THE FUTURE OF LEARNING AND TECHNOLOGY IN DEPRIVED CONTEXTS

A report for Save the Children

Tim Unwin, Mark Weber, Meaghan Brugha and David Hollow

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EXECUTIVE SUMMARY

This report addresses the future of basic education, ICT use in deprived locations, and the use of ICTs in primary school learning in 2020 and 2025, especially in deprived contexts. It draws on research evidence from the literature, the authors' experiences of ICT use in education initiatives, interviews with practitioners and academics, a workshop, and consultations with Save the Children staff from many different countries, mostly conducted in August 2017.

Drawing on existing work at the interface between ICTs and education in deprived locations, the following predictions are probable for the future of ICT for learning:

- There will be considerable further divergence in the use of ICTs in classrooms, both between different countries, and also within them;
- Changes in school systems will encourage greater use of technology throughout education;
- The role of teachers will evolve so that they will work in very different ways in the technologically mediated school systems of the next decade;
- There will be a different combination of digital content and devices than that which is found at the present;
- ICTs will play an increasingly important role in assessment, and the data produced will enable more refined approaches to individualised learning; and
- The role of parents and communities in helping children gain learning experiences will increase.

In low-income and peripheral areas, a further five observations seem likely:

- There will be an increase in the number of innovative ICT solutions available and it will therefore be more difficult to identify what works best where;
- More people will be sharing devices to gain access to information through the Internet;
- Digital multi-purpose hubs will still be used to provide access to connectivity and learning in the most marginal areas;
- Caching online content for use offline will be an important means for people to access information in peripheral areas; and
- There will be an increase in the amount of non-formal and informal learning among people of all ages, especially in low-income and peripheral contexts.

In crisis-affected areas, which the report differentiates into short-term acute crises and long-term prolonged crises, the following also seem likely:

- Mobile communication and information gathering will be increasingly important for people forced to move as a result of crises;
- Digital online and offline solutions will increasingly be available for trauma and psycho-social counselling;
- Greater relevant content in local languages will be available for use in crises contexts;
- Emergency digital "schools-in-a-box" will be made available to most victims of short-term crises;
- Digital learning hubs will be prominent in refugee camps during protracted crises; and
- Hybrid cultures of learning will be supported that combine the cultures of hosts with those of refugees.

The expansion of ICT use in education nevertheless also gives rise to greater risks, particularly for children interacting online, and also for the organisations implementing such programmes. Much greater effort also needs to be spent on delivering effective monitoring and evaluation of such programmes, so that lessons learnt about what works best where can be shared in the interests of the most deprived children.

The report concludes with recommendations for Save the Children's education programmes and advocacy. For programmes, the most important of these are that:

- All ICT for education programmes should ensure that they begin with a holistic view of education, and only then identify the most appropriate technologies to support their delivery;
- There needs to be greater focus in programmes on using ICTs to enhance and support teacher training, rather than just provision of technologies in schools;
- ICT for education programmes should be designed at scale, with fewer small scale pilot projects being supported;
- In the short-term especially, there should be greater focus on technologies that are well-established, rather than on digital experiments with vulnerable children;
- The indirect educational benefits of wider ICT initiatives in deprived locations should be explored as effective ways of delivering educational outcomes;
- Child Online Protection should be of the highest priority in all ICT-based educational activities.

In terms of advocacy, the following should be of the highest priority:

- Advocating that ICTs are not a solution to educational change by themselves, but instead need to be incorporated into structural changes in pedagogy and curriculum design;
- The use of language matters – the main focus should be on learning rather than on the ICTs;
- Access to connectivity is indeed important, but it is only part of the solution; and Much more needs to be done to protect children online.

ACKNOWLEDGEMENTS

We are very grateful to the many people who offered advice and shared their ideas with us as we compiled this report. They are all listed in Annex 2, and we hope that they do indeed recognise their contributions in what we have written. We are also particularly thankful to Ken Banks and Mike Trucano who read and commented on a draft of the full report, and many of whose suggestions we have included in this final version. We nevertheless take full responsibility for the predictions and recommendations contained in this report.

Tim Unwin, Mark Weber, Meaghan Brugha and David Hollow

1. CONTEXT AND DEFINITIONS

This report explores likely scenarios for the use of Information and Communication Technologies (ICTs) in basic education and learning in contexts of deprivation over the next decade. The introduction provides a short overview of the terms of reference, a note on definitions and an outline of the methodology.

It is underlain by two important tensions:

- First, technological innovation is currently extremely rapid, at a time when change in the education sector remains painfully slow. This creates interesting tensions at the interface between education and technology, and has encouraged many people designing educational initiatives to explore how new technologies might be introduced to effect change in educational systems. Our report suggests in contrast that it is first essential to address questions around the sort of education that communities want, and only then should the most appropriate technologies be identified to help deliver it.
- Second, absence of technology is itself a measure of deprivation. As digital technologies become ever more pervasive, those places and people without access to ICTs, and the necessary infrastructure, notably electricity, that is necessary to support them, are going to become increasingly deprived. Hence, the most deprived will often actually be those with least access to technology. This report therefore also focuses briefly on the indirect mechanisms whereby ICTs may be used to enhance their learning.

Terms of reference

This report explores the future of technology in primary school learning and basic education in deprived contexts, both in the short term (up to 2020) and in the medium term (to 2025). It does so through an analysis of literature and consultations on three themes:

- The future of primary school and basic education learning, focusing on basic education in general, and especially in circumstances of deprivation;
- The future of ICT use in deprived locations, exploring how children access information, and what technologies will be in use; and
- The future of ICT use in primary level learning in low-income and crisis affected location, addressing the implications of the rapid evolution of ICTs for learning in contexts of deprivation.

These are used to provide a series of policy and practice recommendations for Save the Children to consider with respect to the use of ICTs in basic education for the most deprived children.[1] The report is supported by six case studies of ICTs and education in contrasting contexts.

Definitions

ICTs are an omnipresent part of the lives of at least half the people in the world, and this will be true for an even higher percentage of the world's population by 2025. Increasingly, therefore, it no longer makes sense to speak about specific technologies for education and learning, but instead it is important to focus on how people gain the skills and knowledge necessary to enjoy life to the full and gain a livelihood. By 2025, this will increasingly be through a diversity of ICTs, including search engines, social media, the Internet of Things (IoT), online learning, and artificial intelligence (AI).

There are complex debates around the meanings of many of the terms associated with education, deprivation and ICTs, and by preference the report draws on Save the Children's evolving definitions. Five concepts require particular clarification: primary schooling and basic education; the difference between education and learning; deprivation; literacies; and ICTs. The use of each of these in the report is described in Annex 1.

Methodology and report structure

Methods

The report is a synthesis of findings from four main methods. First, reviews of recent literature on basic education, and ICT use in education were undertaken, with annotated summaries of some of the most important recent relevant resources being provided in Annex 3.

Second, much of this literature is insufficiently forward looking for the purposes of this report, and a workshop was therefore held to bring together 29 practitioners and academics from 9 countries (Annex 2) working at the interface between technology and education to seek consensus as to the most likely scenarios that will emerge over the next decade.[2] The outputs from this guided the structure of the themes that are summarised in this report (see Annex 5 for detailed workshop outputs)

Third, one-hour interviews were held with 32 people with direct experience of the use of technology in education and especially in low-income and crisis affected areas, as well as a further 9 Save the Children staff (Annex 2).[3] They were asked a series of questions about education, the deployment of ICTs in deprived areas, and the use of ICTs for education in low income and crisis affected areas.

Finally, two 90-minute consultations were held with 22 Save the Children staff from 12 countries to explore the implications of our emergent findings for children's learning in general and Save the Children's programmes and advocacy in particular (Annex 1). This was particularly valuable to enable them to contribute their thoughts to the report, to validate emerging ideas, and for

Save the Children to develop some ownership of the conclusions. As Annex 4 shows, there was overwhelming support for the emergent findings, with participants thinking that almost all of the predictions were either likely or very likely to occur by 2025.

Approach and report structure

It is impossible to predict anything with certainty. This is especially so given the rapidity of innovation in the ICT sector, although the slowness of change in the education sector make predictions relating to learning more reliable. This report identifies the most important current trends in basic education and ICTs, and weighs up the likelihood that they will continue through to 2020 and 2025. It then explores scenarios for possible ICT use in delivering basic education to deprived children, supported by example case studies from six contrasting locations: Colombia, Grenada/Solomon Islands, Jordan, Pakistan, Somalia, and the UK.[4] The next section examines some of the risks associated with the use of ICTs for delivering basic education in low-income and crisis-affected locations, focusing both on potential risks to educational programmes, and also the various risks associated with children's uses of ICTs in general. This section also highlights the risks of not undertaking appropriate monitoring and evaluation for all such initiatives. The penultimate section of the report summarises the implications of the review for Save the Children's advocacy and programmes on the ground. A conclusion draws together the findings, highlighting the overarching themes that emerge from the analysis. Each prediction is grounded in the data gathered through the methodologies noted above. Specific predictions are not attributed to individual contributors in order to maintain confidentiality and enhance the flow of the report.

JONATHAN HYAMS/SAVE THE CHILDREN

2. THE FUTURE OF PRIMARY SCHOOL AND BASIC EDUCATION LEARNING IN 2020 AND 2025

"Ignorance is even more expensive than education"

(Lord Avebury, 1909)[5]

Context

UNESCO's review of achievements in education between 2000 and 2015 makes challenging reading; 2000 was the year of the Millennium Development Goal (MDG) commitments as well as the Dakar Framework for Action to achieve Education for All, and 2015 was the year by which they were meant to be achieved.[6] Despite some significant progress, the education targets were not met. In 2015, education remained seriously under-funded, 58 million children were out of school globally, 100 million children did not complete primary education, the poorest children were four times more likely not to go to school than the richest, and the poor quality of primary level teaching and learning meant that millions of children left school without basic skills.[7]

The Sustainable Development Goals (SDGs) announced in 2015[8] now provide an overarching framework for addressing global education challenges. Regardless of whether the SDG targets will be met, it seems probably that there will be slow and systemic change within most education systems. It is likely that more people will have access to better quality learning opportunities by 2025. However, there will be rather little substantive change by 2020; evidence of new policies would already have to be apparent for that to be achieved.

There is strong unanimity among those consulted for this report about the main changes in basic education that they hope will happen by 2025. However, there was recognition that unless fundamental changes take place in the wider social, political, economic and cultural contexts in which education and learning occur, the pace of improvement is likely to remain slow.

Nine changes in basic education by 2025

1. Continued slow pace of change in education

There will be change in education systems across the world, but this will be slow. Unlike health systems, where inoculation campaigns can swiftly contribute to eliminating diseases, there is no simple and swift inoculation for ignorance. Change is most likely to happen either in richly resourced countries with visionary political leadership, or in crisis situations where an education system has completely failed and requires rebuilding from scratch.

Finland represents one encouraging example of the former, where a new curriculum was introduced in 2016, in which "the focus is on transversal (generic) competences and work across school subjects. Collaborative classroom practices, where pupils may work with several teachers simultaneously during periods of phenomenon-based project studies are emphasised".[9] This was done explicitly in order to meet what the government's perceived as being the challenges of the future.

2. Increasing diversity and inequality in learning

Despite change in education only being slow, it seems likely that the structures currently in place will lead to increasing diversity and inequality in basic education provision. Rich, privileged children, often privately educated at considerable cost, will have well paid, highly trained and enthusiastic teachers, who will use innovative and creative curricula and resources to provide high quality and relevant learning for children (see UK case study). Most state-funded education systems, especially in low-resource contexts, will remain constrained by resources, class sizes will be large, stressed teachers will be inadequately trained, there will be insufficient appropriate content, assessment systems will dominate approaches to learning; children may be able to regurgitate sufficient accepted knowledge to pass examinations, but they will continue to learn in ways that are inappropriate to their needs, and the needs of societies, in the next decade.[10] This disconnect is exemplified by an ambitious new K-12 basic education reform programme launched in the Philippines in 2015, despite claims that there are serious "electricity and water supply problems in hundreds of public schools" and that the programme will not succeed unless these core problems are first resolved.[11]

The most marginalised will continue to be unable to, or prevented from, going to school (see Pakistan and Colombia case studies). Children with disabilities, girls in intolerant patriarchal societies, and those who have to earn money for their families to survive, will continue to experience learning on the streets or in their homes much as they do today.

3. Increasing advocacy about the importance of qualified teachers

UNESCO's review of progress between 2000 and 2015 notes that in one-third of countries with data in 2015 less than 75% of primary school teachers were trained up to national standards.[12] Most of those consulted for this report therefore argued strongly that well trained teachers will remain essential for the successful delivery of education at all levels in both 2020 and 2025, from pre-school, through primary and secondary, to higher education.

It is therefore remarkable that many national educational initiatives, especially those using ICTs, still place their main emphasis on schools rather than on teacher training. The logic for placing more emphasis on pre- and in-service training for teachers is convincing, because a single teacher at primary level will have an impact on many generations of children. Much can be done with effective school-based mentoring to enhance and support in-service training for poorly qualified teachers. It therefore seems probable that much more emphasis will be placed in 2025 than it is now on raising the quality, profile and status of teachers, as well as doing more to retain them in the profession.

4. Increased advocacy for fundamental curriculum and pedagogical change

Teacher training is likely to be combined with fundamental curriculum reform and associated pedagogic change. Most commentators hope to see education systems that are student-centred and more closely aligned with children's lifelong needs for employability. Teachers will be encouraged to move away from being perceived as the sources of all knowledge to being facilitators who inspire children and guide them towards new ways of thinking and learning. One interviewee went even further and commented that teachers should not even be facilitators or guides, but rather friends who walk alongside children in their learning experiences. Another summarised this change well, arguing that there needs to be a move away from the three Rs of "reading, 'riting and 'rithmatic" to the four Cs of "creativity, collaboration, critical thinking and communication". This, though, is likely to create fundamental challenges in many societies, and will require careful handling so that teachers do not feel undermined in terms of their status and roles.

5. Increased diversity of content provision

By 2025 there will be much greater diversity of content provision, and the precise balance between different types and sources of content will vary considerably in different countries. Two related tensions can be recognised: between global and local content; and between proprietary and open content.

Global corporations may well become more dominant by 2020, providing uniform content that is seen as being essential for all young children to know in global languages. In some places where there is sufficient demand this will be re-versioned in local languages. However, ongoing efforts to develop original local content in indigenous languages, often supported by donors and NGOs is also likely to become more common (see Solomon Islands case study). The Open Education Resource (OER) movement has not yet broken through into mainstream provision of educational resources at primary level,[13] although many initiatives are encouraging teachers to share lesson plans online.

There will be many more types and sources of ICT-based learning resource available in 2025. Digital resources are likely slowly to replace books and paper, and the role of video and digital games will expand universally.

6. Increased emphasis on life-long and non-formal learning

The widespread recognition that much education is delivering neither on the employment needs of economies, nor the social and cultural needs of young people will lead to much greater emphasis on life-long learning and the full continuum of education including non-formal learning.

The important objective for childhood learning will be to give children the foundational skills to be able to learn creatively for themselves in the future. Non-formal learning, and learning that takes place out of school will become increasingly recognised,[14] with new types of certification being developed to measure and reward this. Young children will have the potential to learn wherever they are, not only in schools but also in the fields where they help sow and harvest, or on the streets where they work for a living.

7. Increased implementation of a holistic approach to learning

If education is to be improved, it will require the adoption of a more holistic approach, both in terms of overall national strategies, and also in recognising the importance of communities in supporting learning. Governments have a fundamental role in resourcing and supporting learning appropriately for all people and throughout their jurisdictions. However, most of those interviewed for this report also emphasised the very important role that parents play in encouraging critical thinking and an open approach to their children's learning. It may well be that by 2025 greater attention to lifelong learning provision for parents, particularly in deprived contexts and among women, will have a significant indirect impact on the learning of their children.[15]

8. Increased role of the private sector in delivering education

The current trend whereby global private sector corporations have been contracted by governments to deliver low-cost education in countries such as Pakistan,[16] as well as in India, Nigeria and East Africa,[17] is likely to continue certainly until at least 2020.

