **planning of technology-enabled crisis-resilient school systems** that allows for accessibility of school education programmes in multiple interconnected learning spaces (namely physical school spaces, and distance learning spaces from home or other alternative venues) with a view to ensure that the right to education will not be disrupted by crises or emergencies.
- **Inform the essential technology, content, and human infrastructure** and constitute elements of the technology-enabled crisis-resilient school systems, and **provide resources mobilization strategies** as well as support to strengthen capacities of educational institutions and stakeholders in enhancing the readiness towards a more crisis-responsive school system.
- **Guide the effective pedagogical practices and professional development of teaching staff and other pedagogical facilitators,** and steer the use of technologies in varied learning spaces towards advancing inclusion, equity, gender equality, and quality of learning in the context achieving SDG4 by 2030.
- The framework is structured around three tiers, each of which is anchored on the following building blocks:

TIER 1 - Policy and resources enablers

1. **Leadership and governance**: includes governing mechanisms, vision and strategy development, policy planning and periodic review.
2. **Financing and resource mobilisation**: governmental budgeting; sustainable funding mechanisms; crowdsourcing contribution from telecom sector, technology platforms or media channel providers, internet service providers, content providers, training institutions, communities and civil societies to contribute to the tech-enabled school systems.
3. **Community and stakeholders engagement**: communities of teachers, administrators, parents or caregivers, private tutorials.

TIER 2 - Technology, content, and human infrastructure

4. Education program delivery technology:

4.1 Centralized: Online platforms, TV and radio media and channels; reliability and security.

4.2 School based or household: school connectivity and devices; household connectivity and devices.

5. Teachers and human facilitators: Teachers' roles; formal training and informal professional development on ICT competency and pedagogical skills; ICT supporting staff; Awareness & skills of other stakeholders.
6. Curricular courses and supporting resources: Distance learning courses covering all and parts of subjects and grade levels; access to and teachers generated OER.

TIER 3 - Teaching, learning, and assessment planning

7. **Teaching and learning**: technology enabled multimodal teaching and learning (inside and outside schools: school based, home based, or community based) and for various purposes (formal and informal).
8. **Social interaction and caring**.
9. **Assessment and credentialing of learning outcomes**: the use of learning technologies to support an integrated approach to assessment and credentialing of learning outcomes.

Connecting schools is necessary, and imperative as it widens the opportunities not only of the children and youth attending those institutions, but also those of the communities around them. But connecting them alone does not provide sufficient condition to ensure continuity and quality of learning when crises hit. Any technologies available should be leveraged to enable an open form of school systems that can ensure continuity and quality especially under crises and humanitarian emergencies. Technology-enabled open school systems allow **continued access to school education programs** outside of physical school spaces, either from home or a third physical space.

[1] SDG-Education 2030 Steering Committee Secretariat. (2020). Sustainable Development Goal 4 (SDG4).



© UNESCO/MINEDH
Pupils in pilot e-schools engage with ICT equipment provided by an e-school project in Mozambique.

4.4 Conclusions

The COVID-19 pandemic showed that schools are not only a place for learning concepts, but also a place for learning about face-to-face interaction, social norms and humanity. They also provide a safe space for children where they can grow healthy, and escape from violence, abuse, and socio-economic burdens. Schools will not be replaced in the short term, nor should they. Nevertheless, they need to seize the opportunity presented by the COVID-19 crisis, and reinvent themselves.

Education and connectivity must serve a greater purpose than merely getting schools online: they must **empower learners** and help them develop the self-discipline and self-responsibility required to move forward in life, and the resilience and confidence needed to face life challenges. EMPOWER is about bringing **solutions for learning on top of connectivity**; it is also about facilitating access to partners, resources and technical assistance that increase access to information, opportunity and choice for children as well as safety, once connectivity has been established. EMPOWER is also about helping governments **identify**, **assess** and **support** solutions that facilitate the use of digital technologies for quality learning in school environments and through remote learning, as well as guarantee inclusiveness, facilitate local ownership and decision making, and generate value for the countries developing and deploying these solutions.

School connectivity must also be about empowering those who are online by providing them with **high quality**, **meaningful**, **inclusive** and **relevant content** that is accessible through safe and secure platforms and delivered by innovative methods of instruction. High quality, inclusive, and relevant content and DPGs must be developed by taking into account principles for **localization**, **inclusiveness**, **openness**, **safety** and **security**. They must provide learners with

core competencies for thriving in an even more digital and connected world, and for making a positive impact to the communities they belong. They must also be deemed most appropriate by teachers in order to advance the learning of their students, and facilitate local ownership and decision making, while generating value for the local ecosystems creating and deploying these solutions. More importantly, they **must be made available online to every child and young person in the world** and also to parents, teachers, administrators and political leaders, via an open repository.

