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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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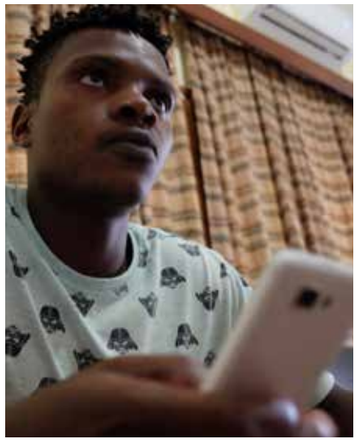

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Schoolchildren at Binga Primary school take time to familiarise themselves with computers at the school.

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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.

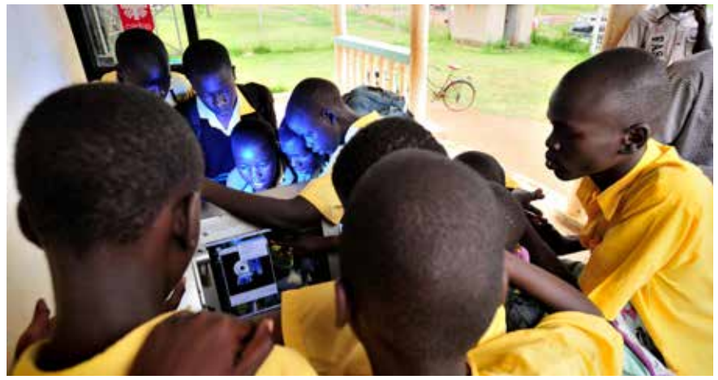
For instance, a computer-assisted learning (CAL) programme in India, which used mathematics software that allowed children to learn at their own pace, increased math scores by 0.35 standard deviations the first year, and 0.47 the second year, and was equally effective for all students[27]. Importantly 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:

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"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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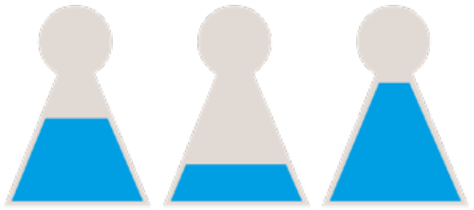
"Teachers and schools can make a difference for students who lack the cultural and social capital that will allow them to benefit from the use of digital media in a way that is significant for their educational performance. If teachers and schools fail to acknowledge this second digital divide, and act 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.

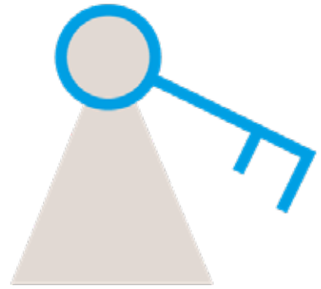
The introduction of ICT for learning into classrooms and schools is frequently disruptive to the professional identity of teachers. Beyond the obvious and unhelpful pitting of technology against teacher, the traditional role of teacher as the 'expert' is often challenged in the examples we have seen,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

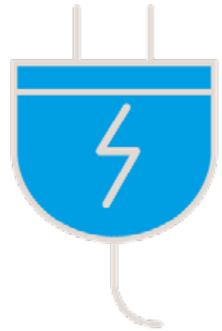
For more, see Appendix II

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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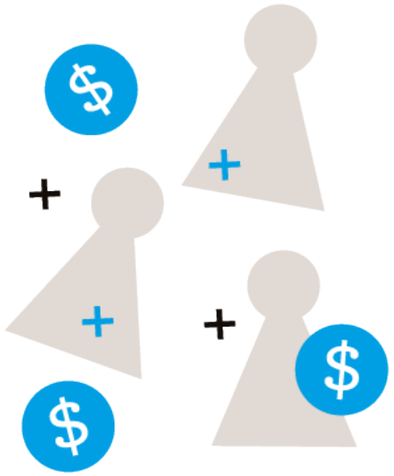
8 Resources

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.

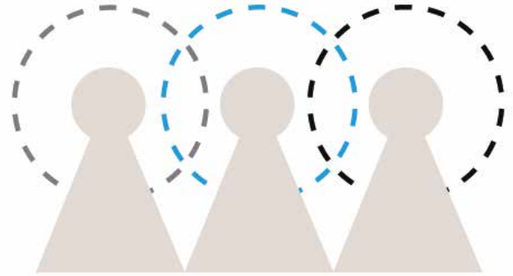
Key takeaways:

- 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.**

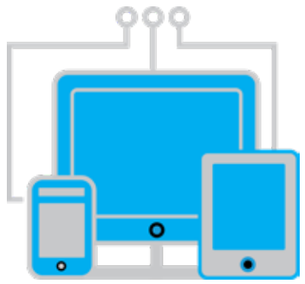
Building the knowledge and confidence of ICT for learning across the region

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

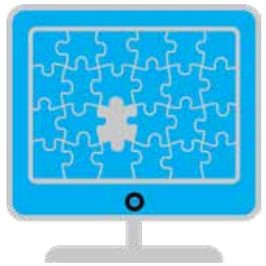
To mobilise a real sense of practical possibilities within the ICT for learning landscape, UNICEF should consider how best to move from knowledge to action. As an influential international agency, UNICEF is in a position to inject a growing understanding of the opportunities and challenges of ICT for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

(78) 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.

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

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