However, serious and growing criticism of initiatives such as the Bridge International Academies[18] highlights the very real problems with many such private sector initiatives, and it may be that by 2025 some governments will have realised that appropriately funded state-run education can deliver better outcomes in the interests of all of their citizens. Caution will certainly be required when civil society organisations choose to embark on close collaboration with the private sector in delivering education for children in deprived contexts. Nevertheless, it will be recognised that micro- and local-businesses can both contribute to and benefit from such engagement.

9. The all-pervasive role of technology

There is no doubt that technology will play a rapidly increasing role throughout basic education in the future. Many primary children are already accessing learning through ICTs (see especially case studies of Colombia, Jordan and UK), and many ICT-based assessment systems in 2025 will still be based on the "learn and regurgitate" mentality that dominates much education. However, the mass availability of information online will lead to the development of new assessment systems that place the emphasis on skills other than memory. It may well be that by 2025 many traditional literacy skills will also have become replaced by technology, so that children do not have to learn to read and write and will simply speak and listen mediated by ICTs; where necessary, text-speech systems will enable such conversations to be recorded in traditional text format, and indeed in different languages.

3. ICTS IN DEPRIVED LOCATIONS: 2020 AND 2025

"The Internet will disappear... you won't even sense it, it will be part of your presence all the time"

(Eric Schmidt, Executive Chairman, Google, 2015)[19]

Context

Eight years ago, few people had imagined the dramatic impact that mobile broadband, cheaper devices and more affordable connectivity would have on the world today. In eight years' time, there will be a commensurate change in the character and impact of ICTs. However, drawing on existing trends it is possible to make some broad generalisations about the extent and character of the digital world.

The ITU's latest facts and figures provide a snapshot of ICT use across the world in 2017[20]: young people are at the forefront of Internet adoption, with 70% of the world's population between 15 and 24 now being online, although in Africa this figure falls to 40%; 84% of households in developed countries have Internet access, but only 43% do so in developing countries, and a paltry 15% have access in the least developed countries; the gender gap in Internet use in developed countries is only 3%, but in the least developed countries it is a staggering 33%, and it has increased in recent years; mobile broadband subscriptions remain twice as high in developed countries as in developing ones, but the total growth rate in developing countries over the last five years has been around 55%; by the end of 2017, global mobile broadband subscriptions are expected to reach 4.3 billion; and prices of broadband connectivity as a percentage of GNI per capita halved between 2013 and 2016, but remain 20 times higher in least developed countries than in developed countries.

These figures highlight the very significant differences and inequalities that exist in the distribution and spread of ICTs. There is, though, growing recognition of what needs to be done to create a more equal digital world.[21] The World Economic Forum's Internet for All initiative, has thus highlighted three main areas where actions is needed: infrastructure – ensuring investment to expand access; affordability – ensuring that more people can afford to connect to the Internet; and skills and awareness – educating people to ensure that they understand the benefits of connectivity. Precise future scenarios with respect to the use of ICTs in deprived locations depend very much on the extent to which these are achieved.

Eight generalisations about ICTs in 2025

1. ICTs will be increasingly all-pervasive in human life

There is no doubt that ICTs will become more and more a part of everyday life for most people in the world by 2025. Indeed, many new technologies to enable humans and machines to be ever more closely intertwined as cyborgs are likely to have emerged by 2025.[22] The Internet of Things (IoT), whereby tiny sensors will be communicating constantly with each other everywhere will create a huge demand for connectivity and electricity. Advances in Artificial Intelligence (AI) will mean that people come to rely on machines for much of their daily decision making to a far greater extent than they do at present. Robots will become very much more sophisticated, and there may well be increased demand for "teachbots" to replace human teachers in conflict zones and isolated rural areas where human teachers are often unwilling to work. The current trend for companies to chip their employees so that they can login securely to their computers, purchase produce in their canteens, and be monitored securely in their movements,[23] may very well have become the norm, and given the emphasis on digital child birth registration, perhaps babies in poor countries will even be chipped at birth because of the perceived advantages that this will give to delivery of health and educational services. Although these predictions may seem by some to be extreme, there is no doubt that by 2025 there will be much greater symbiosis between humans and machines, even in the more deprived areas of the world. In particular, the combination of biometric recording of individual identities will enable much more sophisticated analysis and recording of individual educational performance and certification.

2. ICTs, and their benefits, will be increasingly unequally distributed

Although ICTs do indeed have the potential to empower poor and marginalised people, they have in practice led to a much more unequal world over the last decade. The difference between rich and poor has become significantly greater, fuelled in large part by the roll out of ICTs. Those who have the latest advanced ICTs are able to benefit ever more advantageously than those who have older ICTS, or even none at all. What can be done with an old mobile 'phone with 2G access is completely different from what can be done with the latest smartphone with 4G connectivity.

Despite global rhetoric about using ICTs to reduce poverty and contribute to the sustainable development goals,[24] there is no convincing evidence to suggest that this trend of increasing inequality will be reversed by 2025. The poorest and most marginalised, those living in places that have no connectivity (see Colombia and Solomon Islands case studies), those who cannot afford the latest technologies, those who are prevented from using ICTs because of their gender (see Pakistan caser study), their ethnicity or their disabilities will be left further and further behind. It is possible that some global initiatives will indeed substantially support some groups of disadvantaged people, but the overwhelming use of ICTs will be to maintain and strengthen the position of the rich and powerful.

3. The expansion and diversification of mobility

In the short-term digital technologies will continue to become increasingly "mobile", building on the long evolution of the portability of technology. The dramatic expansion of mobile broadband and smartphones over the last decade will continue, but newer types of mobile digital communication will also be created, especially for the richer people who can afford them.

It is not yet clear what these will be, but by 2025, mobile phones and tablets may begin to seem as outmoded as fixed telephone lines and desktop computers do today. By 2020, it is likely that substantial progress will have been made by governments and the private sector to provide mobile broadband connectivity for many more people than have access at present, although some areas with difficult terrain and low densities of population will remain digitally accessible only through satellite connectivity (see Colombia, Pakistan and Solomon Islands case studies). By 2025 at least 90% of the world's population will have potential access to mobile broadband. It will also become very much easier for people to remain connected on the move wherever they are, not only within a country but also when travelling across borders.

4. Declining costs of devices and connectivity

Closely linked with the above point, the costs of devices and connectivity will continue to decline, especially in the poorest countries. This will open up substantial new markets for devices and apps that may drive innovation for products designed to enhance the lives of poor people.[25] Tablets and smartphones will therefore become much more widespread by 2020, and readily affordable for more than 75% of the world's population by 2025. However, top-end devices will continue to push the boundaries of creativity, while the poor will only be able to benefit from much lower-performance technologies, thereby further increasing inequality. For example, while 3D printers will be used to support children's learning in richer countries ad for the elites in poorer countries, it is unlikely they will be widespread in the most deprived locations.

5. Data and security

The recent increase in the production and use of large amounts of data will dramatically expand, especially with the advent of the IoT. Increasingly, governments will make large amounts of personal data about individuals available to global corporations who will use these to generate further commercial advantage and profit. Companies offering internet services will also use ever more data they collect from an expanding body of human and non-human users to refine their technological solutions, and will increasingly offer access to their traffic data to other companies to generate further revenue. It is widely expected that the data analytics business will continue to expand rapidly, growing from a market of $130.1 billion in 2016 to more than $203 billion in 2020; in 2025 the world is expected to create 180 zettabytes of data, up from less than 10 zettabytes in 2015.[26]

This raises complex questions relating to the security of these data, and individual privacy. Increasing reliance on digital technologies presents major potential hazards for increased global tensions, with international political and commercial hacking becoming ever more prominent. The danger of more extensive and sophisticated attacks on critical infrastructure is likely to increase, and more attention will be paid to trying to ensure that this infrastructure is much more resilient than at present. The rapid expansion of the IoT also exacerbates these difficulties, and gives rise to a very substantial hacking risk.

Notions of individual privacy will also have been rethought by 2025, with many governments having changed their legal definitions of the concept. As more data about people is available online, much of it willingly placed there by individuals through social media, old concepts of privacy are likely to have been replaced, apart from among a few activists and aged people who will continue to seek to maintain hidden identities. This also raises fundamental questions about the darker side of the internet, especially as it relates to individuals. Trolling, digital harassment, and the use of the Internet for unpleasant and illegal activities, particularly child pornography, are all likely to increase, and government and international agencies may have difficulties in taking action to limit its extent.

6. Increased personalisation

Closely linked with the rapid expansion of data capture and analysis will be a considerable increase in the personalisation of ICTs. Corporations will increasingly use data about individuals to tailor their marketing of commodities to them anywhere and at any time. As individuals walk along a street, personalised messages will light up on electronic billboards, and they will also receive short messages on their phones inviting them into shops that they will shortly be passing. Devices will increasingly be able to be personalised, so as to suit the particular characteristics of users. Many consumers will like such tailored "information", and there will be considerable potential individual advantages of personalisation. However, it will be the corporations controlling the algorithms that determine the structure of the personalisation that will benefit most financially.

7. Rapid evolution in use of different types of digital content

The increase in bandwidth available through fibre cables and 4G mobile broadband networks in recent years has enabled a dramatic shift towards the streaming of video content and away from hard media such as CDs, DVDs and USB sticks. The likely further expansion that will occur in the amount of video content generated will in its turn place even greater demands on the capacity of digital infrastructures. It seems likely that higher speeds and greater capacity will be introduced first where there is most demand, as in urban areas, and that remote rural regions will be left with much slower speeds of connectivity, which will often remain insufficient for video streaming. However, continued advances in the amount of data that can be stored on smaller and smaller devices will also mean that it will be possible to provide very large amounts of content to children in areas that do not yet have high quality connectivity simply through introducing preloaded devices into their schools and communities.

It is difficult to predict the precise balance of content that will be available through the Internet in 2025, but it will be different from that pertaining today. Information transmitted through sensors, for example, will undoubtedly form a much higher percentage of data than at present, providing that the IoT evolves as predicted.[27]

8. Increasing power of global corporations

One fundamental prediction that can be drawn with certainty from the above is that major global corporations, be they headquartered in China or the USA, will increasingly play a controlling role in the ICT sector. While US corporations such as Alphabet (Google), Facebook and Amazon currently dominate the sector, it is possible that by 2025 their control will be replaced by the rise of Chinese corporations such as JD.com, Tencent and Alibaba. Some Indian companies may also grow in significance, but there is little evidence to date that India has the capacity over the next decade to be able to compete globally in the ICT sector as effectively as do the USA and China. This has fundamental implications for the structure of the Internet and the entire field of ICT in the future, but it is not easy to predict exactly how this will change by 2025. Much may depend on the evolving balance of political power between the USA and China, but the potential for a very different digital world to emerge by 2025 is very real. Scenario 1 provides insights into one possible, albeit pessimistic, outcome.

Implications for ICT use in the most deprived areas

The above predictions do not bode well for ICT use in the most deprived contexts; there is little evidence based on current trends that inequalities in access and use of ICTs will change substantially over the next decade. Undoubtedly more poor and marginalised people will have access to some kind of connectivity and content, but the differences between the digital lives of those living in connected smart cities and isolated rural areas will remain stark, especially in the poorest countries. Likewise, it is probable that social and cultural divisions will continue to be exacerbated through the use of ICTs; women and girls in patriarchal societies may even become further marginalised, as they are increasingly abused and harassed through mobile devices. ICTs can transform the lives of people with greater disabilities far more than they can those of the lives of people with fewer disabilities. However, accessible technologies are usually more expensive than other devices, and they are therefore unaffordable for those living in the most deprived contexts.

It is likely, though, that substantially more people living in deprived contexts will have access to digital connectivity by 2025, either through shared devices or access in local community centres. This will increase the need for appropriate learning content to be available for families to access in local languages, so that they can indeed begin to use ICTs to enhance their children's learning. These options are explored further in the next section.

Scenario 1: The Locked Down Net.

The continued rise of terrorism around a growing number of niche causes, facilitated by the miniaturisation and decreasing costs of advanced weaponry, alongside the emergence of new, effectively un-hackable, quantum entanglement chips and associated cryptography, mean that the days of the free net that dominated the first two decades of the 21st century have rapidly become a faded memory. Now the internet is a patchwork of highly secured national, regional and corporate networks, each heavily protected and defended against any potential unapproved access or utilisation. The use of the net as a massive resource of free and open information has all but disappeared, with walled garden search engines and highly managed social communities all "for the security of the people" dominating day-to-day use of the now-multiple "nets". In the school environment networks are heavily controlled by global corporates, dominating both the supply of secure digital devices and the content accessible on those networks. The rise in cryptography has also seen the end of the blurred sense of IP ownership - now every pixel is labelled, owned and tracked - and access can be removed for any user in a millisecond without any warning. As a consequence, poorer governments, unable to afford their own networks, are terrified of upsetting the access rights they have been granted, and have effectively outsourced the digital backbones of their education systems to the global corporate world. Although still presented as a common good, it has been accepted in most circles that these corporate educational networks mainly function as a talent scouting system for the richer worlds, and those who attempt to disrupt the control rapidly find themselves caught up in the security systems of both corporates and states.

4. ICT USE IN BASIC EDUCATION IN DEPRIVED LOCATIONS

"The lamentable reality" is "that, for the most part, 'solutions' touted for use in schools in e.g. rural Africa, or in isolated communities in the Andes, are designed elsewhere, with little understanding of the practical day-to-day realities and contexts in which such technologies are to be used."

(Mike Trucano, World Bank, 2016).[28]

Context

In the above quotation, Mike Trucano neatly captures the fundamental point that most ICT for education interventions suggested for use in deprived locations, or amongst marginalised communities, are usually designed elsewhere, and are often inappropriate for the contexts in which they are deployed. However, there is increasing evidence that some of the lessons of the past have indeed now been learnt, and that a small number of initiatives are beginning to be implemented that do indeed deliver enhanced learning opportunities for poor children in marginalised communities (see especially case studies from Jordan and Solomon Islands). These will not become widespread by 2020, but with care in the development of national and local education strategies they will indeed be able to make a change to the learning opportunities of some groups of deprived children by 2025.

The fundamental challenge, as outlined in the previous two sections, is that it will require widespread political will to change education systems and make appropriate technologies available to the poorest and most marginalised, whether they live in remote rural areas or are prevented from using them because of social or cultural reasons. Moreover, technologies will need to be used to support widespread educational reform, rather than as a silver bullet that can alone solve the problem of education. It will be increasingly apparent in 2025 that technology is actually the easy part of this equation; it is much more difficult to change the human side of educational transformation.

The lack of access to technologies in deprived locations nevertheless remains a key obstacle for implementing ICT for education initiatives in remote and deprived locations. Moreover, it is still often forgotten that the provision of

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electricity is also an essential prerequisite for implementing any such initiatives (see Colombia case study).[29] Although there will be substantially improved access to broadband connectivity by 2025, there will remain parts of the world without such connectivity, and in these it may well be better to focus on systemic changes to enhance education and learning other than through the use of ICTs.

This section of the report is divided into three broad parts that build on the evidence of the previous two sections: a generic overview of how ICTs are likely to be used globally in education by 2025; predictions of how it may be used in low-income areas; and predictions of its use in crisis-affected areas, subdivided into acute short-term crises, and longer term protracted crises.

ICTs in education in 2025

1. Increasing diversity in use of ICTs in education

The most important prediction is that the use of ICTs in education will become very much more diverse by 2025. This makes it extremely difficult to predict exactly how it will be used in any particular context (see case studies). There will be rich countries where ICTs are used poorly (see UK case study), merely to try to reduce costs while reinforcing the "learn and regurgitate" model through automated assessment of memorised information. Equally, though, there will be some innovative and creative cases in extremely deprived contexts (see Jordan and Grenada case studies), where well-trained inspirational teachers will be using ICTs to encourage children to explore critically a wealth of knowledge and ideas that will help them develop the skills and understanding to change the world in which they live.

2. Changes to school systems encouraging more use of technology in education

It is likely that there will be changes in the education system of many countries by 2025. Many of these will explicitly encourage greater use of ICTs in education, driven in part by the interests of major global corporations, but also by increasing recognition of the potential benefits that such technologies can bring. Unfortunately, it is likely that such changes will often be underlain by a misplaced belief that ICTs can reduce the cost of education delivery and even replace teachers.

