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Raising Learning Outcomes:

the opportunities and challenges of ICT for learning

Innovation Unit
New solutions for thriving societies

AGA KHAN FOUNDATION

Aga Khan Education Services

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Executive Summary

There is a growing global consensus that 21st-century learning ought to look rather different from 19th-century learning but that in practice, for the vast majority of learners, it does not. International academic, policy and provider organizations are in the process of rethinking learning outcomes and learning environments, and some are even engaged in a fundamental review of the very purpose of education in a more digitally enabled, complex and fast changing world. New learning frameworks are emerging, many in response to UNESCO's 2030 Agenda for Sustainable Development – an aspirational and universal agenda to wipe out poverty through sustainable development by 2030, which captures ambitions for education.

Characteristically,[1] these frameworks promote the integration of:

- Cognitive and non-cognitive (sometimes called soft) skills;
- Behaviours or traits (team-work; risk-confidence; and self-regulation);
- Dispositions (leadership; entrepreneurship; and creativity); and
- Character (values; empathy; and global citizenship)

These so-called 21st-century learning outcomes are often marginalized by schools, due to their low status and their invisibility in summative assessments, and also in the instance of under-developed curricula, and the low skills of teachers in these areas.

UNICEF understands that this debate is as relevant in Africa as in any other part of the world. Maybe even more so. As the continent with the world's fastest growing youth population[2] and some of the world's fastest growing economies, alongside many challenging political, social and economic circumstances, low levels of resources and high rates of out-of-school-children (OOSC), countries in Africa are well motivated to accelerate progress towards these 21st-century learning outcomes. These factors create a necessity – and therefore an opportunity – for innovation and alternative modes of education. The more agile an education system can be in response, the more the learners within that system will benefit.

The role of technology has defined the acceleration of many industries and sectors, with education likely to be no exception. Yet with the potential of technology comes risks. Technology can be introduced to schooling and learning to the detriment of learning outcomes. Equally, access to technology can expose children and young people to new risks that – left unmitigated – can do them serious harm. In recognition of this, UNICEF has developed *Global Guidance* to ensure that technology can be a positive force for learning and children's rights. They include five key policy recommendations:

- All UNICEF's ICT for education initiatives and policies must first focus on the intended educational outcomes rather than on the technologies;
- UNICEF should play a stronger global role in advocating and ensuring that international and national ICT for education policies and practices should first of all focus on the poorest and most marginalized;
- Issues of security and the dark side of using ICTs for education are insufficiently addressed in most ICT for education initiatives, and should be of the highest priority for UNICEF given its commitment to child safety and security;
- UNICEF should take a global lead in working in collaborative and consensual partnerships, especially with other UN agencies; and
- Language really matters. UNICEF should ensure that there is consistent use of language relating to the use of ICT in education and for learning throughout the organization

(1) See also (Four-Dimensional Education, Deep Learning Progressions, Graduate Performance System, Foundations for Young Adult Success, Education for Life Success, Skills for Social Progress, *Life Skills and Citizenship Education Initiative Middle East and North Africa*

(2) "By 2030 Africa's under-18 population will increase by nearly 170 million. By 2050 40% of the world's children under 18 will live in Africa." See UNICEF (2014) *Generation Africa 2.0: Prioritizing investments in children to reap the demographic dividend*. United Nations Children's Fund.

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In this context, the UNICEF regional offices in sub-Saharan Africa commissioned the Innovation Unit, Aga Khan Education Services (AKES) and the Aga Khan Foundation (AKF) to lead a research project to inform the development of a UNICEF's thinking on ICT for learning. The project built on previous work completed for AKES in which the team investigated learning technology stories from diverse contexts, including many that are complex and resource-constrained. For UNICEF, the team looked in particular at stories from the African continent, supplementing the AKES data set with new examples identified by UNICEF ESARO and WCARO.

In particular, the research process was designed to answer the following questions:

- What is the role of ICT for learning to ensure effective and relevant learning outcomes?
- How can ICT for learning promote educational inclusion?
- What are other partners and organizations doing in ICT for learning?
- Who are the partners and donors to work with in the area of ICT for learning?
- What is UNICEF's role in the ICT for learning space?

This paper shares the key findings of the research project. It is supplemented by three sets of insights in relation to ICT for learning:

1. lessons from the experience of introducing ICT for learning in Singapore, New Zealand and Brazil;
2. examples of ICT for learning initiatives that were selected to draw out learning from a range of implementation stories – success and failures – and provide a broad set of examples of use of ICT for learning examples that are relevant for the sub-Saharan African context; and
3. country case studies providing background as well as the experience and prognoses for ICT for learning of UNICEF country offices.

This research project identified ten issues that UNICEF's regional offices in sub-Saharan Africa should consider as they develop their position and begin formulating their strategy around ICT for learning:

1. **Purpose and problem solving** - to what extent is there clarity around the purpose of introducing technology in education and which learning problem(s) it is helping to solve?
2. **Student capability** - what are the existing and needed technical capabilities of students, and how do these vary across each student population?
3. **Teacher capability** - which skills do teachers need to use new technology, and what is the relationship between these skills and broader teacher competency? In particular, how is the ability of teachers to create powerful learning environments/ experiences enhanced by technology?
4. **Student and teacher agency** - how can students and teachers engage as active participants in the introduction and implementation of ICT for learning?
5. **Technological infrastructure** - what are the technical requirements of the technology and are these in place (e.g. power, bandwidth, data security)?
6. **Implementation and change** - what is the role of local leaders and what support do they need to create a culture of innovation and improvement?
7. **Enabling environments** - what are the conditions that support a thriving learning ecosystem, enhanced by technology?
8. **Resources** - what is required for effective and sustainable use of ICT for learning, including on-the-ground support capability?
9. **Coalitions** - what role might partnership play in 'bundling' solutions to complement and amplify ICT for learning?
10. **Risks** - which risks are associated with ICT for learning, and how might we mitigate against them?

With a nascent evidence base about the impact of ICT on learning outcomes and a loose global community of entrepreneurs, philanthropists, educators and policy makers still learning in real time about what works (and what does not), to say 'the jury is still out' on ICT for learning would be a gross understatement. Therefore making recommendations would be ill advised.

However, a further learning and consultation agenda does emerge from the challenges and opportunities explored during the research process. There are three urgent priorities for UNICEF to consider:

1. **Building knowledge of and confidence about ICT for learning across the region:** UNICEF should consider how best to engage country offices in contributing to a stronger evidence base, locally and globally. This area requires more flexibility and openness to different ways of designing and delivering programmes of work.
2. **Enabling strategic and practical action:** To mobilize a real sense of practical possibilities within the ICT for learning landscape, UNICEF should consider how best to move from knowledge to action. As an influential international agency, UNICEF is in a position to inject a growing understanding of the opportunities and challenges of ICT for learning into existing global, regional and national education work streams.; and
3. **Coordination, coherence and integration:** UNICEF should consider building active partnerships committed to ICT for learning internally and more widely. It should actively coordinate its efforts to offering more clarity and coherence within the ICT for learning landscape

The above areas for action are not intended as recommendations but as starting points for further discussion. To fully understand the possibilities of the above, UNICEF should consider how to test these areas of action in a multitude of countries and regions, with a range of frontline stakeholders (school leaders, teachers, students) as well as key agents of change (donors, providers, ministries). Building energy and buy-in across global, regional and local ecosystems will be critical to enable transition from a fragmented and dislocated landscape to clear and coherent visions of the role ICT for learning can play in enhancing teaching and learning towards impact on outcomes.

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Ines is speaking live from Abidjan during the weekly young reporters' radio show broadcasted in 9 locations across Côte d'Ivoire.

Valter, 21 year old, participates in a user testing session for the mobile service Internet of Good Things (IoGT) in Maputo, Mozambique.

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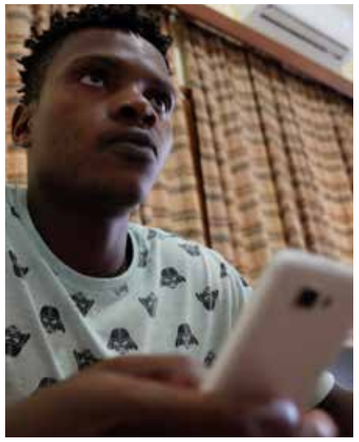

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Schoolchildren at Binga Primary school take time to familiarise themselves with computers at the school.

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In the computer lab at the Boys Remand Home in Accra, Ghana on 12 May 2015.

Introduction

A definitive technological revolution has enabled fast-paced change around the world. Technology has connected remote populations, improved communication, and facilitated widespread knowledge sharing. Increasingly, information communication technology (ICT) has been introduced and applied in the education space – for both the learner and the teacher, in classrooms and schools, and across the Global North and Global South – to improve the efficiencies and effectiveness of programmes and operations.

The application of technology in education varies across the Eastern and Southern Africa Region (ESAR),[3] and West and Central Africa Region (WCAR)[4] and numerous technology-enabled approaches are being used to improve the quality of education and learning outcomes. Technological innovations in education, such as tablet-based tools, are often viewed as "disruptive" and against the grain of doing "business as usual" when first designed and implemented, and frequently viewed as transformative for teaching and learning. This is true for both the Global North and Global South.

Globally, and especially in sub-Saharan Africa, UNICEF's primary experience using technological innovations in education is for real-time monitoring –largely administrative tasks that track quality education indicators via mobile phones. As technology – both hardware and software – becomes more flexible and cheaper to deploy, opportunities to leverage technological tools and platforms for learning are growing.
Today, technology is increasingly being applied for learning and is referred to as 'digital learning'. Globally and across the region, countless organizations are developing digital learning platforms, programmes, and content, and UNICEF Country Offices (COs) are increasingly exploring how to deploy these tools.

However, despite the many opportunities that technological innovations can bring for learning, UNICEF's Eastern and Southern Africa Regional Office (ESARO) and Western and Central Africa Regional Office (WCARO) lack clear guidelines about how and where ICTs can add the greatest value for children to achieve improved learning outcomes.

In this context, the UNICEF regional offices in sub-Saharan Africa commissioned the Innovation Unit, along with Aga Khan Education Services (AKES) and the Aga Khan Foundation (AKF) to undertake research to inform the development of a UNICEF ESARO and WCARO position on ICT for learning. The project built on previous work completed for AKES in which the team investigated learning technology stories from diverse contexts, including many that are complex and resource-constrained. For UNICEF, the team looked in particular at stories from the African continent, supplementing the AKES data set with new examples identified by UNICEF ESARO and WCARO.

In particular, the research process was designed to answer the following questions:

- What is the role of ICT for learning to ensure effective and relevant learning outcomes?
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- What is UNICEF's role in the ICT for learning space?

This paper shares the key findings of the research project. It is supplemented by three appendices, to be published separately, which look at (1) lessons from the experience of introducing ICT for learning in Singapore, New Zealand and Brazil; (2) examples of ICT for learning initiatives that are relevant for the sub-Saharan African context; and (3) country case studies providing background as well as the experience and prognoses for ICT for learning of UNICEF country offices.

(3) The Eastern and Southern Africa Region for UNICEF is made up of 21 countries: Angola, Botswana, Burundi, Comoros, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Rwanda, Somalia, South Africa, South Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe

(4) The West and Central Africa Region for UNICEF is made up of 24 countries: Benin, Burkina Faso, Cameroun, Cape Verde, Central African Republic, Chad, Congo, The Democratic Republic of Congo, Cote D'Ivoire, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Soa Tome and Principe, Senegal, Sierra Leone and Togo.

Chapter 1:

Setting the scene for ICT for learning in sub-Saharan Africa

Context

Eastern, southern, western and central Africa are, of course, highly diverse. The countries in the regions include:

- Middle-income countries with relatively well developed social infrastructure and services. In these countries (for example several southern African states), challenges include high rates of HIV and significant inequalities;
- Stable lower-middle and low-income countries (such as Kenya, Nigeria and Tanzania) with high under-five mortality and weak systems and service. In these countries there is government buy-in for development programming;
- Low-income, conflict- and emergency-prone countries with high child mortality rates and relatively less developed social infrastructure (such as the Democratic Republic of Congo, Ethiopia, Madagascar and Mozambique); and
- Countries with fragile contexts and/or governance challenges that necessitate adaptive programming (such as Chad, Somalia and South Sudan).

These countries share a deep commitment to education as part of the solution to tackling their challenges. Decades of public investment have resulted in progress in increasing access and improving quality. However sub-Saharan African countries continue to struggle with complex and seemingly intractable problems in education. These include, but are not limited to:[5]

- Large class sizes and high student-teacher ratios;
- Schools and families picking up the hidden costs of "free" education;
- Over-reliance on rote learning methods that deliver poor learning outcomes;
- Teacher absenteeism and too much low-quality teaching;
- Low levels of participation in pre-primary and secondary education; and
- The persistent challenges of out-of-school children, irregular attendance, repetition and dropping out of primary education.

Too often this leads to uninspired and underachieving students, disappointed parents unable to see sufficient returns on their investment in their children's education, and employers struggling to identify the literate, numerate young African creative thinkers, problem-solvers and adaptive, lifelong learners they need for their businesses to grow and thrive.[6]

UNICEF is committed to ensuring that all children and young people have access to high-quality learning as a precondition for happy, healthy and meaningful lives. The organization's strategic plan for 2018-2021 sets out how UNICEF intends to work towards realizing the rights of every child, especially the most disadvantaged, including by ensuring that Every Child Learns, in line with United Nations Sustainable Development Goal 4.

Unfortunately, the world as a whole is running behind schedule, and on current trajectories it will be fifty years late to achieve the global education commitments:

- universal primary completion will be achieved in 2042, with the poorest countries achieving universal primary education 100 years later than the richest;[7]
- universal lower secondary completion in 2059; and
- universal upper secondary completion in 2084.

The equity issues this analysis raises are inescapable, and UNICEF's commitment to every child requires a new solution – a fresh response – if the most disadvantaged are to be in any way included in the opportunities that success in education might create.

(5) These challenges were identified in a 2017 survey of team members in 12 UNICEF country offices undertaken as part of this project.

(6) "Employers across the region already identify inadequately skilled workforces as a major constraint to their businesses, including 41% of all firms in Tanzania, 30% in Kenya, 9% in South Africa and 6% in Nigeria. This pattern may get worse in the future. In South Africa alone, 39% of core skills required across occupations will be wholly different by 2020." – see World Economic Forum (2017), The Future of Jobs and Skills in Africa Preparing the Region for the Fourth Industrial Revolution.

(7) *http://www.unesco.org/new/en/media-services/single-view/news/2016_global_education_monitoring_report_launched_with_urgent/*

New thinking about learning

"While there has been very rapid technological change over the last 30 years, education systems have in many countries remained largely unchanged over the last century. There is widespread agreement that education in the future needs to ensure that people gain skills such as communication, collaboration, creativity and critical thinking, foundational skills such as literacy and numeracy, and digital skills, and support the development of core values. As life expectancy increases and job markets shift with increasing speed, demand for non-formal education and life-long learning opportunities will rise."

Henrietta H. Fore, Executive Director, UNICEF, at Chief Executives' Board for Coordination meeting, May 2018

There is a growing global consensus that 21st-century learning ought to look rather different from 19th-century learning but that in practice, for the vast majority of learners, it does not.

International academic, policy and provider organizations are in the process of rethinking learning outcomes and learning environments, and some are even engaged in a fundamental review of the very purpose of education in a more digitally enabled, complex and fast changing world. The OECD's Education 2030 International Working Group,[8] for example, is aiming to develop a new learning framework that would provide policymakers with a clearer agenda for successful school reform. This working group was established in response to UNESCO's 2030 Agenda for Sustainable Development – an aspirational and universal agenda to wipe out poverty through sustainable development by 2030, which includes ambitions for education.

The drivers for this reform are well researched in an avalanche of recent studies exploring the implications of disruptive change for educating the next generation. These changes include:

- automation, machine learning and unpredictable labour markets;
- urbanization and globalization;
- political uncertainty;
- environmental (un)sustainability;
- inequality; and
- fundamental shifts in demographics (e.g. the aging population in Japan and the youth bulge on the continent of Africa).

NESTA and Pearson's recent publication on The Future of Skills, for example, emphasizes increasing demand for strong interpersonal skills (teaching, social perceptiveness and coordination), higher-order cognitive skills (originality, fluency of ideas and active learning) and systems skills (socio-technical skills such as judgement and decision making, systems analysis and systems evaluation).

Characteristically, frameworks such as OECD's Education 2030 promote the integration of:

- Cognitive and non-cognitive (sometimes called soft) skills;
- Behaviours or traits (team-work; risk-confidence; and self-regulation);
- Dispositions (leadership; entrepreneurship; and creativity); and
- Character (values; empathy; and global citizenship)

These so-called 21st-century learning outcomes are often marginalized by schools, due to their low status and their invisibility in summative assessments, and also because of under-developed curricula, and the low skills of teachers in these areas.

(8) *http://www.theewc.org/Content/Home/News/OECD-Learning-Compass-2030*

(9) see Gore, A. (2013). The Future: Six Drivers of Global Change. New York: Random House., and Hannon, V. with Peterson, A. (2017) Thrive: Schools Reinvented for the Real Challenges We Face Innovation Unit Press.

(10) Nedelkoska, L. and Quintini, G. (2018), Automation, skills use and training, OECD Social, Employment and Migration Working Papers, No. 202, OECD Publishing, Paris

(11) Bakhshi, H., Downing, J., Osborne, M. and Schneider, P. (2017) The Future of Skills: Employment in 2030. London: Pearson and Nesta

(12) See also (see Four-Dimensional Education, Deep Learning Progressions, Graduate Performance System, Foundations for Young Adult Success, Education for Life Success, Skills for Social Progress, Life Skills and Citizenship Education Initiative Middle East and North Africa

An opportunity for Africa

UNICEF understands that this debate is as relevant in Africa as in any other part of the world. Maybe even more so. As the continent with the world's fastest growing youth population[13] and some of the world's fastest growing economies, alongside many challenging political, social and economic circumstances, low levels of resources and high rates of Out-Of-School-Children (OOSC), countries in Africa are well motivated to accelerate progress towards these 21st century learning outcomes. These factors present a necessity and therefore an opportunity for innovation and alternative modes of education. The more agile an education system can be in response, the more learners within that system will benefit.

The role of technology has defined the acceleration of many industries and sectors, with education likely to be no exception. Yet with the potential of technology comes risks. The introduction of technology to schooling and learning can be done to the detriment of learning outcomes. Equally, access to technology can expose children and young people to new risks that left unmitigated can do them serious harm. In recognition, UNICEF have developed some *Global Guidance* to ensure that technology can be a positive force for learning and children's rights.

5 key policy recommendations for UNICEF:

- All UNICEF's ICT for education initiatives and policies must first focus on the intended educational outcomes rather than on the technologies;
- UNICEF should play a stronger global role in advocating and ensuring that international and national ICT for education policies and practices should focus first on the poorest and most marginalised;
- Issues on security and the dark side of using ICTs for education are insufficiently addressed in most ICT for education initiatives, and should be of the highest priority for UNICEF given its commitment to child safety and security;
- UNICEF should take a global lead in working together in collaborative and consensual partnerships, especially with other UN agencies; and
- Language really matters. UNICEF should ensure that there is consistent use of language relating to the use of ICT in education and for learning throughout the organisation.

5 key programme recommendations for UNICEF:

- UNICEF programmes should focus primarily on the support and implementation of systemic ICT for education initiatives that address ways of enhancing the learning outcomes of the most deprived and marginalised children;
- Teachers/facilitators should be at the heart of most ICT for education programmes;
- All UNICEF ICT for education programmes should ensure that appropriate total-cost-of-ownership financing and budgets are in place and guaranteed over the intended duration of an initiative;
- All UNICEF ICT for education programme should build mitigating actions for cybersecurity breaches centrally into their planning and practice; and
- All UNICEF ICT for education programmes should include appropriate monitoring and evaluation policies and practices.

UNICEF's Global Guidance on ICT for education

(13) "By 2030 Africa's under-18 population will increase by nearly. By 2050 40% of the world's children under 18 will live in Africa." See UNICEF (2014) Generation Africa 2.0: Prioritizing investments in children to reap the demographic dividend. United Nations Children's Fund.

▲

Teacher Albert Matakone uses a computer tablet as a reference to draw the human digestive system on a blackboard as he teaches a class of children at a school in Baigai, northern Cameroon, Tuesday 31 October 2017

The extent to which innovations, technological or otherwise, can accelerate the progress of the developing world's education systems has been tested successfully elsewhere, notably in parts of China, Brazil[14] and India[15]. Whether this can enable them to leapfrog the progress of their developed world counterparts is still up for debate[16] but perhaps one of the most well-known 'leaps' was made by Singapore.

(14) *https://www.brookings.edu/research/innovation-to-leapfrog-educational-progress-in-latin-america/*

(15) *https://ssir.org/articles/entry/leapfrogging_toward_success_in_education*

(16) Winthrop, R. et al. (2018), Leapfrogging Inequality: remaking education to help young people thrive, Brookings Institution Press.

SINGAPORE

Singapore is a very high-performing system that has outpaced all other systems in its improvement. In 2015, Singapore became the top-performing education system in the Program of International Student Assessment (PISA), operated by the OECD.

Currently on its fourth Masterplan for ICT in Education (2015 onwards) the Singapore government has pursued a systematic and systemic approach to the introduction of technology into schools and continuing support for its effective adoption and deployment for teaching and learning.

Masterplan 1 (1997 – 2002 $2bn)

'Building the foundation for technology' aimed to:

- provide all schools with the basic infrastructure to support technology
- provide training of teachers to use technology (by sending team of trainers to each school)
- target to have ICT-enabled lessons for 30% of curriculum time
- create a change in mindset of teachers to embrace ICT as a tool for teaching and learning
- introduce telecommunications tools to enable students to collaborate with people elsewhere to resolve problems.

Masterplan 2 (2003 – 2008 $600m)

'Seeding innovation in schools' aimed to:

- introduce baseline ICT Standards for students to achieve at certain milestones
- develop alternative pedagogies (inquiry-based learning and problem-based learning and usage of virtual worlds and blogs, wikis, podcasts, e-portfolios, animations and video production, as well as mobile learning)
- stimulate innovative use of ICT in schools in daily learning
- have schools produce digital content and expand the resource base for others to share.

Masterplan 3 (2009 - 2014)

'Strengthening and scaling technology' aimed to:

- strengthen competencies for self-directed learning
- tailor learning experiences according to the way that each student learns best
- encourage students to go deeper and advance their learning
- enable students to learn anywhere.

Masterplan 4 offers a vision for future ready and responsible digital learners, where quality learning is in the hands of every learner, empowered with technology. In this vision teachers are designers of learning experiences and environments and school leaders are culture builders.

The aims of Masterplan 4 are to:

- bring ICT into the core of the education process (from planning and design of lessons to testing)
- focus on improving the capabilities and skill sets of teachers (ICT-savvy must also be able to translate into effective teaching)
- improve the sharing of best practices and successful innovations
- further build up infrastructure (in phases according to readiness of schools and teachers) For more, see Appendix I.

The role of technology in improving learning

Fundamental to the success of leapfrogging stories like this is technology. The story of the relationship between education and technology is rich and complex.

"ICT interventions include a wide range of technological monitoring and information systems at all levels of education, from individual students to education systems. Computers and computer-assisted learning software, as well as online platforms such as Google Classroom, Blackboard, and Brazil's Education Connection, enable learners and parents to communicate with teachers about assignments and materials, and they offer free materials that educators and parents can use in designing age-appropriate development activities. These platforms include interactive whiteboards, text messages to support teachers, and televised programs to improve instructional quality in areas with limited access to trained teachers. "

The World Development Report 2018: LEARNING to Realize Education's Promise, The World Bank Group

Technology is on the one hand seen as a threat and an opportunity on the other. For example, automation threatens employment prospects for young people currently in education and therefore represents a focus (and an opportunity) for new content learning: first computer science, then the use of software applications, then coding and robotics and then big-data fed algorithms (machine learning) and AI.

Access to technology has intrinsic value and can contribute towards economic inclusion. However, if we want all children to thrive during the Fourth Industrial Revolution and beyond, then all children must be equipped with the necessary skills to do so. Be it through governmental systemic transformations or otherwise, access to technology and the necessary skills to use it are essential for a prosperous digital workforce and today's children realising their full potential.

"Digital technology can be a pathway to expanding economic opportunity for young adults entering the workforce and for children and adolescents preparing themselves for the jobs of tomorrow in several important ways."

UNICEF, State of the World's Children report, 2017, pg.28

Countries like Singapore and Brazil have reaped the rewards of deliberate, systemic and systematic technology strategies,[17] placing them at the heart of its post-independence prosperity agenda (see Appendix I). Similarly leaders in Brazil see technology as a critical component of their march towards greater democratic and economic participation (see Appendix I). On the African continent, the Rwandan government's push for advancement in ICT across all sectors comes from a desire to become the "Singapore of East Africa", in their advance towards becoming middle-income in status.

Beyond economic inclusion, technology is seen as an effective tool in solving problems throughout education systems, in particular influencing how education systems are managed. The widespread implementation of Education Management Information Systems (EMIS) has meant that administrators and leaders are able to more efficiently run their schools, can capture, share and analyse data more systematically and in real-time.

Technology is also changing the way schools and parents communicate[18], offering opportunities for the kind of home-school partnership that we know play an important part in learning. Technology can expand the range of settings in which teaching and learning can happen, going beyond schools and formal provision into homes and community spaces, by making learning asynchronous and mobile. Making learning mobile creates a wealth of new opportunities to address Africa's educational challenges, for instance:

- through access to new and broad curricula offline[19] to compensate for poor teacher supply, attendance or quality;
- providing real-time two-way interactive distance lessons via projectors[20] to close the distance between home and school for learners in rural and remote communities; or even,
- using digital classrooms in a box[21] to provide all the content and learning materials communities need to set up their own school.

Perhaps in its most ambitious form, technology has the potential to significantly transform teaching and learning. From established technologies such as computer aided design to the more emergent virtual reality, the opportunities to create new learning landscapes and innovative pedagogies[22], to reduce the sense of risk in the development of new skills and to (eventually) reduce the cost of materials required for experiential learning are clear.

However, it is important to be measured in assessment of the likely impact for learning of such developments:

"For years – ever since the 1970s – we have heard promises that technology is about to transform the performance of education systems. And we want to believe the promises; but mostly that is what they have remained. The transformation remains stubbornly five or ten years in the future but somehow never arrives.[23]"

Michael Fullan, Katelyn Donnelly (2013) Alive in the Swamp: assessing digital innovations in education. NESTA.

Part of the problem is that the evidence base system leaders require to make significant investment decisions, and that teachers and school leaders require before they will adopt and integrate technology into their practice, does not yet exist:

"Taken together, the correlational and experimental evidence does not offer a convincing case for the general impact of digital technology on learning outcomes. This is not to say that it is not worth investing in using technology to improve learning. But it should encourage us to be cautious in the face of technological solutions to educational challenges. Careful thought is needed to use technology to best effect.[24]"

Higgins, S., Xiao, Z. and Katsipataki, M. (2012) The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation. School of Education, Durham University.

A synthesis of all high-quality education Randomized Controlled Trials (RCTs) conducted in low-resource contexts[25], published in *Science*, concludes that the interventions which have most impact are those which "match teaching to students' learning levels", and that technology appears to be one way to do this effectively[26].

(17) *https://ictconnection.moe.edu.sg/*

(18) *https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/texting-parents*

(19) *http://e-limu.org/*

(20) *https://www.varkeyfoundation.org/content/making-ghanaian-girls-great*

(21) *https://www.brck.com/education/*

(22) Paniagua, A. and Instance, D. (2018), Teachers as Designers of Learning Environments: The Importance of Innovative Pedagogies, Educational Research and Innovation, OECD Publishing, Paris.

(23) Michael Fullan, Katelyn Donnelly (2013) Alive in the Swamp: assessing digital innovations in education. NESTA.

(24) Higgins, S., Xiao, Z. and Katsipataki, M. (2012) The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation. School of Education, Durham University.

(25) Kremer et al. (2013) The Challenge of Education and Learning in the Developing World. Science, 340(6130), 297–300.

(26) Also see Evans, D. K., Popova, A. (2015) What Really Works to Improve Learning in Developing Countries? An Analysis of Divergent Findings in Systematic Reviews. World Bank Group, Africa Region, Policy Research Working Paper 7203.

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▲ Twelve-year-old Waibai Buka (centre front) learns with the help of a computer tablet provided by UNICEF at a school in Baigai, northern Cameroon, Tuesday 31 October 2017.

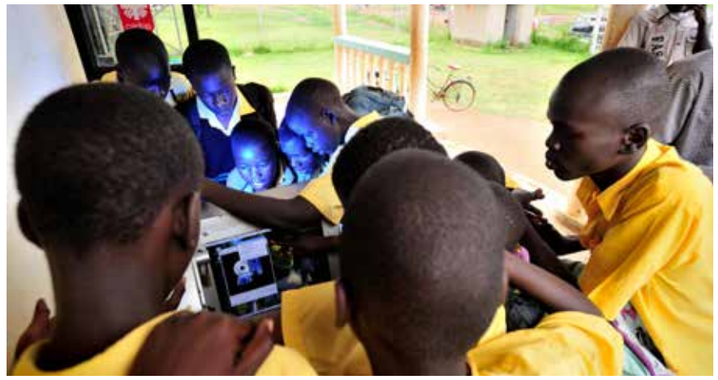
For instance, a computer-assisted learning (CAL) programme in India, which used mathematics software that allowed children to learn at their own pace, increased math scores by 0.35 standard deviations the first year, and 0.47 the second year, and was equally effective for all students[27]. Importantly though, the synthesis highlights how there were no significant test-score gains from other CAL programmes (in Peru or Colombia), illustrating that the impact of ICT for learning on outcomes is not guaranteed. The OECD's PISA results further reinforce this, showing "no appreciable improvement in students' achievement in reading, mathematics and science in the countries that had invested heavily in ICT for education"[28]. What we should take from this is that attention must be paid to the 'how' of effectively implementing ICT for learning, and consider the amount or level of ICT that supports learning, i.e. the dosage to be administered.