Although the goal is to connect every school and every child to the Internet and to provide them with access to information, opportunity and choice, this access needs to take place in a safe and secure way that protects children from online dangers. **Child Online Protection** must be a **top priority** not only for governments, but also for providers, the private sector and all stakeholders involved in education and technology. There is a need for stronger collaboration among these stakeholders to disseminate and enforce many of the tools already available. Child Online Protection is a very important and sensitive element that must be present in the design and deployment of any strategy for school connectivity.

Institutional capacity and the development of local ecosystems for the production of vetted, high – quality content and DPGs are also key to the sustainability of any school connectivity program. Moreover, the human factor is one of the key ingredients for making connectivity work for learning. **Teachers are key in driving successful adoption of high quality content, DPGs, and technology.** Teacher training allows them not only to acquire new skills and competences, but also to overcome fears of using technology; this in turn helps in the deployment and adoption of online tools and content, and empowers them to become more vested in the process of vetting and assessing those solutions.

Monitoring and assessing the learning outcomes that should occur through the delivery of high quality online content and DPGs is essential when evaluating the success of any connectivity initiative. If the ultimate goal is to empower children and youth with skills that enhance their opportunities in live, effective mechanisms must be in place to evaluate the absorption of core concepts.

Connectivity has to be more than just connecting schools. In order for school systems to be resilient, shock absorbent, and crisis respondent, **connecting learners** should also be part of the focus of any connectivity program and strategy.

The engagement through **partnerships** and appropriate **coordination of multiple stakeholders** (Telecommunication companies, content providers and developers, teacher training institutions, among others) is an imperative for designing technology-enabled crisis-resilient school systems.

4.5 Case Studies

This section presents four case studies that illustrate successful examples of:

- Successful country deployment of open source solutions and content developed with the empower principles highlighted throughout the chapter.
- Initiatives that incorporate the principles of sustainability and local ownership.
- Successful connectivity deployments that generate inclusiveness, and empower children, youth, and entire communities.
- Examples of application of Child Online Protection principles to school connectivity programs and strategies.

4.5.1 Uruguay's Plan Ceibal

Principle Addressed
Country deployment of open source solutions and principles of sustainability and local ownership.

Project Name
Plan Ceibal.

Location
Uruguay.

Date
2007 – present.

Partners
- Technological Laboratory of Uruguay (LATU)
- National Agency for Research and Innovation (ANII)
- Agency for the Development of Government Electronic Management and Information Society and Knowledge (AGESIC)
- National Telecommunications Administration (ANTEL)
- Ministry of Education and Culture (MEC)
- Primary Education Council (CEP)
- National Public Education Administration (ANEP)

Situation/Challenge
The Basic Information Educational Program for Online Learning (CEIBAL) was launched in May 2007 with the initial objective to provide all public primary school children and teachers with free laptop access. It also aimed to promote equal access to information and communication tools for all. At the time of its launch only 34 per cent of individuals in the country were using the Internet, however, in the last 10 years this figure has improved to 75 per cent in 2018.[169]

Aim of Project
To support Uruguayan educational policies with technology so as to ensure inclusion and equal opportunities.

[169] International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).

Project Details

Since Plan Ceibal began in 2007, the program has aimed to ensure that every child aged 6 to 15 attending primary and middle public school in Uruguay is provided with access to a personal computer with free Internet connection at school. The initiative also provides programs, educational resources and teacher training courses, such as: the Ceibal Digital Library, which provides free access to textbooks, books and multimedia resources; PAM (an adaptive platform for learning mathematics); a collection of open educational resources; educational projects like Ceilab, a maker space initiative, Design for Change and the Computational Thinking project, as well as a collection of educational video games and a content management platform for teachers and students.

Results

Since 2007 the government has distributed 1,681,830 tablets and laptops to students and teachers in primary and secondary public schools, as well as providing capacity building and training to 28,000 teachers.[170]By 2009, all public primary school students and teachers had access to a digital device through Plan Ceibal, and by 2013 all public secondary school students and teachers had access to a digital device through Plan Ceibal.[171] In addition, 100 per cent of public primary and public schools have Wi-Fi connectivity and Internet access, with 93 per cent of those in urban areas having a fiber optic connection.[172]

The Ceibal platform currently provides a full learning management system, preloaded educational resources for students and professional development opportunities for teachers, as well as access to students, and the general public, to an online library of over 7,000 books.

Of the digital learning programs now on offer, 70 per cent of children in urban public primary schools undertake English classes via the program Ceibal en Inglés.[173] Since 2012 the program has also provided an adaptive learning platform for mathematics, which allows students to learn and progress at their own pace through exercises and games. In 2016, 41 per cent of public school students in primary through to Grade 3 were using this mathematics platform with 41 million activities carried out that year.[174] Finally in 2018 there were over 230,000 users of the virtual learning environment promoted by Ceibal.[175]

Lessons Learned

Part of Plan Ceibal's success has been the result of continuous monitoring, with educational resources constantly updated, and improvements undertaken with regards to functionality and other enhancements to the system. One such example has been the introduction of a contingency plan to mitigate the educational disruption caused by COVID-19 with such features such as support for teachers, students and families, and a pilot online videoconference tool on the platform. Another success factor has been the consistency and coherence in the implementation of public education policies, which have stuck to the original goals whilst accommodating for revisions of the plan because of technology advancements (such as the change from one laptop per child to one device per child which allowed the use of tablets to be included).