3. The evolving role of teachers in a technologically mediated school system

In 2025 teachers will remain fundamentally important in education systems still dominated by schools. However, in the best systems their role will have changed from being that of providers of knowledge to being guides to help children learn to navigate the world of digital information. This may be even more important when working with deprived children who may not have the parental and communal support that is necessary to help structure and socialise learning. To be sure, it will remain possible for children to gain information about many things through the Internet without such guides,[30] but most of those interviewed for this report argued strongly that well-educated teachers will become even more essential to help young people learn appropriately. This means that teacher training, both pre-service and in-service will become ever more important over the next decade as teachers need to learn how best to make use of ICTs in schools.[31]

The temptation for many governments, seduced by the promises and rhetoric of the private sector, will still be to try to use ICTs as a cheaper solution to the shortage of quality teachers. ICTs, be they radios, mobile devices or the Internet, can indeed help students learn in the absence of teachers (see Jordan and Somalia case studies), but children perform very much better when they are inspired and supported in their socialised learning by a qualified teacher.[32]

4. A new mix of digital content and device provision

There is considerable uncertainty about the precise mix of digital content that will be available for learners in 2025. Existing trends suggest that there will be much more digital educational content available, but it seems likely that much less of it will actually be used effectively by learners. Few people today explore beyond the first page of search engines such as Google, or video sites such as YouTube, and so it is highly probable that this concentration of content will increase in the future. Currently, most learning is generally still based on text, but by 2025 very much more learning content will be through video, often with local language audio to accompany it. This will place considerably increased demands on bandwidth, and may therefore further disadvantage those living in areas with poor quality connectivity, for whom digital video downloads will remain very time-consuming and expensive.

The balance of logics and philosophies between proprietary and open content will continue to ebb and flow, but it seems likely that a few global content providers may well come to dominate the market. Augmented and virtual reality is also likely to become much more widespread as gaming technologies are increasingly developed for the classroom. Objects with digital sensors in them will also be used much more widely in early childhood learning, and will possibly become especially valuable in supporting children with learning difficulties or with those suffering trauma from being involved in crises.

Many schools across the world still prohibit the use of mobile devices, whilst others provide tablets or laptops to all pupils. This diversity is likely to continue to exist in 2025. There are those who believe that the use of bring-your-own devices can be a very divisive element in education, since richer children bring higher performance devices than do their poorer neighbours. Moreover, concerns over security issues, and pupils playing with their mobiles rather than participating in class are also commonplace. Whilst such pressures against the use of mobile devices in classes should be acknowledged, it is nevertheless likely that there will be much greater use of mobile devices (tablets or mobiles) across the basic education sector, both by teachers and by pupils.

5. Assessment and big data

Advances in the range of AI and IoT technologies combined with the increased power of big data analytics will enable much more personalised and refined assessment of individuals. Indeed, it seems likely that complete records of individuals' academic performances, including every mark they are ever given from the day they enter school until they graduate from higher education will be readily available by 2020. For those who choose to be chipped, this educational certification will be stored within, or accessible from their bodies, so that if they become refugees they will retain evidence of their attainments. The main driver for such uses of technology will be the ever-increasing competitiveness of employment, and the desire of many par*ents to ensure that their children are able to get the "best jobs". The e-mail in Box 1 from Samsung advertising an IoT workshop highlights the value of this new market for companies.

Box 1: Samsung, the Internet of Things, and the market of eduction

"The Internet of Things (IoT) is bringing amazing things to schools with internet-connected technologies such as mobile devices and smart HVAC. However, its true value lies in the real-time data and security to students, parents, faculty and administration. It is so valuable that many are already planning to invest in IoT - 83% of IT professionals at schools expect their IoT investments to increase over the next three years by an average of 47%.

IoT cannot become a complete reality without a reliable, scalable technology solution. In this webinar, we will explore what opportunities IoT can bring to your school and how Samsung can help you realize its greatest potential."

Source: Samsung advertising email 22/8/1

Running counter to such a dystopian view where all humans will be chipped from birth, it may be that new modes of digital assessment are indeed developed that will enable much more refined assessment of the process of learning rather than its output, which would help teachers identify the most appropriate learning needs of pupils. This is needed most in deprived areas, but is most likely to be implemented in schools for the children of parents who can afford the privilege of high quality education.

6. Changes in the role of parents and communities enabled through online resources

It seems possible that the increasing failure of education systems across the world by 2025 will lead to a greater emphasis on learning outside school and in informal contexts. Parents and communities will therefore seek to take on greater responsibility for overseeing children's learning. There will be increased demand for high quality online resources to support those who cannot afford to send their children to school, or are unwilling to let them attend because of cultural or social reasons, but who still wish their children to be educated. Indeed, more generally, it is likely that there will be further benefits from using effective online resources to support young mothers in learning how to nurture their children, not only physically but also in terms of their approach to learning. The value of pre-school activities in influencing the subsequent progress of children through the education system is now well recognised,[33] and the use of ICTs to support families, and especially women, in providing such activities is likely to be very worthwhile.

Such use of ICTs is not directly focused on the delivery of education in primary schools, but this indirect use of ICTs is likely to increase in importance in delivering effective learning to children by 2025.

Implications for ICT deployment in education in low-income and peripheral areas

The above generic comments about the use of ICTs in education will also largely apply in low-income and peripheral areas. However, as the case studies from Colombia and the Solomon Islands clearly suggest, there is widespread expectation that even by 2025 marginal areas, such as mountainous forested regions and isolated islands, will not have the quality of connectivity, or indeed electricity, required for the sorts of technology deployment that will be standard in more prosperous areas. In large part this reflects difficult choices that governments have to make in allocating resources; deprived regions are deprived not primarily because of their physical environments, but instead because of long-established political and economic interests.

It is, though, possible to identify the following five likely trends in these areas.

1. Increase in innovative solutions for ICT use in deprived locations

In recent years there has been much innovation and experimentation about how to provide robust hardware and new connectivity solutions in peripheral areas (see Solomon Islands case study), and it is therefore possible that the use of ICTs will indeed become much more widespread in remote communities. The challenge is that many of these innovative solutions have been pilot projects that have not originally been designed at, or for, scale or sustainability. They show what is possible rather than what will happen. It is likely that many more such "technical solutions" will be designed and available by 2025. However, two key issues need to be addressed if they are to have a significant impact on education: first, they need to be developed for specific educational contexts, and in line with curriculum and pedagogic reform; second, governments will need to have the commitment, and provide the resources, to enable such deployments to be delivered at scale.

2. Device sharing

Device sharing is already widespread in locations where access to them is expensive or difficult, and it is likely that this will continue to be the case in 2025. This may well be positive for learning in two ways. First, much use of mobile devices in classrooms today is claimed to support collaborative learning, but in reality it largely reinforces a model of individual learning. Instead, where devices are few, teachers and pupils have to engage collaboratively in their use to achieve effective learning outcomes. Second, in the household context, a single mobile device can be used by all members of the family to gain learning benefits. Although there are undoubtedly intra-family divisions, with girls and women in patriarchal societies often being excluded from their use, this does nevertheless provide the potential for everyone in a family, including the parents, to gain new learning opportunities. Given the importance of parental support for learning, and the health and other benefits gained from educating women, there is potential that by 2025 there will be exciting family based learning initiatives developed in such contexts.

3. Use of digital multi-purpose hubs for learning

Telecentres, and village information centres, have long been seen as an important means for enabling rural communities to have at least some access to digital connectivity, but they have also been subject to much criticism, in part because of their lack of sustainability and their reinforcement of existing socio-economic inequalities.[34] Where there is good mobile connectivity, their role and benefit undoubtedly diminishes, unless they can be combined with a continuing need for other service provision. The work of the Indian Public Library Movement nevertheless shows the potential for libraries with connectivity to act as learning hubs for all people in their vicinity.[35] Consequently, in areas that remain without much digital connectivity or electricity in 2025, it is likely that such centres, especially if they are co-located with schools could remain a valuable addition to the array of options for delivering effective education and learning.

4. Caching online content for use offline

Good existing examples exist of ways through which schools can gain access to digital content although they are offline for much, or all, of the time.[36] Such downloading and caching of key educational content, especially bandwidth heavy video, in locations where there is good connectivity, and its subsequent use in a distant unconnected school is likely to remain an excellent way through which content, and indeed management of administrative processes, can be undertaken cheaply and effectively, and is likely still to be one of the main ways through which isolated schools can gain valuable digital educational resources. At present, such activities have mainly been undertaken by individual teachers, eager to use opportunities to visit distant towns also to gain access to information for their pupils. However, if systematised on a regular basis, even just through officials regularly bringing content updates on motorbikes or boat trips to isolated locations, this could prove to be very valuable in reducing content inequalities between schools in peripheral areas and those in urban locations.

5. Learning on the go: the rising importance of non-formal and informal learning through ICTs

A final important prediction about the use of ICTs for education in low-income and peripheral areas is that it is likely to become increasingly mobile. As costs reduce and connectivity widens there will be a significant increase in digital learning out of school, even in areas with low connectivity. It is possible to imagine parents who occasionally visit distant towns being able automatically to download relevant learning content, and especially games and videos for their children, on their basic smartphones. Everyone in their households could then benefit from accessing such content on their return. Moreover, the on-going potential to use older technologies, such as radio, in new ways should not be underestimated. Radio is inherently mobile, and is likely still to have significant educational value in 2025 as almost everyone can have access to it through very low-cost devices.

ICTs for education in crisis-affected areas

Respondents to the interviews and the consultations held for this report are confident that global and local crises are likely to increase by 2025, despite the efforts by the global community to reduce them. Such crises will result from increasing numbers of people living in environmentally dangerous areas, such as deltas, floodplains, earthquake zones and low-lying coastal areas subject to violent storms, as well as those crises resulting from social, political, economic and cultural conflicts, which will be much more likely, in part because of increasing global inequality. Significantly, as noted throughout this report, the global expansion of ICTs has been one of the major factors increasing inequality over the last decade, and so their more judicious use could perhaps be one way through which global crises themselves could be reduced. Much more explicit emphasis will be required on the ways through which ICTs can, for example, be used to reduce conflicts and the impacts of disasters relating to human interactions with the physical environment.[37]

It is helpful to consider the use of ICTs for education in two main crisis contexts, short-term acute and long-term protracted, because of their different response implications.

1. Short-term acute crises

Short-term acute crises often arise because increasing numbers of people are living in areas with volatile physical environments, but they can also be a result of civil disturbances in countries at times of elections, or cross-border conflicts and wars.[38] Recent years have seen innovative solutions being developed for maintaining the provision of education to children in these circumstances.

Based on current trends it is probable that the following responses will be available to respond to the education needs of children caught up in these crises:

- Mobile solutions for mobile people. Mobile technologies will enable children fleeing such crises to continue to participate in both formal and informal learning. Some governments are already using ICTs to deliver parts of the curriculum in areas

where environmental crises are endemic, and they will be able to make this readily available in the future to children wherever they are. If mobile broadband is unavailable or disrupted, it is also possible that education could continue to be delivered through older technologies such as radio. It will be necessary for this to be planned systematically and be available for rolling out should any crises occur. Moreover, teachers used to delivering education in such contexts will need to be enrolled to help facilitate the learning process. Where refugees flee beyond country borders, but have connectivity, it will also be possible for them to connect to educational resources from their home countries (see Jordan and Somalia case studies).

- Digital trauma counselling. Increasingly, online resources are being developed to provide counselling for many different groups of people, including children traumatised by disasters and war.[39] By 2025, it seems highly likely that these will have been developed much more extensively, and online chat facilities in multiple languages, even using video where bandwidth permits, are likely to be available to support families and children affected by crises
- Relevant content for crisis contexts. The learning requirements that children have in crisis contexts are additional to those of their unaffected peers. It is likely that by 2025 online resources will be available specifically to provide such children with additional information about any crisis in which they are caught up so that they will be better able to survive, often in the most difficult of circumstances and when they have lost parents and relatives. It is also important that children can have safe spaces where they can play and learn in peaceful environments.[40]
- Schools-in-a-box. In many acute crises, digital connectivity and electricity supplies are seriously disrupted. However, there is now much good practice in making connectivity systems more resilient, so that they can be restored relatively quickly. It takes much longer to rebuild schools, and find teachers willing or able to work in them. Currently, School-in-a-Box solutions, such as that provided by UNICEF, usually do not provide much digital materials, but are designed to enable children to continue learning in the aftermath of emergencies, and contain basic school supplies such as exercise books and pencils, as well as a wind-up/solar radio.[41] In such circumstances, it is likely that by 2025 numerous different ICT-enhanced school-in-a-box solutions, combining connectivity, electricity, devices and content, may be available that can be set up quickly and effectively wherever in the world there is a need.
- Knowledge for refugees about host countries. Many refugees already use mobile phones to find out information about entering other countries, and what they need to know about the different cultures and ways of life there in order to survive. It seems likely that by 2025 at least some such online resources will be readily accessible for refugee children as well.

2. Long-term protracted crises

Long-term protracted crises present a different set of challenges (see Jordan case study). A fundamental tension that arises is the balance between refugees integrating with the culture and education system of their host communities, and retaining a separate identity with the hope of returning home or being resettled to a third location as soon as possible (see also Somalia case study). Many of the suggested uses of digital technologies in the previous section also apply in these cases, but there are also two other interesting potential uses of ICTs to support childhood learning there:

- Digital community and learning centres. There are particular connectivity challenges and opportunities when seeking to provide education for refugees who are settled in camp environments. It is technically simpler to provide camps with digital connectivity than it is to provide connectivity to dispersed rural communities, because in a camp there is high density fixed demand. Those working in camps want to have connectivity, and this can help generate the financial wherewithal to enable commercial providers to deliver connectivity. Moreover, as donors increasingly realise the value of giving direct payments to refugees, many choose to spend some of this money on communication technologies. Hence, it is possible to provide ICT-enhanced learning, using online resources, in many camps, where the ICT connectivity can also be used for a wide range of other purposes, including delivery of telemedicine and health training. Integrated digital community and learning centres are thus a very viable means to enhance education in refugee camps, and have been in existence for well over a decade.[42] There is every reason to expect that the experiences gained over this period will lead to much improved systems by 2025.
- Hybrid cultures of learning. As noted above, there is often pressure for refugees to be acculturated within their host societies, and this can mean that refugee children are taught in a language other than their mother-tongue and in an entirely different cultural context. They must struggle from an early age with the complexities of growing up in a hybrid context. Often, there are also few trained teachers from their own culture to help them make this transition. Digital content, especially the use of video in multiple languages, accessible through robust child-friendly devices, can prove to be very valuable in such contexts even where there is not Internet connectivity.[43]

An optimistic perspective

So many mistakes have been made in the search for ICT-based silver bullet solutions to perceived problems with education systems across the world that it is to be hoped that by 2025 some more lessons will indeed have been learnt so that ICTs can be used more effectively in support of educational delivery, especially for deprived children. The most important point to be made here is to repeat the conclusion of Section 2, that it is essential to begin with the desired educational outcomes, and only then choose the appropriate mix of ICTs to deliver them. It is also likely to remain the case that schools will be the primary institutions for delivering education, and therefore that the role of teachers will be fundamental to any effective use of ICTs in education.

Rather than highlighting specific successful ICT for education initiatives, this report has instead emphasised primarily the general principles that can be seen to underlie the appropriate and effective use of ICTs in learning. Many of the most important of these are captured in Trucano's useful summary in Box 2.

Box 2: Notable practices for using ICTs effectively in poor, rural and isolated communities

1. Using "old" technologies (like radio and television) in new ways
2. Sharing one device with lots of people
3. Caching on-line content for offline use
4. Promoting literacy and learning, and supporting teachers, with mobile phones
5. Using low-cost video to support peer learning and support
6. Developing content and tools locally

Source: Trucano (2016)[44]

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5. RISKS ASSOCIATED WITH DIGITAL LEARNING IN LOW-INCOME AND CRISIS-AFFECTED LOCATIONS

"The Internet has hugely positive potential to provide enhanced education, health, and governance that are of benefit to poor people, but it is also used for much darker purposes that most people would see as threatening their lives."