We also must pay attention to the associated opportunity cost. Inevitably, when education systems invest in ICT for learning, funding for other education interventions is squeezed. Policy makers and investors must consider cost-effectiveness as much as effect sizes. However, much like the 'what works' evidence base, research on the cost-effectiveness of ICT for learning compared to other education interventions is still in its infancy. Meta-analysis of randomized experiments has found mean effect sizes for interventions associated with computers or instructional technology compared to other interventions, yet have failed to gather sufficient data to judge the relative cost-effectiveness of different categories of interventions[29].

Critically, any evidence base around cost-effectiveness of education interventions, technological or otherwise must take into account context. Costs of inputs (infrastructure

(27) The computer-assisted learning program was implemented by Pratham, a very large NGO operating in conjunction with government schools in India. It targeted all children, but was adapted to each child's current level of achievement. Children in grade four were offered two hours of shared computer time per week, during which they played games that involved solving math problems whose level of difficulty responded to their ability to solve them. For more details on the study, see - Banerjee, A. et al (2007) Remedying Education: evidence from two randomized experiments in India, MIT Department for Economics.

(28) OECD (2015) Students, Computers and Learning: Making the Connection. OECD Publishing, Paris.



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◄ Boys view information at a UNICEF solar-powered Digital Drum computer kiosk at Bosco Youth Centre in the northern district of Gulu.

and/or labour) vary from country to country, therefore any judgements made on cost-effectiveness need to be made locally. Global analyses[30] can act as helpful steers, but local datasets and evaluations should lead policy and investment decisions.

• • • •

"Knowledge about improving learning must take both the costs and the benefits of learning interventions into account...The evidence base on costs is much thinner than that on benefits, with a tiny fraction of studies examining both. But some programs have been evaluated on both effectiveness and cost-effectiveness. This evidence on costs—adapted to local contexts—should qualify policy recommendations."

The World Development Report 2018: LEARNING to Realize Education's Promise, The World Bank Group

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Beyond assurances around social return on investments, there is certainly a need to calculate and manage associated risk, in particular as it relates to equity:

• • • •

"Researchers at the OECD have warned that the digital divide in education goes beyond the issue of access to technology. A second digital divide separates those with the competencies and skills to benefit from computer use from those without."

Michael Trucano, Senior Education & Technology Policy Specialist and Global Lead for Innovation in Education, World Bank.

Finally there are traps to fall into around feasibility, especially when it comes to low and middle income countries:

• • • •

"In rural areas, technology may be more attractive because of weak education systems, but at the same time those weak systems—with their limited access to electricity or the internet—have the least capacity to support education technology interventions."

The World Development Report 2018: LEARNING to Realize Education's Promise, The World Bank Group

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Progress to connect Africa is being made, but remains uneven. In 2015 the proportion of schools with internet access varied from 0% in many countries, with most below 20%, to 100% in Botswana (lower and upper secondary public schools)[31].

(29) McEwan, Patrick J. 2015. "Improving Learning in Primary Schools of Developing Countries: A Meta-Analysis of Randomized Experiments." Review of Educational Research, Vol. 85, Issue 3: 353–94.

(30) The International Commission on Financing Global Education Opportunity (2017). The Learning Generation: investing in education for a changing world

(31) Manji, Jal, Badisang, & Opoku- Mensah, (2015). The trajectory of change: Next steps for education. eLearning Africa Report

How UNICEF can add value to a crowded ICT for learning landscape

A survey completed in late 2017 by 34[32] UNICEF country office education staff across sub-Saharan Africa found that:

- ICT for learning is somewhat emergent across sub-Saharan Africa - 94.1% of country offices are actively supporting up to three technology-in-learning initiatives within their local education context.
- The majority of ICT for learning initiatives are currently in pursuit of solving the problem of low quality teaching and widening access to national curricula.
- ICT for learning currently focuses on developing basic skills (numeracy and literacy) in sub-Saharan Africa.
- The top three future ambitions for ICT for learning are the development of 21st century skills, digital literacy skills and basic skills.
- The top three challenges when it comes to ICT for learning are reported to be cost, power and connectivity, and maintenance. However, reasons such as security remain a disproportionately critical barrier to some country contexts (for instance in South Sudan).
- Financial investments, sustainability and training are consistently among the biggest programmatic challenges highlighted by country offices.

These insights into the specific challenges teams face in the complex contexts in which they work start to hint at how UNICEF might position itself on the issue of ICT for learning and some of the strategic approaches for which they might advocate.

UNICEF holds a very particular brokering role at the intersection of research and practice, providing evidence-informed, strategic advice to regional education systems, while also working on the ground through high-quality large scale programming, technical assistance, quality assurance and oversight.

In addition, working alongside Governments, other United Nations partners, civil society, the private sector and communities makes UNICEF natural conveners. They are well placed to steward a process by which stakeholders like these can consider the opportunities and challenges that technology introduces into the wider project of improving learning and, with it, improving the life chances of learners in the region.

This research identified ten issues that UNICEF ESARO and WCARO should consider as they develop their position and begin to formulate their strategy around ICT for learning:

1. **Purpose and problem-solving -** to what extent is there clarity around the purpose of introducing technology in education and what learning problem(s) it is helping to solve?
2. **Student capability -** what are the existing and necessary technical capabilities of students, and how do these vary across a student population?
3. **Teacher capability -** what are the skills teachers need to use new technology, and what is the relationship of these skills to a more general teacher competency? In particular how are teachers' abilities to create powerful learning environments/ experiences enhanced by technology?
4. **Student and teacher agency -** how can students and teachers engage as active participants in the introduction and implementation of ICT for learning?
5. **Technological infrastructure -** what are the technical requirements of the technology and are these in place (e.g. power, bandwidth, data security)?
6. **Implementation and change -** what is the role of local leaders and what support do they need to create a culture of innovation and improvement?
7. **Enabling environments -** what are the conditions that support a thriving learning ecosystem, enhanced by technology?
8. **Resources -** what is required for the effective and sustainable use of ICT for learning, including on-the-ground support capability?

(32) Sixty-three questionnaires were issued and so this equates to a 54 per cent response rate

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9. **Coalitions -** what role might partnership play in 'bundling' solutions to complement and amplify ICT for learning?
10. **Risks -** what are the risks associated with ICT for learning, and how might we mitigate against them?

Critically, many of the above issues reflect and align with UNICEF's Principles for Innovation and Technology in Development[33]. For instance, considerations of the enabling environments of ICT for learning would encompass best practice for 'Understanding the Existing Ecosystem' and 'Designing for Scale'. Being thoughtful about *implementation and change* strategies that enhance ICT for learning would inevitably recognise best practice around how to 'Be Collaborative', how to 'Be Data Driven' and how to 'Build for Sustainability'. Equally, recognition of the *risks* associated with ICT for learning would ensure that efforts would involve best practice that 'Do no harm', such as risk mitigation and a focus on equity and fairness. This coherence builds a strong sense of how to be rigorously and robustly navigate the opportunities and challenges of ICT for learning.

The next section explores each of these issues with reference to evidence from a range of sources including a rapid review of published research, interviews with expert providers and practitioners, a scan of technology strategies in countries where technology plays an important role in education, and seven illustrative case studies. Importantly, these case studies were selected to draw out learning from a range of implementation stories – success and failures – and provide a broad set of examples of the uses of ICT for learning examples, rather than exemplars. They are as follows:

- Bridge Academies/Spark Schools – Use of technology in groups of low cost schools;
- One Laptop Per Child – A programmatic approach to rolling-out affordable tablets, at scale;
- Mwabu – Tablet based e-learning and school improvement;
- School in the Cloud – Self-organised learning environments;
- Eneza Education – An affordable mobile classroom;
- One Billion – Adaptive android apps; and
- Aga Khan Foundation and Dubai Cares – Transforming teaching and learning through technology.

(33) *https://www.unicef.org/innovation/innovation_73239.html*

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Chapter 2:

Discussion on the evidence - ten issues for UNICEF to consider

1 Purpose and problem-solving

To what extent is there clarity around the purpose of introducing technology in education and what learning problem(s) it is helping to solve?

PROBLEM IDENTIFICATION AND RECOGNITION

Technology that seeks to address problems that teachers and school leaders don't recognise or consider a priority is unlikely to gain traction in schools and therefore unlikely to make a difference to students' learning outcomes.

An ideal scenario is one in which technology offers a solution to a specific problem, which teachers acknowledge and want to solve, and which also addresses a wider purpose identified at the level of school or system.

For example, in New Zealand, the overarching narrative of opportunity for all New Zealanders, including those from minority groups, is to benefit from improved access to quality STEM teaching and learning. This is echoed in the Nation of Curious Minds programme which involves 101 locally designed and delivered technology enabled programmes, funded centrally but owned by teachers in schools.

New Zealand has long been a top performer in international league tables in relation to student performance. However, the gap between the highest and lowest performing students in New Zealand is wider than in any of the other high performing countries. Students from Maori and Pasifika communities are at a particular disadvantage.

The New Zealand government sees another gap opening up in employment opportunities in science and technology. Demand for digital skills is on the increase and New Zealand's schools need to be preparing all young people to meet that demand.

The solution to meeting these twin challenges in New Zealand has been a coherent and concerted national focus on STEM subjects (science, technology, engineering and mathematics) in schools, with an emphasis on generating demand through engagement and inspiration as well as ensuring supply and quality. Funding and other incentives have been targeted to schools in disadvantaged areas, termed low decile in the New Zealand system.

For more, see Appendix I

Equally, the most critical problems may require solutions beyond formal education. ICT for learning can open the door to the potential for alternative modes of learning, especially for the high number of Out-Of-School-Children.

THE IMPORTANCE OF CONTEXT

Most education priorities and problems vary depending on local context, therefore ICT for learning needs to clearly respond to local demand. Whether it's to improve teaching quality or provide access to a broader and better curriculum, the purpose, problem or opportunity needs to be explicit and recognised in the context.

The Onebillion phone app which recently won $1 million in funding from the Learning XPrize, is explicit in its purpose and design. The app sets out to teach modular, basic numeracy and literacy without the need of direct adult support, making it a suitable tool for schools with high student to teacher ratio.

Onebillion is a UK-based charity that aims to reach one billion children in developing countries. Its mobile and tablet apps have been designed to progressively develop children's knowledge of early mathematical concepts (such as count to 10 and basic times tables) and reading and writing skills. The app sets out to teach modular, curriculum-appropriate numeracy and literacy with no direct adult support, making it a suitable tool for schools with high student to teacher ratio. Onebillion is also a finalist in the $15m Learning XPrize.

The 'onecourse' numeracy material is curriculum-aligned and available for download on the App Store and Google Play in fifty different languages. Reading is still in the works to become a standalone app and is being developed in Swahili, English and Chichewa, with more languages to follow. The apps are currently being used by approximately 100,000 children worldwide, including Malawi, Uganda and India. Notably, 20,000 of those are in a monitored trial in Malawi, in conjunction with Voluntary Service Overseas (VSO).

For more, see Appendix II

In the case of both Mwabu and Eneza Education, content is contextually relevant and aligned to the curriculum. ICT for learning providers acknowledge that if the content is not acutely aware of its context, students disengage as they struggle to relate to the material.

Founded by a US teacher and Kenyan 'techie' in 2011, Eneza Education Limited provides mobile technology based education services in Kenya and other parts of Sub-Saharan Africa. Eneza aims to lower barriers to quality education in some of the most remote parts of the world through some of the simplest technology available there: mobile phones. Its mobile platform gives students access to quizzes, mini-lessons and tips and tricks via the web, mobile web, and text messaging. The emphasis on text messages enables users to continue learning even if they can't afford to pay for data or expensive handsets, or if there is no data network in the area.

For more, see Appendix II

Every time Eneza enter a new country, a content map is generated by a group of freelance teachers who are employed to produce lesson units based on the national standards. This content is then certified by a relevant local authority.

Mwabu's aim is to reach one hundred million learners by 2020. The focus is on rapidly improving the educational space in Africa by introducing e-learning resources for teachers and students. The programme offers interactive, local curriculum-aligned e-learning content for maths, science and English - which is uploaded onto the Mwabu educational tablet - and professional development courses, specifically created for African markets.

Mwabu have found that students disengage if content is not related to context. To ensure content is engaging for students, Mwabu have local contextual specialists who focus on culturally specific elements of the content. Because many teachers struggle to access the whole curriculum and/or subject knowledge is weak, Mwabu

work with local education departments to access curriculum content; certain parts of which are combined on the tablet to alleviate time pressures.

For more, see Appendix II

INTEGRATION WITH TEACHING AND LEARNING

There is little research evidence to suggest that technology-based instruction in which technology replaces the teacher is beneficial. High-quality studies point to poor outcomes from online courses[34] and mixed engagement in virtual schools[35].

Research suggests that relative to courses with some degree of face-to-face teaching, students taking online-only courses may in fact experience negative learning outcomes[36]. While the temptation is to use ICT for learning that doesn't depend on teachers in contexts where they are poorly prepared with limited training and motivation, most attempts have failed[37].

Fundamental is the notion that "technology can amplify great teaching, but great technology cannot replace poor teaching", as demonstrated by PISA data suggesting that induction and ongoing support needs to focus on supporting teachers to use technology effectively[38]. This goes beyond the teaching of technical skills in using the technology itself, and should also focus on the successful pedagogical use of ICT to support teaching and learning aims[39].

The experiences of One Laptop Per Child (OLPC) are emblematic of the importance of integration of technology into teaching and learning. Originally a distributor of devices, OLPC came to realise that access to equipment alone was insufficient and that they needed to focus on supporting the teacher and the community as part of the programe.

The One Laptop Per Child (OLPC) initiative, established in 2005, sought to challenge leading entrepreneurs and industry leaders to develop a $100 laptop that could enable the provision of technology to every child on the planet. The initiative was a response to the digital and technology gap that exists for many young people in the developing world.

OLPC saw that what children lack is not capability, but opportunity and resources. To this end, OLPC designed hardware, content and software for collaborative, joyful, and self-empowered learning. They designed the XO Laptop, combining an interface that graphically captures a collaborative community of learners emphasising the connections among people, and their activities, with an ultra-low-cost, powerful, rugged, low-power, ecological hardware design.

OLPC take a programmatic approach, working with governments and private foundations to provide 1:1 access for students in a particular region or country. From Uruguay to Alabama (USA), Peru to Nicaragua, OLPC has had mixed success in achieving its access goals and improving learning outcomes

For more, see Appendix II

(34) Figlio, D. N., Rush, M., & Yin, L. (2010). Is it Live or is it Internet? Experimental Estimates of the Effects of Online Instruction on Student Learning (Working Paper No. 16089). National Bureau of Economic Research. Retrieved from *http://www.nber.org/papers/w16089*

(35) Pazzaglia, A. M., Clements, M., Lavigne, H. J., & Stafford, E. T. (2016). An Analysis of Student Engagement Patterns and Online Course Outcomes in Wisconsin. REL 2016-147. Regional Educational Laboratory Midwest. Retrieved from *https://eric.ed.gov/?q=learner+agency&pr=on&ff1=eduSecondary+Education&pg=5&id=ED566960*

(36) Escueta, M. et al (2017), Education Technology: an evidence-based review. NBER Working Paper Series. Working Paper 23744 *http://www.nber.org/papers/w23744*

(37) The World Development Report (2018) LEARNING to Realize Education's Promise, The World Bank Group.

(38) OECD (2015) Students, Computers and Learning: Making the Connection. OECD Publishing, Paris. *http://dx.doi.org/10.1787/9789264239555-en*

(39) Higgins, S., Xiao, Z. and Katsipataki, M. (2012) The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation. School of Education, Durham University.

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In year three of Uruguay's Ceibal Plan (an initiative to provide a computer to every school and every public school teacher, which included the deployment of OLPC's XO Laptops) a series of targeted education initiatives was launched, specifically to leverage the technology that now existed in all Uruguayan schools. These initiatives ranged from adaptive mathematical platforms and robotics to remote foreign language classes and programming classes to support 17-26 year olds gain access to new employment opportunities.

The relative progress of OLPC in Uruguay, demonstrates that not only can technology be an enabler of good practice when properly integrated, it can also be a catalyst for innovative pedagogy and approaches to delivering content in new and more flexible ways.

Similarly, SPARK Schools and School in the Cloud actively elevate 21st century skills through more innovative pedagogies such as personalised learning and Self-Organized Learning Environments (SOLEs).

SPARK Schools is a network of eleven primary schools dedicated to delivering accessible, high-quality education, mainly in South African cities. SPARK is an acronym for the school's core values: Service, Persistence, Achievement, Responsibility and Kindness. SPARK schools use a 'Learning Lab' rotational blended learning programme, which combines traditional classroom instruction with adaptive software intended to accelerate learning and increase student achievement.

School in the Cloud is underpinned by Self Organised Learning Environments (SOLEs), which provide self-directed education to students in areas where high-quality teachers are not available. SOLEs and the School in the Cloud approach values learning outcomes that go beyond conventional measures, such as test scores. They are designed to develop 'softer skills' and dispositions such as; teamwork, independent learning, presentation skills, confidence, critical thinking, questioning, deeper thinking and digital literacy.

For more, see Appendix II

However, this is not always the result. Bridge International Academies have introduced ICT for learning specifically to counteract a lack of highly qualified teachers. Their educational technology strategy seeks to bring scripted, high-quality instruction to students who have only previously known a poor quality of teaching. Their focus remains on rote learning and prioritises narrow, foundational literacies.

Bridge International's highly standardised 'academy in a box' provides the training, processes, tools, materials and curriculum a community needs to open and run a low-cost, quality school. Teacher tablets are a core component of the Bridge model. They are uploaded with daily lesson scripts and step-by-step instructions for teachers, regardless of experience. Bridge have writers in Nairobi who create lessons in Swahili, but many lessons are delivered in English.

For more, see Appendix II

All of which suggests that technology can both catalyse and reinforce broader education movements and philosophies, for good or for ill. Any strategy for ICT for learning must be mindful of this, and have a clear vision for teaching and learning.

Key takeaways:

- Be clear of the vision for learning and the purpose of technology within it.
- Contextualize the use of ICT for learning to meet local demands.
- Technology must integrate with learning, and teachers must play a critical role.

2

Student capability

What are the existing and necessary technical capabilities of students, and how do these vary across a student population?

DIGITAL DIVIDES

Michael Trucano of the World Bank warns against the risk of creating two digital divides: (i) access to technology and (ii) access to the necessary knowledge and skills to use technology effectively. A strategy for ICT for learning requires a commitment to ensuring all students have the understanding and select the right technology for their learning purpose, and the competencies to use that technology well. That means ensuring basic cognitive skills such as interpreting information (digital or otherwise), creativity in the use of technology, and the ability to make judgements about the accuracy and quality of digital information and experiences.

There are at least two schools of thought advocating different routes to students' acquisition of these skills.

On one side of the argument:

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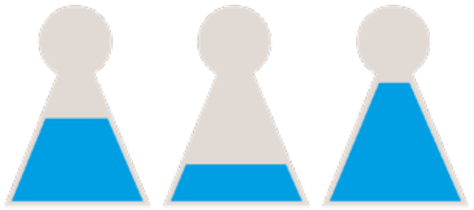
"Teachers and schools can make a difference for students who lack the cultural and social capital that will allow them to benefit from the use of digital media in a way that is significant for their educational performance. If teachers and schools fail to acknowledge this second digital divide, and act accordingly, they will reinforce its emergence. It is important to realise that the fact that students appear to be technologically 'savvy' does not mean that they have developed the skills and competencies that will make them responsible, critical and creative users of technology"[40]

OECD (2010) Are the New Millennium Learners Making the Grade? Technology Use and Educational Performance in PISA 2006



UNICEF's *The State of the World's Children* report reinforces the need to address these divides, which often mirror broader socio-economic divides, between rich and poor, men and women, cities and rural areas, and between those with education and those without.

UNICEF Rwanda are working to address some of these divides through extra-curricular Remedial Clubs which look to utilise learning apps to enhance the curriculum and engage the disengaged - especially girls - through different pedagogies and interactive learning styles.

UNICEF Rwanda are working to address gender equity in the country through extra-curricular Remedial Clubs (girls have lower learning outcomes than boys in Rwanda). They have worked with the Government to establish a paper-based remedial curriculum which is more child-centred and interactive than traditional classroom learning. They are now in the process of mapping all open source learning apps onto the grade levels/subjects being targeted to help improve the curriculum. This catalogue of learning apps would have implications and impact beyond the Remedial Clubs, by sharing with teachers in other parts of the education sector.

Part of the mapping is identifying gaps where there isn't an appropriate app to compliment the curriculum. The aspiration is to partner with technology companies to fill these gaps by developing apps to give over to the government.

For more, see Appendix III

(40) OECD (2010) Are the New Millennium Learners Making the Grade? Technology Use and Educational Performance in PISA 2006. OECD Publishing. Paris.

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LIBERATING THE MARGINALIZED

On the other side of the argument sit the proponents of approaches such as Self Organised Learning Environments (SOLEs) at the heart of School in the Cloud. Sugata Mitra's pioneering SOLEs seek to demonstrate that well designed content and/or tasks can provide all the scaffolding learners need to independently utilise technology for learning. Evidence collected by SOLE Central - a global hub for research into self-organised learning environments (SOLEs) at Newcastle University - suggests that using SOLEs have led to improved comprehension and digital skills amongst children.

Brazil's curriculum materials in Educopedia and the online lessons comprising Descomplica have been designed in a similar vein to give students access to 24/7 learning without the need for teachers (see Appendix I). These platforms rely heavily on students' own capabilities for use when access to high-quality teaching and learning content is limited.

With content designed by some of the best and brightest teachers in Brazil, Educopedia is an online platform for collaborative digital lessons, where students and teachers can access self-explanatory activities through play and practice, anywhere, anytime.

Part of the motivation for developing Educopedia was to even out inequalities in access to high-quality teaching by making it possible to compensate for poor teaching and, in the most extreme cases, remove the need for teachers all together.

For more, see Appendix I

UNICEF Kenya is working with the government and other partners to focus on a long-term vision for all students to become inventors of technology, rather than simply users (see Appendix III). In addition to targeted teacher training to provide adequate guidance and support, the country office expects to see a high level of intuition and instinct from its children when utilising technology in the classroom.

(41) *http://allinschool.org/location/eastern-and-southern-africa/*

Becoming proficient in the use of technology for Kenya also involves removing technological and more importantly, social barriers to marginalised cohorts. Kenya's aim is to empower children with disabilities through the use of specifically designed learning apps to widen access to school and communication with peers.

Examples like this are critical since, in many parts of the world, technology could be the key to providing low cost, high-quality learning to students who would otherwise receive little or none at all. However, it is important to note that this area of research is still emergent and more work needs to be done to evidence how technological intuition can enhance learning. Sub-Saharan Africa has some of the highest rates of Out-Of-School-Children (OOSC) in the world. The Eastern and Southern Africa region has an average of one in five OOSC, and with countries struggling with conflict, that number rises to two in five[41]. The West and Central Africa region have some of the highest numbers of OOSC in the world – Nigeria, for example, has 8.7 million primary-school-aged children who do not attend school[42]. With the right foundational capabilities, these children can access content and engage in alternative modes of learning beyond formal schooling.

As the gap between the two positions above suggests, there is as yet little agreement about what digital literacies (skills and competencies) students need in order to take full advantage of the learning opportunities that technology offers, let alone how to acquire them. Many consider it critical to explicitly develop the levels of literacy required to access content, as well as the fine motor skills required to physically interact with the technology. Others advocate for a more hands-off learn-as-you-go approach.

Key takeaways:

- Recognise and mitigate against new inequities that come from ICT for learning
- Be deliberate in how ICT for learning can impact the most marginalised young people
- Be clear about the necessary digital literacies that students need to take full advantage of ICT for learning.

(42) *http://allinschool.org/location/west-and-central-africa/*

3

Teacher capability

What are the skills teachers need to use new technology, and what is the relationship of these skills to a more general teacher competency? In particular how are teachers' abilities to create powerful learning environments/experiences enhanced by technology?

INTEGRATING TECHNOLOGY AND DEVELOPING PRACTICE

Of all the issues emerging from our research, considerations surrounding the role, the dispositions, the capabilities and the necessary support for teachers were the most consistently occurring and most compelling. We are as certain as we can be that, in any ICT for learning strategy, technical training (in the use of technology) and the development of related pedagogical practice (how teachers teach using the technology) must reinforce one another in order to effectively improve learning. In many ways this is a deep, more individual focus on integration. At the level of the school or system, integration is about focus and purpose - what problem does the technology solve? For the individual teacher the question is - how can the technology solve my problem? Or even more specifically - how can I use the technology to ensure that it solves my problem?

Teachers must be equipped with the capabilities for deploying technology effectively, like any other tool used in the classroom. Aga Khan Foundation and Dubai Cares' 'Transforming teaching and learning through ICT' programme in partnership with Kenyan and Ugandan governments as well as local providers, seeks to explicitly enact the principle of integration. The programme provides hardware and engaging digital content in tandem with investing in the delivery of teacher and government professional development. The programme has even developed a mobile app to support communities of practice that go beyond the school or immediate clusters to share and refine practice in the effective integration of technology in teaching and learning.

The 'Transforming teaching and learning through ICT' project is a partnership with the Governments of Kenya and Uganda and locally based innovative ICT and mobile companies to test and demonstrate the transformative potential of ICT to strengthen teaching and learning in formal primary education, using mobile phones and computers. As the focus on education shifts from Education for All (EFA) to Learning for All (LFA), the role of the teacher remains critical.

Teachers can find it difficult to identify the resources appropriate for their students and relate these to their classrooms. This project has developed content for teachers that was directly related to the curriculum. While this lengthened the process for developing the content, what has been produced is relevant to the national context, rather than being contextualised from global content. This enables teachers to make concrete linkages between the content and the curriculum and so enables them to use ICT with confidence and integrate ICT more meaningfully into their teaching and learning.

For more, see Appendix II

In Singapore, every stage of their Masterplan for ICT for learning has included capability building for teachers and New Zealand is tackling both initial and continuing teacher education head on to ensure teachers have access to high-quality professional learning as they adopt technology into their practice.

The Manaiakalani Digital Teaching Academy (MDTA) is a partnership between the University of Auckland, Google and Manaiakalani Education Trust set up in 2011 to use digital technology to bridge and enrich learning in school and at home. Piloted in 2013-2016 and now in its first full year, MDTA brings together newly qualified and experienced teachers as mentors to accelerate the skills development of the beginning teachers so that they can 'keep up' with the students in the Manaiakalani schools. Both groups of teachers are studying on Masters Programmes.

The programme grew out of a frustration that initial teacher education was not producing teachers with the necessary digital know-how or the pedagogical skills to make the most of technology for the benefit of student learning. Through the financial support of the Manaiakalani Education Trust, all students at cluster schools have access to a 1:1 digital device. The MDTA then coaches teachers in digital pedagogy to make best use of these tools. All teachers progressed successfully through the pilot to 2016 and the digital pedagogy, mentoring and induction practices are now being developed across the network.

For more, see Appendix I

We see three key aspects to teacher capability necessary to the effective implementation of ICT for learning. Teachers need to be able to:

- straightforwardly learn how to use the technology, its functions and features, and to feel confident that they know what to do when it goes wrong;
- integrate technology into their teaching practice so that it adds value and they feel comfortable with the role of facilitating learning rather than the source of all knowledge; and
- understand and use the data that many examples of ICT for learning generate about student progress to diagnose students' learning needs and design next steps.

INTEGRATING TECHNOLOGY, PRACTICE DEVELOPMENT AND SCHOOL IMPROVEMENT

Interestingly, without the focus on technology these capabilities would be desirable goals for any teacher. Teachers should be able to learn and integrate new tools and new approaches into their teaching practice. And they should be proficient in the use of data to diagnose student progress and needs. The relationship might be between teacher competency generally and teacher capability with ICT for learning specifically. Is it the case that only 'expert' teachers – those who have sufficient experience and training – can deploy ICT for learning effectively? What does it take for emerging teachers to be successful? What does this look like for struggling teachers?

A focus on learning new skills, growing in confidence in the use of new tools and approaches, integrating new approaches into existing practice and using data are all recognisable features of classic school improvement strategies precisely because they have the potential to catalyse improvements in teaching and learning. By weaving together the introduction of ICT for learning and professional development associated with school improvement, systems and schools create the opportunity to accelerate the development of teacher competency generally alongside equipping teachers with the specific capability to deploy ICT for learning effectively.

Technology itself has a role to play in the professional development of teachers[43] and improving the quality of teaching. Digital platforms can act as e-libraries for curriculum content and teaching resources to support teachers in their teaching preparation and practice. They can also provide access to online courses which scaffold professional development processes that help teachers to refine and enhance their pedagogic practice. Better yet, technology can connect communities of practitioners who can share and co-develop best practice together, empowering professionals to take ownership of their own development.

BALANCING CHALLENGE WITH SUPPORT

In recognising the level of training and development teachers need to effectively utilise ICT for learning, it's equally important to recognise that the burden that technology puts on teachers is high. Support for them must therefore also be high.

"Consider the case of an overwhelmed (and ill-prepared) teacher working with students in a

(43) *http://www.edudemic.com/high-quality-online-professional-development/*

poor, remote, rural community. It is certainly possible to introduce new technologies (laptops, tablets) into such learning environments in ways that are useful to her (and indeed: powerful!), but doing so is often, to borrow a phrase popular in Silicon Valley, non-trivial."

Michael Trucano, Senior Education & Technology Policy Specialist and Global Lead for Innovation in Education, World Bank

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Take Rwanda (see Appendix III) for instance, where the UNICEF country office reports that teachers are often responsible for over 60 students, and already balance this with agricultural and family commitments. The introduction of technology is a relatively alien concept which would no doubt be overwhelming and possibly spark hesitation or resentment from the outset. It also runs the risk of reducing teacher time on key instructional tasks. However, that's not to say that we should dismiss technology as a tool for teachers in underserved contexts. In fact, when done well, the introduction of technology can actually protect and sometimes increase teacher's time on task. A strategy for ICT for learning must be thoughtful and creative about how to best support them.