Access to digital technologies alone does not ensure improvements to digital literacy. It is important to also ensure that teachers are supported to develop their digital skill and to help them to understand how to use digital technology to improve learning outcomes.

Increase use of digital technology can result in challenges which need to be considered by policy makers, educators and technology implementers, such as regulating screen time, online privacy and security, and cyber-bullying.

170 UNESCO. (2018). Enhancing social inclusion through innovative mobile learning in Uruguay.
171 UNESCO. (2018). Enhancing social inclusion through innovative mobile learning in Uruguay.
172 UNESCO. (2018). Enhancing social inclusion through innovative mobile learning in Uruguay.
173 UNESCO. (2018). Enhancing social inclusion through innovative mobile learning in Uruguay.
174 UNESCO. (2018). Enhancing social inclusion through innovative mobile learning in Uruguay.
175 UNESCO. (2018). Enhancing social inclusion through innovative mobile learning in Uruguay.

4.5.2 Niger's Smart Villages

Principle Addressed
Connectivity for inclusiveness and empowerment of children, youth and communities.

Project Name
Smart Villages.

Location
Niger.

Date
2018 – 2022 (ongoing).

Partners
- ITU
- National Agency for the Information Society (ANSI)
- WHO
- FAO
- UNESCO
- Digital Impact Alliance (DIAL)

Situation/Challenge
Niger is one of the largest countries (in land mass) in West Africa, with a population of around 23 million,[176]half of who are under the age of 15.[177] Niger has one of the lowest Internet access and broadband coverage in both Africa and the World, with only 5.25 per cent of individuals in the country using the Internet.[178] Part of this is due to the difficulties in last mile connectivity in rural areas, in a country where 81 per cent of the population live in rural regions.[179]

Since the development in 2017 of the Niger 2.0 Strategic Plan, the government of Niger has been working to achieve 100 per cent Internet coverage, to foster a digital economy, which is focused on four areas: e-Government, Smart Villages, the creation of a city of Innovation & Technology, and the promotion of digital services.

Aim of Project
The aim of the Smart Village project is to digitally connect 15,000 administrative villages in Niger, and provide the inhabitants with access to digital services (such as Health, Education, Agriculture, Commerce and Finance). The project aims to accelerate and facilitate the connection of more than 85 per cent of the population.

The smart villages project aims at making the first steps possible for rural development by promoting connectivity and digital literacy in rural settlements that need it the most. It focuses on inclusive digital transformation through improvement of the living conditions by addressing the root causes of poverty and hunger, investment in rural development through delivery of digitally-enabled services, establishment of ICT-supported social protection systems, establishment of rural-urban linkages, and increase the income of smallholder family farmers, especially women and the young.

176 United Nations. Country Data: Niger.
177 International Telecommunication Union, (ITU). (2017). Country Profile: Niger.
178 International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).
179 International Telecommunication Union, (ITU). (2019). Smart Villages: Empowering rural communities in 'Niger 2.0'.

Project Details

The establishment of Smart Villages can improve the provision of services in the following sectors:

- Health: the deployment of telemedicine and e-health services will allow patients to have remote consultations and healthcare workers to deliver efficient services, improving access to diagnosis and care, while also reducing the cost for the healthcare system.
- Education: the access to open and distance learning opportunities will enable capacity building for teachers and education administrators as well as providing equitable access to quality literacy, lifelong learning and skills programs for children, youth and adults.
- Agriculture: e-Agriculture services can support efficient and productive farming capabilities among farmers, making rural communities more resilient from both economic and nutritional point of view.
- Multi-hazard early warning and response: ICT systems for hazard risk monitoring, alert, and post-alert guidance and information.
- Banking: support access to digital financial and investment services for citizens and businesses.

Results

This project is still ongoing, therefore results are yet to be achieved and measured. However, the goal is to empower the population, by providing digital services for the improvement of the school systems and delivery of vocational and literacy training. The provision of digital services to rural villages is aimed to facilitate improvements in health, through early warning and prevention, awareness raising on health risk, and telemedicine. Rural villagers might then benefit from connectivity to modernize their agricultural practices by providing information on best practices in agriculture and dissemination of useful weather data.