(Tim Unwin, 2017).[45]

Context

All development interventions carry with them risks that they might do more harm than good. Children are some of those most vulnerable and at risk, and Save the Children is therefore strongly committed to the principle of "Do no harm". Its education strategic direction for 2016-2018, for example, states very explicitly that "Working in conflict affected and fragile states, we will need to prioritise Conflict Sensitive Education to ensure that, at a minimum, our work does no harm and, at its best, contributes to conflict prevention and long-term peace building.[46] The use of ICTs by children both in and out of school raises very considerable questions about child safety,[47] and it is important that this issue is addressed in any discussion of the use of ICTs for education initiative. This section therefore briefly raises three broad issues: risks associated with child online safety; risks to Save the Children from investing in ICT for education initiatives; and risks in failing to invest in appropriate monitoring and evaluation.

Child online safety

There is now a considerable body of evidence about the scale of child online abuse across the world, and this suggests that the situation is actually getting very much worse rather than better. Such abuse ranges from the peer pressure of sexting to videos of violent child abuse and death on the hidden or Dark Web, and includes everything imaginable in between. The UK-based Internet Watch Foundation, for example, in 2016 identified 57,335 URLs that contained child sexual abuse imagery, had links to such imagery or advertised it.[48] There is therefore an urgent need for all ICT initiatives, both in schools and more widely in community learning initiatives, to prioritise the safeguarding of children and the secure management of all information about children.

A second concern that many have about children using ICTs, and especially the internet, is that of Internet addiction, whereby lives are ruined by causing neurological complications, psychological disturbances, and social problems.[49] The amount of time that many children and young people spend on the internet, especially gaming, has given rise to much discussion around the ways that this is changing brain functioning, and other wider health concerns around fitness and well-being. Many richer parents, for example, give their children digital devices to avoid having to parent them personally and simply to keep them quiet and occupied. If ICTs have such negative impacts, it might well, therefore, be that the poorest and most marginalised children, without frequent access to technologies, could accrue greater health benefits from not using them than do more privileged children who over-use them.

Third, at a more mundane level, many schools across the world, in both economically rich and poor countries alike, prohibit the use of mobile devices in school classrooms because they are seen as being disruptive, although other concerns over cheating, health and bullying are also often cited.[50] By 2025, it is likely that the vast majority of the world's children will have at least some occasional access to such devices, and given their potential benefits for education it seems likely that such bans will increasingly be lifted.

These problems, though, do not mean that children should be prevented from accessing the Internet or using ICTs. As discussed above, ICTs can provide very valuable learning experiences and indeed enjoyment for them, and any risks need to be weighed up against the overwhelming benefits that can accrue from using digital technologies. The critical need is to ensure that children, parents and communities are indeed all aware of the threats that exist, and that action is taken by governments (both national and local), companies, schools and individuals to address them. There is much good practice on appropriate ways to tackle child online protection, and it is imperative that lessons learnt are applied systematically and comprehensively in all contexts where children are accessing the Internet.[51] This starts in the home or hostel, must be continued in all school and community activities, and companies and governments must also put in place mechanisms to reduce the proliferation of unwanted content and behaviours, and sentence offenders appropriately.

Programme risk

A second important area of risk for Save the Children is associated with the actual delivery of any ICT for education initiatives. Rarely are detailed cost-benefit analyses undertaken in advance of the roll out of very expensive technological initiatives in schools. Indeed, some interviewees asserted that the allocation of numerous tablets to school children often owes more to political campaigning in advance of elections than it does to any real educational benefit. Moreover, a constant refrain is that very many ICT in education initiatives are unsustainable, with countless projects being abandoned once the initial funding has ceased. Rarely are the total costs of implementation over a substantial period of time taken into consideration before ICT for education projects are implemented. Whilst some governments might be able to give all of their schools a tablet for every child in a particular year group, they can rarely afford to do this for every generation of children.

Great care is therefore necessary in identifying what exact interventions will indeed benefit the poorest and most marginalised children and communities. Given the arguments

above, especially when it is recognised that the most deprived locations are least likely to benefit from the latest and best technologies, the option to explore alternative indirect scenarios should always be explored for the funding of novel ICT solutions in support of education. For example, giving young mothers after the birth of their first child a good quality mobile device, with comprehensive content and apps contained within it about healthcare, education, parenting and accessing sources of information relevant to their needs, might in the long term do more to enhance the quality of learning of their children in the future than putting tablets and interactive whiteboards into schools, especially if they were able to update the apps with the latest content on future visits to a clinic, or when health visitors travel to their isolated villages.

Too many ICT for education initiatives have failed to deliver sustained educational outcomes and the increasing loss of reputation of those implementing them is an important risk that should be considered. It may well be that by 2025 the most successful initiatives will remain those that use today's established and accessible technologies, rather than those that seek to introduce high cost and high risk innovative solutions. Deprived children and communities should not be laboratories for experimentation by academics and companies in their search for ever greater profits and acclaim.

Insufficient attention to monitoring and evaluation of ICT in education initiatives

A final important risk that must be noted is the potential not to pay sufficient attention to the need for effective monitoring and evaluation of ICT for education initiatives. Despite the plethora of projects, there are still far too few high-quality monitoring and evaluation studies undertaken on such initiatives, especially in terms of their real educational outcomes. This is one of the main reasons why it is possible for there to be such divergent views on the subject; the rhetoric is often very different from the reality. It is also worth noting that different types of research can reveal very different results.[52] Short-term cross-sectional quantitative surveys of ICT for education initiatives, for example, often show apparent success, while research done using in depth longitudinal research on small cohorts of teachers and pupils is often more critical. In this context, it is salient to recall that even the OECD is now suggesting that even in countries that have invested heavily in ICTs for education have seen no noticeable improvement in their PISA scores.[53] This reinforces the view that ICTs by themselves will not transform education, and they need to be integrated closely into a holistic approach to reform.

Monitoring and evaluation are often used together as a single term, but in practice these words denote very different processes, both of which provide different kinds of insights and both of which are necessary.[54] First, it is essential for all good ICT for education initiatives to have high quality and appropriate ongoing and internal monitoring, through which teachers, administrators and implementers can all learn from the process and continually enhance their effectiveness. ICTs themselves can provide a useful means to help deliver real time monitoring of students and teacher performance. There then needs to be high quality external evaluation, that examines the overall impact and outcomes of any initiative, seeing how it has advanced these from an initial baseline, and making recommendations for future implementations and practices. Again, digital data collection tools can assist in delivering accurate and comprehensive evaluation.

Neither of these can be done in a rigorous manner without significant resources. While many people suggest that 10% of any ICT for education budget should be spent on monitoring and evaluation, one recent recommendation has even suggested that this figure should be 20%.[55] This seems high, but indicates the importance that should be attributed to good monitoring and evaluation within this sector because of the need proactively to build evidence and assess impact.

Implications

This section has emphasised that there are important risks in implementing any ICT for education initiative in terms of both the harm that it can do to children, and also the programming challenges that can arise. Whilst these risks are very real, the increasingly ubiquitous presence of ICTs is such that they will undoubtedly play an ever greater role in the learning experiences of children, both out of school and within school by 2025. These risks must therefore be addressed. Furthermore, unless greater amounts of good and effective monitoring and evaluation are undertaken, children, educators, communities and governments will not really know what combinations of technologies work best to enhance quality learning in which circumstances. This too is a fundamental risk, but one that can readily be addressed.

6. IMPLICATIONS FOR SAVE THE CHILDREN'S PROGRAMMES AND ADVOCACY

"We will do whatever it takes to ensure that by 2030 all children survive, learn and are protected."

(Save the Children, Education Strategic Direction 2016–2018).[56]

Context

As the above quotation highlights, Save the Children has a very ambitious, diverse and wide-ranging education strategy for the immediate future. In seeking to deliver this, it recognises that the need for its work in education and child protection is growing rather than diminishing, at a time when its resources are becoming increasingly constrained. If it is accepted that ICTs can reduce costs, improve the quality of delivery, and extend the reach of its educational programmes, then these technologies might be seen as an ideal solution to deliver Save the Children's educational strategy. Unfortunately, there is little clear evidence that this will indeed be so in 2020 and 2025. This report has focused specifically on how ICTs can contribute to the provision of basic education to children in the most deprived locations, and its conclusions would be very different if the focus was instead on how ICTs might contribute to education in richer and more privileged areas of the world.

These recommendations emerge directly from the intersection between the report predictions and Save the Children's current policies, and they have also been influenced by consultations with some of the organisation's highly committed and very knowledgeable staff (see Annex 2).

Implications for Save the Children's programmes

ICTs have very considerable potential to enhance basic education in deprived locations. The following eleven recommendations offer suggestions for how Save the Children can maximise such benefits in their programmes. Several of these are closely aligned with Save the Children's current practices, but are highlighted here because of their particular importance in ICs-based contexts. These recommendations are summarised in both positive and negative formats, because different people generally respond best to either one or the other of these two alternative types of proposition.

1. It is essential to begin with a holistic vision for education and then identify appropriate technologies to support it; ICTs should not be seen as a silver bullet that will overnight solve all of education's problems

There is wide recognition of the need to transform education so that it provides young people everywhere with the knowledge and skills to live fulfilled lives. ICTs can contribute very significantly to this agenda, but they need to be used appropriately in support of such a holistic vision. There is no "one-size-fits-all" solution. Those designing and delivering programmes on the ground should therefore focus very much on the educational outcomes, and then identify the technologies best suited to help deliver them. In some of the most dispersed and isolated areas these may often be tried and tested ICTs, such as radio. However, innovative new solutions will also be able to deliver exciting opportunities for some of the most deprived children to learn, and it is therefore important for those delivering programmes to remain aware of the potential of new technological advancements. Save the Children could, for example, convene annual briefings from people such as those interviewed for this report to update staff on relevant new uses of ICTs in education.

2. It is essential to work collaboratively and in effective partnerships when delivering ICT for education programmes on the ground; despite the temptations, do not compete with other organisations for limited resources.

Delivering effective ICT for education initiatives requires close collaboration with relevant stakeholders, including parents and children, governments, civil society organisations and companies. All have a role to play. The introduction of technology in schools, for example, can have a significant knock-on effect on local economies by generating employment and income, thereby helping to make initiatives more sustainable Crafting effective partnerships to deliver such initiatives is a complex and time-consuming task, but the outcomes can be very much more rewarding and effective in delivering positive educational outcomes.

3. Focus on using ICTs to enhance teacher learning and competence before rolling out to schools; do not begin by putting large amounts of new technologies into the schools or learning centres, especially if teachers are not involved.

Very many ICT for education initiatives have begun by putting computers or tablets into schools, sometimes in the mistaken belief that ICTs can replace teachers. Most of the evidence suggests that it is essential that children have some guidance in their learning, and that well-trained teachers are likely to remain a very important element in the education system for the foreseeable future. Where it is not possible for teachers actually to be present, as in war-zones or very remote areas, ICTs can still play a useful role in enabling communication between teachers and children. Save the Children should ensure that all of its education programmes place strong emphasis on enabling teachers to use ICTs effectively to develop their own knowledge and understanding so that they can better help children to learn.

4. Design and implement ICT for education programmes at scale; do not implement pilot projects that are unlikely to go to scale.

Many ICT for education programmes begin life as small-scale pilot projects, often funded by the Corporate Social Responsibility departments of private sector companies. These companies expect the pilots to show success, so that they can then persuade donors and governments to roll them out regionally or nationally. This model usually fails because the projects are never originally designed at scale, taking into account the total cost of ownership of the initiatives. There is a need instead to focus on initiatives that are intended to go to scale from the beginning, and that use pilots to test at-scale solutions or to identify optimal ways for ensuring that solutions do indeed go to scale. Enough knowledge and experience already exists to be able to design and deliver effective education initiatives that make use of existing ICTs to support the learning of deprived children at scale, and Save the Children should concentrate on these in its programmes rather than trying to find the latest innovative technological "solution".

5. Ensure that Monitoring and Evaluation is built in to all ICT for Education programmes at the beginning, and is appropriately funded and delivered; do not merely leave external evaluation as an afterthought until the end.

Effective monitoring and evaluation are crucial elements of all ICT for education initiatives, both so that those involved can learn during the process of implementation and improve the programme as they go, and also so that future ICT programmes within the organisation and beyond can benefit from the evaluation lessons learnt. For this to happen, it is essential that monitoring and evaluation is integrated as a systemic part of all such programmes, and that it is appropriately funded at the very beginning. While it is clear that this focus on monitoring and evaluation is necessary for all education programmes, it is particularly pertinent when considering the future of how ICT is used in education because so many programmes have been based on anecdotes instead of rigorous evidence. Realising the transformative potential of ICTs requires embedding learning and evidence building throughout every stage of a programme lifecycle and then disseminating the lessons learnt as widely as possible for the benefit of all those operating in the sector. Moreover, although monitoring and evaluation is often cited as being important, it is frequently still omitted or poorly undertaken.

6. Work with technologies that are known to be effective, especially in the most deprived locations; do not be beguiled into treating children as experiments by those wanting to test their new innovative technologies.

Save the Children has limited resources, and cannot afford for its funding not to have real educational benefits. It is therefore important that all of its educational programmes that use ICTs should have a high probability of success, and this is more likely when tried and tested technologies are used. Existing digital assistive technologies, for example, can transform the lives of people with disabilities, but are usually too expensive for use in the most deprived contexts. Financial subsidies to enable such technologies to be used in deprived communities would be an easy way to ensure that people with disabilities could afford learning. Save the Children's programmes could have immediate impact on the education of some of these most marginalised people, simply by helping to make such technologies more readily available in these contexts.

Moreover, organisations need to think carefully about the relative benefits when educational experiments are undertaken on or with children. This is especially so when the private sector seeks to pilot the use of technology, the successful implementation of which will raise considerable profit for them. Caution is always necessary in balancing the profit-seeking interests of the private sector with the benefits that they can bring in the use of ICTs in education for children in deprived areas.

7. Explore the indirect educational benefits of the use of ICTs in deprived locations; do not always think only of using ICTs in the classroom.

One of the most interesting outcomes of this review is the suggestion that the indirect advantages of the use of ICTs in communities in deprived locations for children's learning might actually outweigh the benefits of programmes specifically intended to use ICT in an education context. Those interviewed for this report often emphasised the role that parents and other carers play, and that digital resources designed specifically for them could be a further way of supporting early childhood learning. This has three main implications: first, more research needs to be done around the wider impact on children's learning of ICT-related initiatives whose main focus is little to do directly with education; second, the introduction of ICTs into isolated villages or socially marginalised communities needs to be considered in a holistic way, so that health, livelihoods and education benefits are all considered in the design of programmes; and third, this once again reinforces arguments around the value of parental support for education, especially in deprived contexts.

8. Build sustainability into all ICT for education programmes at their very beginning; do not think about how to make a project sustainable only when it is nearing completion.

Too many ICT for education programmes leave consideration of their sustainability until very near their end, by which time it is almost always too late to do anything to make them actually last. Once project funding dries up, interest usually fades in their continuation as the organisations involved seek to gain new funding for their latest innovative project. This is hugely wasteful of resources, and can mean that children no longer continue to gain benefits from the expensive roll out of the previous projects. It is essential that the design of ICT initiatives take into consideration at least five main types of costs to help ensure their sustainability: maintenance of the equipment, connectivity to the Internet, provision of electricity, regular training of staff and administrators, and replacement of hardware and software. It should also be recognised that hardware in deprived locations and communities very often lasts for much less time than it does

in the air-conditioned, clean conditions where it is designed and made. Even robust equipment designed for use in one deprived location, such as a desert, may not be suitable for use in another, such as a rain-swept island (see Solomon Islands case study).

9. Child Online Protection must be considered in every educational programme that uses ICTs; do not assume that someone else will take care of this and that it is not your responsibility.

Child Online Protection is a very real issue, not just to protect children from sexual predation, but also to empower them to use digital technologies healthily and wisely. The extent of sexting among primary school children, for example, is very much higher than most people think, and so too is gaming. Given Save the Children's strong emphasis on the rights of children and child safety, it is essential that all of their educational programmes that use ICTs have embedded within them not only high quality security mechanisms, but also provision for training and support for teachers, administrators and parents. This is a complex and difficult issue, but it is one that Save the Children must address.

10. All relevant staff in Save the Children should be trained in the appropriate use of ICTs in education; it should not just be assumed that, because they use some technologies in their own lives, they sufficiently appreciate the benefits that ICTs can offer children's learning in deprived contexts, as well as the potential negative impacts.