Mwabu and SPARK both invest in professional learning but also introduce new schooling and learning designs, like classroom rotational models, which free up teacher time to be spent working with small group of students.

Before the Mwabu programme is initiated in a school, the principal receives a full day of training, three days are allocated to the teacher(s) and a full day for the newly appointed coordinator who acts as intermediary between the school and Mwabu. Training involves utilising the tablets in the classroom, the three rotational model - where learners explore through understanding, analysing and solving a range of tasks in groups using the Mwabu tablet, individually or with the teacher - and a course in change management.

Schools are allocated a mentor from the Mwabu Academy who offers in-person or virtual training using social networks. Mwabu encourage the delivery of in-person and observational training as schools are implementing technology for the very first time. Managing change is vital for continued use. The mentor service is an additional cost to the school and recommended at least three times per year.

For more, see Appendix II

Teacher and tech champions can also play a critical role in introducing and sustaining technology in new school environments, especially those with high-burdened, low-skilled teachers. In Uganda (see Appendix III) the UNICEF country office is leveraging peer-to-peer strategies of support through the establishment of a network of teachers who are skilled in ICT in education. This network is mobilised to help shift attitudes and practice within the broader school system, supporting emergent e-learning initiatives like Kolibri.

UNICEF Uganda are working to ensuring that the focus is placed on the environment and infrastructure where the technology can thrive, rather than a pure focus on the technology itself. They are therefore concerned with teacher and student attitudes, as much as investment in hardware, electricity and access for all students.

One strategy is to work with 'Champions' - a network of teachers who are skilled in ICT - to help shift attitudes and practice within classrooms.

For more, see Appendix III

School in the Cloud (see Appendix II) reports that the on-site presence of a coach/expert/champion of the approach is most valuable in winning over sceptics, especially when it's the face of the innovation, in this case Professor Sugata Mitra.

TECHNOLOGY CHALLENGES TEACHER IDENTITY

Getting the technology right is one thing, but equally important are the strategies by which we get the social and human aspects right too.

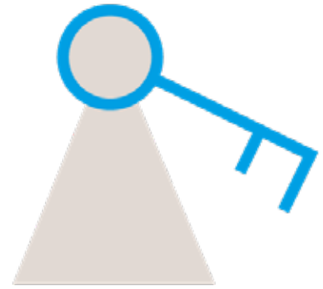
The introduction of ICT for learning into classrooms and schools is frequently disruptive to the professional identity of teachers. Beyond the obvious and unhelpful pitting of technology against teacher, the traditional role of teacher as the 'expert' is often challenged in the examples we have seen, which instead position the teacher as a facilitator or even a collaborator in the learning process.

Although there is a need to be sensitive to the complexity of 'resetting' professional roles like this, there is opportunity here too: the chance to grow a workforce equipped with the capabilities, including but not limited to the use of ICT for learning; to create 21st century learning experiences for African students; to use technology to perform the mundane tasks in teaching and learning (e.g. assessment, basic skills development) allowing for more creative and deeper learning to be designed and facilitated by the teacher.

Key takeaways:

- Develop the technical as well as the pedagogical capabilities of teachers to deploy technology for learning
- Integrate technology into practice development and school improvement strategies
- Balance the disruption of technology with the right support for teachers to adapt and grow.

4 Student and teacher agency



How can students and teachers engage as active participants in the introduction and implementation of ICT for learning?

TEACHERS AS CO-DESIGNERS OF ICT FOR LEARNING

Examining the country and provider case studies reveals that a local sense of ownership is achieved by creating opportunities for teachers to participate in the implementation of technology through disciplined co-design processes that adapt and iterate the technology and its use in context. For example, Brazil's National Curriculum has been designed by a group of the best and brightest teachers from all over the country and will include tips and guidance for the incorporation into the classroom. Lessons are accessed through an app that can be iterated or adapted to suit teacher needs and encourage buy-in and ownership. Brazil's aim is to empower teachers and view them as a facilitator, providing students with the right tools to produce work that will lead to the best learning outcomes.

Highlighting the customisable offer and tailored content of Namibia's *Do Like Edu* eLearning platform meant that buy-in was gained from teachers and school leaders as it demonstrates how the platform meets their curriculum needs and assessment strategies. Therefore, to truly benefit learners, teachers and school leaders, the design process for digital products must at the very least consider the specific needs of users, and at best involve them in the process itself.

Do Like Edu eLearning platform is a joint initiative of UNICEF Namibia and the Ministry of Education, Arts and Culture. It's been designed and deployed with a view to improve access to quality open education resources in Namibia. The "proof of concept" T4D solution is being implemented in two successive phases: 1) Development of the "Do Like EDU" eLearning portal to support learner performance in key subject areas (Mathematics, English and Sciences) and 2) Development of the "Talk to EDU" mobile application to provide

learners with psycho-social support and career guidance. The objective is to test the deployability of platform in terms of ICT infrastructure, user readiness, and the policy and coordination environment.

Learners will be encouraged by both the school and the community to access these innovative tools to improve their academic performance and foster overall wellbeing in schools. Both phases will be tested during a pilot phase to ensure that the innovation is useful and does no harm.

For more, see Appendix III

Conversely, Bridge International Academies (see Appendix II) take a highly centralised approach to how they collect, interpret and act upon the data collected by their schools to iterate their product. A team of central office experts coordinate the use of A/B testing to make the case for widespread changes to practice. They test and collect data on two different instructional approaches, over and over again, to determine what is the best lesson plan or teaching strategy for a particular subject content. This allows them to roll-out best practices, supported by contextually relevant evidence, through changes to their scripted lessons and associated lesson plans.

The question is what impact this highly centralised approach has on teacher agency and confidence over time. It is hard to see how teachers outsourcing assessment and planning like this builds their capability or encourages a sense of ownership of their classrooms and practice. The financial implications of maintaining a central team able to review and update content is also clearly a consideration. While in the short-term there is a cost saving associated to avoiding large-scale teacher training interventions, the long-term cost is a severely under-developed cohort of teachers. In contrast, SPARK Schools (see Appendix II) actively invest in their teachers on the ground, growing their ability to interpret and act upon data that is collected at a school and classroom level.

OPPORTUNITIES FOR STUDENT OWNERSHIP

Eneza Education's 'straight to user' strategy emphasises engagement of learners as much as consumption, and elevates student agency not just as an outcome but as a relevant and necessary focus in how they design their products.

> *"The digital revolution is about more than learning to use new tools and technologies. It is about a major paradigm shift in people's mindsets and habits."*
>
> *The State of the World's Children 2017: children in a digital world, UNICEF, (2017). Pg 50*

Eneza Education is an example of even further decentralisation of power. The mobile platform gives students direct access to quizzes, mini-lessons, tips and tricks via the web, mobile web, and text messaging, allowing Eneza to empower the user to take ownership of their learning, beyond school.

Eneza allows students to directly access lessons aligned to the local curriculum, tutorials, Wikipedia, tips and assessments through USSD/SMS, an online Web app, an offline desktop app, and an Android app. Interaction between student and teacher is enabled through live teacher chat, and students can compete for places on leaderboards through 'play&share'. The Eneza platform enables classroom teachers to see how their students are performing and to assign relevant homework, but also detects student progress and proposes what courses students should take, based on their level of proficiency. Currently, schools can buy individual accounts for $180 per year which permits access to student data and teaching resources. Parents can request similar accounts for $15 per year that allows direct access for their children beyond school.

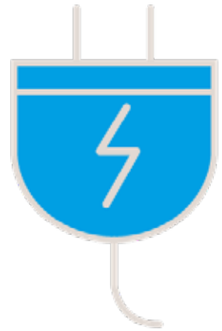
For more, see Appendix II

Key takeaways:

- Involve teachers and students in the design, development and deployment of technologies for learning
- Recognise and embrace the opportunity ICT for learning

5 Technological infrastructure

What are the technical requirements of the technology and are these in place (e.g. power, bandwidth, data security)?



READINESS AND INVESTMENT

It is axiomatic that, without a suitable power supply and reliable broadband, a vast number of technology solutions simply are not viable. However it remains the case that for schools in many parts of the world, these fundamental requirements are not yet technically or financially achievable, noting that the dynamics of cost and what is technically possible is rapidly changing. School readiness surveys are valuable tools in bringing clarity about what is needed to utilise ICT for learning, but also which infrastructure investments can have greatest impact at scale.

In the case of Mwabu (see Appendix II), site surveys determine the limitations of implementation by assessing power and connectivity levels. While power is essential for charging and storing the tablets, if schools have no or little access to power, alternatives such as their capacity to install solar panels can be considered.

One of the striking features of the country cases from New Zealand and Singapore (see Appendix I) is the systematic investment in infrastructure in advance of (Singapore) and alongside (New Zealand) national programmes to stimulate and support the implementation of technology into schools. For example, one of the components of Singapore's Masterplan 4 is to further build up infrastructure in phases according to readiness of school and its teachers.

UNICEF country offices like Uganda are taking the needs of the unconnected into account when developing infrastructure plans (see Appendix III). With invisible barriers such as limited connectivity being a challenge, software is favoured when open-source and made available with an offline option. The learning platform, Kolibri was designed for low resource communities and runs without Internet to mitigate against these infrastructural barriers for use.

UNICEF Uganda recognise that technological innovation in developing countries must look at solutions that take into account limited connectivity. There needs to be an offline option.

Kolibri is designed for low resource communities. It is an open-source, offline platform and runs without internet (but is also available online).

For more, see Appendix III

BYOD MUST BE HANDLED WITH CARE

Mobile phones are widespread across a number of countries on the African continent, providing the opportunity for Bring Your Own Device (BYOD) strategies that have generally been underutilised. As the World Bank's World Development Report 2016 points out:

> *"More households in developing countries own a mobile phone than have access to electricity or clean water, and nearly 70 per cent of the bottom fifth of the population in*

developing countries own a mobile phone."

World Bank World Development Report, Digital Dividends (2016)

As mobile adoption proliferates in many countries, including emerging economies, the opportunity for mobile learning now and in the future, is rife. This is particularly true on the African continent, where mobile penetration is high (although data remains expensive in many cases), and smartphone access is growing rapidly in many countries.

For Eneza Education (see Appendix II), the solution to scale content and quality without the infrastructural and bureaucratic challenges of school systems lies in using the mobile phone network and low cost data options such as text messaging with teachers and via the platform. Partnership with mobile service providers has made it possible to lower the cost of data usage as the number of users of the platform grows. Eneza also work closely with parents to help make sure students have sufficient phone credit to access learning materials.

Eneza uses technology that major mobile operators have access to, which means that operators are able to increase their revenue streams by selling more services, and Eneza's reach of users subscribing to the platform grew significantly. This close collaboration with Telecom, enabled Eneza to lower the price of their data, in order to make it accessible to users.

For more, see Appendix II

UNICEF South Africa saw the potential in mobile learning and the opportunities associated with using mobile applications to support particular educational functions. However found that both require detailed testing and ongoing monitoring and management. While the Ukufunda Virtual School worked on a Bring Your Own Device (BYOD) model of access to reach remote areas, therefore incorporating a strong equity focus, findings from the evaluation showed that there was an affordability implication for those wanting to access some apps on the platform. Proprietary services (where there is a subscription fee) were uploaded by the project partner and users were expected to pay for their own data, although costs were reduced for learners and parents of low socioeconomic status where possible. Despite attempts to keep costs low, it was found that BYO-Data services excluded vulnerable audiences and were a recurrent concern for all users.

The Ukufunda virtual school (or UVS) is an innovative m-learning service, conceptualised in 2013 and launched in September 2014 by a partnership comprising the South African Department of Basic Education (DBE), UNICEF SA, and the Reach Trust (formerly known as Mxit Reach). It was the DBE's first attempt to develop and mobile-learning portal. The UVS is a portal that uses a social-networking platform (Mxit) to provide access to learning resources and content, counselling and safety services and other value-added services and programmes via mobile technologies. The platform aggregates pre-existing learning and psycho-social applications ('apps'), but also new, bespoke apps developed specifically for the UVS. The UVS makes applications available to users through three views: a learner view, a teacher view, and a parent view.

For more, see Appendix III

Carefully designed business models offer promise in certain contexts. In Portugal, a One-Laptop-Per-Child initiative have designed a *Telecommunications Partnership for Education Framework* which outlines a shared responsibility model between operators/ providers, governments and beneficiaries of the technology, tied together by a combination of tax relief, user discounts and family contributions.

While Bring Your Own Device and mobile learning models can mitigate against infrastructural challenges, the costs borne by beneficiaries for both devices and data must be a fundamental consideration. In some especially poorer and rural contexts, these models can contribute to the widening of equity gaps and system leaders should be cognisant of these risks. Many poorer and rural families are already struggling to pay to ensure their children access education, through uniform, books and fees. Technological devices are a further burden, creating new barriers for poor and marginalised communities.

PROBLEM SOLVING CONNECTIVITY - WITH TECHNOLOGY

Lower-income, rural or remote communities often struggle with access to power supply and connectivity. This can leave schools with the single option of learning about the Internet as a concept, rather than using it as a tool for learning. With large-scale infrastructure investments often not possible due to lack of funding, or where they are a long way from completion, innovative solutions that bridge the divide between access and connectivity, are critical.

UNICEF Cameroon is piloting an initiative that aims to provide digital education tools to children in Cameroon who have never had access to them before. Critically, Internet connectivity is provided by installing solar-powered satellite units in each school. The Units provide connectivity with a 500 metre radius to communities that have historically been isolated from the world-wide-web. UNICEF Cameroon is now looking at how to best integrate the use of the tablet into the lessons and refine the underlying pedagogical approaches - an opportunity that wouldn't exist for these schools without an innovative infrastructure solution.

In Cameroon, access to quality education – including internet access – is challenging. By connecting remote schools and students to technology, one new initiative has begun to bridge the divide, starting with those who need it most in northern Cameroon. 'Connect My School' has been successfully implemented in six schools in remote areas of the country: two in the Far North Region (Baigai Public School and Minawao Refugee Camp), two in the East (Abou Boutila and Timangolo) and two in the capital of Yaoundé. Schools received child-friendly tablets loaded with educational games and apps like Wikipedia, as well as drawing, text and photo apps.

For more, see Appendix III

The early success of the pilot has encouraged UNICEF Cameroon to work with public and private donors to introduce the satellite units to more than 100 schools in the most vulnerable regions of the country. With equity as a guiding concept for UNICEF, innovative solutions that help bridge infrastructure gaps for schools and communities that are too often left behind should play an integral part in ICT for learning strategies.

Key takeaways:

- Understand the limitations of local infrastructure prior to investment and deployment of ICT for learning
- Be cautious about the implications for equity of 'Bring Your Own Devices' strategies
- Innovative technologies can be solutions to infrastructure challenges.

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6

Implementation and change

What is the role of local leaders and what support do they need to create a culture of innovation and improvement?

HOLISTIC CHANGE

As with any significant change, the 'how' of implementing ICT for learning is almost as important as the 'what'. Intelligent and agile programme plans that attend to local conditions and that are widely shared, understood and supported are fundamental for successful implementation and sustained change.

The research literature provides strong evidence that ICT for learning is more effective within broader improvement and change strategies which consider social and pedagogical factors. A large scale Randomized Controlled Trial to investigate peer effects in computer-assisted learning (CAL) in primary schools in rural China[44] found that students make more progress in maths when engaged in CAL than the control group, but most notably that 'weaker students' (students who perform far below average in an initial maths test) do better when they are paired with "stronger students", while having no negative impact on the performance of stronger students. This insight is further corroborated by a meta-analysis which looks at One-to-One Laptop Environments[45], concluding that pedagogy was more important than technology in determining the effectiveness of the laptop programmes.

One Laptop Per Child's programmatic approach, which sought to deploy ICT for learning 'at scale', failed to have the impact it promised. In trying to roll-out across hundreds, sometimes thousands of schools, officials were often distracted by logistical challenges and paid scant attention to local conditions. Over time the model began to shift their 'drop and go' approach to become more holistic, combining technology with a prolonged community engagement, teacher training and local educational efforts and insights.

In its early years, OLPC encountered significant criticism, with many pointing to the lack of impact on test scores, declining technology usage, and a lack of a direct relationship to the pedagogy needed in the local context. These failures were attributed to OLPC's initial and under-sophisticated 'drop-and-go' strategy.

Through some hard lessons, OLPC came to realise the really important role that teachers play in the learning process. This led them to focus more on supporting the teacher and the community as part of the programme, rather than just deployment of devices. OLPC's openness to shifting from the technology to 'technology and teachers' is critical to their evolution and the successes they have achieved. The realisation that sustainability was critical has led to significant investment strategies in community engagement and development.

For more, see Appendix II

Recommendations from the Ukufunda Virtual School evaluation report[46] highlight the need for a coherent theory of change that is specific to the target audience and focus of the initiative, specifically the impact on learning outcomes it hopes to achieve. In the case of Ukufunda, a theory of change was retrofitted into the programme design, but by this point the parameters of what was intended (originally designed for students) were not explicit and kept changing (later, teacher and parent platforms were added). It was also observed that the implementation was insufficiently monitored.

Furthermore, in the case of South Africa, the investment case had not been made clear. In the instance of the hardware (2G feature phones), there was a lack of understanding about their limited functionality and the tech world on the precipice of launching cheap smartphone devices. Thus, in order to rationalise the implementation of a particular ICT for learning offer, an investment case must be made. How technology performs relative to other outputs in the system (e.g. training, workbooks, coaching, other devices) is a fundamental consideration if initiatives are to be sustained and continue to have impact.

Investment cases for professionals' time and attention must also be considered when institutions are making meaningful decisions about which kind of technology initiatives make sense for them to provide.

Massive Open Online Courses (MOOCs) provide a free and flexible way to learn new skills. Diana Laurillard, Professor of Learning with Digital Technologies at the London Knowledge Lab, UCL Institute of Education, champions the potential of MOOCs as a provider of localised professional development for teachers. She argues that if implemented through sound digital pedagogies using a cascading model, a highly qualified professional can be trained to teach 25 local adults and less qualified teachers using blended learning. If 10,000 professionals are enrolled in the MOOC, the professional learning can ultimately reach a quarter of a million teachers[47]. Adopting a cascade model can have a large-scale impact at low cost, making a compelling investment case for using MOOCs, coaching and innovative digital pedagogies for professional learning. Furthermore, the widespread technology can offer a vehicle to support teachers living in areas where traditional capacity building opportunities are scarce.

CHANGE AS THE ONLY CONSTANT

Typically, Monitoring and Evaluation (M&E) strategies have been used to isolate causal impacts of interventions – finding out 'What Works' – to help inform policy and funding decisions. Yet there is greater value in M&E strategies which incorporate more agile, experiential learning processes which can feed back into the design and implementation the intervention.

• • • •

"The right combination of M, e [structured experiential learning], and E provides the right space for innovation and organizational capability building while at the same time providing accountability and an evidence base for funding agencies."

Lant Pritchett, Harvard Kennedy School and Center for Global Development[48]

Hence, to meet the local need, fit into the local context, and maintain relevance and lasting change, programmes need to be designed with frequent opportunities to review what has been learned and make adjustments to what happens next.

Moreover, the more users are given the opportunity to share the work they are doing, gather feedback or ask questions, and have this built into the process, the more inclined they will be to engage in the technology.

In the case of New Zealand (see Appendix I), learning and change is fostered through networks that create opportunities for schools to collaborate and support one another to solve problems, develop and share new ideas or best practice in real time. These networks are a layer in the New Zealand education system;

(44) Fafchamps & Mo, (2017) Peer Effects in Computer Assisted Learning: Evidence from a Randomized Experiment. NBER Working Paper No. 23195.

(45) Zheng et al (2016) Learning in One-to-One Laptop Environments: A Meta-Analysis and Research Synthesis. Review of Educational Research, Vol. 86, No. 4, pp. 1052–1084.

(46) (Roberts, N., Spencer-Smith, G. and Butcher, N. (2016) An implementation evaluation of the ukuFUNda virtual school. UNICEF, on behalf of The Department of Basic Education.

(47) Laurillard, D. and Kennedy, E. (2017) The potential of MOOCs for learning at scale in the Global South. Centre for Global Higher Education working paper series. No.31.

(48) Pritchett, L., Samji, S. and Hammer, J. (2013) It's All About MeE: Using Structured Experiential Learning ("e") to Crawl the Design Space, Faculty Research Working Paper Series, Harvard Kennedy School.

they are part of the solution to scaling and diffusing innovation, and make it more likely that new approaches, particularly in the teaching of science and technology, are understood, evidenced and widely adopted.

Learning and Change Networks (LCN) were collaborations between schools, and their communities; partnerships designed to identify local challenges and make changes to improve student learning. In July 2014, there were 53 networks, comprised of 286 schools and kura, about 11% of the schools in New Zealand.

The 'daughter' of Learning and Change Networks, Communities of Learning are not directed to or required to focus exclusively on STEM; although naturally some of them do, that is not their function. The Communities are a 'layer' in the New Zealand education system, connecting schools in self-identified communities of practice to develop and share new ideas and practice. They are part of the solution to scaling and diffusing innovation, and make it more likely that new approaches, including in the teaching of science and technology will be adopted.

For more, see Appendix I

Off the back of its experience of the Do Like Edu e-learning platform (see Appendix III), UNICEF Namibia reflected that schools needed follow up support to see how they were fairing with the technology; whether they were happy with the product; and whether the learners were using the technology effectively.

There will inevitably be specific contextual challenges in each country relating to, for instance, infrastructure and local cultural conditions, which require local knowledge and adaptation. Technology should therefore not be a 'bolt on'/'lift and shift' solution, but should instead be continuously tested to ensure that the deployment continues to adapt itself to improve learning experiences for all users.

MORE THAN TRAINING

The paper has dealt elsewhere with the importance of training and high-quality support to the success of introducing ICT for learning. However where technology is pervasive and is intended to make a major contribution to culture and practice, more than a training course may be required.

In the case of Mwabu, five days of training is provided for staff to engage with the technology and associated pedagogical approaches so they are able to see what success of the programme looks like in practice. This can ensure all staff members in the school are moving in the same direction as one another. Training covers the use of the tablets in the classroom, training on the underpinning rotational classroom model, and a course in change management. The Principal receives a full day of training, with three days allocated to the teacher(s) and finally a full day for the newly appointed coordinator who acts as intermediary between the school and Mwabu. Coordinators are also responsible for assisting teachers use the tablet and provide Mwabu with feedback about implementation and general use.

Schools are allocated a mentor from the Mwabu Academy who offers in-person or virtual training using social networks. Mwabu encourage the delivery of in-person and observational training as schools are implementing technology for the very first time. Managing change is vital for continued use. The mentor service is an additional cost to the school and recommended at least three times per year.

For more, see Appendix II

Singapore's Ministry of Education work closely with teachers and school leaders to support them to be culture builders (see Appendix I), and encourage teachers to update themselves on changes in content and teaching methods to enable more considered creativity and innovation[49]. This is to ensure the right conditions are created within the school so that the technology can flourish. This role is important for staff having a strong belief in the school's vision and what it is trying to achieve, which is a critical factor for change. Furthermore, to build teacher capabilities as teaching professionals who can guide their students in their growing years.

(49) www.Moe.gov.sg

Singapore's Masterplan 4 offers a vision for future ready and responsible digital learners, where learning is in the hands of every learner, empowered with technology. In this vision teachers are designers of learning experiences and environments and school leaders are culture builders.

The aims of Masterplan 4 are to:

- **bring ICT into the core of the education process (from planning and design of lessons to testing)**
- **focus on improving the capabilities and skill sets of teachers (ICT-savvy must also be able to translate into effective teaching)**
- **improve the sharing of best practices and successful innovations**
- **further build up infrastructure (in phases according to readiness of schools and teachers).**

For more, see Appendix I

THE NEED FOR SPEED

The rapid proliferation of new technologies in education means that choosing which technology to invest in can be a difficult decision for governments, providers and systems leaders. This is especially true when the speed at which new technologies reaching the market has far outpaced the ability of governments and providers to evaluate and adapt their strategies. South Africa's Ukufunda pilot was designed for users of 2G feature phones, but by the time of implementation, the majority of users had switched to smartphones (30% remained on feature phones). Similarly, during Ukufunda's planning phase, the programme's platform *Mxit* was at its most popular and had a substantial number of users. However, at the point of roll out, the application *WhatsApp* was launched. This consequently meant that *Mxit* lost a significant proportion of its user-base and subsequently shutdown.

That being said, in instances of instability, endemic, or conflict, governments can be forced to move quickly without the need for the latest technologies or software. Instead a reliable system can meet the basic need of countries where violence and unrest have forced many out of school. In Sierra Leone and the Central African Republic, UNICEF are working with governments to use data collection systems as a way of collecting basic information to track the number of open schools and students in attendance, even in the most 'hard to reach' areas.

Key takeaways:

- ICT for learning is more effective within broader improvement and change strategies which consider the social context and pedagogical factors.
- Rigorous monitoring and evaluation practices must be in place to help test, refine and adapt the use of ICT for learning.
- Technology moves fast. Teachers need ongoing support to help respond to the change.

7

Enabling environments

What is the role of local leaders and what support do they need to create a culture of innovation and improvement?

VISIONING AND POLICY

Providing the right conditions for ICT for learning to thrive can be as critical as the implementation strategies themselves. ICT for learning needs to play a role in a wider narrative of, and case for, education change, animated and supported by a policy platform that stimulates demand from stakeholders and authorises and enables change.

New Zealand's Curious Minds initiative (see Appendix I) is a compelling example of a coherent and clear direction of travel. A ten-year national strategy supports all New Zealanders to engage with STEM subjects, in particular disengaged groups such as students from Maori and Pasifika communities. The initiative invested in ICT for learning and technological infrastructure, developed a digital curriculum and built up the digital capabilities of teachers, especially those serving the poorest communities. This strategic approach gained traction from an ongoing public campaign that linked the challenge of closing the achievement gap for Maori and Pasifika learners with providing science and technology opportunities to all New Zealanders.

Curious Minds reaches out beyond schools and into communities, connecting young people with scientists and technologists to grow demand for engagement with science and technology.

The campaign also includes a review of the positioning and content of digital technologies within the NZ national curriculum and Te Marautanga o Aotearoa (the national curriculum for Māori-medium).

For more, see Appendix III

A risk in technology policy making is too much of a focus on the technology, and not enough on teaching and learning. UNICEF Rwanda (see Appendix III) recognises that the President vision for SMART classrooms in every school had somewhat of a catalysing effect, and mobilised a number of providers (Koica and Jica). Yet while these SMART classrooms align with the President's political narrative for making Rwanda the "Singapore of East Africa" through cross-sector technological advancement, its alignment with a vision for teaching and learning is seemingly absent.

• • • •

"Both principal-agent relationships and behavioral biases likely play a role. The principal-agent model is relevant because public officials may derive political returns from any technological interventions, independent of their usefulness for better learning. Thus their personal incentives (to make highly visible investments) may diverge from the goals of students (to learn)."

World Development Report 2018: LEARNING to Realize Education's Promise, World Bank Group

What this tells us is that finding a balance between what is politically valuable and what best impacts learning outcomes is important in any strategy for ICT for learning, especially considering the financial investment that is often at stake.

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A ROLE FOR GOVERNMENTS

It is clear however that elected governments have a continuing role to play, in particular in securing equity in a competitive and immature technology market place:

• • • •

"Without state-led commitment to complement market-based and private sector solutions, children left behind in a digitally connected world will be at great risk of further exclusion and marginalization."

UNICEF's State of the World's Children report 2017

Governments have a role in ensuring:

- The rights of communities and schools to broadband and other technological infrastructure.
- The prioritisation of equitable investment cases, and interventions which remedy differences between learning levels at the baseline.
- Mitigation against the abuse and misuse of children's data, as recommended in UNICEF's 2017 The State of the World's Children report.
- Regional agreement on policy and regulatory commitments, much like that envisaged by SMART Africa[50].
- Partnerships, entrepreneurship and knowledge sharing that's critical for system-wide change.

These responsibilities represent an emerging set of pre-requisites that governments should consider before ICT for learning initiatives are to be seen as desirable, feasible or viable.

Governments can also helpfully specify State expectations for the:

- competencies of technology-enabled learners; and
- skills teachers need to harness technology in the service of teaching and learning.

In South Africa (see Appendix III), aligned to the Government's 'Education Action Plan to 2019: Towards the Realisation of Schooling 2030', a professional framework for digital learning is being developed and will list the competencies teachers should have in relation to digital learning.

Government signalling of the importance of the development of such skills to secure the implementation of ICT for learning can be valuable in and of itself[51]. But 'top-down' approaches like these are insufficient. An enabling environment also supports and fosters innovation from the 'bottom-up'.

The 'Transforming teaching and learning through ICT' project, launched by Aga Khan Foundation (AKF) and Dubai Cares (see Appendix II) recognises that across the learning ecosystem, no one stakeholder could account for all the necessary moving parts.

Its application in Kenya saw the initiative enable the Government to provide the policy environment, infrastructure, and frameworks; other partners like AKF provide the system support, professional development, and community engagement; Elimu (a local producer of digital content) develop the interactive content for the platform; and Camara Education (an international education social enterprise, specialising in technology) provide the hardware and ICT support.

In comparison, implementation of the project in Uganda lacked the same level of policy support and investment. The overall impact achieved was neither deep nor broad, thus clearly illustrating how bottom-up partnerships and coordination are needed to deliver better results.

MANAGING RISK THROUGH GREAT GOVERNANCE

Poor understanding of the potential and risks of technology can be a problem when people in positions of institutional and decision making power lack the experience or the insight to spot and mitigate problems. As such, creative approaches to governance that acknowledge limits unequal digital expertise and knowledge are required to respond to this challenge.

(50) *http://smartafrica.org/?-Smartafrica-Overview-*

(51) Laurillard, D. and Kennedy, E. (2017) The potential of MOOCs for learning at scale in the Global South. Centre for Global Higher Education working paper series. No.31.