Lessons Learned

As the project is still ongoing, lessons are yet to be drawn in full extent. Niger, ITU and DIAL have however developed a methodology[180]for the Smart Village platform to guide a common cross-sector digital infrastructure. It is based on a "whole-of -government" approach to delivering services in a more integrated and coordinated manner. While previous projects focused on addressing SDGs have resulted in duplication of efforts, highly fragmented ecosystems, and constraints around interoperability and scaling up, it is hoped that this 'whole-of-government' approach will allow for a more coordinated solution. It will incorporate core foundational building blocks, such as registries, and digital identification and authentication services, which would then allow for easily scale up and information sharing between different organizations, departments and projects.

[180] International Telecommunication Union, (ITU). (2019). SDG Digital Investment Framework - A whole-of-Government Approach to Investing in Digital Technologies to Achieve the SDGs.

4.5.3 Rwanda Child Online Protection

Principle Addressed
Child Online Protection.

Project Name
Child Online Protection Implementation Plan.

Location
Rwanda.

Partners
- Government of Rwanda
- University of Rwanda
- 5 Rights Foundation
- University of East London

Cost
RFW 2 billion (budget for 5 years).

Funded by:
End Violence Fund / Safe Online portfolio.

Situation/Challenge
In 2011 the percentage of individuals using the Internet was 7 per cent, and by 2017 this had grown to 22 per cent[181]. Rwanda has committed strongly to digital transformation programs, however, the growth in Internet use poses potential new risks to children in the form of indecent and violent images, fake news or false narratives, child trafficking, sexual exploitation, cyber bullying, predatory marketing schemes, fraud and gambling. These risks are particularly acute if there are no Child Online Protection (COP) Policies or laws in place.

Aim of Project
Creation of a Child Online Protection Policy to empower Rwanda's younger generation for productive and safer use of the Internet by:
- Establishing a governance framework to drive COP initiatives.
- Establishing responsive policy and legal regimes for COP enforcement.
- Promoting awareness for productive use of the Internet by children.
- Developing technical tools for combatting child online exploitation.
- Stimulating Research and development in the field of COP.
- Promoting national, regional and international Cooperation for COP.

[181] International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).

Project Details

Research was undertaken in conjunction by 5Rights Foundation, University of East London and in collaboration with the University of Rwanda[182] , to conduct an assessment, which drew on the lessons from the introduction of regulations in other countries, international best practice and, in consultation with a cross-sector expert working group and the Government of Rwanda. The final goal was the production of a Child Online Protection Policy Document that was presented to the Minister of ICT and Innovation, and the development of a communications strategy for the roll out of a COP public awareness campaign[183] . The entire project was funded and supported by the End Violence Fund through its Safe Online Investment Portfolio.

Results

In June 2019, the "Rwanda Child Online Protection Policy" was adopted by the government.

A National advisory committee has since been established to oversee and advise the overall implementation of the COP Policy.

Lessons Learned

Review of existing domestic and international legal and judiciary frameworks is recommended in order to strengthen local COP Policy and enforcement.

Capacity building and awareness raising is recommended to strengthen the COP capabilities of key administrations and institutions that have to deal with child protection.

COP needs to be considered when there are changes in circumstances that have an impact on children, for example in Rwanda, as a result of COVID19, COP was included in mitigation strategies with COP awareness messages embedded into the Education and ICT sectors.

[182] 5Rights Foundation. (2019). Child Online Protection in Rwanda.
[183] 5Rights Foundation. (2019). Child Online Protection in Rwanda.

4.5.4 Ukraine Child Online Protection

Principle Addressed
Child Online Protection

Project Name
National Child Online Safety Assessment

Location
Ukraine

Date
2019

Partners
- ITU
- South West Grid for Learning
- Ombudsman for Children with the President of Ukraine Office

Situation/Challenge
According to the ITU, 63 per cent of individuals in the Ukraine are using the Internet,[184] whilst it is estimated that 50 percent of under 15s in the country are online. Online surveys of children and parents conducted by the ITU[185] estimated 67 per cent of children surveyed reported that they had been upset by something online.

Aim of Project
To support the Ombudsman for Children with the President of Ukraine's Office to carry out an in-depth review of the status of Child Online Protection (COP) in the Ukraine, and develop a national strategy and multi-year plan for action.

Project Details
In order to carry out the assessment and provide recommendations, research was carried out through a series of online surveys completed by children, parents and stakeholders within the country; interviews with Government Ministries, NGOs, Industry and Schools; as well as via desk based research. From the research a number of issues were identified and recommendations were given.

Results
The research highlighted a number of issues such as:
- Access to unwanted or inappropriate content.
- Lack of clarity on reporting online safety concerns.
- Existing coverage of Child Sexual Abuse Material legislation.
- Lack of national coordination on Child Online Protection.
- Quality of teachers' digital skills and competencies.
- Low awareness of online risks and threats (particularly amongst parents).