Many Save the Children staff are very experienced in the use of ICTs in education, and many of these also want to learn more about the very real benefits that appropriate uses of ICTs have to offer learning in deprived contexts. It is, though, also important that those who may be less experienced in the usage of ICTs in education are also well-informed about the strengths and weaknesses of such initiatives, so that the organisation as a whole can internalise existing good practices, and build on them in the future to deliver even better educational programmes through the use of ICTs.

11. Societies need to focus on the sort of education that they want

The most important change that needs to happen in provision of basic education by 2025, especially as far as the foundations of learning are concerned, is for societies to focus first on the sort of education and learning that young people should have, and only then on the means of delivering it through a range of modalities and contexts including the use of ICTs in schools. School systems will continue to exist in 2025, but if education is to be fit for purpose by then fundamental changes will need to have taken place over the next five years.[57] There is little difference in this objective between the economically richest and poorest countries of the world. A more holistic approach to learning, that provides the skills necessary for subsequent ongoing learning throughout people's lives needs to be inculcated by inspirational teachers at the primary level, and this needs to go hand-in-hand with community and family commitments to supporting young learners.[58] The role of schools also as locations where children can develop their social and emotional skills is also crucially important. There is considerable optimism among all those consulted that change towards these ends will indeed have progressed by 2025.

Implications for Save the Children's advocacy

Save the Children has very wide experience of implementing educational initiatives for the poorest and most marginalised children, although it has previously not focused heavily on the use of ICTs in such projects and programmes. Its voice is well respected both globally and nationally, and it can therefore play a major role in advocating for the appropriate and wise use of technology in supporting the learning of children in deprived contexts. This role clearly builds on the work that it does in its programmes, but it might well be that its advocacy role could have an even bigger global impact than what the organisation might do through the use of ICTs in its programmes on the ground. There are two fundamental issues that need to be addressed. First, education reform is becoming ever more pressing, and governments and societies need to find ways to fund this appropriately. Holistic solutions will be necessary in such reform, and the appropriate use of ICTs will be important in enabling it to occur. However, second, as has been emphasised throughout this report ,ICTs are not the single solution to such reform, and can often place an unwarranted burden on already over-stretched educational bureaucracies. It is therefore crucial to get the balance right so that technology is primarily used to support education, rather than the other way around. Six clear recommendations for advocacy arise.

1. The urgent need for funding educational reform

The dominant theme in most interviews and discussions was that respondents hoped that by 2025 education systems would have been fundamentally reformed, so that the "learn and regurgitate" model that currently dominates education is replaced by one where the skills of critical thinking, collaborative learning, communication and creativity dominate. Introducing ICTs into education systems without such reform will merely serve to replicate existing challenges within education systems. Used as part of a wider reform process, though, ICTs can contribute to an effective process of change that will indeed enhance education provision for poor and marginalised children. This will require substantial levels of funding, which are beyond the means of many countries given their present political and economic systems. However, there is increasing recognition that ignorance is in the long run much more expensive than education, and the pressure for change will increase. It is not likely that such reform will be widespread by 2025, unless there is much greater advocacy and funding to make it happen.

2. ICTS are not a solution to educational change by themselves

Despite much rhetoric to the opposite, ICTs are not a silver bullet that will transform education overnight. They can, though, contribute very significantly to enhancing the quantity and quality of learning, especially in the most deprived locations. To achieve this, it is very important that organisations such as Save the Children clearly articulate the argument that the focus of such initiatives should first be on the intended educational outcomes and only then on the technologies that can be used to deliver them.

3. Language matters

Closely linked to the above point, it is very important that appropriate language is used to convey these arguments. To give but one example, the term "EdTech" places the emphasis on the technology rather than the education. In contrast, phrases such as "ICTs for learning" can be used to drive home the message that it is the technologies that are being used to support the learning. Throughout its advocacy of ways that technology can be used in the education sector it is therefore importantthat Save the Children is very careful in the terminology that it chooses.

4. Engage in real collaboration; don't just talk about partnerships

Several interviews conducted for this report highlighted the extent to which international agencies and civil society organisations are increasingly competing for funding and visibility, particularly in the context of ICT-based development interventions. This leads to problems of duplication, reinventing the wheel, inefficiency, and waste of resources, that are all to the detriment of the poorest and most marginalised children that such organisations are meant to be serving. Partnerships are difficult to deliver, require much time to coordinate effectively, and usually require skill sets different from those that are found in competitive organisations. However, they can indeed deliver effective and sustainable interventions that make a real difference to the lives of the most marginalised.[59] Save the Children could contribute very significantly to relevant global partnerships in the field of technology and education, where their voice and delivery capacity would be much appreciated.

5. Emphasis on the need for access to connectivity, but realisation that this is only part of the equation.

An increasing number of global initiatives, such as the ITU and UNESCO's Broadband Commission and the World Economic Forum's Internet for All initiative, have placed emphasis on the need for access to high speed connectivity to the Internet as a basic prerequisite for the effective delivery of development. They also, though, point out that access is insufficient by itself to increasing the quality of life of the world's poorest people. Save the Children has much to contribute to these discussions by advocating for the wise usage of Internet connectivity in delivering educational benefits to the most deprived children.

6. Protecting children online and using ICTs

Save the Children can bring added value to international discourse through its advocacy is in the area of child online protection. As has been emphasised above, children can be especially vulnerable to abuse, and indeed violence, through digital technologies and much more still needs to be done to reduce the threats that these technologies can pose. Save the Children is very well-placed to work closely with cognate organisations to help protect children while maximising the benefits that ICTs can bring to their education and learning.

7. CONCLUSIONS

This report has focused on predicting what basic education, the use of ICTs, and the ways that these technologies will contribute to education will look like by 2025, with a particular emphasis on the implication for those living in the most deprived locations. Three broad conclusions are appropriate.

First, there is immense diversity, not only in education delivery but also in access to, and use of, ICTs. This will remain the case in 2025, and the resultant inequalities might well be very much worse than they are today. If current trends continue, then the use of technologies by the rich will be markedly different from the use of ICTs by the poor. The most deprived will continue not to have access to ICTs, will continue not to benefit from them, and will become relatively more disadvantaged. However, millions of slightly better off poor people will indeed be able to benefit from the potential that existing ICTs will be able to deliver over the next decade, especially in terms of access to educational content that may enable them to live more fulfilled lives.

Second, for education systems to be improved, especially for the poorest and most marginalised children, there must be a fundamental rethinking of the vision for education in almost every country of the world. Educational change is slow, but some of those consulted for this report were optimistic, and thought that the pressure for change will soon become so high that governments will have to respond by instigating fundamental reforms. These, though, will be very expensive, and it still remains unclear how they will be funded and implemented. While the ICT sector is still likely to experience much rapid innovation, it is much more probable that the education sector will only evolve slowly. It is therefore also important that these technologies are used to enhance opportunities for learning everywhere, even where the education systems are slow to evolve.

Third, there have indeed been many exciting and innovative uses of technology within education over the last two decades, and some of these are already being applied in contexts of both physical and socio-cultural deprivation. However, all too often those implementing ICTs initiatives in the education sector focus primarily on the technologies, rather than the education. If technology is indeed to be used to support learning, both in school and out of it, there needs to be a complete reversal of much current practice. The focus must be first on the education, and only then on the various technologies that can help deliver it.

Save the Children is in a strong position to be able to take advantage of current understandings about good practices in the use of ICTs for education, and can implement these in most of its education programmes. This report has sought to outline some of the ways in which it can best do this. However, the organisation also has a powerful voice of advocacy, and by working collaboratively with other global organisations, UN agencies and private sector companies, it has an important role to play in helping to ensure that much better use is made of ICTs in the education sector than has heretofore been the case.

DAVID HARTMAN/SAVE THE CHILDREN

CASE STUDIES

This report draws in part on the evidence obtained from detailed interviews and literature reviews on six case studies, covering seven countries, which are summarised in the following pages. These were chosen in consultation with Save the Children to reflect a diversity of contexts and trajectories, as outlined in Table 1 below. The intention was to include countries of varying sizes in different continents, with different levels of ICT use, different levels of educational attainment, and varying levels of inequality. In particular, the report highlights the particular circumstances of small island states, and so includes two examples (Grenada and Solomon Islands) with different levels of educational attainment and ICT provision in a single case study. The report also emphasises that inequalities exist in richer countries as well as poorer ones, and so the case studies focus especially on the use of ICT in education in situations of deprivation. Given the report's emphasis on education for refugee children, the case studies also include countries with high levels of refugees (Jordan and Pakistan). Data for the case studies was drawn primarily from World Bank, ITU and UNESCO reports and data sources.

Table 1

	Colombia	Grenade	Jordan	Pakistan	Solomon Islands	Somalia	United Kingdom
Region							
Africa						•	
Asia				•			
Caribbean and Latin America	•	•					
Europe/North America							•
Middle East			•				
Pacific					•		
Human Development Index 2015							
Very High							•
High	•	•	•				
Medium				•			
Low					•	•	
World Economic Forum Networked Readiness Index 2016							
Ranking	68	-	60	110	-	-	8
ITU ICT Development Index 2016							
Ranking	83	74	85	146	153	-	5
Inequality (World Bank c. 2016 latest data)							
Gini coefficient	53.5	-	35.4	29.6	-	-	32.6
UNESCO Education for All EDI Index, 2015							
EDI Index	0.930	-	0.977	0.660	-	-	0.994
UNHCR registered refugees, mid-2015							
Refugees/1000 people	-	-	89.55	8.33	0.01	0.34	1.82

CASE STUDY OF ICTS AND BASIC EDUCATION IN COLOMBIA

Population: 2005 – 42,285,634; **2015** – 48,228,697

Education: 2005 – Children out of school: 2.5% (2.3% F);
Primary completion rate 108.4% (106.4% M / 110.5% F);
Lower secondary completion rate 76.0% (70.5% M / 81.6% F);
Primary pupil/teacher ratio 28.3%;
Secondary pupil/teacher ratio 26.2%;
Government expenditure as % GDP 4%;
Youth (15–24) literacy rate 98.0% (97.5% M / 98.4% F)

2015 – Children out of school: 6.8% (6.6% F);
Primary completion rate 100.5% (101.2% M / 99.8% F);
Lower secondary completion rate 77.6% (72.6% M / 82.9% F);
Primary pupil/teacher ratio 24.3 (2014);
Secondary pupil/teacher ratio 24.9 (2014);
Government expenditure as % GDP 4.7% (2014);
Youth (15–24) literacy rate 98.7% (98.2% M / 99.1% F)

ICTs: 2005 – Fixed broadband connectivity 318,683;
Mobile cellular subscriptions 21,849,993 (51.7%);
Access to electricity 96.8%;
Households with computer (unavailable);
Individuals using Internet 11.0%

2015 – Fixed broadband connectivity 5,525,763;
Mobile cellular subscriptions 57,327,470 (118.9%);
Access to electricity 97.8% (2014);
Households with computer 45.2% (2016);
Individuals using Internet 55.9%

Colombia has had one of the most impressive recent commitments by a government in Latin America to using ICTs in national development.[60] On coming to power in 2010, the Santos government identified four main obstacles to achieving widespread Internet use in the country: it not being perceived as useful; the high costs of installing infrastructure; limited government resources; and low purchasing power of Colombians. The Plan Vive Digital was therefore introduced to overcome these challenges, with the aim of achieving three objectives by 2014: tripling the number of municipalities connected to the national fibre optic network; connecting half of the micro-enterprises and small- and medium-sized enterprises, and half of all homes, to the Internet; and increasing the number of Internet connections fourfold to 8.8 million by 2014. This was to be achieved through four components: expanding the infrastructure; creating services at lower prices; developing relevant applications and digital content; and fostering ICT adoption and use. Education was a particular priority in Vive Digital: 82,000 computers were given to children and youth in more than 3,500 educational sites through the Computadores para Educar (CPE) programme, which had first been created in 2002; and a further 7 million children were seen as benefitting from the purchase of 577,000 companies which were delivered to more than 13,500 educational centres. The CPE programme was specifically intended to bring ICTs to children in rural and remote areas, and to train teachers so that they were better acquainted with technology, and consequently that education in public schools would improve.

Nevertheless, as the above account indicates, the emphasis was primarily on the inputs in terms of technology delivered, rather than on the educational outcomes. An important earlier report from 2009 had showed that in previous ICT for education initiatives in Colombia there had been little visible improvement in educational quality through the CPE programme, which had installed refurbished computers from the private sector in schools, and trained teachers in their use. Indeed, this report concluded with the sobering finding that "this widely implemented national program has no effect on students' academic performance".[61] The authors argued that the main reason for this was a failure actually to incorporate the computers into the educational process; although computers were provided, and teachers trained, the teachers did not actually incorporate the computers into their delivery of the curriculum.[62] As in so many other computer in schools initiatives across the world, although the intention was to enhance learning through computers, in practice the computers were only really used for basic instruction in computer skills.

The second phase of Vive Digital (2014-2018) continued the ambitions of the first phase, and it is estimated that by the end of 2017 95% of Colombia's municipalities will be connected through public-private partnerships to the National Optical Fiber Project. Moreover, it was also estimated that in 2017 for every 100 Colombians there are 35 smartphones, 10 notebook computers, 8 desktop computers and 6 tablets.[63] The government's commitment to delivering infrastructure has attracted much foreign investment, and it is currently seen as being a best prospect industry sector in the country for US exporters.[64]

However, the impact of all this on educational achievement, particularly for those living in the most marginalised areas, remains uncertain. Many mountainous parts of the country, especially in the west which are inhabited by Afro-Colombian people, still do not have electricity, and so roll-out of ICTs there will remain slow.[65] Moreover, there remains a feeling in the country that most of the benefits of ICTs are being experienced in urban areas, and this will continue to be so in 2025, despite government rhetoric to improve access to the Internet throughout the country. Bandwidth and reliability of connectivity are low in rural areas, and there seems little evidence that inequalities between urban and rural areas will change markedly by 2025. The capacities of rural teachers in using ICTs will increase, but the skills of urban teachers will increase more rapidly; more locally relevant content will be available in the country as a whole, although little of this will be direly focused on the needs of the most-marginalised ethnic communities. Although the peace process with FARC and ELN holds out prospects for a more stable country in which education for all can indeed prosper, other armed groups are increasing in strength and are now controlling substantial areas of coca production and illegal mining. There remains a real danger that minorities, especially those living on the Pacific Coast, are being left behind by the current emphasis primarily on delivering ICT infrastructure, and that unless more attention is paid to the real learning outcomes for the poorest and most marginalised, they will still remain relatively disadvantaged by 2025.

CASE STUDY OF ICTS AND BASIC EDUCATION IN GRENADA AND THE SOLOMON ISLANDS

Grenada (Caribbean)

Small island states suffer from particular challenges in implementing effective ICT for education, especially when they consist of numerous, tiny, scattered islands. Most have small markets that are often not appealing to foreign private sector investors; all tend to have elites drawn from a small section of the population, who are often in conflict with each other; most have difficulty in raising sufficient tax revenue to be able to provide quality state-run services. However, their small population sizes do mean that if effective policies are introduced, they can achieve substantial social and economic advances. The contrasting examples of Granada and the Solomon Islands provide insights about the use of ICTs for education, especially among some of their deprived citizens.

Population: 2005 – 102,949; **2015** – 106,823 (3 islands)

Education: 2005 – Children out of school: 9.3% (8.5% F);
Primary completion rate 102.4% (103.3% M / 101.5% F);
Lower secondary completion rate 79.6% (72.6% M / 86.6% F);
Primary pupil/teacher ratio 17.7% (2004);
Secondary pupil/teacher ratio 20.1% (2004);
Government expenditure as % GDP 3.9% (2003);
Youth literacy rate (unavailable)

2015 – Children out of school: 2.2% (2.4% F);
Primary completion rate 89.4% (89% M / 89.9% F) (2014);
Lower secondary completion rate 87.4% (86.6% M / 88.3% F);
Primary pupil/teacher ratio 14.5 (2014);
Secondary pupil/teacher ratio 12.5 (2014);
Government expenditure as % GDP (unavailable);
Youth (15–24) literacy rate (unavailable)

ICTs: 2005 – Fixed broadband connectivity 3,222;
Mobile cellular subscriptions 46,858 (45.2%);
Access to electricity 85.2%;
Households with computer (unavailable);
Individuals using Internet 20.5%

2015 – Fixed broadband connectivity 19,757;
Mobile cellular subscriptions 119,767 (157.6%);
Access to electricity 90.8% (2014);
Households with computer (unavailable);
Individuals using Internet 53.81%

Grenada has made considerable progress in developing its basic education sector. With a relatively small population, commitment to education and health delivery from all political parties, and some high quality civil servants, it has made substantial progress in recent years, so that in 2014 the primary pupil/teacher ratio was as low as 14.5, with primary completion rates at 89.4%. As in many other Caribbean countries the female completion rate is higher at all ages than the male. Hurricanes, though, can have a devastating effect, with Hurricane Ivan in 2004 providing lasting impacts on the education sector for several years.