In South Africa's Ukufunda programme (see Appendix II) for instance the app's service provider held a too-powerful role, driving forward new versions of their learning platform based on technology requirements rather than attention to learning outcomes. In addition, much of the Intellectual Property resided outside of government and with the provider, as did access to data and progress indicators. This left educators and ministerial representatives without sufficient control over the direction of travel and led to poor oversight of the impact the technology was having on teaching and learning.

UNICEF's Technology for Development (T4D) Design Criteria[52] show how a set of best-practice guidelines might govern and inform the design of technology enabled development programmes, however the extent to which the T4D design criteria have been meaningfully internalised and adopted across UNICEF's country offices is mixed. Other governance approaches might usefully explore how to hold partners to account for impact on learning outcomes and balance the power of large vendors over commissioners in emerging economies.

UNICEF's Technology for Development (T4D) Design Criteria:

1. **Design with the User**
2. **Understand the Existing Ecosystem**
3. **Design for Scale**
4. **Build for Sustainability**
5. **Be Data Driven**
6. **Use Open Standards, Open Data, Open Source, and Open Innovation**
7. **Reuse and Improve**
8. **Do no harm**
9. **Be Collaborative**

These principles have been endorsed or adopted by the following partners: UNICEF, USAID, The Gates Foundation, EOSG Global Purse, WFP, WHO, HRP, OCHA, UNDP, SIDA, IKEA Foundation, UN Foundation, and UNHCR.

Institutions like the European Union have already begun to explore how to better steward the introduction of technology into education systems, and challenge the tech industry to nurture more of a moral compass.[53] Countries on the African continent might consider what an African Union equivalent might be, and how it can be focused on the learning outcomes they want the world's largest youth population to achieve.

Digital technology itself can form part of new and innovative mechanisms for governance. Just as Apple's App Store acts as a highly trusted platform for providing personalized content for smart phones, governments can provide a platform for a thriving ecosystem alongside their own resources and products, enabling them to quality assure provision and secure and prioritize the engagement of educators. This model broadly describes the role of state and city governments in Brazil, where a diverse and thriving and largely unregulated technology market, is nevertheless quality assured and market driven by universities and philanthropy, working alongside Government.

Key takeaways:

- ICT for learning needs to play a role in a wider narrative of, and case for, education change, animated and supported by a policy platform.
- Top-down government signalling is most effective alongside strategies to foster innovation from the 'bottom up'.
- Good governance of ICT for learning is critical.

(52) *https://www.unicef.org/innovation/innovation_73239.html*

(53) *https://www.theguardian.com/technology/2016/jan/30/europe-google-facebook-technology-ethics-eu-martin-schulz*

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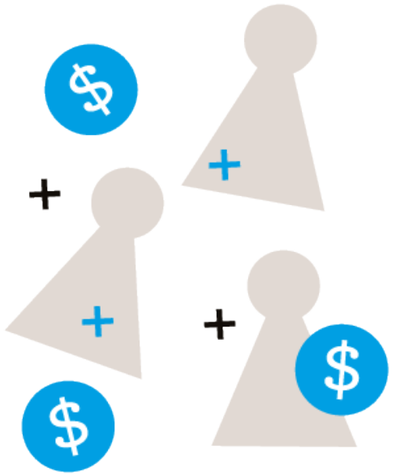
8 Resources

What is required for the effective and sustainable use of ICT for learning, including on-the-ground support capability?



Considered, committed investments

Capital investments in infrastructure and hardware, as well as ongoing financial costs of maintenance and repair, add up to a significant financial investment for those intent on making headway on ICT for learning. As we have noted, ancillary investment in teacher professional development is also required to ensure teachers have the necessary capabilities to deploy technology effectively.

In all our examples associated costs are high, but they are considered by the people making these financial decisions to be *investments*, holding out the hope of increased productivity in examples like Bridge International Academies and Eneza Education and improved learning outcomes across the board.

Eneza's vision is to be the global go-to learning platform that empowers the next generation of leaders with the skills they need to succeed. Their ambition is to provide 50 million learners with affordable quality education for a subscription of $5 a year, to be paid for by individual parents, students or teachers (current price is $20 a year for a basic SMS subscription).

For more, see Appendix II

The flip side of this is what happens when there is underinvestment. The failure of 'drop-and-go' strategies is emblematic of efforts to implement ICT for learning on an inadequate and often one-off expenditure without strategic thought of which resources best enable ICT for learning to be introduced and sustained effectively.

Experiences such as those of One Laptop Per Child (see Appendix II) point to the need to invest in local assets and capabilities. Networks of schools and communities of practice consistently feature as solutions to sustaining and deepening the impact of technology, beyond the initial investment in implementation.

Having learned from their early 'drop-and-go' mistakes, OLPC now identify a local partner organisation to work with their multidisciplinary team to design a bespoke programme, and to be responsible for the day-to-day oversight of the programme in the longer run. This involves building a local team that are capable of providing various technical and operational support, to ensure long-term sustainability of the programme. Systems of inventory and maintenance would be developed to overcome the logistical challenges of getting the laptops into the hands of each child.

For more, see Appendix II

It is also important to note that, while we know that there are organisations keen to fund projects like OLPC with one-off capital investments, philanthropy and Corporate Social Responsibility (CSR) funding is less likely to be available for ongoing maintenance and support. Beyond up-front investments, the cost of maintaining and repairing equipment and updating software and curriculum content falls to schools or local and national governments. This is one of the main reasons that technology falls into disuse. Another is how legacy systems - one-off large-scale infrastructure investments in operating systems and devices - fail to respond to the increasingly dynamic needs of users and the fast-moving evolution of technology.

Critically though, alternative access to resources exist. The volume of freely available, open-source software in the public domain has proliferated in recent years, presenting a strategic opportunity to improve the quality of education, knowledge sharing and capacity building.[54]

However, one caveat is that the quality of content is inconsistent, in turn reiterating the need for human investment, not least to administer critical appraisal of content to ensure it contributes towards improving learning outcomes.

NEW SKILLS FOR NEW TECHNOLOGIES

Even prior to implementation, skills gaps appear, which need to be plugged if technology is to reach its potential. One of the lessons learned by UNICEF South Africa from their trial of the Ukufunda Virtual School (see Appendix III) was the requirement for someone who was both experienced in the use of technology and its application in an education setting. Having this person meant that the country office team could talk the talk of service providers, while playing an important role in negotiating the opportunity to solve the teaching and learning problems of their own educational context.

Similarly the team in Rwanda's UNICEF office, currently feel they lack the necessary technical expertise to integrate technology into learning through teacher training, and to critically navigate the marketplace and negotiate provider contracts/subsidies. They recognise the need for more business-savvy strategies that protect them from exposure to hidden costs and contractual obligations, securing deals that are sustainable and cost-effective.

This combination of business acumen, technological awareness and pedagogical expertise is unlikely to be found in one person. The opportunity for collaboration across country, regional and headquarter offices to create the necessary capacity is clear.

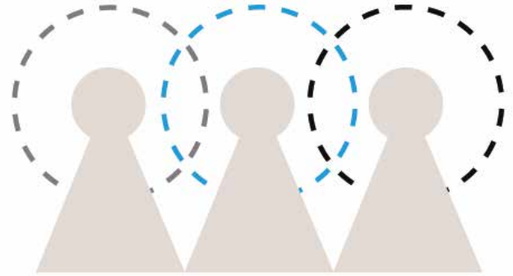
Key takeaways:

- The failure of 'drop-and-go' strategies is emblematic of the need to considered, committed investments.
- Alternative access to resources exist in increasingly proliferated and freely available, open-source software.
- Combining the necessary business acumen, technological awareness and pedagogical expertise requires meaningful, coordinated collaboration across teams and institutions.

(54) UNICEF (2017) The State of the World's Children in 2017: Children in a Digital World. United Nations Children's Fund

9 Coalitions

What role might partnership play in 'bundling' solutions to complement and amplify ICT for learning?



ALIGNMENT WITH LOCAL AND GLOBAL AGENDAS

One way to maximise the reach and the impact of ICT for learning is to appeal to, and align with, existing education policy agendas. Too often, the public narrative that surrounds technology is focused on infrastructure investments and access to kit, reinforcing the myth that introducing technology into education systems automatically equates to progress.

Singapore's agenda for the advancement of technology across all sectors (see Appendix I), aligns the investment of technology in education to wider agendas which go beyond access and commit to specific learning outcomes, with implications for the country's economic and social growth.

By aligning ICT for learning initiatives to broader debates, dialogue and fora across education, countries harness public and professional buy-in and energy. Integrating with these broader efforts to improve achievement and progress throughout local, regional and global education systems can provide better coherence and clarity around the role that technology can and should play in learning.

Inter-ministerial collaboration, between ministries for Education, ICT and Business but also Health and Infrastructure, can better align technology with broader efforts to improve and transform learning outcomes (and other factors effecting wellbeing). UNICEF are an international agency with the reputation, capabilities and knowledge of how to do this well.

PUBLIC/PRIVATE PARTNERSHIP BEST PRACTICE

Building coalitions for the delivery of technology for enhanced teaching and learning is a complex challenge. Knowing when and how to convene the private sector and orientate actors towards a common, public goal requires further thinking.

> ***"The future of education in emerging markets, within Africa and beyond, will be hybrid systems — not a monopoly of public financing and public provision of education services, but mixed public and private. This is being driven by consumer demand, by the market stimulating innovations in supply, and by the fiscal realities of governments that are increasingly engaging private sector capital and delivery solutions to provide services and products for rapidly growing populations."***
>
> *The Business of Education in Africa, Caerus Capital (2016)*[55]

Public/Private Partnerships (PPPs) are seen as a natural model that can harness the potential of technology providers and investors, but also regulate them, ensuring a focus is kept on learning outcomes and equity.

(55) *https://edafricareport.caeruscapital.co/thebusinessofeducationinafrica.pdf?aug_2017*

"Many public sector reformers expect to bring together the best of the private and public worlds: the state's presumed orientation towards equity and social cohesion, together with the alleged innovation, dynamism, and efficiency of the private sector, and the compassion and social commitment of the private not-for-profit sector"

Verger, A. and Moschetti, M. (2017) Public-Private Partnerships as an Education Policy Approach: Multiple Meanings, Risks and Challenges. UNESCO Education Research and Foresight Working Papers.

In reality, the ability of PPPs to act as an innovative vehicle for education initiatives is contested. As outlined in UNESCO's 2030 education research and foresight working papers[52], the term 'partnership' adopts multiple meanings in public policy and is partly why PPPs have been able to gain bipartisan support. They can take different forms and functions. From education delivery and the procurement of services, to building technological infrastructure, partnerships exist on a spectrum between those which are tightly controlled by government, and those that more loosely resemble a contractual arrangement with private providers. Crudely put, those in the private sector lean towards the perspective that PPPs are a natural progression towards market-oriented solutions, aligned to 'public choice theory' such as School Vouchers. Those in the public sector tend towards the perspective that PPPs are an extension of the regulatory environment that seeks to control private sector activity in education.

The extent to which PPPs can be a valuable and innovative tool in realising the opportunities of ICT for learning will depend on the ability of these partnerships to genuinely integrate vested interests towards a common public good, but also a shared vision to teaching and learning.

"The level of integrality of a PPP can also be defined by whether the partnership fulfils clear conditions of knowledge transfer, mutual learning and risk-sharing. These conditions are hardly represented in the World Bank continuum and within its broader conceptualization of ePPPs"

- Verger, A. and Moschetti, M. (2017) Public-Private Partnerships as an Education Policy Approach: Multiple Meanings, Risks and Challenges. UNESCO Education Research and Foresight Working Papers.

More needs to be done to understand what best-practice looks like in negotiating and constructing PPPs that are true to their purpose and design, and are clear in what success looks like, for instance in terms of learning outcomes. Questions remain unanswered around what the potential of multi-actor partnerships might be, and what form PPPs might take if they seek to bundle multiple solutions to augment the impact of a holistic integration of ICT for learning, as outlined in The Boston Consulting Group's Closed Loop Instructional System[57].

Key takeaways:

- Maximise the reach and the impact of ICT for learning by appealing to, and aligning with, existing education policy (and other public policy initiatives).
- Be deliberate and ambitious about inter-ministerial collaboration.
- Consider public/private partnerships carefully – the practice remains highly contested.

(56) Verger, A. and Moschetti, M. (2017) Public-Private Partnerships as an Education Policy Approach: Multiple Meanings, Risks and Challenges. UNESCO Education Research and Foresight Working Papers

(57) *https://www.bcg.com/en-gb/industries/education/closed-loop-instructional-system.aspx*

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10 Risks

What are the risks associated with ICT for learning, and how might we mitigate against them?

DAMAGING DIGITAL BEHAVIOURS

Digital technology is full of opportunity for young people, but is also a fertile environment for them to be exposed to damaging behaviours. While bullying, harassment and abuse all exist offline and away from technology, they are all augmented and enabled by the anonymity and scale offered to perpetrators by the online world.

"It has never been easier for bullies, sex offenders, traffickers and those who harm children to contact potential victims around the world, share images of their abuse and encourage each other to commit further crimes. Digital connectivity has made children more accessible through unprotected social media profiles and online game forums. It also allows offenders to be anonymous – reducing their risk of identification and prosecution – expand their networks, increase profits and pursue many victims at once"

UNICEF, State of the World's Children report, 2017

Children and young people can be a risk to themselves when online. Without proper guidance and governance, the internet and all its uncensored content can be an unwanted promoter of violence, racism and discrimination.

Furthermore, use of digital platforms – in particular social media sites – can become a dopamine-fuelled addiction for children and young people, if not managed sensibly[58] There is a worrying correlation between poor mental health and access to the digital world. Recent studies have shown that depression has increased in tandem with smartphone use,[59] and time spent on social media sites is linked to mental health issues.[60]

DIGITAL MISUSE

Like with any new tool, digital technologies are prone to misuse – inadvertent or otherwise. Perhaps most common is the misuse of data. As more young people begin to use digital products, platforms and tools as part of their learning, the extent to which corporations and/or governments collect and store personal data grows. It raises the ethical question about what data should be accessible to these institutions, as well as a more practical one about how best to protect children's data whoever holds it. Both questions put the security and privacy of children's data at the front and centre of the ICT for learning debate.

"Safeguarding privacy and ensuring sensitive data is handled appropriately, especially in conflict settings, are critical issues for our community as it becomes data-driven."

Stephen O'Brien, United Nations Under-Secretary-General for Humanitarian Affairs

Of equal concern is the new demands put on child protection and safeguarding practices by the digital age. Best practice must keep up with the pace of change if children are to remain protected and safe.

"Regulatory frameworks for digital protection, digital opportunity, digital governance and digital accountability are not keeping pace with the rapidly changing digital landscape, and are overlooking the unique impact digital technologies have on children."

UNICEF, State of the World's Children report, 2017

(58) *https://www.theguardian.com/technology/2018/mar/04/has-dopamine-got-us-hooked-on-tech-facebook-apps-addiction*

(59) *https://www.weforum.org/agenda/2017/11/smartphones-are-damaging-this-generations-mental-health?utm_content=buffer41ba3&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer*

(60) *https://hbr.org/2017/04/a-new-more-rigorous-study-confirms-the-more-you-use-facebook-the-worse-you-feel*

MITIGATIONS

As access to the digital world grows across Sub-Saharan Africa, there is a pressing need for effective mitigation strategies against the risks outlined above. Clarity around what the risks associated with ICT for learning is critical in raising the awareness of stakeholders and supporting them to respond effectively. UNICEF's typology of ICT-related harms is a helpful starting point for those on the ground looking to build coherence.

Content Risks: Where a child is exposed to unwelcome and inappropriate content. This can include sexual, pornographic and violent images; some forms of advertising; racist, discriminatory or hate-speech material; and websites advocating unhealthy or dangerous behaviours, such as self-harm, suicide and anorexia.

Contact Risks: Where a child participates in risky communication, such as with an adult seeking inappropriate contact or soliciting a child for sexual purposes, or with individuals attempting to radicalize a child or persuade him or her to take part in unhealthy or dangerous behaviours.

Conduct risks: Where a child behaves in a way that contributes to risky content or contact. This may include children writing or creating hateful materials about other children, inciting racism or posting or distributing sexual images, including material they have produced themselves.

Typology of ICT-related Harm (UNICEF, State of the World's Children, 2017)

Robust governance systems must be developed to form solid foundations for the mitigation of online risks. Some progress has been made around specific child protection issues. For instance, the WePROTECT Global Alliance[61] have developed a Model National Response to combat online child sexual abuse and exploitation globally[62]. More needs to be done to coordinate similar efforts, share knowledge and to stay ahead of the evolving risks associated with the digital age. Mitigation strategies must include raising the awareness and digital skills of children and their parents to be savvy and safe online. This is particularly important as access to technology and the digital world beyond school grows.

• • • •

"Most children – and many parents – have very limited, if any, awareness of how much personal data they are feeding into the internet, much less how it might one day be used"

UNICEF, State of the World's Children report, 2017 (p71)

Many children and adolescents lack the ability to critically gauge the safety of their digital experiences, as well as the credibility of digital spaces (website, forums, social media platforms). Raising the level of digital literacy amongst users themselves must be a priority in safeguarding children online.

There is still a significant role for Teachers. As guardians of children in their school, their responsibilities and practices must extend into the digital world. Continuous professional development must incorporate online child protection and safeguarding practices, alongside their training in the technical use of technology, and how to integrate it effectively into teaching and learning.

Key takeaways:

- Access to the digital world puts children at risk of being exposed to negative and harmful behaviours, of others and themselves.
- The digital world puts new and different pressures on child protection, safeguarding practices and privacy rights.
- Mitigation strategies need to combine effective governance, improvements in digital literacy and continuous teacher training on online child protection and safeguarding.

(61) *https://www.weprotect.org/*

(62) United Nations Children's Fund (2016) Child protection in the digital age: National responses to online child sexual abuse and exploitation in ASEAN Member States, UNICEF EAPRO.

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Mbasa Mengzuva, 14, Gcobisa Maroloma, 12 and Anathi Mlengana, 13 are amongst the best students of the Bijolo School situated in a disadvantaged rural area in Eastern Cape, South Africa. Each of the three friends has a dream that they hope to achieve through education. Mbasa wants to become a pilot, Anathi – a writer and Gcobisa hopes one day to work with technologies.

© UNICEF/UNI0143507/Prinsloo

A student learns with the help of a computer tablet provided by UNICEF at a school in Baigai, northern Cameroon, Tuesday 31 October 2017.

© UNICEF/ Aga Khan Education Services

© UNICEF/UNI0143515/Prinsloo

A student uses a computer tablet provided by UNICEF to record a video as other students participate in an inter-school athletics competition, in Baigai, northern Cameroon, Tuesday 31 October 2017.

The Regional Scene

Our discussion of issues for UNICEF ESARO and WCARO to consider in the development of a position on ICT for learning calls on a global evidence and experience base. Before moving to conclusions, it is important to dwell a little longer and to take a more detailed look at some of the unique challenges and opportunities that exist in the region. To understand and locate our analysis as accurately as possible we have:

- Completed a scan of the donor/funder landscape, as defined by a variety of interviews and attendance at a select group of global education forums with key donors and investors in the sector;
- Collected data (from surveys) and insights (from site visits and interviews) from UNICEF country offices across ESAR and WCAR; and
- Conducted interviews with providers and intermediaries.

This section summarizes learning from each of these three enquiries.

THE DONOR/FUNDER LANDSCAPE

Bilateral and multilateral agencies are prioritising more thought leadership and innovation in promoting the use of technology in and through education; developing new opportunities for investing in research and product development. The United Kingdom's Department for International Development (DFID) has proposed to invest £19.9 million over 8 years in forming a global 'what works' evidence hub to answer key research questions such as: What works to spread and scale ICT for learning interventions to deliver better learning outcomes for the poorest children in developing countries? Which ICT for learning interventions present the greatest value for money? What is critical here, is that these solutions are yet to be rigorously connected to improving learning outcomes. Meanwhile, in December 2017 the Global Partnership for Education confirmed a new funding channel called KIX (Knowledge and Innovation Exchange) globally, to provide seed funding in part for promising innovations to leverage ICT for learning at scale in the developing world, and particularly for classrooms and schools in some of the lowest-resourced countries. This provides a new opportunity for co-financing ICT for learning, driven by government priorities and supported by more nimble funding actors such as those from the private sector and education philanthropy community.

The Canadian government's new Feminist International Assistance Policy (FIAP) will prioritise and incentivise more attention to developing and scaling more gender responsive and gender transformative uses of technology for equitable learning. Global Affairs Canada has convened a new Innovation in Gender Equality working group that includes Gates, USAID, Australia Aid, DFID, and others that is meant to identify ways that women and young girls are benefiting from opportunities to learn through technology. According to the UN's SDG ICT Playbook[63], up to 25% fewer women than men have access to the internet, globally; GAC along with others will reshape the landscape of bilateral and multilateral investments in ICT for learning to be more gender-sensitive, gender-responsive, and gender-transformative moving forward.

The International Education Funders Group (a network of over 100 private foundations investing in education in the global south) have seemed to prioritise a number of shared clusters of ICT for learning investments (confirmed by NAVITAS 2017's Global EdTech Landscape 4.0 report). These include technologies for: learning assessments; gig economies; teacher and school leadership professional learning and development opportunities; curriculum development and lesson planning; and improved educational content. However, in a recent article from EdSurge, the trend for the future of technology companies will be providing supplemental *methodologies* of how to bring often strictly regulated curriculum content to life within and beyond classroom learning environments.

Interestingly, for learning assessments, a number of private foundations are seeking to not only invest in education management information systems, but in new *constructs* and methods of *how* to measure quality learning, including social-emotional learning, leadership, and pluralism. Teach for All's Global Learning Lab seems to positioning itself and other partners around developing new technology platforms to support a new global educational ecosystem that generates public goods (i.e. blended learning courses, teacher-led education communities of practice, etc.) to support the future direction of education professional development schemes and opportunities.

The two areas where most foundations are seen investing in ICT for learning include enabling teachers with complementary tools for improving lesson planning and content delivery. Some examples of the companies receiving support from both private foundations and venture capital include (but are not limited to): Mystery Science (offers online K-5 science lessons that can be delivered by generalist teachers) and BookNook (offers tools to facilitate in-person early childhood reading instruction). ProFuturo, supported by La Caixa Foundation and Telefonica Foundation, aims to reach 50 million learners by 2030 through a new suite of blended learning opportunities through a suitcase full of offline networked tablets and content developed to improve learners' knowledge, skills, attitudes and values to become contributing members to a pluralist society.

The largest offering of funding for ICT for learning still includes content provision for improving maths, science, and literacy lessons. Some highlighted investments include: adaptive math software such as Dreambox, KnowRe, Carnegie Learning, Mathspace, and Imagine Learning[64]. Tinybop develops science education apps for children while Labster offers browser-based virtual labs[65]. Games such as Kerbal Space Programme are built around realistic physics situations[66]. Newsela adapts news stories and nonfiction articles to multiple reading levels, and then combines these with exercises such as quizzes and writing prompts. Services like 'Epic!', Speakaboos, and FarFaria also offer access to a library of digital children's books on a subscription basis[67]. Within Kenya alone, ENEZA Education[68] offers more than 3 million African children with access to increased learning content via their mobile phones (SMS or via smart apps).

Technology Infrastructure, hardware and maintenance remain the most common reasons why donors remain hesitant of investing in large projects related solely to ICT for learning within the Sub-Saharan African context. Rarely are we seeing traditional or new donors provide significant investments in the much needed digital infrastructure needed to run ICT for learning solutions at scale. Facebook, Google, and Microsoft Philanthropies are of course providing new innovations in generating access to the Internet and power; but the fact is that 3.6 billion people still have no or partial access to electricity, and this figure does not reflect broader deficiencies in affordability, reliability and quality of service.[69] Connectivity also remains a significant issue; while many strides have been made in making technology resources more visual, video-based and interactive, questions of data affordability and internet download speeds still prevent a number of investments that are gaining momentum in West to be similarly supported within Sub-Saharan African contexts. More than half of the world's population, including the vast majority of individuals in the least developed countries, do not have Internet access; a crucial issue needed to be addressed as soon as possible to be able to fully realize

(63) UN Foundation (2015) SDG ICT Playbook: from innovation to impact.

(64) For more, *http://www.dreambox.com/ ; http://knowre.com/ ; https://www.carnegielearning.com/ ; https://mathspace.co/us ; http://www.imaginelearning.com/programs/math*

(65) For more, *http://tinybop.com/ ; https://www.labster.com/*

(66) *https://kerbalspaceprogram.com/makinghistoryexpansion-eu.php*

(67) For more, *https://newsela.com/ ; https://www.getepic.com/ ; http://www.speakaboo.io/ ; https://www.farfaria.com/*

(68) *http://enezaeducation.com/*

(69) UN Foundation (2015) SDG ICT Playbook: from innovation to impact.

ICT for learning's promising potential at scale.

Tech giants such as Salesforce, Microsoft or Google see investment in the development of ICT for learning as needing to either a) align with their business interests (as with Microsoft Philanthropies) and/or b) adopt a 1:1:1 to their giving patterns that reflect giving 1% of their capital, 1% of their talent and 1% of their product to charitable investments. In other words, rather than only cash, the 'big tech companies' are offering their time, talent, and products to support otherwise weak markets for innovation and uptake of meaningful technology for student learning, professional learning and education systems learning. LinkedIn, Twitter, and Facebook (or the Chan Zuckerberg Initiative) are crucial partners moving forward as they continue to develop their international giving and investment strategies.

Finally, we continue to learn from the crowdfunding age where investments in some of the most innovative, culturally relevant, and sustainable ventures in education technology in the developing world have been funded by crowdfunding platforms such as DonorsChoose, SchoolsPlus, AdoptAClassroom, and GlobalGiving[70]. There is growing demand for developing more localized versions of giving platforms to not have to depend on large international transaction costs; for example in Kenya, the Aga Khan Foundation and USAID have supported the Yetu Initiative[71] – a local philanthropy giving platform for Kenyan donors. Other initiatives hold promise if more engagement and collaboration between local civil society, edtech entrepreneurs, and locally financed solutions can be strengthened moving forward.

PROVIDERS AND INTERMEDIARIES

Technology providers come in different shapes and sizes. There are well-established vendors who have long-standing legacies across the Global North and South, such as Microsoft and more recently Google and Salesforce. They tend to be global behemoths who have the brand recognition to permeate down into local and regional contexts. But there are also increasingly animated and thriving 'start-up' ecosystems that exist much more locally and are more likely to include native education entrepreneurs. These two contrasting groups each come with different challenges and require different considerations.

For established global providers, UNICEF is seen as a route to scale in a number of emerging and largely untapped markets. Yet even with the discounts that come with working at scale, and subsidies offered through CSR initiatives, the unit costs remain high for low/middle income countries (although many economies still see it as a critical investment).

• • • •

"What's cheap in Silicon Valley, or Europe, is incredibly expensive in relative terms in [UNICEF] programme countries."

Juan-Pablo Giraldo, Global Education Team, UNICEF.

The solution most often put forward to this is to turn to local vendors who tend to have lower associated costs. While this solves the pricing issue, it opens up another set of challenges. Most ICT for learning ecosystems in low/middle income countries are still emergent, saturated by small start-up providers who are revenue-sensitive, with shallow reserves. There is a disconnect between what these companies need to survive (i.e. quick and easy revenue streams) and the realities of slow-moving bureaucracies. Ministries of Education are rarely equipped with the confidence, knowledge and skills to comprehend and leverage the potential of technological solutions quickly, while the tech-industry, in particular start-ups, underestimate the time it takes for procurement for example, or gathering sufficient consent and buy-in across ministry teams and other government agencies. For this reason, start-ups such as Eneza Education (see Appendix II) have a higher propensity for exploring opportunities to go straight to the consumer (learner) and the customer (often parents). They opt to bypass school systems to avoid getting bogged down in what they perceive to be red tape. Instead, they pursue funding through impact investors and foundations. As users increase, funding increases.

These frictions between public education systems and technology providers is further muddied by the reality that on the one hand, Ministries of Education have a duty of care as well as a responsibility for the effective use of public funds, and on the other providers are perceived to be more market-driven. Often, providers approach ministries and intermediaries such as UNICEF as a route to market, with the impact on children's lives a secondary objective.

There is a growing perspective that a number of technology providers are acting more like venture-capitalists than humanitarians, subsequently breeding suspicion and confusion around which interests are in play and therefore how to make good decisions about partnerships and investments. It has also caused problems for those who are genuinely mission-driven, social entrepreneurs, balancing their modest commercial ventures with solving problems and having positive impact. eKitabu[72] has sought to overcome the suspicion that they as a commercial venture have met by embarking on a public/private partnership with their sister NGO and the Kenyan Ministry of Education.

An alternative to these frictions has been to rely on quasi-autonomous non-government organisations (QUANGOS), such as Kenya's Institute for Curriculum Development to act beyond the full constraints of the public sector to build more effective partnerships with providers.

We know that if ICT for learning is to realize its potential, it needs time, commitment, acceptance of failure, and the space for iteration and improvement. The challenge is to best support public/private interactions that allow for these enabling conditions, while satisfying the competing priorities of different stakeholders.

UNICEF COUNTRY OFFICES

Firstly, each country across WCAR and ESAR is distinctly different in its context, but also in the level of understanding of the potential and challenges of ICT for learning. For instance, Uganda and Namibia UNICEF teams are increasingly capable and ambitious in their use of technology to improve teaching and learning, while some countries such as South Sudan and Sierra Leone are limited by fundamental security and conflict issues. The purpose of ICT for learning and which problems it might seek to solve therefore varies greatly, as does the levels of sophistication. Seemingly, the significance of ICT for learning is mixed and countries have wavering levels of understanding about how to do it well.

Most country offices have a desire to understand the skills, training and expertise teachers need to use ICT for learning, and create powerful learning environments that are enhanced by it. While many of the educational challenges faced relate to teachers: teacher absenteeism (South Africa); high student-teacher ratios (Central African Republic); other agricultural and familial commitments (Rwanda), poor mastery of the content they are required to teach (Kenya); there has been no desire to replace teachers with technology. Rather, they seek to explore a) what role technology can play in better preparing teachers, and b) how they can support teachers to integrating technology into their pedagogies and practice.