Recommendations were then made with regards to Child Sexual Abuse Material, Bullying, and the establishment of a National Stakeholder Council and provision of Parental Control Tools. Further recommendations were made regarding how school and public open Wi-Fi access should be managed, how Child Sexual Abuse Material should be reported, the establishment of a Safer Internet Centre and ensuring a better understanding amongst the population around legislation in this area. Each recommendation also included a suggested lead to implement the recommendation (e.g. Ministry of Justice vs. Ministry of Digital Transformation).

184 International Telecommunication Union, (ITU). (2017). Percentage of Individuals using the Internet (excel).
185 ITU survey conducted from 7-30 October 2019 of 5,813 parents and 5,373 children.

Lessons Learned

By conducting research into existing policies, legislation and attitudes to child online safety a number of gaps and issues were identified. Research and recommendations were also informed by the ITU's "Guidelines for Policy Makers on Child Online Protection".[186]

The ITU's Guidelines propose concrete recommendations on developing a national strategy on COP, provide tools to identify key stakeholders to engage with and coordinate efforts as well as alignment with existing national frameworks and strategy plans.

Highlighting the clear benefits of a national Child Online Protection strategy included:

- Development of adequate national legislation,
- Development of legal framework, and
- Harmonization at the international level.

These frameworks may be self-regulatory, co-regulatory or full regulatory frameworks.

The State should promote the use of ICTs in preventing and addressing violence, such as the development of technologies and resources for children to access information, block harmful material and report instances of violence when they occur.

To face the global Child Online Safety situation, Governments must facilitate the communication between their relevant entities and cooperate openly to eliminate harm to children online.

The national checklist includes recommendations on:

1. Legal framework
2. Regulatory framework
3. Reporting - illegal content
4. Reporting - user concerns
5. Actors and stakeholders
6. Research
7. Education digital literacy and competency
8. Educational resources
9. Child protection
10. National awareness
11. Tools, services and settings

Coordination between various stakeholders is necessary to implement recommendations that generally require multiple actors to take steps. Changes to legislation will also require efforts to educate the public on new legislation and reporting channels.

[186] International Telecommunication Union, (ITU). (2020). Guidelines for Policy Makers on Child Online Protection.



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Zlata, 7, works on schoolwork from home in Ukraine, with all schools in the country closed as part of measures to combat the spread of COVID-19.

5. Going Forward

Never before have broadband networks and services been so vital to keep our economies and societies working. One and a half billion children are in need of online education due to the pandemic and many more are in need of just having access to the basic right to learn. The educational inequality born out of this crisis will continue to have an impact on income inequality and will likely affect the progress made on achieving the Sustainable Development Goals, in particular those related to education (SDG4), gender equality (SDG5), industry, innovation and infrastructure (SDG9), reduced inequality (SDG10), and the promotion of peace and end of violence and abuse (SDG16). Connecting all schools to the Internet and increasing the speed/quality of connection of those already connected, is an imperative for attaining the SDGs and for lifting millions of people out of poverty in the years to come after the pandemic.

Now is the time to act. There has never been an opportunity like this one to raise the issue of education and school connectivity, moreover, the importance of connectivity overall and everywhere: at school and at home. School connectivity must be addressed with a comprehensive approach that looks not only at infrastructure, affordability, regulation and technologies, but also at the human component, which includes: closing digital and literacy barriers, having localized and meaningful content, measuring the impact on learning outcomes and strengthening the capacities and the role of teachers. Schools must continue being the neuralgic cells they are to societies and economies; a physical place where all children and youth gather to learn, grow healthy and escape from violence, abuse, and socio-economic burdens.

Although this report serves as a culmination of a year's advisory and consultative effort, the members of the Broadband Commission Working Group on School Connectivity in their individual capacities will continue supporting the cause of school connectivity and advocating for universal broadband access to achieve high-quality and inclusive learning.

Through the future work of **Giga** and **UNESCO's e-Schools Initiative**, the key learnings and proposals coming out of this year of collaboration will continue making an impact at the country level. These two initiatives will ensure schools get the support they need to go online, and that learners are provided with the right skills for employability and for safe access to information, opportunity, and choice.

Giga – Priorities moving forward

Giga is now being regarded as a "new and potentially transformative model" by the United Nations, and highlighted as one of the roadmap steps for achieving universal connectivity by 2030. [187]

As Giga moves forward, the focus will continue to be on financing and implementing school connectivity in an initial set of countries: four in **Sub-Saharan Africa** (Rwanda, Kenya, Niger, Sierra Leone); three in **Central Asia** (Kazakhstan, Kyrgyzstan, and Uzbekistan); and six in **Latin America and the Caribbean** (El Salvador, Honduras, Dominica, St. Lucia, St. Vincent and the Grenadines, and Granada). At the moment of writing this report, conversations are been held with a growing number of countries in these regions, who have expressed interest in joining Giga, and are assessing the value this initiative can bring to help push forward their school connectivity work.

[187] United Nations. (2020). United Nations Secretary-General's Roadmap for Digital Cooperation.