The decade from 2005-2015 saw the dramatic roll-out of technology with many people now having two mobile subscriptions, and more than half the population using the Internet. This shows what can be achieved on a relatively small island, with political will, commitment, and the involvement and support of the private sector. However, the initial take-up of ICTs in education was slower than in its larger neighbours. In 2003, the OAS funded a project to introduce ICT into primary and secondary schools, but in the first instance maintenance of the equipment was an issue; Hurricane Ivan, which occurred shortly afterwards meant that much available funding went on school reconstruction. In 2007, the government began the development of educational-TV programming; radio assisted instruction has also been important. By 2010, it had one of the highest learner-to-computer ratios (55) in primary schools in Latin America and the Caribbean. The IT Unit in the Ministry of Education, Human Resource Development and the Environment has a comprehensive set of responsibilities including managing computer labs in secondary schools, providing trainings for teachers, principals and administrative staff in schools, and developing relevant policies for teaching and learning.

Without rigorous monitoring and evaluation studies it is difficult to tell the exact impact that computers in schools and the use of radio and TV have had on primary learning, but at the very least it means that computer literate pupils are being trained on the island. It will be interesting to see how the rapid increase in the number of mobile devices will be incorporated into school learning on the island over the next decade, but there is the potential for some innovative approaches to be trialled. At the same time, care must be taken over child online protection, especially given recent concerns over the use of ICTs in sexual harassment.

CASE STUDY OF ICTS AND BASIC EDUCATION IN GRENADA AND THE SOLOMON ISLANDS

Solomon Islands (Pacific)

Population: 2005 – 469,885; **2015** –587,482 (6 main islands and >900 smaller islands)

Education: 2005 – Children out of school: 24.4% (26% F);
Primary completion rate 85.8% (85.2% M / 86.5% F);
Lower secondary completion rate 45.7% (51.2% M / 39.8% F);
Primary pupil/teacher ratio (unavailable);
Secondary pupil/teacher ratio (unavailable);
Government expenditure as % GDP (unavailable);
Youth literacy rate (unavailable)

2015 – Children out of school: 29.5% (29.3% F);
Primary completion rate 88.6% (88.7% M / 88.5% F);
Lower secondary completion rate 70.7% (70.1% M / 71.4% F);
Primary pupil/teacher ratio 19.1 (2012);
Secondary pupil/teacher ratio 25.9 (2012);
Government expenditure as % GDP 10% (2010);
Youth (15-24) literacy rate (unavailable)

ICTs: 2005 – Fixed broadband connectivity 450;
Mobile cellular subscriptions 6,000 (1.6%);
Access to electricity 18.5%;
Households with computer (unavailable);
Individuals using Internet 0.8%

2015 – Fixed broadband connectivity 1,420;
Mobile cellular subscriptions 424,712 (72.3%);
Access to electricity 35.1% (2014);
Households with computer (unavailable);
Individuals using Internet 10%

The Solomon Islands consist of six major islands and an estimated 900 smaller islands; they are thus a dramatic contrast to Grenada. The official language is English but it is only spoken by a very small percentage of the population, most of whom speak Pijin; there are about 70 other living languages. For a long time, radio has played an important role in providing media coverage across these dispersed islands. Most Internet connectivity is by satellite, but costs are extremely high at US$ 5000 a month for a slow and variable connection. Talks are underway in 2017 to provide a submarine cable link to Australia, but Australian security concerns over the cable being built by the Chinese company Huawei seem likely to delay this potential development.

The Solomon Islands are heavily reliant on international aid, with the Asian Development Bank funding several infrastructure projects, and other donors also providing support for the education sector. The government has placed considerable emphasis on improving education, as reflected in the 10% budget allocation in 2010, but there is still a long way to go. There is an overall education Strategy Framework 2016-2030 that is intended to help make the necessary changes. The National Education Action Plan 2016–20[70] developed within this framework focuses on improving access, quality and management of education services. This identifies that one of the key challenges is designing and implementing affordable and effective policies that will allow equitable access and improving completion for priority group, alongside the overall improvement of education. In August 2017, UNESCO undertook a mission to help develop an ICT in education masterplan. Nevertheless, this needs to be undertaken within a holistic approach to national development. Around 70% of schools do not currently have electricity, and if ICTs are to be used effectively both the challenges of electricity and broadband connectivity need to be addressed.

A fundamental problem is how to provide relevant education to dispersed populations on outlying islands, both in terms of qualified teachers, and access to relevant curriculum content in the correct language. A recent innovative 5-school pilot project to explore how ICTs could indeed be used effectively in education has been the trialling of the Kenyan designed BRCK and Kio Kit.[71] This all-in-one solution provides connectivity and tablets, and the project focused on helping teachers understand how to use such technology and apply it in the classroom. Nevertheless, the kit is not marine-rated and therefore not particularly suitable for a marine environment; most of the content was also in English. Those involved in the pilot suggested that if the Khan Academy videos could be dubbed into Pijin, and relevant content also developed in local languages, then such solutions show what might be possible in isolated small island communities.

However the triple challenges of distance, electrification and availability of funding mean that by 2025 substantial diversity will remain in the quality of basic education provision across the islands.

CASE STUDY OF ICTS AND BASIC EDUCATION IN JORDAN

Population: 2005 – 5,714,111; **2015** – 9,159,302

Education: 2005 – Children out of school: 1.1% (2003);
Primary completion rate 105.5% (104.7% M / 106.3% F);
Lower secondary completion rate 89.4%
(87.9% M / 90.9% F) (2004);
Primary pupil/teacher ratio 19.9% (2003);
Secondary pupil/teacher ratio 17.9%;
Government expenditure as % GDP (unavailable);
Youth (15–24) literacy rate 99% (99% M / 98.9% F)

2015 – Children out of school: 10.7% (10.9% F) (2013);
Primary completion rate 91.1% (90.9% M / 91.1% F) (2014);
Lower secondary completion rate 81.2% (79.7% M / 82.7% F);
Primary pupil/teacher ratio (unavailable);
Secondary pupil/teacher ratio (unavailable);
Government expenditure as % GDP (unavailable);
Youth (15–24) literacy rate 99.2% (99.1% M / 99.4% F)

ICTs: 2005 – Fixed broadband connectivity 23,551;
Mobile cellular subscriptions 3,137,700 (54.9%);
Access to electricity 99.1%;
Households with computer (unavailable);
Individuals using Internet 12.9%

2015 – Fixed broadband connectivity 320,205;
Mobile cellular subscriptions 13,797,968 (150.6%);
Access to electricity 100% (2014);
Households with computer 47% (2014);
Individuals using Internet 60.1%

With few physical natural resources of its own, Jordan has long seen its people as its richest resource. It therefore has a strong tradition of educating its citizens, and the results of this are well reflected in the statistical data shown above. It has also placed great emphasis on the potential of digital technologies to enhance learning, and was one of the first countries to initiative partnership initiatives with the private sector to develop the quality of its education system. One of the most important of these was the Jordan Education Initiative, initiated at the World Economic Forum meeting in Davos in 2003, which lasted until 2017 when it was transitioned to the Queen Rania Foundation for Education and Development.[72]

However, Jordan has also long encountered the manifold challenges of hosting refugee populations, and with more than 2.7 million refugees in 2016 it hosted more refugees than any other country in the world, consisting mainly of long-term Palestinian refugees (2.1 million) and more than 655,000 refugees from Syria in 2016/17.[73] This places particular pressures on the country, not least in terms of the conflicting views of different donors and international agencies, all wanting to be seen to be supporting refugees, while also often competing with each other rather than delivering a combined strategy of support. As far as Jordan is concerned, the government seeks to integrate refugees as far as possible into its existing education system.

Jordan has also turned to ICTs as a means to build the country's economic competitiveness, utilising the strengths of its well-educated population; most children now have smart phones. However, its 2013-17 ICT strategy recognises that its previous lead in the ICT sector over other countries in the region has decreased, and highlights that much still remains to be done to build the country's knowledge-based industries.[74] This strategy, in particular recognises that ICTs can be an engine of economic growth for Jordan that harnesses the energy, creativity and talent of its youth, and can establish and maintain export markets through enabling the high value added non-ICT sector to improve its competitiveness, exploiting national infrastructure, developing international technical and business linkages, and serving international technological needs.

The recent influx of refugees from Syria has placed substantial pressures on the education sector, and has led to the reintroduction of more than 600 double-shift schools. This has resulted directly from the political decision to integrate refugees within the education system of the most densely populated areas, rather than locating them in camps in the low-density areas in the south of Jordan. Although there is considerable international funding coming into the country to support refugees, much of this is directed at specific diffuse programmes advocated by the donors and does not cover the government's basic costs in hosting them. One positive use of ICTs in responding to the refugee crisis has been the development of online resources to support teachers and refugee children. At the start of the present refugee crisis, Jordanian teachers were unable to cope with the psycho-social issues of refugee children and the larger class sizes that resulted from their arrival, and so the Queen Rania Teacher Academy and UNESCO developed a set of face-to-face training modules for teachers and counsellors, parts of which have now be rolled out online in a blended learning programme. Another example of the use of technology partnerships has been in the development of EDRAAK, the first non-profit educational MOOC in the Arab world, developed in 2014 in partnership with edX.[75] UNRWA has also undertaken some important and innovative work

using ICTS to support refugee education, not least through the development of its interactive learning programme (ILP),[76] and its overall Education in Emergencies (EiE) programme.[77] However, it has also shown the success of using older ICTs such as television through its UNRWA TV which launched educational programmes in 2012.[78] Outside Jordan, it is important also to note the work of UNRWA in setting up safe learning spaces that provide a haven for Palestinian children in Syria to learn and play.[79]

Experiences of those closely involved in the education sector in Jordan nevertheless also highlight three main problems. First, there is still too much of a tendency among donors and sometimes officials to see ICTs as a silver bullet for education. In practice, this does not work unless the technologies are closely integrated into the overall pedagogy and curriculum. Children, especially refugees, need to have a context and purpose for using ICTs for learning, because otherwise they have a tendency to chat and explore social networks. Second, considerable attention needs to be placed on helping teachers learn how best to use these technologies for their own intellectual progression, and also in practice in the classroom. Third, donors and agencies seeking to support education, especially for refugees, all too often compete amongst themselves, and do not listen sufficiently to the Jordanian governments own agendas. It is therefore essential that all new funding should be directed in line with the recommendations of the country's new education strategy launched in 2016.[80]

AHMAD MUHSEN/SAVE THE CHILDREN

CASE STUDY OF ICTS AND BASIC EDUCATION IN PAKISTAN

Population: 2005 – 153,909,667; **2015** – 189,380,513

Education: 2005 – Children out of school: 31.3% (40.5% F);
Primary completion rate 64.5% (74.7% M / 53.7% F);
Lower secondary completion rate 34% (30.2% M / 28.5% F);
Primary pupil/teacher ratio 38.3%;
Secondary pupil/teacher ratio 23.3%;
Government expenditure as % GDP 1.2%;
Youth (15–24) literacy rate 65.1% (76.7% M / 53.1% F)

2015 – Children out of school: 26.2% (32.1% F);
Primary completion rate 71.9% (77.9% M / 65.3% F);
Lower secondary completion rate 52.1% (56.6% M / 47.2% F);
Primary pupil/teacher ratio 41.4 (2012);
Secondary pupil/teacher ratio 21 (2012);
Government expenditure as % GDP 2.5% (2014);
Youth (15–24) literacy rate 73.7% (80.2% M / 66.8% F)

ICTs: 2005 – Fixed broadband connectivity 14,600;
Mobile cellular subscriptions 12,771,203 (8.3%);
Access to electricity 83.9%;
Households with computer (unavailable);
Individuals using Internet 6.3%

2015 – Fixed broadband connectivity 1,793,199;
Mobile cellular subscriptions 125,899,638 (66.5%);
Access to electricity 97.5% (2016);
Households with computer 16.1% (2016);
Individuals using Internet 14%

Primary and Junior Secondary education indicators have shown substantial improvement in Pakistan between 2005 and 2015, yet significant gender differences in access and achievement remain. One third of girls in 2015 were out of school, and only two-thirds of female youths were literate. The use of mobile phones and connectivity have increased dramatically, with mobile subscriptions in 2015 being 66.5%; electricity is officially now also almost universal, but many villages still lack it, and there is much load shedding. Governments doubled the expenditure on education as a percentage of GDP between 2005 and 2014, and continue to be committed to educational reform. This improvement has occurred alongside substantial international donor funding for the education sector: the World Bank provided $800 million between 2002 and 2012 for textbooks, new teachers and infrastructure; [81] and DFID's Punjab Education Sector Programme II (PESP II) aims to improve education access, retention and quality for 12.2 million children in Punjab between 2013 and 2020 at a cost of just under £382 million.[82] Slow improvements in education indicators are likely to be seen in the country to 2020 and beyond, providing there is political stability in the country, and good governance. There has been substantial development in the ICT sector, with the government taking an active interest in promoting the use of ICTs throughout the economy. Reduction in taxation on mobile devices in 2017 is likely to lead to further investment in the sector, and an increase in mobile and broadband services. By 2020, 3G and 4G mobile broadband services are likely to be used by 3 in 10 people, compared with <1 in 10 in 2017. However, most new mobile broadband users will upgrade from 2G, and are unlikely to be new mobile users.[83] There is an active app-development community in Pakistan, with developers being eager to produce apps not only for the growing middle-class market, but also relevant to the needs of people with disabilities, as well as girls and women.

There remain real challenges within the education system. The quality of education received, depends largely on affluence. Many richer parents send their children to private schools, yet around 23 million children remain out of school.[84] Low-cost private education is also being introduced,[85] but its impact remains uncertain. Parents are very grade conscious, and children are pressured into working hard towards assessments; there is little time just to enjoy just being a child. The assessment agenda has exacerbated a "learn and regurgitate" approach that will be difficult to change in the short term. There are stark contrasts in primary school provision and quality, both between rural and urban areas, and also within the major cities. Deprived rural areas, in Khyber Pakhtunkhwa (KPK), Baluchistan, Sindh and parts of Punjab, suffer from poverty and lack of infrastructure. Anecdotal evidence suggests that some schools constructed through PESP II are being used by powerful feudal landlords as cattle byres, with young female teachers being threatened with violence. Refugee children from the conflicts in adjacent Afghanistan are amongst the most marginalised, but girls and women in traditional rural areas dominated by patriarchal Islam also have little access to either quality education or the most basic mobile phones. Digital technologies are already used in schools, but only to a limited extent. Some local language content is available in Urdu, but not much in other languages such as Pashtu. Videos with local language voice-overs have much potential for learning, both in-school and also informally. Recent innovations include requiring teachers at schools and colleges in Punjab (since 2014), and more recently in KPK, to use fingerprint readers to indicate their attendance in order to help reduce the numbers of teachers not turning up for work (ghost-teachers).[86] Similar innovative uses of ICT are likely to proliferate in the future, but mainly as pilot projects.

By 2025, substantial progress is likely to be made in increasing both the numbers of children participating in primary and lower secondary schools, and also in the quality of teaching. Despite rhetoric advocating the importance of critical thinking and collaborative learning, though, the didactic mode of teaching is likely to remain prominent, enhanced by traditional assessment schemes. The majority of households will have access to mobile broadband, and young children from richer households will use mobile 'phones and tablets to play games and access some learning content in

local languages. Nevertheless, existing inequalities in the use of ICTs for learning are unlikely to be reduced and may well become more pronounced. In many rural areas, far from cities, in deserts and mountains, limited connectivity to higher speed broadband will limit its use by most children, especially for video. Girls and ethnic minorities in these areas will continue to be disadvantaged. Floods and earthquakes are major hazards, and digital learning provision in their aftermath may enable continuity of learning for affected children. Should conflicts continue in Afghanistan and KPK there will remain an important need to educate refugee children. Where parents understand the potential of digital content and give their children access to mobile devices, they will increasingly enhance their out-of-school learning through videos and games. It is likely, though, that children, and especially girls, whose parents reject Western models of education, and prefer to see them gathering fodder or sifting rubbish, instead of using "demonic and un-Islamic" ICTs, will become increasingly isolated and marginalised.