For the majority of UNICEF country offices, the lack of technological infrastructure is a fundamental challenge. Access to new digital tools and content via the internet are critical elements that make technology attractive to the education systems UNICEF country office representatives are working with. Yet, poor electricity and connectivity are fundamental barriers. Many country offices (Uganda, Namibia, Central African Republic) are therefore pursuing offline solutions and working from the lowest common denominator. This is seen to be critical in fulfilling UNICEF's commitment to equity in education.

(70) For more, *https://www.donorschoose.org/ ; https://www.adoptaclassroom.org/ ; https://www.globalgiving.org/*

(71) For more, *http://yetu.org/*

(72) *http://unicefstories.org/2017/07/11/ekitabu/*

Insufficient financial resources and high Total Cost of Ownership (TCO) are common hindrances to the sustained use of a ICT for learning. The majority of country office representatives stressed the need for software to be free and open-source to encourage continued use and avoid hidden costs (licensing, subscription) which are usually applied following a pilot scheme. South Africa's country office recommend using supply chain management processes to ensure more transparency of costs following its evaluation of Ukufunda, which demonstrated that the intervention was not cost-effective. Sustainability of initiatives is both the priority and the critical challenge for ICT for learning initiatives.

A number of UNICEF country offices reported that they are planning to, or have aspirations to, pursue ICT for learning initiatives in the coming years. They simultaneously report that Ministries of Education have yet to set out a coherent policy platform to support ICT for learning. If Ministries of Education are not fully engaged, the sustainability of initiatives becomes an issue, especially when reliant on short-term philanthropic funding.

In Kenya, UNICEF has been embedded within the Ministry of Education for four years, working with them on their guiding principle of engagement: digital learning, which sits at the heart of their new competency-based curriculum. In contrast, the Ghanaian government has taken more of a catalytic role, providing only guidance and authorisation to partners who wish to instigate initiatives beyond that of data collection (see Ghana's Mobile School Report Card in Appendix III). Without a coherent and committed political agenda, priorities remain elsewhere and efforts to leverage technology for teaching and learning remain fragmented.

Lastly, interviewees recognised specific and often significant skills gaps in their own country offices that limited their ability to confidently and effectively explore the potential of ICT for learning. Some countries that were interviewed (South Africa, Rwanda) holistically evaluated their unique programme contexts to get a sense of the skills required to better run the programme. South Africa identified a gap in needing experts who understood technology and at the same time understood how technology could be applied in an educational setting. Without this skill set, the technology provider drove the change rather than the education system. This led to a series of negative consequences for the Ukufunda programme, including cost implications and misalignment to the context in which they were working. Similarly in Rwanda, there was a frustration at the lack of expertise and in-house knowledge around how best to integrate technology into practice, but also how to navigate business negotiations and contractual agreements with technology providers, considering the tendency for hidden costs and license fees to undermine sustainable and long-term provision.

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Chapter 3:

Next steps for UNICEF to consider

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High school students using technology in class, in the town of Odienné in the North West of Côte d'Ivoire.

With an immature evidence base about the impact of ICT on learning outcomes and a loose global community of entrepreneurs, philanthropists, educators and policy makers still learning in real time about what works (and what does not), to say 'the jury is still out' on ICT for learning would be a gross understatement and the move to recommendations, traditional at this point in a paper like this, therefore ill-advised.

However, we do see a further learning and consultation agenda emerging from the challenges and opportunities we have explored through our various enquiries and the insights and guidance offered from our generous respondents and advisers.

We see three urgent priorities for UNICEF to consider:

- **Building the knowledge and confidence of ICT for learning across the region; and**
- **Enabling strategic and practical action;**
- **Coordination, coherence and integration.**

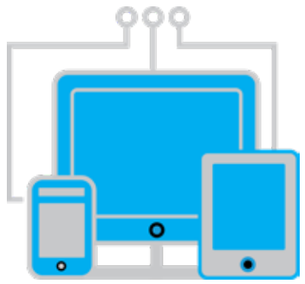
Building the knowledge and confidence of ICT for learning across the region

UNICEF should consider how best to engage country office teams in what we know about the opportunities and challenges of ICT for learning, as well as engage them in ways of contributing to a stronger evidence base, locally and globally. Many Chiefs of Education and other senior representatives have resisted venturing into this space because they lack the confidence and expertise to do so effectively, as well as the time and necessary safety net to take measured risks. It requires more flexibility and openness to different ways of designing and delivering programmes of work.

As a foundation, UNICEF country offices should be well-equipped to offer a neutral and objective voice of reason to governments, providing them with a sounding board for ideas about what role technology might play in their national education agendas, specifically how it can bridge existing inequities, be them between rich and poor, urban and rural, or girls and boys. That means providing informed advice grounded in the broad knowledge base (explored in this paper) and their understanding of the local context.

To ensure this foundational knowledge exists, UNICEF should consider different strategies and mechanisms for sharing and making familiar what is known about the opportunities and challenges of ICT for learning. While this paper offers one such vehicle, UNICEF should consider more innovative and pedagogically grounded approaches. These might include:

1 **The mobilizing of existing regional communities of practice around ICT for learning** - for instance, cluster supporting ICT in education component of the Continental Education Strategy for Africa (CESA 16-25) lead by GESCI , ADEA ICQN on teaching and learning - by connecting UNICEF country teams with regional counterparts (e.g. other country office teams or regional experts), cohorts can collectively engage in active peer-to-peer social learning and action-research, providing opportunities to critically engage in, and contribute to, the knowledge base from a breadth of perspectives.



2 **The development and rolling out of a Massive Open Online Course (MOOC) and cascading model of Continuous Professional Development (CPD) focused on ICT for learning -** enrolling a number of lead staff from UNICEF country and regional offices in a rigorously designed online curriculum which covers the broad ICT for learning knowledge base and broader Technology for Development (T4D) principles. UNICEF's Global Hub for Learning Development, AGORA,[76] would be a natural home for such a course. Representatives will establish working groups that include relevant departments outside of education, to engage them in the curricula to share and make familiar the ICT for learning knowledge base. An additional benefit of administering Continuous Professional Development in this way is the opportunity to demonstrate the potential of ICT for learning across country offices, and model best practice.

(73) *http://gesci.org/*

(74) *http://www.adeanet.org/en/icqn/teaching-and-learning*

(75) *https://www.edu-au.org/cesa/launched-clusters*

(76) *https://agora.unicef.org/*

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Enabling strategic and practical action

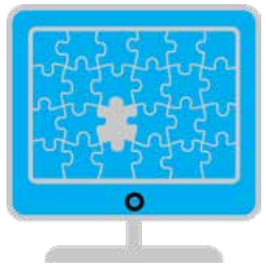
To mobilise a real sense of practical possibilities within the ICT for learning landscape, UNICEF should consider how best to move from knowledge to action. As an influential international agency, UNICEF is in a position to inject a growing understanding of the opportunities and challenges of ICT for learning into existing global, regional and national education work streams.

1 Integrate ICT for learning into existing teacher training and school improvement practices - ICT for learning can reinforce, augment and align broader efforts to impact on key learning outcomes.

2 Share and make familiar the ICT for learning knowledge base through the creation and dissemination of resources - handbooks, toolkits and best-practice guidelines can open the door for UNICEF country office teams to feel confident in exploring the potential of ICT for learning and build local capacity to realise its potential across ministerial teams.

3 Develop a set of rigorously designed tools for system strengthening that enable ICT for learning ecosystems to thrive - change management tools, such as roadmaps, capture what is known about ICT for learning and provide UNICEF, governments and other stakeholders with the ability to practically shape flexible and bespoke strategies.

Coordination, coherence and integration



UNICEF should consider building active partnerships committed to ICT for learning within the agency and beyond. The level of noise surrounding the efficacy of ICT for learning is rife, not to mention the complexity that underpins the opportunities and challenges that of blending technology with teaching and learning. UNICEF should actively coordinate their efforts towards offering more clarity and coherence within the ICT for learning landscape. This might include:

1. **Greater coordination between UNICEF headquarters, regional offices and country offices to build on existing global and local ICT for learning research**

a. feeding in ongoing experiences of what is needed on the ground to do ICT for learning well in diverse and challenging contexts;
b. exploring the role of co-design and community-based research to better contextualize research bases and empower educators to be designers and innovators; and
c. developing new forms of research and monitoring and evaluation techniques that allow for more seamless integration of research into agile programme design and decision-making processes (such as Rapid-Cycle Evaluation Processes[77] and Structured Experiential Learning[78]).

2. **Leverage UNICEF's brand and global stature to influence existing local and global agendas, and advocate for clear and coherent approaches to ICT for learning**

a. appealing to and aligning with the education agendas of key stakeholders, such as DfID's Innovation Fund, the International Education Funders Group (IEFG), and technology companies and philanthropies such as Google Inc., Zuckerberg Chan Initiative, the Bill and Melinda Gates Foundation, Microsoft Foundation, Salesforce Foundation and XPrize, which are all likely to influence technology markets and education sectors over the coming decade;
b. promoting and encouraging governments to be more vocal about the role technology should play in their education systems, and to balance the powers of technology providers; and
c. exploring the potential economic benefit of ICT for learning and what role cross-ministerial collaboration can play going forward.

3. **Mobilize UNICEF's global operations to actively shape technology markets and steward a clear and coherent direction of travel for global and local providers**

a. supporting governments to pursue effective integration and interoperability of ICT for learning, ensuring the efficient and sustainable use of high-stakes public investment;
b. leveraging UNICEF's Supply Division to explore new market pathways for ICT for learning to reach learners and impact on learning outcomes; and
c. considering how to close the relational gap between governments and the private sector to build effective Public/Private Partnerships that share risks and rewards in pursuit of better teaching and learning.

4. **Localize the ICT for learning debate to better ground discussions and decision making in the problems of specific, local circumstances**

a. championing local solutions to local problems, in turn mobilizing local creative deviants – those who are challenging local convention – that are open-source, non-profit and aligned to UNICEF's values;
b. connecting UNICEF's local expertise to stakeholders in pursuit of ICT for learning initiatives in the region; and
c. stimulating demand by leveraging local connections to help inform parents' expectations about what a technology-enhanced school can and should look like.

(77) Escueta, M. et al (2017) Education Technology: an evidence-based review. NBER Working Paper Series. Working Paper 23744 *http://www.nber.org/papers/w23744*

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Raising Learning Outcomes:
the opportunities and challenges of ICT for learning

Innovation Unit
New solutions for thriving societies

AGA KHAN FOUNDATION

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Raising Learning Outcomes:
the opportunities and challenges of ICT for learning

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Appendix 1

Lessons from system stories - Singapore, New Zealand and Brazil

Innovation Unit
New solutions for thriving societies

AGA KHAN FOUNDATION

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Lessons from system stories - Singapore, New Zealand and Brazil

The systems we have chosen are intentionally diverse in almost every way imaginable: their geographies, economies, cultures and histories are utterly different from one another, aiming to draw lessons from a breadth of different contexts – Singapore, New Zealand and Brazil.

Singapore is small in size with 366 schools. In New Zealand, schools are significantly decentralised and autonomous, organised into networks across a geographically wide area. Interestingly while New Zealand has 60% more students than Singapore it has nearly seven times as many schools, serving suburban and rural communities, contrasting with the City State of Singapore. Brazil has significant geographical, political and cultural diversity. Whereas coherent policy making and administration are possible in New Zealand and Singapore, Brazil presents a more complex challenge to designing and implementing education strategy, comprising as it does multiple and diverse jurisdictions.

What these three countries share with one another is a strong belief in the value of education for the prosperity of their young people and their countries, which translates into both political attention to and financial investment in education in general and, recently, ICT for learning in particular.

Brazil and New Zealand are two of the top three spenders on education in the OECD each investing around 13% of their total public spending budget in education, 60% more than the 8% OECD average. Singapore will, in 2017, spend $12.9 billion on education, the second largest ministry budget, topped only by defence at $14.2 billion.

Singapore, New Zealand and Brazil are also systems which out-perform others like them. Singapore is a very high-performing system that has outpaced all other systems in its improvement. In 2015, Singapore became the top-performing education system in the Program of International Student Assessment (PISA), operated by the OECD. 15 year olds in Singapore score the highest on average in Literacy, Maths and Science, in assessment designed to test application of knowledge and skills. Its 2012-2015 score improvements in Science and Reading were amongst the highest of all above-average countries; in Maths, it was one of few countries that did not have a decline.

In the same year, Singapore's 10 and 14 year olds scored highest in the Trends in International Mathematics and Science Study (TIMSS), which assesses more curriculum-based knowledge and skills. In 2015, scores in Singapore where the highest for over a decade. Despite an already high starting point, the average maths score for 10 and 14 year olds has continuously improved since 2003. As such Singapore kept pace with and then finally exceeded comparable improvements in other East Asian countries.

New Zealand is a system that performs above average in the OECD. While, like most high-income countries, it has seen a small decline in average scores, the decline has not been so substantial, and from 2012 to 2015 New Zealand improved its relative standing. It has also managed to decrease the influence of social background on student performance in PISA. Beyond foundational skills, New Zealand has positioned itself well to prepare its young people for the future. In 2017, the Worldwide Educating for the Future Index, developed by the Economist Intelligence Unit, ranked New Zealand top amongst 35 high-income countries. The index is made up of 16 indicators, which cover a range of aspects of policy and teaching to offer a judgment of how well students are being prepared for the future.

Brazil, meanwhile, has made considerable improvement from a lower starting point. From 2003 to 2012, it has the highest improvement in Mathematics of all countries. During this period, Brazil was also supporting many more young people to stay at school who otherwise would drop out into the unrecorded cohort, making its sustained improvement all the more remarkable.[6] From 2012 to 2015, it continued to make progress and saw improvement in both Maths and Science scores.

Investment in education is, in each of our three focus systems, a direct consequence of political agendas that place education at the heart of a nation-building narrative. From post-independence prosperity in Singapore, to democratic and economic participation in Brazil, and equity and reconciliation with indigenous communities in New Zealand, education has featured in each system as a dynamic force for societal change supported by coherent government policies and consistent investment.

As we have noticed, being clear about the purpose and specific contribution that ICT for learning can make is fundamental to both understanding and realising its potential. These histories and conditions are therefore important to note as a first step to understanding the ICT for learning journeys so far of Singapore, New Zealand and Brazil.

The following takes a closer look at each system and the role that ICT for learning is playing in the latest instalments in these fascinating stories.

(1) OECD (2017), Public spending on education (indicator). doi: 10.1787/f99b45d0-en

(2) http://www.singaporebudget.gov.sg/data/budget_2017/download/05%20Government%20Expenditure%202017.pdf

(3) OECD (2016) PISA: Results in Focus. https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

(4) PISA 2015: New Zealand Summary Report. Education Counts. https://www.educationcounts.govt.nz/publications/series/PISA/pisa-2015/pisa-2015-summary-report

(5) The Worldwide Education for the Future Index. Economist Intelligence Unit. http://educatingforthefuture.economist.com/

(6) OECD Country note – Results from PISA 2012: Brazil. https://www.oecd.org/brazil/PISA-2012-results-brazil.pdf See also: "Pisa tests: Turks and Brazilians have shown most progress." Financial Times, December 4 2013. https://www.ft.com/content/61d56292-919d-36c8-8514-6fe1076b2c0f

Singapore

Currently on their fourth Technology Master plan (2015 onwards)[7] the Singapore government has pursued a systematic and systemic approach to the introduction of ICT for learning into schools and continuing support for its effective adoption and deployment for teaching and learning.

Master plans 1-3 focused on:[8]

Master plan 1(1997 – 2002 $2bn) 'Building the foundation for technology' aims were to:

- provide all schools with the basic infrastructure to support technology
- provide training of teachers to use technology (by sending team of trainers to each school)
- target to have ICT-enabled lessons for 30% of curriculum time
- create a change in mindset of teachers to embrace ICT as a tool for teaching and learning
- introduce telecommunications tools to enable students to collaborate with people elsewhere to resolve problems.

Master plan 2(2003 – 2008 $600m) 'Seeding innovation in schools' aims were to:

- introduce baseline ICT Standards for students to achieve at certain milestones
- develop alternative pedagogies (inquiry-based learning and problem-based learning and usage of virtual worlds and blogs, wikis, podcasts, e-portfolios, animations and video production, as well as mobile learning)
- stimulate innovative use of ICT in schools in daily learning (recognition as LEAD ICT@ Schools or FutureSchools@Singapore)
- have schools produce digital content and expand the resource base for others to share (i.e. West Zone Sharing of Resources Project, WeSHARE && Inter-cluster Sharing of Resources project, iSHARE).

Master plan 3(2009 - 2014) 'Strengthening and scaling technology' aims were to:

- strengthen competencies for self-directed learning
- tailor learning experiences according to the way that each student learns best
- encourage students to go deeper and advance their learning
- enable students to learn anywhere.

Master plan 4 offers a vision for future ready and responsible digital learners, where quality learning is in the hands of every learner, empowered with technology. In this vision teachers are designers of learning experiences and environments and school leaders are culture builders.

The aims of master plan 4 are to:

1 bring ICT into the core of the education process (from planning and design of lessons to testing)
2 focus on improving the capabilities and skill sets of teachers (ICT-savvy must also be able to translate into effective teaching)
3 improve the sharing of best practices and successful innovations
4 further build up infrastructure (in phases according to readiness of schools and teachers).

(7) https://ictconnection.moe.edu.sg/masterplan-4/our-ict-journey

(8) https://wiki.nus.edu.sg/display/SPORE/3.+Compare+Three+Masterplans+in+Education

From a teacher and school leader perspective there are currently three opportunities to engage with Master plan 4

- The Future Schools Project - A set of test bed schools, seen as 'trailblazers', selected for their use of ICT for learning as suitable sites for ICT projects which develop ICT for learning innovations that can be adopted by other schools.
- eduLab 2017 - schools who are tasked with developing ICT innovations so that they can be adopted by schools across the system.
- ExCEL Fest - an annual event attracting over 13,000 people each year, which features exciting and innovative practices in schools. It is also where parents and members of the public can find out about the latest education technology developments in school.

Taken together these three represent a coherent strategy for scaling innovation in the use of ICT for learning in Singaporean schools:[9]

- Future schools are the incubators for new tech and new pedagogy
- EduLab schools are the early adopters where new tech and new pedagogy are adapted for widespread use in a variety of contexts
- And ExCel Fest is the big awareness and interest raising event which feeds the pipeline of new ideas on the one hand (supply) and new adopters on the other (demand).

New Zealand

New Zealand has long been a top performer in international league tables in relation to student performance. However, the gap between the highest and lowest performing students in New Zealand is wider than in any of the other high performing countries. Students from Maori and Pasifika communities are at a particular disadvantage.

The New Zealand government sees another gap opening up in employment opportunities in science and technology. Demand for digital skills is on the increase and New Zealand's schools need to be preparing all young people to meet that demand.

The solution to meeting these twin challenges in New Zealand has been a coherent and concerted national focus on STEM subjects (science, technology, engineering and mathematics) in schools, with an emphasis on generating demand through engagement and inspiration as well as ensuring supply and quality. Funding and other incentives have been targeted to schools in disadvantaged areas, termed low decile in the New Zealand system.

Four strategic systemic interventions have been introduced to drive up student engagement and performance in STEM subjects. They are:

1. A public campaign to grow public awareness of and demand for STEM education

A Nation of Curious Minds[10] is a collaboration between the Ministry of Business, Innovation and Enterprise and the Ministry of Education. Curious Minds is a ten-year campaign to support all New Zealanders to engage with science and technology. Targeting young people and, in particular, young people not currently engaging and science and technology, Curious Minds aims to create:

- more science and technology-competent learners, and more choosing science, technology, engineering and mathematics (STEM)-related career pathways;
- a more scientifically and technologically engaged public and a more publicly engaged science sector;
- a more skilled workforce and more responsive science and technology.

Curious Minds reaches out beyond schools and into communities, connecting young people with scientists and technologists to grow demand for engagement with science and technology. Nevertheless many of the 101 projects are led by or include schools.

The campaign also includes a review of the positioning and content of digital technologies within the NZ national curriculum and Te Marautanga o Aotearoa (the national curriculum for Māori-medium).[11]

2. Significant, sustained and systematic investment in infrastructure

Over $700 million (NZD) has so far been spent to provide high speed broadband for New Zealand's schools. N4L (Network for Learning) is a national provider for schools, partnering with government to provide high-speed connectivity to a quality assured network, enhanced by a platform for school-to-school collaboration and access to curriculum resources and administrative support. Training for teachers and co-design of new products are the final parts of this picture. Current policies are now building on this infrastructure. The Ministry of Education has worked with school leaders to develop a Digital Technologies curriculum. This will sit within the national curriculum and include a focus on computational thinking and digital design. A draft has been released and the Ministry of Education has committed NZ$40million to invest in developing teachers' capacity to teach the curriculum.

To ensure that assessment matches curriculum, the New Zealand Qualifications Authority (NZQA) is implementing a digital strategy such that by 2019, external assessments for the National Certificate of Educational Achievement will take place online. This is seen as the first step in transitioning to more adaptive or more complex computer-based assessment.

3. Enhancements to teacher education, initial and continuing, to increase the quality and supply of STEM teaching

(i) Initial Teacher Education

Teach First[12] is a leadership programme designed to attract high achieving graduates into teaching as a first or early career move. In New Zealand, to harmonise with the focus on STEM, candidates are recruited with science and technology degrees and deployed to teaching STEM subjects in schools in the most disadvantaged communities across New Zealand. Of the 5000 students taught by Teach First teachers, 4200 are Maori or Pasifika. The evaluation of the programme's pilot phase (2013-16) concluded that the programme was successfully implemented and the majority of principals and coordinators reported their Teach First participant had a positive impact on teaching and learning in their school[13]. The Ministry of Education is supporting its further expansion.

The barrier to entry is high with only 7% of applicant's being accepted on to the programme. Since 2013, 74 candidates have qualified through Teach First. Half of Teach First New Zealand science and technology graduates say they would not otherwise have considered teaching as a career.[14]

• • • •

"One of the things that became clearer to us this year is the extent to which participants are being prepared as 21st century future-focussed teachers: they are confident about opening up their classrooms and their practice to ongoing scrutiny... they are fluent users of digital technology in teaching and learning..."

NZCER Evaluation of Teach First[15]

In 2017, Teach First NZ worked with Mind Lab in Auckland to develop a new teaching qualification to codify what it has been learning about preparing technologically savvy and future-oriented teachers.

(ii) Continuing Teacher Education

The Manaiakalani Digital Teaching Academy (MDTA) is a partnership between the University of Auckland, Google and Manaiakalani Education Trust[16]. Manaiakalani is a cluster of 12 schools in the poorest part of south Auckland. The Manaiakalani Trust was set up in 2011 to use digital technology to bridge and enrich learning in school and at home.

Piloted in 2013-2016 and now in its first full year, MDTA brings together newly qualified and experienced teachers as mentors to accelerate the skills development of the beginning teachers so that they can 'keep up' with the students in the Manaiakalani schools. Both groups of teachers are studying on Masters Programmes.

The programme grew out of a frustration that initial teacher education was not producing teachers with the necessary digital know-how or the pedagogical skills to make the most of

(9) http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/ED/images/singapore.pdf

(10) http://www.curiousminds.nz

(11) https://nz.educationhq.com/news/33914/so-why-the-stem-push/

(12) https://teachfirstnz.org

(13) https://www.educationcounts.govt.nz/__data/assets/pdf_file/0017/181610/Final-Evaluation-Report-Teach-First-NZ-programme-pilot.pdf

(14) teachfirstnz.org/images/uploads/Documents/TFNZ_Impact_Infographic_FINAL.pdf

(15) https://teachfirstnz.org/stories/fourth-nzcer-independent-evaluation-report-released

(16) http://www.manaiakalani.org/home

technology for the benefit of student learning. Through the financial support of the Manaiakalani Education Trust, all students at cluster schools have access to a 1:1 digital device. The MDTA then coaches teachers in digital pedagogy to make best use of these tools. All teachers progressed successfully through the pilot to 2016 and the digital pedagogy, mentoring and induction practices are now being developed across the network.

During the final full year of the project (2015), children in 7 out of 10 cluster schools have made above expected progress in writing against national standards, and over or expected progress in reading and maths.[17]

4. Communities of learning to encourage the spread of ideas and to foster innovation

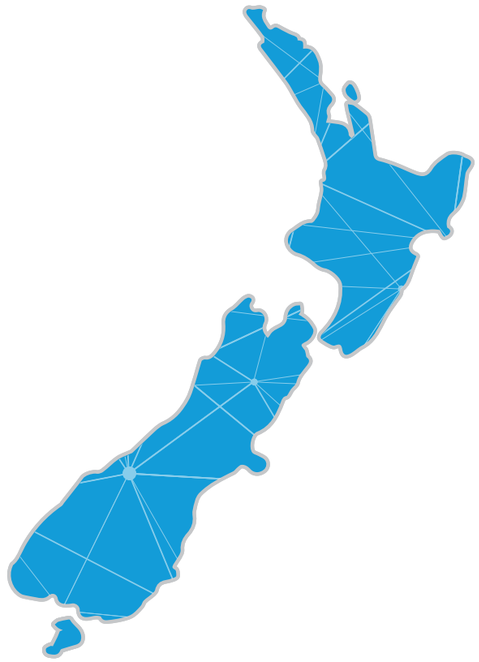
A Community of Learning is a group of education and training providers working together to help learners achieve their full potential. A community can include early childhood education services, schools, kura (Maori medium schools) and tertiary providers. Each Community of Learning shares goals, or achievement challenges based on the particular needs of its learners. Since 2015, 69 Communities have been approved and funded by the NZ Ministry of Education.[18]

This formal Ministry sponsored arrangement is new, but networking in New Zealand is a tried and tested approach to fostering and adopting innovation in schools.

Learning and Change Networks (LCN) were collaborations between schools, and their communities; partnerships designed to identify local challenges and make changes to improve student learning. In July 2014, there were 53 networks, comprised of 286 schools and kura, about 11% of the schools in New Zealand.[19]

The 'daughter' of Learning and Change Networks, Communities of Learning are not directed to or required to focus exclusively on STEM; although naturally some of them do, that is not their function. The Communities are a 'layer' in the New Zealand education system, connecting schools in self-identified communities of practice to develop and share new ideas and practice. They are part of the solution to scaling and diffusing innovation, and make it more likely that new approaches, including in the teaching of science and technology will be adopted.

NEW ZEALAND



(17) Manaiakalani Education Trust Evaluation of the 2015 school year. available at http://www.manaiakalani.org/our-story/research-evaluation

(18) https://education.govt.nz/ministry-of-education/col/

(19) OECD (2013), "The case study sites", in Innovative Learning Environments, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264203488-11-en

Brazil

Brazil is an enormous country measuring 8.5 million km^2 , comprising 27 states in 5 regions and inhabited by over 200 million people. There are 195,000 schools in Brazil serving 51.5 million students.[20]

In such a huge and diverse country, with federal, state and city administrations, it comes as no surprise to learn that there is no single education strategy in Brazil, but instead a complex landscape in which government, private sector edupreneurs and philanthropists are prosecuting different agendas, occasionally in collaboration, more often independently.

Approaches range between huge investment in technology and a commitment to 21st Century skills, to a relentless focus on 'the basics' of numeracy and literacy.

If there is any agreement at all, it is that Brazil must look to the future for ways to educate their young people and not to the past. Brazil hopes to avoid the 'mistakes' as they see them, of other developing nations who have adopted US or European style systems.

Instead the Brazilian narrative of emancipation — freedom from the past, from political oppression and poverty, and freedom to grow into a confident, modern, democratic society – translates into a more radical approach, in which Brazil plans to move straight to a 21st Century education system, untrammelled by the infrastructure and orthodoxies of 19th and 20th Century schools and systems we see around the world. The Brazilians call this 'leap-frogging', and ICT for learning is at the heart of what makes it possible.

Learning without teachers

In the 1990s and early 2000s, Brazil experienced massive economic and population growth, which fuelled an explosion in demand for high quality education, in particular for secondary age students. In a country where most adults have only a primary education if that, the challenge of meeting this demand is significant.

With content designed by some of the best and brightest teachers in Brazil, Educopedia[21] is an online platform for collaborative digital lessons, where students and teachers can access self-explanatory activities through play and practice, anywhere, anytime.

This 24/7 access makes it possible for schools to operate a half-day, split shift changeover, doubling the number of students they can accommodate.

It also helps teachers to manage larger class sizes and enables parents to engage in home learning with their children in better served areas and dramatically improves the quality of home learning in those less well served.

Part of the motivation for developing Educopedia was to even out inequalities in access to high quality teaching by making it possible to compensate for poor teaching and, in the most extreme cases, remove the need for teachers all together.

GENTE – a school that isn't a school[22]

However, one of the more inspiring purposes to which Educopedia has been put is as curriculum content in GENTE - Gimnasio Experimental de Novas Tecnologias Educacionais, which translates as the Experimental School of New Educational Technologies.

Not enough teachers is only part of the demand challenge facing Brazil – there simply

(20) GELP Brazil country profile 2014

(21) http://www.educopedia.com.br/

(22) Caldwell B. & Spinks J (2014) The Self-transforming School Routledge

aren't enough schools either and, as we have seen, Brazil has rejected the idea that they should build schools to the existing template. GENTE, a new model of 21st century learning being developed in Rio de Janeiro to help prepare students for the challenges of the modern world, offers an alternative. The fullest realisation of the GENTE model, GENTE André Urani, was developed in 2013 and serves students from grade 7-9.

Despite being situated in one of Rio's more dangerous favelas, Rocinha, GENTE breaks down classroom walls, literally and figuratively, to rethink what a school, the physical environment and the learning that happens in it should look like. So much of what we might traditionally expect to see in a school is absent or radically different.

There are no classes or year groups and students learn in large groups in converted space that was never designed to be a school. Each student joins with a formative itinerary, highlighting their individual pathway; a kind of personalised digital map that lists the skills and competencies they already have as well as those that they need to develop.

Students work, individually and in groups, on tablets and smartphones – there are no notebooks or textbooks – to access curriculum and run through online games and diagnostics that guide them through different learning levels.