The 11 Steps Process:

The country work of Giga will follow an 11 steps process to connect schools, and the communities around them.

Step 1. Work with country leadership to structure a Giga-specific partnership.

Step 2. Form a multi-stakeholder partnership coalition around a country-specific work plan.

Step 3. Develop a foundation of data to identify the need for connectivity and size the investment opportunity.

Step 4. Build on existing country plans and policies by gathering data on the economic, political and regulatory landscapes.

Step 5. Evaluate regulatory barriers and identify potential **"opportunities"** to finance connectivity.

Step 6. Survey the market conditions for implementation through discussions with operators, providers, and User Services Platforms (USPs).

Step 7. Secure public financing to de-risk private investments in connectivity.

Step 8. Form a bloc of private funders and implementation companies to finance connectivity.

Step 9. Advise the country government on procurement structuring and build an accountability platform for evaluating implementation (real-time monitoring maps).

Step 10. Support the government to rolling-out the procurement process.

Step 11. Work with the government to create a sustainable business model, including continuous monitoring and expansion of technology and digital public goods.

In-Country Activities:

Some of the specific activities that Giga plans to perform in the above-mentioned countries include:

In Sub-Saharan Africa:

- Specifically, in Kenya, Niger, Sierra Leone, Rwanda and Zimbabwe, Giga will be implemented to provide affordable digital connectivity to schools; through "Giga Accelerate", the first 1,000 schools in each country will be connected by early 2021.
- Rwanda will lead digital cooperation efforts in Africa through Giga to connect all schools in the continent by 2030.
- Sierra Leone will share their experience in school mapping and lead the Digital Public Goods work in the region.

In Latin America and the Caribbean:

- Specifically in El Salvador, Giga will develop a real-time monitoring tool for connectivity and a new financial model to invest in a national telecommunications company based on a public-private collaboration.
- Honduras, with the support from a loan from the Inter-American Development Bank (IDB), will develop a digital connectivity bond using their Universal Service Fund as a guarantee.
- Colombia will be developing a real-time monitoring tool to assess the quality of service that schools receive.

Opportunities for rapid success:

Giga is identifying a series of opportunities that are happening concurrently with this bigger process, and which are generating interesting results. These include:

- Technical projects that are "already in the works". (e.g. Niger's Smart Villages).
- Giga: Accelerate – connecting set numbers of schools to pilot the Giga model and bring immediate response. This ties specifically with COVID-19 response and with concrete needs from countries that need to be addressed "now".
- Strategic Initiatives for knowledge creation (e.g. reports and communication materials).
- Easy to build, replicable partnerships to engage specific partners including other ITU/ UNICEF programs (e.g. partnering with UN Women to create: Giga Girls).

Partnering with Giga

- From private sector partners, Giga seeks:
    - ***Data sharing*** – Giga relies on school location and connectivity mapping data to identify gaps and aggregate demand for funding proposals.
    - ***Financial support*** – Giga's mission to connect every school in the world is ambitious. Giga calls for help in the form of funding to move more quickly and to bring school connectivity in more places.
    - ***Technical assistance*** – Giga welcomes bright minds that can help build cases for financing, develop new technologies, and introduce "out-of-the-box" ways to overcome big challenges.
    - ***Country-level investments*** – if you have an interest in supporting a specific country, either with financial contributions or service provision, Giga can add services that amplify the impact of your investment.
    - ***Local business investment*** – UNICEF Venture Fund brings expertise that can help guide your investment in developing businesses and digital services enabled by connectivity.
- For **country governments** wanting to join Giga:
    - Start with **stakeholder engagement** and **data collection**. Giga will work with country governments to gather information that can help initiate discussions with investors. Similarly, Giga will help governments assess the availability of data and begin to use that data to produce analyses that will be critical to financing and implementation.

Giga works with **ALL countries** and adapts to their current stage and context in these efforts.

UNESCO e-Schools Initiative – Priorities moving forward

Improving the quality of learning will not happen automatically once schools are connected to the Internet. Broader challenges like: overall school readiness; integration of digital content in the curricula; teachers' competencies and digital skills; impact of technology in learning outcomes, and the application of real time data for improving overall education systems will still need to be addressed, as they continue to affect the performance of schools.

The school as a physical space will remain indispensable. Traditional classroom organization must give way to a variety of ways of "doing school" but the school, as a separate space-time

of collective living, specific and different from other spaces of learning must be preserved.[188] Moving forward, schools need to transform themselves into open-schools and connectivity should also reach learners.

UNESCO will continue developing its **Technology Enabled Open School model** anchored in the principles of: school-based blended learning, home-based distance learning, and access to distance learning, content and coach any time, any where. UNESCO will continue advocating this model through its **e-schools Initiative**, which will go into a second phase, developing pilots in Côte d'Ivoire, Ghana and Senegal.