SAVE THE CHILDREN

CASE STUDY OF ICTS AND BASIC EDUCATION IN SOMALIA

Population: 2005 – 10,409,925; **2015** – 13,908,129

Education: 2005 – Primary pupil/teacher ratio 35.5 (2007); Secondary pupil/teacher ratio 19.3 (2007); (Other data unavailable)

2015 – (Data unavailable)

ICTs: 2005 – Fixed broadband connectivity (unavailable); Mobile cellular subscriptions 500,000 (4.8%); Access to electricity 10.3%; Households with computer (unavailable); Individuals using Internet 1.1%

2015 – Fixed broadband connectivity 82,000; Mobile cellular subscriptions 5,836,000 (42.0%); Access to electricity 19.1% (2014); Households with computer (unavailable); Individuals using Internet 1.8%

Somalia has faced more than two decades of conflict, severely disrupting and nearly destroying the educational system. The areas of Somaliland, Puntland and South-Central Somalia have taken fundamentally different approaches to establishing education services since this collapse, yet all continue to face complex and multidimensional challenges. These challenges include insufficient numbers of qualified teachers, inadequate resources, poor school infrastructure, and weak governance and regulation. Student enrolment remains very low across Somalia, with only 29% of school-aged children enrolled in primary school and 7.4% of secondary school-aged youth enrolled in secondary school, although enrolment varies quite significantly in each area, with Somaliland typically having slightly higher rates. Girls and women, individuals with disabilities, displaced people, rural communities and nomadic pastoralists in particular continue to be disproportionately excluded from accessing and engaging in education. In particular, fewer than 50% of primary school students are girls, with parents citing lack of separate latrines and adequate sanitation facilities, few female teachers (less than 20% of primary school teachers in Somalia are women), and safety concerns as reasons for not enrolling their daughters in education. Poverty is also a significant barrier to enrolment as the cost of private schools remains prohibitive. It is anticipated that the cost of school will continue to be high into 2025, and while there may be a greater number of free public school available, there will probably be little money left to incentivise qualified teachers to leave higher paid positions at private schools by this time. Efforts are currently underway to develop better accessibility to basic education for marginalised children by 2025 through pilot projects as well as what will hopefully be a more unified curriculum that focuses on child-centred pedagogy, with Somaliland already implementing a revised outcome-based curriculum. Gender-specific pilots are also being run to test innovative approaches to inclusivity and their impact on attendance, as reported by Kipchumba and Sulaiman (In Press).

It is clear that innovative approaches are needed to cater for the diverse educational requirements of both children and adults as the country becomes more stable. This may include leveraging the digital infrastructure already seen throughout the country to support new ways of learning,[90] but integrating ICT in education faces its own set of challenges, including lack of infrastructure, cost of bandwidth and devices, lack of electricity, no national policy framework, and little access available for rural and pastoral populations. While ICT-related gains have been made in Somalia, demonstrated by the exponential rise in mobile phone subscriptions, increasing computer use, and widening reach of internet service providers, this access appears to be significantly more prevalent in urban than in rural areas and it is anticipated that this will continue into 2025. It is also considered unlikely that ICTs in Somalia will be regulated under a unified national regulatory framework in the near future.[91]

While societal and technological change will continue to take place throughout Somalia, the prerequisite demands for basic education as well as for the ICT industry are still very high for ICTs to be fully integrated in the education system by 2025. As much as ICTs may be considered an effective tool for enhancing the quality and access to education, educational reform is in its infancy and 2025 does not give the system much time for fundamental changes to take place. Rather, it is anticipated that elements of ICT will continue to be introduced in subsets of schools as more pilot projects emerge, but development organisations will be likely to need to continue to fund a significant proportion of these programmes because of ongoing government budgetary constraints. It is recommended that for these pilots to be successful they should focus first on enhancing literacy, since there is currently low literacy among students enrolled in schools, although it is hard to quantify the precise literacy levels since no large scale study has been carried out. The Save the Children International pilot project in Puntland, 'Alphabet King' focuses on enhancing literacy through the use of tablet and mobile-based literacy applications that are contextualised and translated into Somali (a critical element of any ICT initiative in Somali education) for deprived children.

Somalia is an important case study for discussions of state fragility and the considerations and possibilities for the use of ICT in learning in such contexts. It is recommended that as more pilot projects emerge across the different areas of Somalia, there should be greater emphasis on evidence-gathering and sharing through effective monitoring and evaluation. As more evidence on integrating technology in education is produced, as well as evidence from neighbouring countries, it will be easier to know how best to deliver at scale nationally and have government buy-in. Producing data in a systematised manner will be integral for the future of Somali education, with very recent gains including the Cabinet approving the bill establishing the National Statistics Bureau.[92]

CASE STUDY OF ICTS AND BASIC EDUCATION IN UNITED KINGDOM

Population: 2005 – 60,401,206; **2015** – 65,128,861

Education: 2005 – Children out of school: 0.2% (0.2% F);
Primary completion rate: 97% (2010);
Lower secondary completion rate (unavailable);
Primary pupil/teacher ratio: 17.5%;
Secondary pupil/teacher ratio: 14.9%;
Government expenditure as % GDP: 5.2%;
Youth (15–24) literacy rate: (unavailable)

2015 – Children out of school: 0.2% (0.3% F);
Primary completion rate: (unavailable);
Lower secondary completion rate: (unavailable);
Primary pupil/teacher ratio: 17.4;
Secondary pupil/teacher ratio: 15.8 (2014);
Government expenditure as % GDP: 5.7% (2013);
Youth (15–24) literacy rate: 99.99% approx.

ICTs: 2005 – Fixed broadband connectivity: 9,898,653;
Mobile cellular subscriptions: 65,471,665 (108.4%);
Access to electricity: 100%;
Households with computer: (unavailable);
Individuals using Internet: 70%

2015 – Children out of school: 0.2% (0.3% F);
Primary completion rate: (unavailable);
Lower secondary completion rate: (unavailable);
Primary pupil/teacher ratio: 17.4;
Secondary pupil/teacher ratio: 15.8 (2014);
Government expenditure as % GDP: 5.7% (2013);
Youth (15–24) literacy rate: 99.99% approx..

The UK was chosen as an example of a relatively rich country where there has been considerable innovative use of ICTs in education,[93] where there is strong political involvement in the system, and yet where substantial inequalities still exist. It shows clearly that whilst most children use ICTs on a regular basis out of school, their use in schools remains very variable, with the most deprived benefitting little from the potential that ICTs have to offer.

UK education includes many contrasts and divisions. A substantial private sector delivers education to around 7% of UK children, and more than 18% of those over the age of 16, and regular surveys show that this privately educated elite continues to take top jobs.[94] The state education sector includes an increasing diversity of schools, with comprehensive schools being introduced in 1965 for children over the age of 16, replacing secondary modern and most grammar schools. State funded academy schools, independent of local authorities were introduced in 2000, and more recently so-called free schools, also free from local authorities have been created.[95] At the primary level, there are both state and private schools, with about 30% of primary state schools being faith schools, funded by the government but supported by faith organisations and choosing what they teach in religious studies. There is widespread concern about the quality of education in UK schools, although most pupils under 16 do indeed attend. Political involvement in the education system has therefore been high, with Ministers regularly wanting to find new ways to improve education; ICTs have featured prominently in this. In terms of ICT coverage there have been more mobile phones in the UK than people for over a decade, and broadband connectivity has increased considerably, although it remains of very variable quality and mobile broadband is still unavailable in many rural areas.

The UK has positioned itself as a leader in the use of ICTs in education, and is home to a thriving educational technology sector. The British Educational Training and Technology exhibition was founded in 1985 and is one of the largest and most important of its kind in the world. The British Educational Suppliers Association dates back to 1933, and has played a leading role in supporting the effective use of ICTs in the sector over the last 20 years. Their annual report for 2015 showed that in the 294 primary and 315 secondary schools surveyed the amount of time that children were exposed to ICT in the classroom rose to 53% from 50% in 2014. There has long been pressure for ICT and Computer Science to be taught at an early age as part of a broad and balanced curriculum, and there has been a tendency for much work to focus on this rather than on the effective use of technology more widely across the curriculum. Since the Education Reform Act of 1988, ICT has been compulsory for all pupils from 5-16 in government funded schools. A government report has recently suggested that in general this is more successfully taught in primary than in secondary schools, with most primary school leaders also having a clear understanding of the contribution that ICTs can have to their school's wider improvement.[96]

The reality on the ground, though, is not always as positive as such reports suggest. Many teachers in state schools face gruelling pressures, and there are significant problems of retention. More than 10% of teachers leave within one year of qualifying, and 30% leave within 5 years; between 2011 and 2014, the number of teachers leaving rose by 11%.[97] Science teachers have particularly high rates of attrition. Many issues influence retention rates, but the main factor appears to be a decline in job satisfaction, often as a result of what is seen as continual political interference. It is estimated that more than 600,000 pupils in state schools in 2017 are taught by unqualified teachers, and this figure has increased by 60% since 2012.[98] ICT use in primary schools is very variable. Although the technology may be present in classrooms, much is left unused, or is indeed broken. Where technology is found in primary schools, it is frequently used purely in a didactic mode, and its potential for collaborative learning is often ignored. Debates continue around the use of mobile devices in classrooms. One recent report has suggested that "restricting mobile phone use can be a low-cost policy to reduce educational inequalities".[99] Such

arguments add to the evidence that the most deprived children in the UK do not yet benefit greatly from the use of ICTs in schools.

Despite such challenges, there are indeed many innovative uses of technology in and for education. One of the most exciting of these is the School in the Cloud concept developed by Sugata Mitra, which links Self-Organised Learning Environments (SOLEs) with the Granny Cloud, originally set up to involve retired teachers in hoeing to teach English to Indian schoolchildren.[100] Elsewhere, there are many less adventurous primary classrooms, where interactive whiteboards are connected to teachers' computers, and pupils use PCs, digital cameras and audio equipment to record and present work.[101]

ANNA KARI / SAVE THE CHILDREN

ANNEXES

ANNEX 1: DEFINITIONS

Primary Schooling and Basic Education. Education systems vary globally, and national definitions of these terms differ. However, primary schools are generally considered to be those that provide 6 years of education to children between 5 and 11 or 12 (1st to 6th grade), with junior secondary schools in some countries providing a further 3 years of schooling (7th to 9th grade). Basic Education has increasingly been used to refer to the education that is considered as the basis for successful learning throughout someone's life, and is therefore not age-bound.[102] For the present purposes, though, we focus primarily on basic education and on children under the age of 15-16, but given Save the Children's strategic emphasis on early childhood care and development, and its emphasis on the first 3 years of primary schooling,[103] we concentrate mainly on skills and knowledge gained in early childhood. We also note that Save the Children formally defines Basic Education "as the compulsory years of education in a particular country", but that it also focuses on alternative, accelerated and remedial education that may not be compulsory.[104]

Education and Learning. The term education is generally used to refer to the system for sharing knowledge, values and skills within a society and is usually institutionalised in schools and universities. Learning focuses instead mainly on the process through which individuals gain such knowledge, which need not be through formal institutions.[105] We explicitly differentiate between both terms, especially in the context of how ICTs have been used to enable traditionally school-centred learning to take place increasingly beyond the confines of formal educational systems based on schools.

Deprivation: places and people. There are many contrasting definitions of the elusive term deprivation,[106] and internal Save the Children documents emphasise not only how important the notion of deprivation is to the organisation, but also how problematic it is. Save the Children's future strategy is based on the rights of every child to achieve three breakthroughs: to survive, to learn, and to be protected from all forms of violence.[107] Linked to these, the most deprived children are seen as being:

- Not likely to survive to their 5th birthday
- Not enrolled in school and not achieving relevant learning outcomes
- Not adequately protected from all forms of violence.

In this report, we distinguish between deprived places, and deprived children. Our terms of reference specifically refer to deprived locations, and we consider these to be places where there is insufficient infrastructure (particularly hard infrastructure, such as schools, electricity and digital connectivity, but also soft infrastructure such as well qualified teachers, efficient administrative systems, and good governance) to prevent the measures of deprivation in which Save the Children is interested. We adopt a broad definition of deprived children, and suggest that refugees, street children, child soldiers, those with disabilities, girls in patriarchal societies, those living in conflict zones, and those living in crisis situations (both short-term and protracted), are usually some of the most deprived. Our report therefore focuses especially on these. In so doing, it can be noted that access to appropriate and affordable ICTs is now often considered to be a human right,[108] and that the absence thereof can itself therefore be seem as a measure of deprivation. We also emphasise that there are many deprived children, even in economically rich countries.

Literacies. Literacy is a broad concept, and is often defined as the four strands of language: reading, writing, speaking and listening. Save the Children places especial emphasis on children's literacy and numeracy, and define it as "All children can speak, listen, read, write, and understand spoken and written words in the primary language(s) of their society, or through adaptive forms of communication, if necessitated by an impairment".[109] However, increasingly, the notion of digital literacy, being the set of competencies that enable people to participate fully in a knowledge society, has been promoted.[110] We adopt a broad approach to literacy, and use the term literacies to imply that there are many types of literacy, including the ability to use digital technologies, that are now important for children to acquire so that they lead fulfilled lives.

Information and Communication Technologies (ICTs). The meaning of ICTs is rapidly evolving, alongside the technologies themselves.[111] The joint trends of miniaturisation and convergence have meant that it is now increasingly difficult to differentiate them. However, we use the term primarily to refer to digital technologies that are used for communication and information acquisition, not only by humans but also by other machines. Key technologies discussed in this report include mobile broadband, the Internet (including IoT), educational applications, Open Educational Resources, radio, mobile 'phones, and tablets. The regulatory and policy environments that influence the availability and affordability of these technologies are also of critical importance.

ANNEX 2: PEOPLE CONSULTED

This report is based in large part on consultations with amazing people who have worked across the world on the use of ICTs in education and learning. We are immensely grateful to all those who have so willingly shared their insights with us for this report. It has been both a pleasure and a privilege to have the opportunity to work with you in exploring this fascinating and important issue.

Formal interviews

Dr. Akber Gardezi (Assistant Professor, Computer Science, COMSATS Institute for Information Technology, Islamabad. Pakistan)*

Alexandra Galeitzke (Advisor, Sector Programme Education, Deutshce Gesellschaft für Internationale Zusammenarbeit. Germany)

Andrew Erbs (Techsmith and Digital Development Practitioner. Pacific)*

Ashraf Uzamman Rony (New Media consultant; formerly Head of Interactive, BBC Media Action. Bangladesh)

Azra Naseem (Assistant Director, Blended Learning, Aga Khan University. Pakistan)

Dr. Bushra Hassan (Assistant Professor, International Islamic University, Islamabad. Pakistan)

Dr. Caroline Pontefract (Director of Education, UNRWA, Amman. Jordan)

David Banes (Director of David Banes Access and Inclusion Services, and formerly CEO Mada, the Qatar Assistive Technology and Accessibility Center. UK)

Emily Unwin (Modern languages teacher, Bacon's College, Rotherhithe – E-ACT Academy in Special Measures. UK)

Ezri Carlebach (Senior Associate, the PR Network, and Visiting Lecturer, University of Greenwich. UK)

Gaurav Gupta (Head of Sustainable Business Development, Purposeful Business Team, BT Group. UK)

Gema Jara (Technology in Education Consultant, specialising in Latin America; formerly Director of Distance Learning, Basic Education Department, Ministry of Education, Mexico. USA)

Graham Brown-Martin (Founder of Learning Without Frontiers, and author of Learning {Re}imagined. UK)

Haif Bannayan (Chief Executive Officer, Queen Rania Teacher Academy. The Hashemite Kingdom of Jordan).