Teachers are the guardians of personalized learning for each student. They are mentors, guiding students on their learning journey and supporting them to collaborate in multidisciplinary projects.

This alternative relationship in which the student is genuinely at the centre of the learning experience, with the teacher as 'guide on the side' reflects the values that underpin the GENTE model; that students are authors of their own life stories and need every opportunity to grow a sense of agency and control over their learning.

GENTE's results are so far good, but it is still small, serving fewer than 300 of Rio's 700,000 children. Plans for training teachers in the GENTE model are advanced, to enable the opportunity to be made more widely available. Moreover, it has become a site for improving ICT for learning options that could then be used in other schools. Through a partnership with Geekie Labs, a Sao Paulo-based start-up, it is providing a site to develop a digital high school curriculum: as students at the school work their way through the curriculum materials, the software is "learning" (through algorithms) how to improve the sequencing and guidance.[23]

The digital capabilities of GENTE André Urani have proved valuable in other unexpected ways. During periods of increased violence in the Rocinha, the school decided it was unsafe for students to be on site, but continued to communicate with them via Facebook, providing online activities and assessments that students could work through from their devices at home.[24]

A learning marketplace

Elsewhere, other ICT for learning start-ups are introducing new products and services into this diverse and high potential market.[25]

EvoBooks[26] specializes in electronic publishing supplying schools with digital books that can be constantly updated and which include 3D images and games that bring curriculum to life in new and exciting ways. Evobooks resources cover maths, the sciences, history and geography and are available offline once downloaded – important in a country with vastly variable broadband access, speeds and reliability. The EvoBooks platform was trialled in the GENTE schools. In this evaluation, students who made greatest use of the platform had gains almost a third higher than the average

(23) "How software that learns as it teaches is upgrading Brazilian education" The Guardian. 10 January 2016 https://www.theguardian.com/technology/2016/jan/10/geekie-educational-software-brazil-machine-learning

(24) https://www.facebook.com/gente.andreurani/

(25) https://atelier.bnpparibas/en/smart-city/article/edtech-brazil-huge-market

(26) http://www.programainspira.com.br/

BRAZIL

after four months.[27] In a separate quasi-experimental study carried out with 8th grade students in Colombia, researchers found that using a "virtual laboratory" on the EvoBook platform was as effective as using a real laboratory in terms of students' understandings of chemistry concepts.

Descomplica (translates as de-complicate or simplify) pays high fees to charismatic teachers from the best independent schools to engage and inspire students in video lessons. In many other ways like Khan Academy, this investment in securing the best teachers to deliver the online lessons is unique. Some of the "classes" take place live, allowing students to interact with teachers.

There are upwards of 4000 lessons in eight subject areas available from the platform, as well as access to personal tutoring, for a subscription of around $35 per year. The platform is aimed at students preparing for the ENEM, Brazil's high-stakes university entrance exams. While it is essentially glorified test-prep, the platform allows those from state schools to access the kind of teaching and preparation usually only accessible to their private-school counterparts. Two thirds of all student subscribers come from low-income families. In 2016, students who used the platform improved their score by an average of 106 points from their previous try.

EvoBooks and Descomplica are just two of many examples, but they are especially interesting as their success can be attributed in part at least to the fact that they build on existing opportunities and trends in Brazil. EvoBooks, was designed to make better use of whiteboards and tablets that were being gifted to schools by Governments and NGOs alike, with no real strategy for how they could or should be used effectively. Previously unutilized or underutilized resources are now animated by engaging content and in the hands of learners.

And Descomplica harnesses Brazilian enthusiasm for YouTube and Instagram and other social media platforms, which are huge in people's day-to-day lives but virtually absent in education.

(27) http://evobooks.education/research.html

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New solutions for thriving societies

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Raising Learning Outcomes:
the opportunities and challenges of ICT for learning

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Appendix 2

Lessons from in-depth innovator and provider case studies

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Aga Khan Education Services

Bridge/SPARK - Use of ICT for learning in groups of low cost schools

OVERVIEW

Bridge is a group of low-cost schools serving more than 100,000 pupils in 520 nursery and primary schools across Kenya, Uganda, Nigeria, Liberia and India. Its ambition is to transform learning by developing lessons aligned to national curricula using a range of technologies. Bridge uses technology to address whole-school issues including teacher training, lesson delivery, and monitoring and evaluation. Its approach can be systematically applied and embedded across all Bridge schools because of its end-to-end model of school design and development: it controls the entire supply chain from school construction and curriculum design to teacher training and lesson delivery.

SPARK Schools is a network of eleven primary schools dedicated to delivering accessible, high-quality education, mainly in South African cities. SPARK is an acronym for the school's core values: Service, Persistence, Achievement, Responsibility and Kindness. SPARK schools use a 'Learning Lab' rotational blended learning programme, which combines traditional classroom instruction with adaptive software intended to accelerate learning and increase student achievement.

(1) https://www.nwea.org/map-growth/

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KEY FEATURES OF BRIDGE AND SPARK

- Bridge's highly standardized 'academy in a box' provides the training, processes, tools, materials and curriculum a community needs to open and run a low-cost quality school.
- Teacher tablets are a core component of the Bridge model. They are uploaded with daily lesson scripts and step-by-step instructions for teachers, regardless of experience.
- Bridge has writers in Nairobi who create lessons in Swahili, but many lessons are delivered in English.
- In the SPARK rotational model, students divide their time between using Chromebooks uploaded with digital content that adapts to the learner, and classroom interaction with a specialized subject teacher.
- In SPARK schools, staff members who facilitate online learning are called 'blended learning facilitators'. They work with specialized subject teachers to adapt their lesson plans. Specialized subject teachers are consulted to ensure a focus on depth rather than breadth

IMPACT

- In 2015, Bridge published its evaluation, 'The Bridge Effect', which assessed the impact of its approach on kindergarten students. It showed a 43 per cent increase in the number of Bridge students who reached the emergent benchmark in English and a 40 per cent increase in learning subtraction in maths, compared with 22 per cent and 15 per cent increases from their public-school counterparts.
- Bridge teacher salaries are competitive. They can earn up to 90 per cent more than other teachers in similar, low-cost private schools. Staff are paid on time every month and are eligible for maternity/paternity, sick and compassionate leave.
- SPARK has extended its Lab rotational model from serving 160 students in 2013 to 4,000 students in 2017. It targets students from lower middle-income families with average annual incomes of 11,000 rands. The annual tuition fee is 1,900 rands (US$1,500) which is around a fifth of average family income.
- 91 per cent of SPARK scholars achieved a year-and-a-half of growth in reading during 2013, and more than 50 per cent of SPARK scholars concluded the year 2013 above international grade level standards in maths.
- SPARK takes part in international testing because standardized testing has been abolished in South Africa. NWEA MAP[1] tests the impact of the model and allows for global comparison. However results were not available at the time of writing.

LEARNING FROM IMPLEMENTATION

Every step of implementation in-house.
Retaining total control has been an important feature of how Bridge operates efficiently at the lowest possible cost. As a conglomerate, Bridge has its own estate agents, construction business, furniture makers, curriculum developers, software developers, customer service centre, procurement process and uniform designers. Because Bridge controls its entire supply chain, when any revision or improvement is made to one aspect of the model it can quickly and effectively be rolled out across all of its existing and new academies.

Technology unburdens teachers of a range of administrative tasks.
In Bridge schools, tablets allow centralized data collection and analysis. This facilitates many aspects of teaching and learning that would traditionally fall on the teacher to collect and monitor (such as attendance tracking). This data is monitored and analysed, with the central team responsible for continuously improving and strengthening the approach. Bridge teachers undertake ongoing professional development both in the classroom and at off-site training events.

Solid connectivity and good infrastructure are essential.
The SPARK Lab rotational model requires a lot of movement between classrooms, so the classrooms need to be close to one another to maximize student learning time and student safety. The SPARK business development team works on infrastructure alongside the academic team (which is dedicated to scheduling and professional development). Chromebooks are used to manage lesson plans and content centrally, and so connection to power is required prior to implementation.

Students have control over part of their learning.
SPARK staff create schedules for when student learning takes place based on the proportion of Chromebooks available to students: one device to every four students. However, students engage with content and work through exercises at a rate that suits them. They are also assigned independent work, which they can decide when, how and with whom to complete.

Subject teachers deliver only five lessons a week and are responsible for instilling core values. Within the SPARK rotational model, lessons are taught on repeat to various groups and this requires fewer teachers than a traditional school model. SPARK teachers are also responsible for teaching the school's core values, as well as working with families so that these values are

implemented in the home. Every family completes 30 hours of volunteer work over the course of the school year, including assisting with classroom tasks, taking part in parent committees or attending school events to get a sense of what their children are learning.

CONDITIONS FOR SUCCESS

Technology as a route to efficiency and transparency.
Technology has been a key component in the successful scaling up of both the SPARK and Bridge models. In Bridge schools, day-to-day administration and classroom instruction is accessed via the tablet, making processes more efficient and transparent, especially for new and inexperienced teachers. It is important that technology is effective given Bridge's high student to teacher ratio (45:1), and so a great deal of focus is given to classroom management and leadership. For SPARK schools, technology has played a critical role in enabling a data-led, innovative approach to learning that has been attractive to both parents and investors.

Well-trained staff and great leadership.
The expected quality of teachers at SPARK is high, with teachers usually holding degrees in specific subject areas. Teachers receive two hours of weekly professional development, which are focused on how to read and analyse data to manage the classroom effectively. They are also given training on using the Lab rotational model, scheduling, lesson planning and delivery two weeks before the new school year. Principals are responsible for professional development, class observation, one-to-one meetings about lesson planning and teaching, feedback sessions and identifying potential areas for improvement. Bridge teachers are often under-qualified but receive significant support from highly trained Academy managers and a centralized team which provides resources, lesson plans and training on best practices.

Changing perceptions and improving understanding of technology.
SPARK has become a thought leader in the education technology space in South Africa, and is working hard to shift the popular belief that technology can fix education inequalities by replacing teachers with cheap devices and software. During conferences, interviews and meetings, SPARK continuously emphasizes its philosophy about using technology to drive student achievement in conjunction with high-quality, value-driven teaching. As Bridge has grown, the company has also expanded its monitoring and evaluation efforts, as a way to build a case for its model and associated use of technology.

One Laptop Per Child - A programmatic approach to rolling-out affordable tablets, at scale

OVERVIEW

The One Laptop Per Child (OLPC) initiative, established in 2005, sought to challenge leading entrepreneurs and industry leaders to develop a US$100 laptop that could enable the provision of technology to every child on the planet. The initiative was a response to the digital and technology gap that exists for many young people in the developing world.

OLPC saw that what children lack is not capability, but opportunity and resources. To this end, OLPC designed hardware, content and software for collaborative, joyful, and self-empowered learning. They designed the XO Laptop, combining an interface that graphically captures a collaborative community of learners emphasizing connections among people, and their activities, with an ultra-low-cost, powerful, rugged, low-power, ecological hardware design.

OLPC takes a programmatic approach, working with governments and private foundations to provide 1:1 access for students in a particular region or country. From Uruguay to USA, and Peru to Nicaragua, OLPC has had mixed success in achieving its access goals and improving learning outcomes.

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KEY FEATURES OF OLPC

The robust XO Laptop was designed collaboratively by experts from academia and industry to combine innovations in technology and learning.

- The price per laptop is dependent on local needs and local capacity but, as an example, in Uruguay the cost to the state was US$260 per child, including maintenance costs, equipment repairs, training for the teachers and internet connections.
- While the price of laptops has continued to fall to the price of the XO Laptop, OLPC argues that none of these have the product characteristics to be sustainably used by young people, especially those in developing countries.
- The initiative has five core principles that underline their ambition:
  - Children get to take the laptops home;
  - There is a focus on early education, and children aged 6-12;
  - Every child receives a laptop;
  - Connectivity; and
  - Free and open source software.

IMPACT

- While a number of countries have aggressively implemented the One Laptop Per Child programme, there is a lack of conclusive empirical evidence on its effects on both access to technology and learning outcomes.
- There is evidence to suggest that the OLPC approach has had limited or no effect on numeracy and literacy, as in Peru and Uruguay (two of OLPC's largest deployments).
- Some positive effects of the OLPC programme were, however, found with regard to general cognitive skills and attitudes to learning.
- While the programme has been successful at increasing the ratio of computers per student – from 0.12 to 1.18 in Peruvian schools where it is being implemented (predominantly in rural settings) for instance – teachers reported decreasing usage as time went on.

LEARNING FROM IMPLEMENTATION

Designing a bespoke programme with a local partner.
OLPC identify a local partner organization to work with their multidisciplinary team to design a bespoke programme, and to be responsible for day-to-day oversight of the programme in the longer term. This involves building a local team that is capable of providing various forms of technical and operational support, to ensure the long-term sustainability of the programme. Inventory and maintenance systems are developed to overcome the logistical challenges of getting the laptops into the hands of each child.

Engaging the community and building local capabilities.
OLPC often looks to leverage universities or teaching colleges to provide long-term sources of potential trainee teachers who are tech-savvy, as well as volunteers in the community who can help with repairs and maintenance. Leveraging community assets supports the transfer of the knowledge and know-how required for the programme to be self-sustaining, albeit with some OLPC support. Generally, OLPC has learned that it takes a year to build sufficient local capacity, but acknowledge that this varies depending on the circumstances. OLPC recognizes that the programme requires investment upfront, but argues that this pays off in the long run.

Ongoing school leadership and teacher training.
Having focused too much on deployment, OLPC elevated teacher training to be a fundamental element of its implementation strategy. While each programme has a bespoke approach, they offer initial and ongoing training for up to five years (depending on the capability of local partners). To account for the varied quality of teaching, training is designed to be modular; providing access to the very basics as well as more advanced courses. It also involves skilling up teachers in innovation and learning strategies that also integrate technology. Pedagogical coaching is also offered, as well as the introduction of learning circles for peer-to-peer support. Importantly, teacher training is dovetailed with training for school leaders, who are expected to be as committed and capable as the teachers. OLPC therefore offers its leaders additional services such as curriculum mapping, mentoring, modules for engaging parents, leveraging technology for health and nutrition, as well as teacher observation, and giving targeted feedback for teachers.

From 'drop and go' to more sophisticated implementation.
In its early years, OLPC encountered significant criticism, with many pointing to the lack of impact on test scores, declining technology usage, and a lack of a direct relationship to the pedagogy needed in the local context. These failures were attributed to OLPC's initial and crude 'drop-and-go' strategy. OLPC learned from its mistakes and began to shift its approach to become more holistic, combining technology with prolonged community engagement, teacher training and local educational efforts and insights.

Mwabu: Tablet based e-learning and school improvement

OVERVIEW

South Africa is one of the more advanced markets in Africa when it comes to education technology. However, in some rural areas, one teacher is often responsible for teaching a class of up to eighty students using traditional 'chalk and talk' methods.

Mwabu's aim is to reach a hundred million learners by 2020. The focus is on rapidly improving the educational space in Africa by introducing e-learning resources for teachers and students. The programme offers interactive e-learning content aligned to local curriculums for maths, science and English – which is uploaded onto the Mwabu educational tablet – and professional development courses specifically created for African markets. The Mwabu Academy provides focused educator support and training to promote the use of technology in the classroom. Mwabu recognises that digital education is beneficial for learning, but believes that teacher acceptance of the technology and training is critical for effective teaching. Part of what makes Mwabu unique is the depth of its enriched learning material, tailored for the markets in which it operates. The content is contextually relevant, developed in English and translated into nine local languages.

With plans to rapidly develop the local e-learning scene, Mwabu is expanding its education solutions and academy services by increasing the number of languages into which its content is translated. It is working towards delivering high quality e-learning content across multiple countries, which will include a range of new educational approaches such as games, interactive immersive technology and formative assessment. Plans are in place to deliver SMS text messages to parents with the intention of engaging learners informally in the home.

KEY FEATURES OF MWABU

- Primary teachers – irrespective of training or experience – access comprehensive, contextually relevant digital lesson plans, interactive lessons and teacher tips using the Mwabu tablet.
- The Academy provides enriched learning for teachers through training and observation visits, as well as the development of action plans.
- An intelligent interconnected network of teachers, learners and parents, who share best practice with each other, provides long-term support.
- The Mwabu tablet is used as part of a three-rotational model that divides classrooms into smaller working groups: each student is engaged in technology-led, teacher-led or self-led learning in each lesson.
- On average, the cost of delivering content and tablet devices (excluding training and solar panel requirements) is between US$1 and US$2 per child. At scale this can be less than US$0.50 per child.

CONDITIONS FOR SUCCESS

A commitment to being hardware agnostic and having open source software.

OLPC is adamant that open source software is important and encourages children to take ownership of, modify and change the device based on the existing software. It continues to be determined to debunk the myth that schools need to have the best, newest and fastest technology, and advocates for devices that are purpose-designed for the context and the users that they seek to empower.

Being open to a shifting strategy.

Through some hard lessons, OLPC came to realize the really important role that teachers play in the learning process. This led it to focus more on supporting the teacher and the community as part of the programme, rather than just deployment of devices. OLPC's openness to shifting from technology, to technology and teachers is critical to its evolution and the successes it has achieved. The realization that sustainability was critical has led to significant investment in community engagement and development.

A commitment to ongoing initiatives that mobilize new technologies and capabilities.

In year three of the Ceibal Plan, an initiative in Uruguay that deployed OLPC's XO Laptops, a series of targeted education initiatives were launched, specifically to leverage the technologies that now existed in all Uruguayan schools. These initiatives ranged from adaptive mathematical platforms and robotics to remote foreign language classes and programming classes to assist 17-26 year olds to gain access to new employment opportunities. This represents a commitment to an open and shifting strategy.

IMPACT

- Mwabu has provided educational tools to more than 500,000 learners in Zambia since 2013.
- Mwabu currently offers nine local languages in Zambia for Grades 1-3. In South Africa, content is currently produced in English, but plans are underway to introduce multi-language content, including Zulu and Afrikaans.
- Mwabu uses Early Grade Reading/Mathematics Assessments (EGRA and EMRA) to evaluate attainment levels, with results consistently showing significantly higher improvements in learning outcomes for pupils learning with Mwabu than in other local schools.
- Evidence shows that numeracy skills are 16 per cent better after one year of using Mwabu lessons, than for a control group.
- Impact studies of Mwabu classes show that teachers deliver more engaging child-centred lessons, with 50 per cent of teachers using songs, games or stories compared to 25 per cent in the control group.

LEARNING FROM IMPLEMENTATION

The barriers to entry are low in terms of cost and practical arrangements.

Readiness to use hardware is assessed prior to implementation of the Mwabu solution. Site surveys determine the limitations of implementation by assessing power and connectivity levels. Power is essential for charging and storing the tablets. However, if schools have no or little access to power alternatives such as their capacity to install solar panels can be considered.

Community buy-in is obtained.

Before the Mwabu approach can be implemented, parents must be informed about how it relates to education. In rural areas, parents can be sceptical of the technology and must be persuaded of the role technology can play in serving students and teachers. Stakeholder support (school leaders, teachers, union groups and parents) is important to ensure teachers that they are not working in isolation and to sustain momentum among teachers and students.

Five days of training for staff to engage with the technology and pedagogical approaches.

Before the Mwabu programme is initiated, the principal receives a full day of training, three days are allocated to the teacher(s) and a full day is allocated for the newly appointed coordinator, who acts as the intermediary between the school and Mwabu. Coordinators are also responsible for assisting teachers to use the tablet and provide Mwabu with feedback about implementation and general use. Training topics include utilizing the tablets in the classroom, the three-rotational model (where learners explore through understanding, analysing and solving a range of tasks in groups using the Mwabu tablet, individually or with the teacher), and change management.

Continued pedagogical training, change management courses and an interconnected network of support.

Schools are allocated a mentor from the Mwabu Academy, who offers in-person or virtual training using social networks. Training and change management courses develop teacher capacity to confidently practice new teaching methods using technology. Mwabu encourages the delivery of in-person and observational training, as schools are using the technology for the very first time. Managing change is vital for continued use. The mentor service is an additional cost to the school and recommended at least three times per year.

CONDITIONS FOR SUCCESS

Content is contextually relevant and aligned to the local curriculum.

Mwabu have found that students disengage if content is not related to context. To ensure that content is engaging for students, Mwabu has local contextual specialists who focus on culturally specific elements of the content. Because many teachers struggle to access the whole curriculum and/or subject knowledge is weak, Mwabu works with local education departments to access curriculum content, certain parts of which are pre-loaded on the tablet to alleviate time pressure.

Invest in powerful agents of change, as they are critical for continued use.

Mwabu appoints an agent of change – the 'coordinator' – who can be a head teacher, teacher or parent. The coordinator remains committed to and immersed in the effect that the technology is having in the school: and believes in its purpose and continued use. Mwabu recognizes the importance of investing in these individuals, using incentives such as remuneration or status. Coordinators based within the school are available for teachers to acquire proficiency to know when and how to utilize the technology in the classroom. Mwabu stresses that in order to have a better learner, you need a teacher who creates an environment that supports better learning, and ultimately creates learners that are self-sufficient.

The bigger the belief base, the harder it is for teachers to work in isolation.

Building capacity and understanding in the school's

leadership team is critical for success, but remains a challenge for some schools using Mwabu. Without top-down buy-in, maintaining momentum becomes difficult. Teachers using technology for the first time should be visible to the school and feel supported. Training for principals is being redesigned so they are able to see what success looks like in the programme, in order to ensure that the school moves forward.

School in the Cloud

School in the Cloud - self-organised learning environments

OVERVIEW

In 1999, Sugata Mitra's pioneering 'Hole in the Wall' experiments helped bring the potential of self-organized learning to the public's attention. Research continues to support his conclusion that groups of children with access to the internet can learn almost anything by themselves. In 2013, Sugata Mitra won the US$1 million TED Award and built the ultimate School in the Cloud where children, no matter how rich or poor, can engage and connect with information and mentoring online. There are now eight School in the Cloud Labs across the globe. The labs provide an environment where a global community of educators can observe the impact of self-organized learning on children from a wide range of educational backgrounds.

School in the Cloud is underpinned by Self Organized Learning Environments (SOLEs), which provide self-directed education to students in areas where high-quality teachers are not available. SOLEs and the School in the Cloud approach value learning outcomes that go beyond conventional measures, such as test scores. They are designed to develop 'softer skills' and dispositions such as teamwork, independent learning, presentation skills, confidence, critical thinking, questioning, deeper thinking and digital literacy. Proponents are clear that the SOLE pedagogy will not necessarily have any impact on helping students 'pass the test'.

SOLEs are not only for schools. The School in the Cloud also supports groups of learners in locations where there are no teachers. They utilize what is called the Granny Cloud: over 100 dedicated volunteers from around the world who Skype in to provide unconditional encouragement rather than outright instruction and guide children on their SOLE adventures.

KEY FEATURES OF SCHOOL IN THE CLOUD

- SOLEs can be created by anyone, anywhere: by educators, parents or communities across the globe.
- An effective SOLE is a physical space in which students form small groups, each with access to an internet-connected laptop or computer (preferably with large screens so each student in the group is able to see).
- Students are given a 'Big Question' and the freedom to learn collaboratively to find the answer, using the internet. They work around a guiding set of rules that help them become a student-led learning community.
- These spaces are fuelled by self-discovery, sharing, spontaneity and limited teacher intervention. Teachers adopt a facilitative role: they stand back and give students space, then play a more proactive role during the presentations phase, a time at the end of a session when students share what they learned with the whole group.
- During a SOLE session students are free to move around, change groups and share information at any time.

IMPACT

- SOLE experiments conducted in Uruguay, where almost every child has an internet-connected laptop, found that the children involved in SOLEs performed better when working on 'hard' problems in groups than they did individually.
- An experiment in the United Kingdom found that SOLEs had a positive impact on teaching practices in primary classrooms (for example, the opportunity to reflect on pupil learning led to higher teacher expectations of their pupils) and on pupil engagement in learning.
- Evidence and evaluation is continuously collated by SOLE Central - a global hub for research into self-organized learning environments (SOLEs) at Newcastle University, and is shared on the platform.
- There is evidence of students developing excellent searching skills, and being highly capable of summarizing the main findings of their enquiries.
- Evidence suggests that support for SOLEs from the Granny Cloud have led to improved comprehension and digital skills amongst children.

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High school student taking a selfie outside his school in the town of Odienné in the northwest of Côte d'Ivoire.

LEARNING FROM IMPLEMENTATION

Building a vibrant and global community of practice.
The ambition of the platform has been to build a community of self-organized self-organizers. It acts as a source of evidence, tools and processes to support experimentation and implementation of SOLEs. While the online resources offer structures and pathways to support learning, the general philosophy is that support needs to mimic the model of learning that SOLEs embody. Therefore, educators pursuing SOLEs are encouraged to experiment, reflect, learn and then share with others on the School in the Cloud platform.

Supporting educators to travel a journey.
SOLEs rely on a radically different teaching process, which requires educators to make a significant shift in mindset. In many of the contexts in which SOLEs have been adopted, teachers are conventionally seen as the ones with all the answers. In SOLEs teachers adopt a different role, which requires standing back and giving the students space. External implementation support is often necessary and, depending on the organization and the timeframes, sometimes takes the form of facilitated training programmes that are designed to mirror SOLEs. School in the Cloud is cautious of the impact that one-off workshops can have in 'training' people how to do SOLEs well.

Winning over sceptics.
School in the Cloud reports that the on-site presence of a coach/expert/champion as most valuable for winning over sceptics (especially when this is Sugata Mitra). When this is too much of a logistical challenge, School in the Cloud will sometimes offer Skype conversations with schools that are experimenting, to discuss things that have gone wrong and help teachers to adapt an approach that will work for them. Teachers are more often won over if they participate in a SOLE, self-reflect and consider how it might work for them in their context.

Technology that's solving a problem for teachers.
Authentic buy-in from teachers is more likely when SOLEs are responsive to what teachers are trying to achieve, or to a problem they are trying to solve. For instance, when teachers are looking to build 21st century skills rather than improve students' test-taking ability, they are more likely to be converted to the SOLE approach. Trialling the method as part of a topic and then extending usage once the teacher is confident enough is a good route to take, and some schools have used the SOLE at the start of a topic as a way of generating interest from students.

Nurturing a developmental mindset.
Educators are reminded that this is an ongoing experiment that will be difficult to begin with, but will evolve, for them and for their students. An effective strategy that some schools adopting SOLE have used to sustain a developmental mindset amongst staff is to bring teachers together every 3-6 months to talk about how things are going. Asking 'why?' over and over again has helped to fine-tune the approach to the school's specific purpose, and has given teachers the agency to make SOLE work for them.

CONDITIONS FOR SUCCESS

Flexible understanding of the role that teachers play.

In some cultures, teachers are seen, and see themselves, as the 'sage on the stage' - the deliverer of knowledge. This is fundamentally at odds with SOLEs. Unless teachers are willing and able to shift their perception of themselves, and adopt a new teaching role, SOLEs will be out of reach. Even in situations in which conventional teachers agree to adopt the SOLE approach, they often revert back to the norm.

Head teacher support and leadership buy-in.
To successfully adopt an approach as ambitious as SOLEs, teachers need the time, space and support to do so. If school leaders actively timetable for innovation and experimentation, teachers are more likely to engage with an idea like SOLE. Time is necessary but insufficient: teachers also need active, sustained and informed support - both day-to-day encouragement and support through school structures, e.g. how teacher performance is measured. Access to shared best practice or an active community of practitioners is also highly beneficial.

Basic but fundamental infrastructure requirements
The School in the Cloud offers guidance on both a minimum set up and an advanced set up of a SOLE. In doing so, it limits the barriers to entry for schools and teachers that are open to experimentation, while also giving them an idea of what high fidelity implementation of SOLE looks like, to help motivate them along their developmental journey.

Simplicity.
The simplicity of the SOLE approach makes it an attractive proposition for teachers and has allowed it to spread quickly and be successful in many contexts. Proponents argue that other innovative pedagogies make the mistake of being too complex, and too often this is off-putting for educators.

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ENEZA Education: An affordable mobile classroom

OVERVIEW

Africa is quickly becoming a mobile-connected continent (95 per cent of Kenyan households own a mobile phone), and this technological explosion is changing people's lives. A wealth of new opportunities are being created by this innovation, not least in education.

Founded by a US teacher and a Kenyan 'techie' in 2011, Eneza Education Limited provides mobile technology based education services in Kenya and other parts of sub-Saharan Africa. Eneza aims to lower barriers to quality education in some of the most remote parts of the world through some of the simplest technology available in those places: mobile phones. Its mobile platform gives students access to quizzes, mini-lessons and tips and tricks via the web, mobile web, and text messaging. The emphasis on text messages enables users to continue learning even if they cannot afford to pay for data or expensive handsets, or if there is no data network in the area.

Eneza's vision is to be the global go-to learning platform that empowers the next generation of leaders with the skills they need to succeed. Their ambition is to provide 50 million learners with affordable quality education for a subscription of US$5 a year, to be paid for by individual parents, students or teachers (the current price is US$20 a year for a basic SMS subscription).

KEY FEATURES OF ENEZA EDUCATION

- Students access lessons aligned to the local curriculum, tutorials, Wikipedia, tips and assessments through USSD/SMS, an online Web app, an offline desktop app, and an Android app.
- Interaction between student and teacher is enabled through live teacher chat, and students can compete for places on leader boards through 'play&share'.
- The Eneza platform enables classroom teachers to see how their students are performing and to assign relevant homework.
- The platform also detects student progress and proposes what courses the students should take, based on their level of proficiency.
- Currently, schools can buy individual accounts for US$180 per year that permit access to student data and teaching resources. Parents can request similar accounts for US$15 per year.

IMPACT

- Eneza currently has over two million registered users and 142,000 active users per month.
- The platform currently operates in four countries – Kenya, Ghana, Tanzania and Zimbabwe – with imminent plans for launching in Zambia, Cote d'Ivoire and South Africa.
- Over the next few years, Eneza will further expand its reach into Uganda, Rwanda, Senegal and Egypt.
- A partnership with Safaricom, Kenya's largest mobile phone service provider, has enabled Eneza to bring subscription prices down towards its long-term goal (US$5 a year).
- Impact studies carried out in 2012 and 2014 found that use of Eneza increased students' test scores by around 9 points (out of a maximum of 500) more than students in the control schools.