Through the e-schools Initiative, UNESCO will continue supporting countries with:

- Access to school readiness assessment framework and toolkit.
- Localized assessments to better understand the response framework.
- Access to a community of practices.
- Capacity building support for the schools leadership.
- Opportunities to contribute to knowledge production.
- Introductions to **Global Education Coalition** members who could support the country's e-school initiative.

UNESCO will continue confirming the interest and commitment from other countries to join the e-schools Initiative, mobilize members of the Global Education Coalition, and engineer action at the national and local levels to deliver on the promise to leave no one behind in the achievement of high quality education for all.

[188] UNESCO. (2020). Education in a post-COVID world: Nine ideas for public action.

How To Get Involved

If you want to get involved, the Broadband Commission Working Group on School Connectivity invites you to:

1. Support the Broadband Commission **Agenda for Action**.
2. Sign the Broadband Commission declaration on Universal **Child Online Safety (COS)** Universal Declaration.
3. Help implement the **ITU Child Online Protection Guidelines for policymakers, industry, parents & educators and Children themselves**.
4. Join the **Global Education Coalition**, to learn alongside other partners, and support governments to enhance and scale up equitable learning during the pandemic.
5. Join **UNESCO's** initiative for the development of an international declaration on connectivity for education to support learning and strengthen the resilience of education systems. The proposed declaration aims to help guide the international community thereby committing to:
    - Ensure connectivity adequately supports the right to education.
    - Recognize the equity and inclusion dimension of connectivity.
6. Partner with **Giga**, to increase the breadth and accelerate progress towards universal school connectivity. If your country is not on the initial set of countries listed above, but already has interest and potential partners, **reach out to the Giga team** via: gigaconnect.org.

ACRONYMS

ACRONYM	DESCRIPTION
2GIS	2 GIS Maps
3G	Third Generation of Wireless Mobile Telecommunications Technology
4G	Fourth Generation of Wireless Mobile Telecommunications Technology
ADB	Asian Development Bank
AfDB	African Development Bank
AGESIC	Agency for the Development of Government Electronic Management and Information Society and Knowledge Uruguay
AI	Artificial Intelligence
ANATEL	Agência Nacional de Telecomunicações
ANEP	National Public Education Administration Uruguay
ANII	National Agency for Research and Innovation Uruguay
ANSI	National Agency for the Information Society
ANTEL	National Telecommunications Administration Uruguay
ARPU	Average Revenue per User
BYOD	Bring Your Own Device
CAGR	Compound Annual Growth Rate
CapEx	Capital Expenditure
CARCIP	Caribbean Regional Communications Infrastructure Program
CEIBAL	Basic Information Educational Program for Online Learning
CEP	Primary Education Council Uruguay
Ceptro.br	Center for Studies and Research in Network Technology and Operations Brazil
Cetic.br	Regional Center for Studies on the Development of the Information Society
CIEB	Center of Innovation for Brazilian Education
COP	Child Online Protection
COS	Child Online Safety
CSAM	Child Sexual Abuse Material
CTU	Caribbean Telecommunications Union
DBOFT	Design, Build, Operate, Finance, and Transfer
DCF	Discounted Cash Flow
DFI	Development Finance Institution

ACRONYM	DESCRIPTION
DIAL	Digital Impact Alliance
DPGs	Digital Public Goods
DSTI	Sierra Leone's Directorate of Science, Technology and Innovation
EBA	Education Information Network
ECTEL	Eastern Caribbean Telecommunications Authority
EMIS	Educational Management Information System
FAO	Food and Agriculture Organization of the United Nations
FAQ	Frequently Asked Questions
FITEL	Telecommunications Investment Fund
FOSS	Free and Open Source Software
GAVI	Global Alliance for Vaccines and Immunizations
GB	Gigabyte
Gbps	Gigabyte per second
GDP	Gross Domestic Product
GDP pc	Gross Domestic Product per capita
GNI	Gross National Income
GPS	Global Positioning System
GSMA	Global System for Mobile Communications Association
GWAN	Government Wide Area Network
IBRD	International Bank for Reconstruction and Development
ICT	Information and Communications Technology
ICT-CFT	UNESCO's ICT Competency Framework for Teachers
ICT4E	Information and Communications Technology for Education
IADB	Inter American Development Bank
INEP	Instituto Nacional de Estudos e Pesquisas Educacionais
IOT	Internet of Things
IRR	Internal Rate of Return
IRU	Indefeasible Rights of Use
ISAP	Information Society and Action Plan
ISP	Internet Service Provider
IT	Information Technology