LEARNING FROM IMPLEMENTATION

Implementation is simple, since no infrastructure is required.
The 'bring your own device' model is vital for implementation on a large scale, as Eneza does not distribute any mobile devices: all students and teachers that want access to the platform must have access to a mobile phone, tablet or computer. Mobile phone content can be accessed offline, even if there is no internet connectivity available.

Leveraging the power of SMS technology.
Eneza's goal is to develop content for devices that people have access to and are familiar with using, and so its content has been primarily designed for mobile phones. As the price of smartphones decreases, there is a growing trend among users of changing from feature phones towards smartphones, so Eneza is now shifting focus to designing content for the android and developing various applications. The technology has also been developed to be interoperable across devices.

Design is informed by teachers, which makes the platform highly intuitive and user friendly.
The platform was co-designed with input from teachers themselves, to ensure it is user friendly. Eneza offers a single course for teachers with instructions on use of the platform and guidance on ways to interpret student outcomes. Besides the course, no other specific training for teachers is required.

Partnering with mobile operators creates benefits for both parties.
Eneza uses technology that major mobile operators have access to, which means that operators are able to increase their revenue streams by selling more services, and Eneza's reach of users subscribing to the platform has grown significantly. This close collaboration with the telecommunications industry enabled Eneza to lower the price of its data, in order to make it accessible to users.

User engagement strategies are pivotal to successful implementation.
Finding reliable ways to attract students to the platform, and keep them engaged, has been one of the main implementation challenges. Eneza ran campaigns and radio advertisements targeted at their key market, and encouraged parents to relinquish their mobiles so that their children could engage in learning. Convincing parents to add credit to the phone is key, since the platform runs on mobile data. Retention of users is a particular issue: of all the enrolled users paying for the product, only a third remain active on the platform the following year. To try to address this, Eneza set engagement targets for students, who are rewarded with free time once goals are achieved.

CONDITIONS FOR SUCCESS

A model for tailored and authenticated content creation.
One of Eneza's main advantages, compared to its competitors, is its content creation model, which ensures that content is aligned with the national syllabus of every

country in which it works. Every time Eneza enters a new country, a group of freelance teachers produce a content map and lesson units based on national standards. This content is then certified by a relevant local authority.

Parental support is an essential precondition for take up.
It is largely parents who make choices about their children's education, particularly when they are younger and, in general, the younger the student the closer the relationship between teacher and parent. Eneza's courses target students aged around 10 to 18 years, but also cater for persons who have dropped out of school up to the age of 25. The product is most effective in environments where parents are dissatisfied with public schooling but are not able to afford private schooling. The optimum demographic for Eneza's implementation has proven to be the ambitious, lower-middle class, in which parents are encouraging their children to climb the social ladder

onebillion

Onebillion: Adaptive android apps

OVERVIEW

Onebillion is a UK-based charity that aims to reach one billion children in developing countries. Its mobile and tablet apps have been designed to progressively develop children's knowledge of early mathematical concepts (such as count to 10 and basic times tables) and reading and writing skills. The app sets out to teach modular, curriculum-appropriate numeracy and literacy with no direct adult support, making it a suitable tool for schools with high student to teacher ratio. Onebillion is also a finalist in the $15m Learning XPrize.

The 'onecourse' numeracy material is curriculum-aligned and available for download on the App Store and Google Play in fifty different languages. Reading is still in the works to become a standalone app and is being developed in Swahili, English and Chichewa, with more languages to follow. The apps are currently being used by approximately 100,000 children worldwide, including Malawi, Uganda and India. Notably, 20,000 of those are in a monitored trial in Malawi, in conjunction with Voluntary Service Overseas (VSO).

KEY FEATURES OF OF ONEBILLION

- Onebillion has set up 'oneclass' learning centres where local teachers teach the entire maths curriculum to young children in their own language.
- The child is instructed by a virtual teacher who guides them through and provides feedback on modular courses which allow for personalised learning using animation and audio.
- Data is fed back to teachers who are trained to interpret it.
- Each Onebillion app has been broken down into a set of three activities: the study zone (where learning takes place), the play zone (where children compete with others and create their own learning content), and a set of bedtime stories.
- Oneclass can be powered by a low-cost renewable solar energy system.

IMPACT

- Research undertaken by the University of Nottingham shows early maths concepts that used to take eighteen months to learn is now accomplished in six weeks.
- Onebillion partnered with VSO to launch the Unlocking Talent Initiative that aims to sustainably scale quality education to Malawi and beyond that now forms part of Malawi's formal education system. A goal of Unlocking Talent is for each of the 5,300 primary schools in Malawi to have access to a Onebillion app.
- By the end of 2017, the Unlocking Talent initiative will reach 50,000 Standard 1 and Standard 2 learners every week, providing students with access to Onebillion's 'onecourse' numeracy and literacy app.

LEARNING FROM IMPLEMENTATION

Infrastructural requirements prior to implementation.
Onebillion's 'oneclass' technology consists of a dedicated solar-powered classroom that provides a sustainable environment for pupils in remote areas, with limited infrastructure and resources, and no access to electricity. Products include a solar-powered projector, tablet, media streaming device, speakers, long-life battery and all associated cables. Local partner organisations in Malawi and Uganda are responsible for the construction of 'oneclass' centres, using sustainable building materials.

Hardware and software Choices.
The content used is media rich and tactile with the emphasis on engagement rather than passive consumption. Pupils are encouraged to swipe, drag and click constantly as they work their way through the activities. Badges and level graduation are common occurrences to keep children engaged. Audio is also used extensively for two reasons; firstly, to begin with many of the learners cannot actually read. Secondly, it allows for other users to listen in and engage just via the audio. The hardware is also locked down so there are no distractions - pupils cannot close the app and play Angry Birds instead.

Ignoring the curriculum.
Onebillion has also taken a very different approach when it comes to the scaffolding of its content. Unlike most other initiatives, Onebillion have chosen to only follow the route that leads to best learning outcomes. This often requires them to move away from the national curricula. This is only possible because they are not working directly with teachers - they work with the pupils. They are expecting to see resistance to this position when it comes to a wider roll-out but hope that the efficacy of their product will outweigh wider political concerns.

CONDITIONS FOR SUCCESS

A complete focus on the learner.
This is actually a subtle but profound difference from the vast majority of other learning products. All claim to be learner focused but actually the customer is either the school or parent, this naturally skews the design. Onebillion's approach removes much of the friction often found in ICT for learning deployments as there are no levels of proxy to navigate. Teacher capability is not a factor, neither is curriculum adherence nor is the politics of education. Longer term this could also be a limiting factor for them, but for now, this laser-like focus is paying dividends in terms of creating a product that actually works for the learner.

A flexible, and mission-driven business model.
Onebillion sell their app in developed markets (UK/US), and uses the revenue generated to subsidise their charitable work. As this only partially covers the costs, they rely on grants and their endowment to pay for the roll out via VSO in places like Malawi. In the longer term, Onebillion plan on selling their app into NGOs and governments. This does allow them right now to be very focused on exactly what will work for the child, not what will necessarily sell into schools or parents.

An Agile approach.
Onebillion maintains that solving the problem of primary education in the developing world is "...a moon-shot. No-one knows really how to do it. Any grand vision is bound to fail and that the only way to succeed is to be agile and test everything, adapting as you go" - Andrew Ashe, CEO. Onebillion puts particular emphasis on the importance of having people physically on the ground next to the learners, observing and testing new approaches constantly. Alternate versions of lessons are presented to different cohorts and the efficacy of each measured and the product adapted accordingly. This happens almost daily.

AGA KHAN FOUNDATION

دبي العطاء
Dubai Cares

AKF and Dubai Cares: Transforming teaching and learning through ICT

OVERVIEW

The transforming teaching and learning through ICT project is a partnership with the Governments of Kenya and Uganda and locally based innovative ICT and mobile companies to test and demonstrate the transformative potential of ICT to strengthen teaching and learning in formal primary education, using mobile phones and computers. As the focus on education shifts from Education for All (EFA) to Learning for All (LFA), the role of the teacher remains critical.

Twelve-year-old Waibai Buka (second left) teaches her friends how to use a computer tablet provided by UNICEF, at a school in Baigai, northern Cameroon, Tuesday 31 October 2017.

KEY FEATURES OF THE AKF AND DUBAI CARES INITIATIVE

Over the past three years, AKF, Elimu, and Camara have been working to:

- Provide hardware in schools including computers, tablets, and projectors
- Develop content aligned to the government curricula to support the teaching and learning of early grade literacy
- Deliver teacher and government professional development programmes to support the effective integration of ICT into teaching and learning
- Provide a mobile app to support communities of practice that go beyond the school or immediate clusters
- Develop an app to support teachers and schools to more efficiently collect, store, analyse, and use data to make information based decisions to support effective teaching and learning.

IMPACT

- 1,404 (M:840; F:564) teachers have been trained on how to integrate ICT into their everyday teaching and learning practices.
- 94 Trainers (M:59; F:35) selected from Inspectors of Schools and Curriculum Support Officers continue to support teachers through mentoring and coaching on how to integrate ICT into their everyday teaching and learning practices. Over 1002 (M:339; F:663) teachers have been mentored and coached by these trainers to date.
- 39,332 (M:19,386; F:19,946) children across 175 schools have engaged with ICT in the classroom using devices provided by the project.
- Under this project, AKF conducted a human centred design process to develop a tablet and mobile phone based school management system to enable schools and teachers to track whether children enrol, attend, transition, and are learning. Designed to reduce the workload of teachers and provide instant analytics and feedback for teachers and schools to better understand what the data are telling them.
- Digitalised stories have been developed by teachers and parents from these regions and curated by AKF. These stories have been built into an interactive platform that has incorporated questioning and other supports to enable children to effectively engage with the story to develop literacy skills. The stories can be used by teachers in the classroom or in the home through an android app. And over 50,000 downloads have been recorded to date.

LEARNING FROM IMPLEMENTATION

Support teachers to navigate the resources available

There is a lot of content around, but much is not aligned to the curriculum, not age/developmentally appropriate, or relevant to the context. As such, teachers can find it difficult to identify the resources appropriate for their students and relate these to their classrooms. This project has developed content for teachers that was directly related to the curriculum. While this lengthened the process for developing the content, what has been produced is relevant to the national context, rather than being contextualised from global content. This enables teachers to make concrete linkages between the content and the curriculum and so enables them to use ICT with confidence and integrate ICT more meaningful into their teaching and learning.

Maximise the power of ICT

Much of the content, particularly those aligned to the curriculum, are not interactive, even to the extent of being PDF. This reduces a tablet to an electronic book. The content developed under this project required learners to engage with the platform and the content as well as supported the teacher to construct appropriate and relevant questions to enable effective learning.

ICT is more than just a computer

When considering ICT, it is important to consider the associated costs. These include maintenance, electricity, software updates, and internet fees to name a few. The inability of schools to meet these costs has the potential to undermine the ability of teachers to integrate ICT into teaching and learning. Close collaboration between government, schools, and communities is needed to mitigate against this issue for long-term sustainability.

ICT can be a disrupter and so considered a threat

Teachers can be threatened by ICT as it has the ability to disrupt existing power dynamics as children take greater agency in their own learning and frequently develop ICT literacy at a faster pace than teachers. This needs to be considered when developing teacher professional development courses so these explicitly support teachers to face this fear and become confident in the use of ICT in the classroom.

CONDITIONS FOR SUCCESS

ICT interventions must be user centred

It is critical not to assume the everyday realities children, schools, and teachers face, but rather understand these from the user's perspective. When developing the App for the digital communities of practice, this was not fully appreciated and so the App has not had the expected uptake rate. Therefore, when developing the school data management App, AKF took a human centred design approach to ensure the App considered the needs and challenges schools face and was designed with the user at the centre. This has enabled the app to maximise the power of ICT, data and data analytics to track children's enrolment, attendance, transition, and learning.

Supportive education ecosystems

ICT cannot be an input that exists in and of itself, but rather has to be integrated into the wider education ecosystem. Therefore, the more supportive the policy environment, investment, school level infrastructure, and school management, the more effectively ICT can be integrated into everyday teaching and learning. This education ecosystem also needs organisations, institutions, government departments and other stakeholders to work together and partner as no one of these can do it alone. Under the project, for example, the Government of Kenya has provided the policy environment, the infrastructure, and frameworks, AKF the system support, professional development, and community engagement, Elimu, the interactive content, and Camara, hardware and ICT support. It is clear that no one could have achieved all. In Uganda, where both policy and investment are far behind, the overall impact is not as deep or broad clearly illustrating the need for effective and supportive partnerships deliver better results.

ICT aligned to the system

Aligning ICT to the requirements of the system enables teachers to meaningfully integrate ICT into learning. This is, perhaps, most prominent in content (see learning point one) as well as with teacher professional development. Alignment helps teachers to see how ICT can support them to develop the competencies they need and enable them to effectively use ICT to develop student competencies as outlined in the national curricula.

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Innovation Unit
New solutions for thriving societies

AGA KHAN FOUNDATION

Aga Khan Education Services

Raising Learning Outcomes:
the opportunities and challenges of ICT for learning

Appendix 3

UNICEF Eastern and Southern Africa Region and West and Central Region country snapshots

Innovation Unit
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A child learns with the help of a computer tablet provided by UNICEF at a school in Baigai, northern Cameroon, Tuesday 31 October 2017

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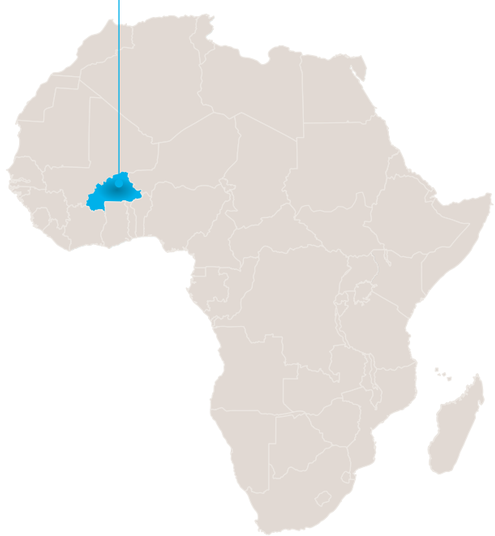
Emmanuel using a computer at the Osu Children's Home in Accra, Ghana in 5 May 2015. The home receives children who require residential care from state organs such as the police, social welfare and the courts, and at the time of this photograph, according to the director, was home to approximately 160 residents ranging in age from babies to young adults.

Burkina Faso



BACKGROUND

Burkina Faso is a stable, low-income country with a population of approximately 20.1 million, and one of the lowest literacy levels in the world.

There is an emphasis in Burkina Faso on integrating ICT into the education system to broaden access for students and teachers. ICT for learning is seen to be a solution to low quality teaching, narrow curriculum and a digital divide amongst children and young people. It is also seen as an opportunity to support new pedagogy and advance digital/ tech skills.

The government have four focus areas when it comes to ICT for learning:

1. Provide access to ICT for teachers and education administrators;
2. Improve/increase the literacy of teachers on digital devices used in teaching;
3. Develop properties that enhance the quality of teaching and learning (although there is no agreed impact on teaching and learning);
4. Create the possibility for teachers and students to bring their own devices (e.g. computers, laptops, phones).

UNICEF Burkina Faso are developing scenarios in which they can support the government on:

1. Access to computers and internet for teacher training and learning data purposes;
2. Use of computer and Internet during class to improve communication with students (video, projectors, printers, etc.).
3. Students using ICT for self-learning;
4. Bring Your Own Devices.

UNICEF EXPERIENCE

UNICEF Burkina Faso report low levels of ICT for learning integration in the country. They recognise that creative capacity exists within the education sector, but innovations are hard to promote without the support of Government.

Interest in, and attention to, ICT for learning is increasing. In collaboration with an inter-ministerial committee, UNICEF Burkina Faso contributed to the elaboration of the National Strategy for Information and Communication Technologies in Education based on different ICT options proposed by a field research.

UNICEF Burkina Faso are keen to develop, integrate and roll out a strategy at scale, however any attempted strategies have proven too weak to meet the demand. Universities and private schools are the main users of ICT for learning.

UNICEF | September 2018

▲ High school student using technology in class, in the town of Odienné in the North West of Côte d'Ivoire.

OPPORTUNITIES AND CHALLENGES

UNICEF Burkina Faso recognise that ICT plays increasingly important role in the access to knowledge and especially in the sharing of experience in real-time. Technology has also been important as it has enabled access to knowledge on HIV and other diseases. Success is linked to the accessibility of technology in the countryside, for instance technology that supports distance learning for those who wish to attend University.

Programme design remains a challenge due to weak infrastructure, low maintenance capacity and insufficient means to acquire the devices. The lack of integration of the project into a national strategy is detrimental for sustainability. There are issues for schools in terms of access to power in rural areas, security risks, a lack of content providers, a lack of innovation and a resistance to change.

Cameroon

BACKGROUND

Cameroon is a lower middle-income country, with a population of approximately 23.4 million. The current focus of the education sector is improving basic numeracy and literacy skills for all children (school age) irrespective of where and what situation they are found in.

The government is focusing its efforts on improving the demand for education in communities and improving coaching for teachers in rural areas, and there is appetite for exploring how ICT for learning can raise the quality of teaching.

An ICT strategy and curriculum exists in Cameroon, however, there is a gap in how ICT can be used as a tool to facilitate learning. Things are moving very slowly, and there isn't a concrete operational guide for implementing ICT for learning. Cameroon has seen a few ICT for learning initiatives that have focused on providing laptops to school (UNESCO, African Development Bank). While there is some goodwill on the part of the Government, as manifested in the ICT strategy and the creation of the Inspectorate of Computer Science in the Ministry of Basic Education (2005) to promote the mainstreaming and integration of innovative technologies in teaching and learning. Despite these laudable efforts, there are some challenges that need to be addressed in order to realize the full benefits of ICT as a tool to facilitate learning. These include the following:

Funding for sustainability and for scale;

- Upfront costs;
- Connectivity;
- Teachers' inability to teach using ICTs;
- Inadequate technical support;
- Difficulties in teaching of abstract concepts across the curriculum;
- Security.

UNICEF EXPERIENCE

UNICEF Cameroon report that the use of technology in education is still quite rudimentary in Cameroon. They have found that the Cameroon government is happy to have the possibility of implementing ICT in schools but the main resistance comes from teachers and communities.

Cameroonian schools face connectivity challenges, and there has been an effort to deliver connectivity to them as well as in refugee camps.

UNICEF Cameroon recognizes the need for more demonstrative and scalable pilots, and are ambitious on how they can evolve pedagogical practice in line with new technology. They also identify teacher training in ICT for learning as a challenge, referencing how few programmes go beyond technical training. They want to help assess where difficulties are in using technology as pedagogical tools, and identify what support is most relevant.

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Twelve-year-old Waibai Buka (second left) shows her family the computer tablet provided by UNICEF for school, at the family's home Baigai, northern Cameroon, Wednesday 1 November 2017.

OPPORTUNITIES AND CHALLENGES

UNICEF Cameroon sees ICT for learning as an opportunity for children and young people to be exposed to the tools of the 21st century, and to gain skills such as collaboration, critical thinking, creativity, communication, but also researching skills that can help them to cover their curriculum well. They also see technological resources as a tool in improving the quality of teaching in Cameroon.

UNICEF Cameroon recognize barriers in infrastructure – most schools don't have electricity – and the need to make ICT for learning part of school in a context where the provision of technological products is low due to a lack of investment. They are also cognisant of resistance to technology at teacher and community levels. Often, teachers see digital tools as an additional burden, and communities can see them as a privilege/luxury.

Mini Case Study: Connect My School

In Cameroon, access to quality education – including Internet access – is challenging. The majority of the displaced children live in remote areas and don't benefit from the same quality of learning as those living in urban centres – especially digital learning. If they do have access to education, these children may learn about the Internet, but not use it. As a result, the digital divide widens, and at-risk children have even fewer chances to succeed.

By connecting remote schools and students to technology, one new initiative has begun to bridge the divide, starting with those who need it most in northern Cameroon. 'Connect My School' is an EU-funded UNICEF initiative aimed at providing digital education tools to children from the Far North region of Cameroon, for the first time ever.

UNICEF Cameroon piloted the initiative with Ringo – a service provider – in 5 schools, providing materials and equipment/tablets, working with regional education authorities and inspectorates at the local level, as well as the Ministry of Communication. The first objective was to connect schools, with a broader ambition of resetting the curriculum, teaching and learning. They are now looking at how to integrate the use of tablets into lessons as a pedagogical tool, and want to explore resetting learning plans so that they can be enhanced by tablets.

Central Africa Republic

BACKGROUND

The Central African Republic is a low-income, conflict- and emergency-prone country, and is among the ten poorest countries in the world with the lowest GDP per capita at purchasing power parity in the world as of 2017. As of 2015, according to the Human Development Index (HDI), the country had the lowest level of human development, ranking 188th out of 188 countries. Approximately half of Central African Republic's adult population is illiterate.

In 2016, The Thomson Reuters Foundation reported The Central African Republic to be the worst country in the world for young people, with little or no access to education and healthcare, poor job prospects and low participation levels in politics.

UNICEF EXPERIENCE

ICT for learning is not in the agenda for learning in The Central African Republic. Providing education to affected children was and remains a priority in the UNICEF Central African Republic (CAR) humanitarian response. A total of 59,114 children received learning materials within the context of programming for education in emergencies. Safe temporary learning spaces (TLS) are set up in Internally Displaced Persons (IDP) sites, to provide access to relevant education opportunities.

UNICEF CAR supported the Ministry of Education to re-establish the education management information system (EMIS), which facilitated the production of the annual statistics yearbook since 2015 for two consecutive years since the outbreak of the crisis, and enabled strategic planning and policy development going forward. Computers, software and furniture were provided to the Ministry of Education, and staff were trained on data collection and analysis. The Ministry received technical assistance to develop tools to assess the progress made on the Education Sector Transition Plan, and 81 education authorities (17 per cent women) and 400 teachers (53 per cent women) received psychosocial training. 411 school directors trained on Edutrac and contributed to collect data of school functioning situation timely. In addition, basic ICT tools such as the e-reader has been adopted in more stable areas to facilitate teachers to prepare their daily educational sheet for quality teaching.

OPPORTUNITIES AND CHALLENGES

UNICEF CAR is exploring how technology can help to improve the quality of both teachers in school and Community teachers (parents/ members of the community with limited levels of education). The school radio will be an area to develop not only to compensate for the gap of trained teachers, poor teaching practices and the limited learning time for schools and the TLSs in CAR, but also to harmonize the teaching program across the country.

Structural challenges facing ICT for learning

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Abidjan U-Reporters.

U-Report is a social platform created by UNICEF, available via SMS, Facebook and Twitter where young people express their opinion and be positive agent of change in their communities.

in CAR is fully recognized. The development of ICT in education is constrained by the long-lasting crisis that resulted in poor teacher training combined with the volatile security context and unreliable electricity coverage. The level of poverty and deprivation also raises the risk that ICT would be traded for basic materials such as food and healthcare. Overcrowded classes will often involve 85-100 children and one teacher. Therefore, basic ICT tools will be introduced in stable areas as well as in TLSs in the IDP sites before progressing towards a more complex system like ICT for learning.

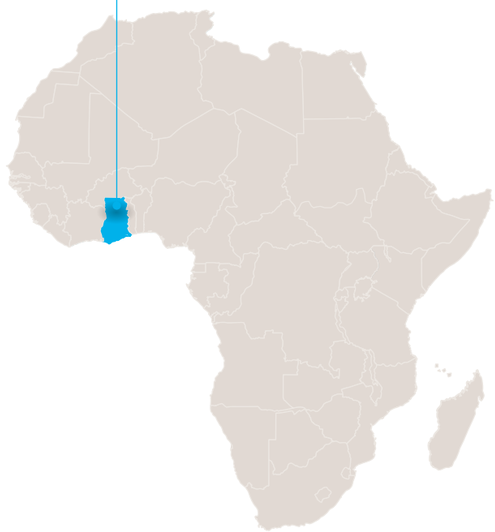
Mini Case Study: pilot – Readers providing digital libraries for teachers

UNICEF Central African Republic have co-financed the creation of 10 numerical libraries in partnership with the French Development Agency. This involves teachers using tablets/readers to access a digital library of resources to help them prepare for lessons. It gives teachers access to dictionaries, reading materials, curriculum to improve the quality of teaching.

The initial pilot involved only 300 tablets/ readers, compared to the 8000 teachers in the country. Teachers reported that they were glad to be rid of books and given access to digital dictionaries. There were complaints that only some teachers have access, and others don't. Inspectors and observers reported that teachers involved in the pilot were performing well, and there is a plan for next year to compare the results of classes using and not using the readers.

The Readers generated excitement, and teachers were engaged especially in response to the opportunity for innovation. The teachers didn't need convincing. UNICEF CAR want to build the governments ownership of the initiative going forward, but are struggling to scale due to a lack of human and financial resources. They have only trained six Ministry of Education staff to repair the Readers in case they break, but if a replacement is needed, it hasn't been given.

Ghana



BACKGROUND

Ghana is a lower middle-income country, with a population of approximately 28.3 million and an emerging digital-based mixed economy. The Education Sector is focused on closing the literacy and numeracy skills gap amongst learners, and achieving quality basic education and free secondary education. Approximately 25-49% of schools are actively using education technologies, with most initiatives in a piloting/experimental phase and tend to do good work but only have a small reach (e.g. MGCubed - The Varkey Foundation[3], Learning Centers - Discovery Learning Alliance[4]). The problems these initiatives tend to respond to are low quality teaching, a narrow curriculum and a digital divide amongst children and young people.

UNICEF Ghana supported the implementation and scale-up of the education system's mobile School Report Card (mSRC) in 20 districts. Evidence of mSRC real-time reporting on school-based indicators influenced the decision to integrate mSRC with the Education Management Information System (EMIS) and other education sector systems.

UNICEF EXPERIENCE

UNICEF Ghana has not yet agreed the extent to which they can explore technology in the classroom itself (as opposed to within the management of education systems). If the Ghana country office were to explore technology to enhance teaching and learning, it would focus on:

- What they can give the teacher to help them deliver better;
- What they can give the learners to help them practice what they have learned.

The Ministry of Education has played an active role when it comes to ICT for learning with the initiation of an ICT in Education Policy, aimed at providing better guidance for how to manage different partners and providers. The Policy is aligned with the Education Sector Plan 2018-30 and clearly articulates both policy and provision of infrastructure as key goals in improving ICT in education in Ghana.

OPPORTUNITIES AND CHALLENGES

There is an expanding market in Ghana for providing different technology-based products, led by NGOs and young entrepreneurs (private-driven). Demand is slowly growing, but more so in the private school sector than in public schools. At the tertiary level, distance learning is well developed, with universities using technology to access their students across the country.

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Boys view information at a UNICEF solar-powered Digital Drum computer kiosk at Bosco Youth Centre in the northern district of Gulu.

There is high mobile phone penetration in Ghana, with most people accessing social media platforms such as Whatsap, Twitter and Facebook. This a good opportunity for use of mobile-based applications. Access to these platforms is affected by poor connectivity especially in remote rural parts of the Country.

ICT for learning faces competing priorities within the Ghanaian education sector, and falls behind others because there isn't an established government policy platform. Sustainability is a challenge, with investment scarce beyond initial external funding. UNICEF, in line with its organisational mandate on addressing inequities, works more in remote areas of Ghana, where there is more deprivation. These are also areas where connectivity is poor.

Tech literacy amongst school leaders tends to be low, although younger teachers increasingly have the technical skills and knowledge to adopt new technologies. There is also question as to whether the education sector is open to new methods of delivery.

Mini Case Study: EduTrac

EduTrac is a real time data collection system in the education sectors. It uses Short Message Service (SMS) on mobile phones to connect students, teachers and community members with UNICEF and the Ministry of Education, enabling them to report on various subjects: the statistic information of each school such as number of students and exam pass rates, as well as qualitative opinions on education in schools. Also, this technology can be used as an early warning / efficient information collection system in the time of emergency, especially for the schools in the marginalised zones where physical access is very limited.

Burkina Faso started piloting the technology in late 2017 with a few schools in the Sahel Region, and is expanding it to all schools in the Region in 2018 to obtain real-time information from schools in the most vulnerable region in the country. It is expected that it will enable UNICEF and its partners to analyse the freshest information from the field and contribute to a rapid and appropriate decision making in the field of education.

Guinea

BACKGROUND

Guinea is a low-income, emergency prone country with a population of approximately 12.4 million. It has one of the lowest literacy rates in the world, with only 41% of adults being literate (52% of males, and 30% females). It was ranked 182 out of 192 countries on the 2015 United Nations Human Development Index.

UNICEF EXPERIENCE

UNICEF Guinea's strategic vision is to build a social movement for change, targeting more than 200,000 youth to build social platforms that deliver services on child protection, education, health, nutrition and hygiene promotion.

UNICEF Guinea recently worked with the Ministry of Education to run a pilot project to support the national system to collect school data. The initiative obtained real time reliable school data for decision-making on education system management, and for UNICEF to adapt its response and planning for the most vulnerable children.

There are small areas of the country where devices are being used in classrooms, but for the majority, ICT for learning isn't prevalent. UNICEF Guinea report that there is no strategy from the government beyond the collection of data.

OPPORTUNITIES AND CHALLENGES

UNICEF Guinea recognise the opportunity to influence the policy direction of ICT for learning in the future. There is an ICT Unit within the Ministry of Education that can be pushed to invest in the right capacity and expertise. The private sector is a willing partner and could be used to share expertise. ICT can be better used in the management of the system, e.g. to improve communication between different layers. It can also be used to improve the quality of teaching, through teacher training and the sharing of resources, such as videos that model high quality practice.

However, there are many logistical challenges to ICT for learning in Guinea. There is a lack of network coverage and reliable power sources for schools. It's more feasible that ICT can play a role at the teacher and principal level, hence the focus on improving the quality of teaching. Maintenance of devices is also a concern, with sustainability of such projects an on going funding challenge. Fundacion Orange and the French Corporation are seen as potential partners for any initiatives involving ICT for learning.