ACRONYM	DESCRIPTION
ITU	International Telecommunication Union
ITU IDI	ITU Information and Communication Technology Development Index
KPI	Key Performance Indicator
LAC	Latin America and the Caribbean
LAN	Local Area Network
LATU	Technological Laboratory of Uruguay
LDC	Least Developed Countries
LLDC	Landlocked Developed Countries
LMC	Last Mile Connectivity
MB	Megabyte
MC	Brazilian Ministry of Communications
MCTI	Brazilian Ministry of Science, Technology and Innovation
MD	Brazilian Ministry of Defense
MEC	Brazilian Ministry of Education
MEC	Ministry of Education and Culture Uruguay
MIC	Middle Income Countries
MIGA	World Bank Multilateral Investment Guarantee Agency
ML	Machine Learning
MNO	Mobile Network Operator
MoNE	Ministry of National Education of Turkey
MOOC	Massive Open Online Courses
NGO	Non-Governmental Organizations
NIC.br	Brazilian Network Information Centre
NPV	Net Present Value
NREN	National Research and Educational Network
OA	Open Access
OD	Open Data
OECD	Organization for Economic Cooperation and Development
OECS	Organization of Eastern Caribbean States
OER	Open Educational Resources
OPEx	Operational Expenditure

ACRONYM	DESCRIPTION
OPIC	Overseas Private Investment Corporation USA
PDO	Project Development Objective
PIEC	National Innovation Policy Connected Education
PIU	Public Private Partnership Commission of Malawi
PPP	Public Private Partnership
QoS	Quality of Service
RCIP	The World Bank's Regional Communications Infrastructure Program
RCPIMW	Regional Communications Infrastructure Program 3 Malawi
RNP	Brazilian National Research and Education Network
ROI	Return on Investment
RTT	Round Trip Time
SDGs	Sustainable Development Goals
SIDs	Small Island Developing States
SIM	Subscriber Identification Module
SLA	Service Level Agreement
SN	Switching Node
STEM	Science, Technology, Engineering and Mathematics
TAS	Telecommunication Authority Suriname
TELCOR	Institute for Telecommunications and Posts Nicaragua
TVWS	Television White Spaces
UIS	UNESCO Institute for Statistics
UKCCIS	UK Council for Child Internet Safety
UN	United Nations
UNCRC	United Nations Convention on the Rights of the Child
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
UNODC	United Nations Office on Drugs and Crime
USAID	United Stated Agency for International Development
USF	Universal Services Funds
USP	User Services Platforms
VLP	Virtual Landing Point

ACRONYM	DESCRIPTION
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
WASH	Water, Sanitation And Hygiene
WHO	World Health Organization
WSIS	World Summit on Information Society

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52.	The word: "Mapping" in this report refers to a series of techniques and procedures used to determine the physical and geographical location of a school, as well as its connectivity requirements.
53.	Project Connect. AI-Assisted School Mapping. (2019). [online]. Available at: http://devseed.com/unicef-school-docs/methodology/school-data-cleaning/ [Accessed 17 Aug. 2020].
54.	UNESCO Institute for Statistics, (UIS). Information and Communication Technologies (ICT). [online]. Available at: http://uis.unesco.org/en/topic/information-and-communication-technologies-ict [Accessed 17 Aug. 2020].
55.	SDG Target 4a: "Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all". Indicator 4.a.1 measures the proportion of schools offering basic services, by type of service, with the following services: access to electricity; access to the Internet for pedagogical purposes; access to computers for pedagogical purposes; access to adapted infrastructure and materials for students with disabilities; access to basic drinking water; access to single-sex basic sanitation, by education level; access to basic hand washing facilities.
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73. The Lemann Foundation strives to make Brazil a more just and equitable place by guaranteeing access to high-quality public education for Brazilians of all backgrounds while supporting the development of leaders committed to the social transformation of Brazil. For more information about the Lemman Foundation: https://fundacaolemann.org.br/en

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80.	For more information on the system please visit https://simet.nic.br/projetos/ (content only in Portuguese).
81.	For more information on the Connected Education Internet Measurement System please visit http://medidor.educacaoconectada.mec.gov.br/ (content only in Portuguese)
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96.	In some countries, primary and secondary schools can also get connected to the Internet by using the backbones of National Education and Research Network (NRENs).
97.	International Telecommunication Union, (ITU). (2013). Connect a School, Connect a Community.
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162.	In Poland for example, the Office of Electronic Communications (UKE) runs an educational campaign #keepCTRL: https://www.uke.gov.pl/en/newsroom/click-sensibly-keepctrl-new-uke-educational-campaign,243.html
163.	The Inter-Agency working group on violence against children strongly recommends providing opportunities for children's views to be heard and taken into account through consultation and dialogue. Other examples of global efforts calling for the inclusion of children's perspectives in the debates around Internet governance and children's safe Internet use include among others: UNICEF Office of Research –Innocenti and the partnership between UNICEF and ITU, GPEVAC, UNESCO, UNODC, WePROTECT Global Alliance, WHO and World Childhood Foundation USA.
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International
Telecommunication
Union
Place des Nations
CH-1211 Geneva 20
Switzerland



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