UNICEF | September 2018

▲

A girl taking pictures with her mobile phone in the village of Kadiola, in the North West of Côte d'Ivoire.

Kenya

BACKGROUND

Kenya is a stable, lower middle-income country, with a population of approximately 46 million, of which 51% are between 0-18 years old. 38.5% of the Kenyan adult population is illiterate, with significant regional disparities – Nairobi has the highest level of literacy at 87.1% compared to the North Eastern Province which has the lowest at 8%.

Kenya has embarked on a large-scale curriculum reform, to better align standards with the Vision 2030 requirements and the country's long-term vision of creating a knowledge-based economy. The new competency-based curriculum includes broader life and 21st century skills, as well as a focus on digital literacy.

In partnership with UNESCO and UNICEF Kenya, fifty policy and curriculum experts from the Ministry of Education and Kenya Institute of Curriculum Development have been trained on international trends in competency based curriculums and their development, including exposure to current teacher support materials to support the national piloting of the new curriculum.

UNICEF EXPERIENCE

UNICEF Kenya has provided technical support to the Ministry of Education with a principle focus on reforming the national curriculum and supporting the introduction of ICT in education, among others. One key initiative was to improve the education information management system (EMIS). What was previously a costly ($7million/annum), time-intensive (2-year process) and paper-based endeavour, it is now a cheaper ($250k/annum), more responsive process, involving technology. Kenya is on the path to reforming EMIS to a more real-time, user friendly technology solution, one that is accurate and efficient that can better support innovation, policy and evidence based decision making.

OPPORTUNITIES AND CHALLENGES

There is an opportunity for UNICEF Kenya to capitalise on the introduction of around one million tablets to all primary schools through the Digital Literacy Programme (DLP). With current usage at only 2%, there is scope for teachers to adapt and grow (with support) their use of ICT for learning.

UNICEF Kenya want technology to transform the way teaching and learning is delivered, particularly in rural, hard to reach contexts. UNICEF Kenya is leveraging innovative private partnerships to support the government in reaching some of these remote areas and provide quality content through Internet and cloud solutions. UNICEF is piloting the development of accessible digital content in form of a "Digital Accessible Textbook", to enable children with disabilities to participate in an inclusive learning environment. There is a desire for ICT for learning to enable students to be inventors of technology and not just users.

The biggest barriers are capacity and skills gaps. For instance, to make the curriculum accessible to those with disabilities, there's a need to adapt all content into mediums such as sign language, audio output and simplified text. There is a high resource requirement to provide access to all, which can be addressed through forming innovative partnerships with mutual benefits. While there is lots of seed money available in Kenya, political will is critical to sustain in the long-term. Equally important is to get the right content on the platforms.

Mini Case Study: Kenya's Digital Literacy Programme (DLP)

The DLP programme, initiated by the Government of Kenya in 2013, aims to integrate ICT in education to enhance the quality of teaching and learning in schools. It is being executed through a multi stakeholder approach that involves different ministries, state corporations and international partners, headed by the Kenya ICT Authority

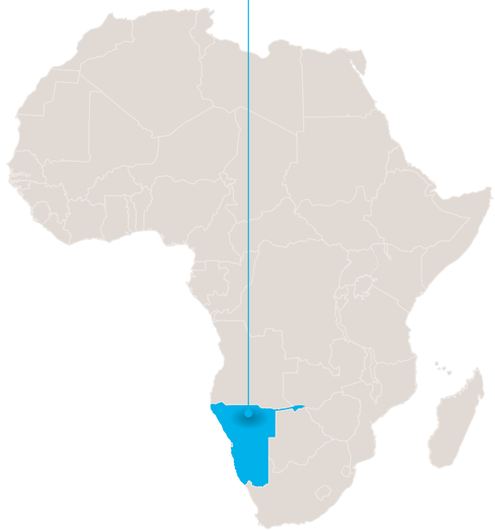
Around one million tablets have been distributed in schools countrywide and are important devices for the delivery of digital content developed by the Kenya Institute of Curriculum Development (KICD). Content is pre-loaded on the devises and there are efforts to provide content through the Kenya Education Cloud in the future. Teachers and learners can access the content for various approved subjects on these devices. There is a need to adopt and develop new content that is alleged with the new competency-based curriculum.

More than 80 per cent of schools have access to these devices, and will help to develop the skills needed to benefit from interacting with technology. The devices are not meant to replace a teacher, but, to complement and make delivery of content more exciting and practical.

Teacher training is an on going and critical component of this programme. They need to appreciate the new paradigm shift in teaching and learning brought about by the emerging technological demands, and be supported to respond to them.

The programme seeks to increase national digital literacy, as teachers and learners use the ICT skills to search for, analyse, integrate, manage and evaluate information.

Namibia



BACKGROUND

Namibia is an upper middle-income country, with a population of approximately 2.5 million. While there have been improvements in enrolment rates since the introduction of universal secondary education in 2016, one-in-five children of school-going age is not in school and another 15% are at risk of dropping out. The overarching focus within the education sector is the resolution of legacies of inequality and poor educational infrastructure as a whole.

There is a real appetite for ICT for learning - one of Namibia's 'Vision 2030' objectives is to integrate ICT education and training into the education and training system. UNICEF Namibia sees the role of ICT for learning as enhancing basic skills (numeracy and literacy), as well as digital literacy skills themselves. There is also an appetite for it to offer psychosocial support to address health and safety-related barriers to education. They recognise the opportunity of ICT for learning to support new pedagogy such as personalised learning, and other more expansive ideas of what education is (e.g. learners being active agents of change, rather than passive recipients of prescribed knowledge), as well as supporting the development of digital/tech skills like coding, robotics and social media.

UNICEF EXPERIENCE

UNICEF Namibia has been heavily involved in efforts to integrate ICT into the education sector across Namibia. They've helped the ministry to digitalise their education management and information system, supported a mapping and scoping exercise in the country and are running a proof-of-concept initiative for an eLearning platform.

They have found the Ministry of Education, Arts and Culture to have partial capacity to spearhead the implementation of their ICT in education policy. Implementation is fragmented and requires improved coordination. The Ministry often finds itself inundated with requests from various stakeholders (private and civil society) with a varying degree of understanding of what meaningful integration of ICT in education entails and insufficient consideration of sustainability dimensions. This is especially true in terms of financial sustainability.

OPPORTUNITIES AND CHALLENGES

UNICEF Namibia has the opportunity to help the government to make sense of, and make the case for investing in eLearning and the results it will bring in the long term. They see Private-Public Partnerships as important - without subsidies from networks and providers, the public investment is too daunting amongst other priorities.

UNICEF Namibia is cautious of the varied quality of ICT for learning initiatives, especially when they aren't effectively guided or supported by government policy. They are wary of how large-scale investments are daunting to governments, and that eLearning initiatives are seen as 'want' rather than a 'need'. Within limited fiscal space, budgets for what is considered essential services in education are prioritised and cost cutting measures does not include ICT due to initial cost factors. There is a growing trend of restricted, non-permissive policies around mobile phones in schools - learners are currently not allowed to bring mobile phones to school as they're seen as a threat to the learning and teaching process, therefore constraining the opportunities of ICT for learning.

Mini Case Study: Do Like Edu eLearning Platform

Do Like Edu eLearning platform is a joint initiative of UNICEF Namibia CO and the Ministry of Education, Arts and Culture. It's been designed and deployed with a view to improve access to quality open education resources in Namibia. The "proof of concept" T4D solution is being implemented in two successive phases: 1) Development of the "Do Like EDU" eLearning portal to support learner performance in key subject areas (mathematics, English and sciences) and 2) Development of "Talk to EDU" mobile application to provide learners with psycho-social support and career guidance. The objective is to test the deployability of platform in terms of ICT infrastructure, user readiness, and the policy and coordination environment.

The project has been rolled out under a wider intervention called Social Accountability and School Governance (SASG) programme, the objective of which is to improve quality of education through shared responsibility.

Learners will be encouraged by both the school and the community to access these innovative tools to improve their academic performance and foster overall wellbeing in schools. Both phases will be tested during a pilot phase to ensure that the innovation is useful and does no harm.

Major learnings from Do Like Edu:

- **Technology is not a silver bullet. No matter how good the technology may be, it has to work within certain environments/realities. Infrastructure donations alone is insufficient - it's intimidating for teachers.**
- **Before deploying the platform, one must carry out consultations with all stakeholders - school management, heads of departments, subject teachers, learners themselves.**
- **The project gained buy-in at the school level by highlighting how the platform offers customised and tailored content, specific to the needs of Namibian learners. That way, teachers and school leaders better recognise how it can meet their curriculum needs and assessment strategies.**
- **The initiative piggybacked on a broader and existing policy initiative that sought to fostered productive linkages between the school and the community.**
- **Continuous support and oversight at a school level is necessary. You can't just dump a bunch of computers and software without initial and on going teacher training. Schools need follow up support to see how they are faring, whether they're happy with the product, and whether the learners are using the technology effectively.**
- **The initiative emerged from an initial mapping and scoping exercise of ICT in education sector, with support from the UNICEF Namibia CO and the Innovation Fund.**

(1) Blog entry on Do Like Edu: http://unicefstories.org/tag/do-like-edu/

(2) http://icta.go.ke/digischool/

Rwanda

BACKGROUND

Rwanda is home to a strong and stable government and a fast-growing economy. It has a population of approximately 11.2 million, of which 40% are 14-35 years old. In education, there continued to be a strong focus on access to quality pre-primary education through the implementation of the country's first national preschool curriculum, design and construction of model facilities, teacher training and a costing study to advocate for increased budget allocations in this area.

UNICEF Rwanda and the Ministry of Education have identified improving learning outcomes and reducing dropout and repetition rates as key priorities for the sector. There is a national agenda for advancing ICT across all sectors, with a push to improve access to ICT in education. The government's focus is on: expanding access to ICT hardware, such as SMART classrooms, developing software to complement the national curriculum, improving the capacity of teachers and education officials to integrate ICT to improve the quality of education and applying ICT platforms to improve education monitoring. Key government partners for these initiatives are KOICA, JICA, UNICEF, UNESCO, MasterCard Foundation and the private sector in Rwanda.

UNICEF EXPERIENCE

While ICT is not a priority of the UNICEF education programme in Rwanda, UNICEF is supporting the Ministry of Education in a few areas. For example, as part of its work on improving learning for children at risk of dropping out, UNICEF and the Ministry are testing a remedial learning programme that uses tablet-based ICT applications to boost learning in English and mathematics for struggling learners at risk of dropping out (more information provided below). UNICEF is also supporting the Ministry of Education to improve its monitoring of education priorities using a real-time monitoring system. UNICEF also uses real-time monitoring in its own programme, through an innovative platform to gather data on programme implementation and impact.

OPPORTUNITIES AND CHALLENGES

Opportunities to advance ICT in Education expanding in Rwanda because of the strong political will in government to make Rwanda a hub for technology in the region. The government's Vision 2050 strategy provides a strong framework for advancing action.

However, many challenges remain. Connectivity and access to reliable electricity are key challenges that the government is working on with the private sector. Low capacity of teachers and education officials to integrate ICT in teaching and learning processes is also a challenge that government and development partners are tackling how the government and its partners are working hard to address these challenges. Resources for investing in ICT hardware and software are growing; however remain insufficient because of the high cost of ICT materials, the large need for materials and competing priorities in the education sector.

Mini Case Study: Learning Clubs

As part of its efforts to boost learning for struggling students, particularly girls, UNICEF Rwanda is supporting remedial learning clubs for students at risk of dropping out. The programme used an innovative club-based model, based on a catch-up curriculum, developed in partnership with REB, teacher training on gender-responsive pedagogy, and an ICT platform intended to enhance children's learning through play.

They are now in the process of mapping all open source learning apps onto the grade levels/subjects being targeted to help improve the curriculum. This catalogue of learning apps would have implications and impact beyond the Remedial Clubs, by sharing with teachers in other parts of the education sector.

Part of the mapping is identifying gaps where there isn't an appropriate app to compliment the curriculum. The aspiration is to partner with technology companies to fill these gaps by developing apps to give over to the government.

The initiative is being piloted in an initial 20 schools, with the intention of being scaled up to 250. The government is playing a validating role (both of ICT and curriculum), with Imbuto (a local NGO) working at the school level to train the teachers in the facilitation of the curriculum.

Major learnings from Learning Clubs:

- **When you change the teaching methodologies through ICT, you need to work with Head teachers and inspectorates as well as teachers.**
- **The remedial curriculum hopes to improve literacy and numeracy skills (especially for girls), but also enhance self-esteem in girls. The learning apps offer an alternative learning experience for those learners who haven't benefited from traditional classrooms.**
- **It was important to know where the value was being added. The Remedial Clubs identified the target group of children who are already underperforming, and develop a rationale that the traditional teaching and learning methods weren't effective for them. The learning apps offer different approaches, rather than just rely on replicating what's happening in the classroom.**
- **Teachers are not necessarily receptive to the fact that their teaching methods aren't always sufficient. It's been critical to work at the school level to sensitise them to the programme, and help them see the value.**
- **In trying to work with technology companies, there was difficulty in costing a consultancy without a) the expertise to navigate the business aspects (e.g. licences, user fees), and b) a long-term financial commitment from government. Many companies wanted to host the apps on their servers, incurring a fee. This didn't align with UNICEF values of open source, and not-for-profit.**

Sierra Leone

BACKGROUND

Sierra Leone is a low-income, emergency prone country with a population of approximately 7 million, of which 70% are living in poverty. The country is responding to a series of humanitarian crises: the Ebola virus outbreak; measles outbreak; and floods in the northern districts and the western area, implementing the President's Recovery Priorities.

Despite this crisis-laden picture, ICT for learning plays an important role in both the National Curriculum Framework and Guidelines for Basic Education (2015), and Education Sector Plan 2018-2020, as emphasis is placed on mainstreaming ICT Literacy in Sierra Leone's education system. A step towards this integration has been the development and validation of the ICT syllabus in 2017. The drive for the introduction of ICT for learning has been Sierra Leone's recognition that children are growing up in a world where technological competence and ICT literacy will be imperative for developing the skills needed for future life and work.

UNICEF EXPERIENCE

UNICEF Sierra Leone is supporting the use of an education management information system (EMIS) and situation room, which increases access to timely and reliable data from 5,487 schools. RapidPro was deployed to collect and share the information on monthly school-level indicators, and to better inform policymaking and programming.

OPPORTUNITIES AND CHALLENGES

The Ministry of Education, Science and Technology (MEST) expects that including technology and ICT literacy in basic education will empower learners with the foundational competencies needed for a variety of occupations. Furthermore, ICT skills will enable students to apply for more jobs in business, engineering and education, as well as encourage various life skills such as personal development and entrepreneurship.

The Education Sector Plan 2018-2020 proposes that an on going technology strategy will help bridge some of the learning gaps for students in areas struggling to access good quality teaching and learning with more ICT platforms. However, the intention is not to replace the teacher or make them redundant, but rather to augment and provide the teacher with additional tools for teaching and learning.

Mini Case Study: RapidPro in Sierra Leone

RapidPro is an open-source platform of applications that can help governments deliver rapid and vital real-time information and connect communities to lifesaving services. Produced by UNICEF's global Innovations Labs in collaboration with Nyuruka, a Rwandan software development firm, and drawing on eight years of experience with SMS-based applications, RapidPro is already being used in several countries.

Initially, RapidPro was used in Sierra Leone to engage individuals using phones, and was deployed during the Ebola emergency. Recently, it has been used to review the opening of over 2000 schools based on nine indicators for readiness. UNICEF Sierra Leone worked with the ministry to develop a more systematic use of the technology, by which Community-based monitors would attend local schools to gather data such as student and teacher enrolment, and the physical and WASH state of the school. The data would be collected, processed and analysed by districts to identify any gaps.

UNICEF Sierra Leone also worked with district officials to adapt the platform by changing the questions to enable them to carry out other rapid assessments. Data is currently captured on nearly 6000 schools per month.

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Schoolchildren at Binga Primary school take time to familiarise themselves with computers at the school.(Tsvangirayi Mukwazhi/UNICEF)

South Africa

BACKGROUND

South Africa is an upper middle-income country, with a population of approximately 54.5 million and a net attendance ratio in secondary education of 88%. UNICEF South Africa has three programme pillars: early childhood development; ending violence against children and supporting results for adolescents. UNICEF South Africa and Department for Basic Education (DBE) recognise low learning outcomes, linked to poor quality teaching, inadequate or no access to psycho-social support and accountability of the education system (including teacher time on task) as some of the major issues within the sector. The different affordances of ICT is seen as a lever to offer differentiated and personalised learning to children, and to advance digital and tech skills (coding, robotics, social media), but equally recognises poor maintenance as a risk to investments, as well as inadvertently promoting inequality rather than reducing it.

UNICEF South Africa report a national focus on teacher and school leadership development, and a huge appetite and commitment for the systematic use of ICT in education. The South African government has written the role of ICT in learning into the Education Action Plan to 2019: Towards the Realisation of Schooling 2030 (a roadmap for education). It has been integrated into the policy framework in theory, but the extent to which ICT for learning is used in practice is uneven. This is in part due to South Africa's semi-federal system and the resultant problem of concurrent functions. While some initiatives are developed nationally, provinces are doing the same. Provinces have some autonomy to reject national initiatives, which can result in gaps and/or duplication.

UNICEF EXPERIENCE

UNICEF South Africa see ICT for learning as a continuum which is constantly evolving, and capable of solving real-world problems in education. UNICEF South Africa recognise that governments need to work more vigorously on partnerships that take certain aspects of e-education forward or target particular disadvantaged areas. For more widespread and sustainable development to occur, government and other stakeholders will need to strengthen the research and monitoring capacity in e-learning, as well as the overarching policy frameworks. Furthermore, investment cases for technology, compared to other interventions and inputs into the system must be developed.

OPPORTUNITIES AND CHALLENGES

UNICEF South Africa is working to support the government to build the capacity of teachers, but at the same time an appetite needs to exist within the education system. There is a recognition of an opportunity in the listing of competencies teachers should have in relation to digital learning, within a professional framework for digital learning that has been developed as part of the Integrated Strategic Planning Framework for Teacher Education and Development.

UNICEF see an opportunity in private technology providers driving change rather than education systems themselves – there is no sophisticated theory of change. Technology evolution is outpacing education uptake, and providers must distinguish between uptake and engagement. Initiatives need regular updates, but South Africa has a problem with connectivity, which poses a huge challenge and could create inequalities in the system: data costs are high, and the poor cannot afford the high charges. Until these issues are solved, it is not feasible to tell people to be online. Investment cases need to be made clearer, as do the upfront and on going costs of the technology.

Mini Case Study: Ukufunda Virtual School

The Ukufunda Virtual School (or UVS) is an innovative m-learning service, conceptualised in 2013 and launched in September 2014 by a partnership comprising the South African Department of Basic Education (DBE), UNICEF SA, and the Reach Trust (formerly known as Mxit Reach). It was the DBE's first attempt to develop and mobile-learning portal. The UVS was a portal that uses a social-networking platform (Mxit) to provide access to learning resources and content, counselling and safety services and other value-added services and programmes via mobile technologies. The platform aggregates pre-existing learning and psychosocial applications ('apps'), but also new, bespoke apps developed specifically for the UVS. The UVS made applications available to users through three views: a learner view, a teacher view, and a parent view.

The UVS was unique because it allowed accessibility and support across 8,000 mobile devices (feature phones and smartphones), and reached remote areas where only 2G connectivity is available, thus incorporating a strong equity focus. It was initially intended to support secondary school learners only, but its focus expanded to include support for teachers and parents.

Major learnings from UVS:

- **Technology moves quickly. The initiative was originally intended for feature phones running on 2G. By the time the initiative launched, most people had switched to smartphones (only 30% of the sample used feature phones). Similarly, during rollout, most users stopped using Mxit in favour of Whatsap as a communication tool.**
- **The technology provider drove the initiative, rather than the education system. There was a real need for people on the team who have an extensive understanding of both.**
- **Lacked a coherent Theory of Change and investment case. The Theory of Change developed should be specific about the target audience and focus of the initiative, ensuring that this is kept tightly defined to increase the prospects of successful implementation.**
- **BYO-Data and device services exclude vulnerable audiences and widen the inequality gap.**

South Sudan

BACKGROUND

South Sudan is a country with a fragile context and governance challenges which necessitate adaptive programming. There are approximately 1.76 million internally displaced persons (IDPs) in South Sudan, 2.45 million South Sudanese refugees in neighbouring countries and 5.1 million South Sudanese who are food insecure.

Average literary rates among the South Sudanese population are very low at 27%, with over 2 million children out-of-school. This figure is the highest in the world, with a disproportionate number of those being girls as a result of rising rates of childhood marriage, unwanted pregnancies, and the on-going conflict that has exacerbated the situation with the serious economic hardships families face. Teachers are often untrained, their status has declined in the last decade, and the government is struggling to pay their salaries which are already exponentially low due to rising inflation in the last two years. The value of education isn't widely accepted, with many South Sudanese prioritising joining armed groups and small-scale agriculture/farming, though insecure environments pose substantial threat to farmers in many parts, forcing the population to abandon their farms.

ICT for learning is somewhere the Government want to get to – the education minister Hon. Deng Deng Hoc Yai wants each child in South Sudan schools to have an iPad and the new curriculum to be digitized– but right now it is not a priority. This is a country in crisis.

UNICEF EXPERIENCE

UNICEF South Sudan are focused on children, especially girls, and teachers. They are providing access to education in emergencies (risen from 39 to 49% of the 500,000 target) through temporary learning spaces (TLS); teacher training; a parent teachers' association (PTA)/school management committees' (SMC) school development plan; psychosocial support; pedagogy; strengthening capacity of school inspectors, supervisors and education managers; supply of scholastic materials; and strengthening coordination. Their key interventions focus on mass distribution of assorted education supplies, including textbooks to the improve quality of teaching and learning in schools and access through TLS (more than 240,000 children were reached – 38% of which were girls).

UNICEF, in collaboration with the State Ministry of Education, Gender and Social Welfare, celebrated International Women's Day on 8 March in Pibor, Yambio and Torit. The event is one of the strategies used to sensitize communities and promote girls' education as part of UNICEF South Sudan's wider Back To Learning (BTL) national campaign. In partnership with the Association of Christian Resource Organizations Serving Sudan (ACROSS), the State Ministry of Education, with support from UNICEF, completed a five-day training of 20 (three women) Early Childhood Development (ECD) facilitators in Lakes State. The training has enhanced the capacity of facilitators to effectively manage ECD classes.

(1) https://www.varkeyfoundation.org/what-we-do/programmes/making-ghanaian-girls-great/

(2) https://vimeo.com/117278962

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OPPORTUNITIES AND CHALLENGES

UNICEF South Sudan see the development of the first South Sudan curriculum as an opportunity. Textbooks are being developed – due in 2019. There is an aspiration to digitalise these textbooks, because of the risk that schools might be burnt down during unrest. Expanding access to learning beyond school through technology is an opportunity, as children and young people often don't go to school because of security risks - looting is a serious risk to schools. However, this comes with the daunting challenge, ranging from lack of basic infrastructure (classrooms to host ICT) to limited or no exposure of teachers to ICT training.

Private and missionary schools fully funded by organisations are more likely to have laptops/desktops in their schools, but there won't be any in public schools, even in town areas. Security fears and budgetary constraints are too high. The priority is keeping teachers in their jobs and keeping the system standing.

UNICEF South Sudan appreciates that ICT for learning has a role to play and are open to learning from similar contexts in the medium term on how ICT is meaningfully introduced into the education system. The country office team are considering how they might test out ICT in very small-scale pilots, including learning through mobile phone initiatives, or kindles for reading, but the humanitarian response to the crisis is the priority for now.

Mini Case Study: Mobile School Report Card (MSRC)

In 2011 Ghana introduced a paper-based report card policy, that sought to help schools to collect reliable data. In 2014, UNICEF Ghana Country Office began working with the Ghana Education Service on a digital version of this policy called the Mobile School Report Card (MSRC) that was a way of providing real-time data via an android-based app, downloaded from Google Play.

MSRC is currently operating in over 1,500 schools across 20/216 districts in Ghana. The indicators are in two categories: those that render themselves to weekly, and termly data collection. The head teacher inputs data every week, and that data is verified at a circuit/cluster level and at district level. The data of schools participating can be viewed on an online platform. It can give you school data on teacher and student attendance for that particular week, teacher preparation (did a teacher prepare lesson notes). Data on school amenities i.e. functionalities of their facilities is collected termly.

The data is uploaded to a web-based platform, which displays the data as a dashboard, which can be accessed at circuit, district, regional and national levels. MSRC is a management tool and not for classroom pedagogy, though it tracks teacher preparedness.

Learnings from MSRC:

- **When introducing the programme, key decision makers needed to see the value in the technology. It has to enhance their work. A case for change helped to reduce resistance and resolves any negative attitudes towards the technology. Now that they appreciate the value of the report card, decision makers are willing to pay for the mobile data themselves, rather than asking UNICEF to pay for it. They own it as a solution.**
- **Compliance was a motivating factor. There is a perception that the headquarters is watching - district director of education can easily go online and see how teachers are performing. They know that this online technology provides transparency/accountability.**
- **It was also recognised that there was a digital literacy gap that needed bridging. The targets were head teachers, and many didn't have the technical computer skills and knowledge to adopt. During the training, they asked head teachers to come with a teacher who is tech-literate, to help them use the tablets.**
- **One of the key challenges has been poor Internet connectivity in some regions. Penetration of mobile phones is very high in Ghana, but connectivity in remote areas is poor (which tends to be where UNICEF works). MSRC is in 20/216 districts, reaching over 1,500 schools.**

Uganda

BACKGROUND

Uganda is a stable, low-income country, with a population of approximately 34.6 million, of which 55% are under 18 years old (2016). UNICEF Uganda are Chair of the Basic Education Working Group, assuming the role of coordinating agency for Global Partnership for Education (GPE)-funded interventions and advocating for a comprehensive reform of the education sector. In response to our survey, low quality teaching was identified as the core problem facing the sector. UNICEF Uganda see ICT for learning as an opportunity to offer personalised learning and access to broader curricula to the children of Uganda, but recognise new forms of child abuse, inequality in digital skills and the poor maintenance of technologies as critical risk factors.

UNICEF Uganda report the focus of the Ugandan Government to be on the enhancement of basic skills (numeracy and literacy), with a growing ambition to improve STEM subjects and skills in preparation for digital economies and competitive job markets. The Ugandan Government have provided some computers to secondary schools, but with no guidance or guidelines for use. There is an emerging appetite amongst universities and colleges to revolutionise education through ICT for learning.

UNICEF EXPERIENCE

UNICEF Uganda has been working with communities to change perceptions of technology by explaining and contextualising the benefits it could have on both schools and the community. The want is to empower government and communities to take ownership of the technology – they do not want to introduce initiatives that are going to remain UNICEF initiatives.

The office is ensuring that the focus is placed on the environment and infrastructure where the technology can thrive (e.g. teacher and student attitudes, investment in hardware, electricity, access for all students), rather than a pure focus on the technology itself.

OPPORTUNITIES AND CHALLENGES

UNICEF Uganda sees a number of opportunities in ICT for learning. For instance, there is a growing demand from teachers who want access to specialised training courses, especially since the rise of MOOCs means there are lots of free, open-source content that is available. Furthermore, UNICEF has found health and youth related issues across their sectors, so this could be an avenue for providing the right information to communities through technology.

UNICEF is working with 'Champions' - a network of teachers who are skilled in ICT - to help shift attitudes and practice. They are engaging teacher colleges to prepare the next generation of teachers for technology by showing them what's available. It is believed that technology can be a game changer when it's free, available offline and the user is empowered. It can also be holistic, offering learning for students, teachers and the community.

UNICEF Uganda recognise that partnerships need to be extended to the private sector and work with these groups to fill infrastructure gaps, however UNICEF are not prepared for this aspect at this time.

UNICEF Uganda do recognise that limited connectivity is a challenge, and software installation relies on the availability of hardware and full hardware functionality e.g. access to video, maintenance, and upkeep. Capacity levels in ICT are fairly low - in some areas they are non-existent - and teaching quality remains a challenge. Furthermore, additional costs such as licensing fees and the lack of contextualised content are obstacles to overcome.

Mini Case Study: Kolibri

Uganda are piloting a 6-month e-learning initiative in an effort to encourage schools and communities to make use of computers provided by the government in 2013. UNICEF are installing the digital platform 'Kolibri' which contains curriculum aligned e-learning content and programmes that teach basic life skills, as well as providing training to teachers and students on how to use it. The initiative is being rolled out across 30 government-aided schools and public spaces such as youth centres and refugee settlements. The tool has been well received because it is free to use and easy to install - it doesn't require an extensive ICT background. Going forward, UNICEF want to build a foundation for scale over the next 5 years. To do so, they must fully engage government and the MoE to take ownership of the tool. At a district level, they are talking to local government officials to sensitise them about the benefits of e-learning and address their concerns (e.g. inappropriate content).

Major learnings from Kolibri:

- **Within the community, Kolibri has been broadly more accepted in youth spaces, as schools tend to be viewed as formal, cultural institutions.**
- **Implementation partners have been critical to the success of the pilot. They have extensive experience in working with adolescents in promoting ICT skills. Implementation partners travel to schools, youth centres and refugee settlements to train users on how to use and integrate Kolibri into learning activities. Similarly, government buy-in is fundamental. Without it, people fail to get excited about it; it loses importance.**
- **Some work needs to be done on the design to make it more appealing to young people. Most of the content has been reviewed by UNICEF and the government to ensure it is appropriate and aligns with the curriculum. However, not enough content is targeted towards an African context (predominantly US). Young people want to see their local context in the learning content, but the capacity for this is low and expense high.**
- **Innovation in developing countries must look at solutions that take into account limited connectivity. There needs to be an offline option. Kolibri is designed for low resource communities. It is an open-source, offline platform and runs without Internet (but is also available online).**

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