Harry Hobson (CEO, Common Everbody. UK)

Jacqueline Strecker (former Learn Lab Manager, UNHCR. Kenya)

Jake Unwin (Deputy Head of History, Whitgift School. UK)

Keith Krueger (CEO of the Consortium for School Networking. USA)

Keith Magee (Head of Education, Camara. Ireland)

Ken Banks (Founder of kiwanja,net, and mobile anthropologist. UK)

Dr. Margaret Perkins (Recently retired, Course Director of Primary School Direct, Institute of Education, University of Reading. UK)

Dr. Marije Geldof (International Institute of Social Studies; the Hague; independent consultant in ICT4D and mobile health; previously Country Director for D-tree International in Malawi. Netherlands)

Matthijs Leendertse (Lecturer in Media Innovation and Business, Erasmus University Rotterdam. Netherlands)

Mel Tan (Programme Officer for ICT in Education, Section for Educational Innovation and Skills Development, UNESCO, Bangkok. Thailand)

Michael Trucano (Senior Education and Technology Policy Specialist, The World Bank. USA)

Prof. Raheel Qamar (Rector, COMSATS Institute for Information Technology, Islamabad; President, Inter-Islamic Network on information Technology. Pakistan)

Rebecca Stromeyer (Owner and Founder of e-Learning Africa; Owner and Co-Founder of Online Educa Berlin. Germany)

Dr. Sajjad Madni (Director, Virtual Campus, COMSATS Institute for Information Technology, Islamabad. Pakistan)

Sara Chamberlain (Director Digital, BBC Media Action. India)

Prof. Sugata Mitra (Professor of Educational Technology, Newcastle University. UK)

Tahir Naeem (Director Planning, Development and Human Resource Development, COMSATS Institute for Information Technology, Islamabad; Executive Director, Inter-Islamic Network on information Technology. Pakistan)

Tony Bloome (Senior Education Technology Specialist, USAID. USA)

Note: * indicates that the person interviewed also kindly commented on a draft of one of the sections or case studies in the report. Other people not interviewed who generously commented on parts of the text were:

Dr. Mukesh Khatwani (University of Sindh, Jamshoro. Pakistan)

Sarah Elisabeth Wragg (Senior Technical Specialist, Basic Education, PDQ, Somalia/Somaliland Country Office, Save the Children, in Nairobi, Kenya)

Workshop participants

Participants in the workshop held to discuss the use of ICTs to support learning in deprived contexts on 4th August 2017 in London included:

Agnes St. John-John (Special Education Needs Officer, Ministry of Education. Grenada) (Online)

Dr. Akber Gardezi (Assistant Professor, Computer Science, COMSATS IIT, Islamabad. Pakistan) (Online)

Amal Hmayed (Service Designer. Lebanon/UK)

Amina Adewusi (Independent Consultant. UK)

Dr. Björn Haßler (Director, Open Development and Education Ltd., and Associate Member, Centre for Research for Equitable Access, Faculty of Education, University of Cambridge. UK)

Charlotte Balfour-Poole (Senior Humanitarian Education Advisor, Save the Children. UK) (Online)

Chris Yapp (Senior Associate Fellow at the Institute of Governance and Public Management, Warwick Business School; former head of public sector innovation at Microsoft) (Online)

Claudia Fernandes (Business Development Manager, Mobile Partnerships EMEA, Facebook. UK)

David Anthony-Hopkins (District Education Officer, Ministry of Education. Grenada) (Online)

Erik Childerhouse (Principal Consultant, Avanti Communications. UK) (Online)

Ezri Carlebach (Senior Associate, the PR Network, and Visiting Lecturer, University of Greenwich. UK)

Gavin Dykes (Managing Director Cellcove, and Programme Director, Education World Forum. UK)

James Lawrie (Senior Education Advisor. Save the Children. Netherlands/UK) (Online)

Jervis Dabreo (IT Officer, Ministry of Education, Grenada) (Online)

Lord Jim Knight (Chief Education Advisor, TES. UK)

Jim Wynn (CEO, Imagine Education. UK)

Junaid Mubeen (Director of Education, Whizz Education. USA)

Kathy James (District Education Officer, Ministry of Education. Grenada) (Online)

Maliha Kabani (Thematic Advisor Education, Save the Children. Sweden) (Online)

Mark Hawkins (Global Humanitarian Technology Manager, Save the Children International) (Online)

Martin Owen (Retired Person and Inventor. UK)

Dr. Michaelle Tauson (Research and Learning Advisor, Education in Emergencies, Save the Children. UK)

Mohammad Ashraf Uzzaman (Bangladesh) (Online)

Paul West (Senior Education specialist, Pretoria, South Africa) (Online)

Paula Young (Digital Collaboration Leader, PWC. UK)

Piya Shah (Manager, iMlango. UK)

Rachel Maranto (Head of Thematic Support, Education Global Theme, Save the Children International. UK)

Ruth Elizabeth Rouse (Permanent Secretary, Legal Affairs, Grenada) (Online)

Tony Wheeler (Head of Innovation, Digital Assess. UK)

Interviews with Save the Children staff

Catherine Johnston (Senior Education Advisor, Save the Children, Australia)

Charles Olaka Kesa (NORAD Framework Programme Manager, Somalia/Somaliland Country Office, Save the Children, in Nairobi, Kenya)

Elijah Kipkech (Research Associate, Somalia/Somaliland Country Office, Save the Children, in Nairobi, Kenya)

Elisander Castro (National Education Coordinator, Save the Children, Colombia)

Itaf Al Awawdeh (Education Advisor, Save the Children, Jordan)

James Lawrie (Senior Education Advisor. Save the Children, Netherlands/UK)

Mengistu Koricha (Head of Education, Somalia/Somaliland Country Office, Save the Children, in Nairobi, Kenya)

Dr. Michaelle Tauson (Research and Learning Advisor, Education in Emergencies, Save the Children, UK)

Rachel Maranto (Head of Thematic Support, Education Global Theme, Save the Children International. UK)

Save the Children consultations

Two online consultations were held with the following Save the Children staff across the world on 15 and 17 August 2017 in order to validate our emerging findings, and seek input on their implications for Save the Children's programmes and advocacy:

Akidul Islam (Deputy Director - Reading, Save the Children. Bangladesh)

Annette Nyquist (Senior Advisor, Save the Children. Norway)

Caroline Paredes (Director, Programme Operations – Education, Save the Children. Colombia)

Catherine Johnston (Senior Education Advisor, Save the Children Australia)

Charlotte Bergin (Education and Policy Advocacy Adviser, Education Policy and Advocacy Catherine Johnston (Senior Education Advisor, Save the Children. UK)

Elisander Castro (National Education Coordinator, Save the Children. Colombia)

Eric Eversmann (Senior Director, Basic Education – International Programmes, Save the Children. USA)

James Lawrie (Senior Education Advisor. Save the Children. Netherlands/UK)

Kate McFarlane (Program Manager, School Disaster Management, Save the Children. Australia)

Khurshid Khan (Education and Policy Advocacy Adviser, Education Policy and Advocacy, Save the Children. Pakistan)

Kondwani Mtalimanja (Head of IT – East and Southern Africa, Information Technology, Save the Children. Malawi)

Lisa Parrot (ESA Regional Programme and Quality Director, Save the Children ESA Regional Office. Kenya)

Marcela Venegas (Education Officer, Save the Children. Colombia)

Nicole Nikolaidis (Education Knowledge Manager, Education Global Theme, Save the Children International. UK)

Nora Chefchaoni (Education Advisor, International Programs, Save the Children. Australia)

Rachel Maranto (Head of Thematic Support, Education Global Theme, Save the Children International. UK)

Rachel McKinney (Director, Education in Emergencies – International Programmes, Save the Children. USA)

Rowan Ainslie (Project Officer, Education Global Theme, Save the Children International. UK)

Sarah Elisabeth Wragg (Senior Technical Specialist, Basic Education, PDQ, Somalia/Somaliland Country Office, Save the Children, in Nairobi, Kenya)

Shirin Lutfeali (Advisor – Basic Literacy and Numeracy, Save the Children. USA)

Talat Mahumd (Senior Education Technical Advisor, Save the Children. Laos)

Tim Murray (Senior Education Advisor, Save the Children. Canada)

ANNEX 3: ANNOTATED BIBLIOGRAPHIES

1. Basic education in low-resource environments: Annotated bibliography of noteworthy resources

Structure of bibliography

The literature listed below includes reports, policy papers, and relevant and influential web resources. These resources have been organised into four categories:

1. General – resources that broadly reflect the sector
2. Financing education
3. Inclusive education
4. Education in conflict

Each resource includes the full citation, link, and a brief summary. Within each category, resources are organised alphabetically, by author.

Resources

General

1. Andrabi, T., Das, J., Khwaja, A.I. (2015). Delivering Education: A pragmatic framework for improving education in low-income countries. Policy Research working paper no. WPS 7277. Washington, D.C.: World Bank Group. Retrieved from **http://documents.worldbank.org/curated/en/439891468001164200/Delivering-education-a-pragmatic-framework-for-improving-education-in-low-income-countries**

Within the debate of private vs public schooling systems, the authors argue that constraints that prevent schools and parents from achieving their own stated objectives must be the first to be alleviated. This report provides examples of how this can be incorporated into policy, and how doing so improves educational outcomes.

2. Banerjee, A., Glewwe, P., Powers, S., & Wasserman, M. (2013). Expanding access and increasing student learning in post-primary education in developing countries: A review of the evidence. Cambridge, MA: Massachusetts Institute of Technology. Retrieved from **https://www.gov.uk/dfid-research-outputs/expanding-access-and-increasing-student-learning-in-post-primary-education-in-developing-countries-a-review-of-the-evidence**

This is a review of 56 sources that finds that demand-side interventions have the clearest policy implications. There is no strong evidence for private schools being better than public schools, however, there is clear evidence that in primary education lightly trained para-teachers and teacher's aides can promote learning, especially among students lagging behind.

3. Glewwe, P., & Muralidharan, K. (2015). Improving school education outcomes in developing countries: evidence, knowledge gaps, and policy implications. University of Oxford: Research on Improving Systems of Education (RISE). Retrieved from **http://www.youthpower.org/resources/improving-education-outcomes-developing-countries-evidence-knowledge-gaps-and-policy**

This is a review of 118 studies that finds demand-side interventions broadly effective at increasing time in school and learning outcomes, with varying cost-effectiveness. Interventions that focus on improved pedagogy, especially remedial learning, appear particularly effective. The report recommends developing countries improve efficiency of education spending by pivoting public expenditure from less cost-effective to more cost-effective ways of achieving the same objectives.

4. Kremer, M., Brannen, C., & Glennerster, R. (2013). The Challenge of Education and Learning in the Developing World. Science, 340(6130), 297-300. Retrieved from **http://science.sciencemag.org/content/340/6130/297**

This report assesses the impact and cost-effectiveness of multiple interventions. It finds addressing demand-side barriers (conditional cash transfer, merit scholarships) increase schooling, while educational advocacy and health interventions do so more cost-effectively. It also finds pedagogical changes to aid learning and to be cost-effective. The impact of teacher-focused and school accountability interventions is limited and context-dependent.

5. McEwan, P.J. (2015). Improving learning in primary schools of developing countries: A meta-analysis of randomized experiments. Review of Educational Research, 85(3), 353-394. Retrieved from **http://academics.wellesley.edu/Economics/mcewan/PDF/meta.pdf**

This meta-analysis reviews 77 randomised experiments that evaluate the effects of school-based learning interventions in primary schools in developing countries. The largest effects appear to arise from instructional technology, teacher training, smaller classes, learning groups within classes or ability grouping, contract or volunteer teachers, student and teacher performance incentives, and instructional materials.

6. Robinson, J.P., & Winthrop, R. (2016). Millions Learning: Scaling up Quality Education in Developing Countries. Center for Universal Education at The Brookings Institution. Retrieved from **https://www.brookings.edu/research/millions-learning-scaling-up-quality-education-in-developing-countries/**

This report identifies 14 key ingredients vital to scaling effective approaches that improve learning outcomes, broadly relating to intervention design, delivery, financing and creating an enabling environment. The report presents stakeholder actions that can create an enabling environment.

7. Shephard, D.D. (2014). Non-formal education for improving educational outcomes for street children and street youth in developing countries: a systematic review. International Journal of Social Welfare, 23(4), 349-361. Retrieved from **http://www.3ieimpact.org/en/evidence/systematic-reviews/details/652**

This review examines the effectiveness of non-formal education interventions targeted at children and youth living and working on the streets in developing countries. It finds insufficient evidence to reach any conclusions and calls for further research.

8. Snilstveit, B., Stevenson, J., Menon, R., Phillips, D., Gallagher, E., Geleen, M., Jobse, H., Schmidt, T., & Jimenez, E. (2016). The impact of education programmes on learning and school participation in low- and middle-income countries: A systematic review summary report. 3ie Systematic Review Summary 7. London: International Initiative for Impact Evaluation (3ie). Retrieved from **http://www.3ieimpact.org/media/filer_public/2016/09/20/srs7-education-report.pdf**

This is a synthesis of evidence from 216 programmes across 52 low-middle-income countries. Cash transfers are found to be the most effective for improving school participation and merit-based scholarships for improving learning outcomes. Pedagogical interventions have the largest and most consistent positive effect on classroom environment. This report recommends interventions that simultaneously address multiple barriers to meaningful school participation.

9. Systems Approach for Better Education Results (SABER): **http://academics.wellesley.edu/Economics/mcewan/PDF/meta.pdf**

This is an initiative that produces comparative data and knowledge on education policies and institutions, aimed at helping countries systematically strengthen their education systems.

10. The Global Partnership for Education (2017). GPE Results Report 2015/2016. Washington DC: The Global Partnership for Education. Retrieved from **http://www.globalpartnership.org/content/2016-results-report**

The Global Partnership for Education is the largest international funder of educational sector planning. This is the first in a series of five reports (2015 - 2020), documenting the progress of the GPE targets. The report presents evidence for the education sector's return on investment. GPE's results-focused financing model prioritises the most vulnerable in lower-middle-income countries, whilst improving institutional capacity.

11. UNESCO (2016). Global Education Monitoring Report 2016. Education for people and planet: Creating sustainable futures for all. France: United Nations Educational, Scientific and Cultural Organization. Retrieved from **http://unesdoc.unesco.org/images/0024/002457/245752e.pdf**

This GEM report is the first of a 15-year series that monitors progress on the SDG education targets. This report establishes that education is at the core of all SDGs by highlighting the impact of education on social, economic and environmental factors. It expresses the urgent need for accelerated progress in education. Current trends show that universal primary and secondary education targets will not be met by 2030.

12. UNESCO (2017). Reducing global poverty through universal primary and secondary education. UNESCO. Retrieved from **http://unesdoc.unesco.org/images/0025/002503/250392E.pdf**

This GEM policy paper emphasises urgency in addressing out-of-school children, where rates are highest in low-income countries. The report asserts that the global poverty rate would be halved if all adults completed secondary school. The paper stresses the need to reduce the financial burden of education on the poorest families through targeted policy solutions and interventions.

Financing education

13. Day, A., Mcloughlin, C., Aslam, M., Engel, J., Wales, J., Rawal, S., Batley, R., Kingdon, G., Nicolai, S., & Rose, P. (2014). The role and impact of private schools in developing countries. Education rigorous literature review. London: Department for International Development (DFID). Retrieved from **https://www.gov.uk/dfid-research-outputs/the-role-and-impact-of-private-schools-in-developing-countries-education-rigorous-literature-review**

This report reviews 59 studies across DFID's priority countries. It finds stronger evidence for higher quality teaching in private schools than in public schools. Moderate evidence is available for private schools having better learning outcomes and being more cost-effective and mostly negative findings appear around government regulation of private schools. There is weak evidence for private schools being more accountable than public schools and limited evidence on effects on privatisation on the broader education system.

14. The International Commission on Financing Global Education Opportunity (2016). The Learning Generation - the Education Commission Report 2016. The International Commission on Financing Global Education Opportunity. Retrieved from **http://report.educationcommission.org/**

This report asserts that in low-income countries, up to half of national education budgets are spent on education costs that do not lead to learning. It outlines four major transformations necessary for better education financing and calls for the international community to build a "Financing Compact for the Learning Generation" that matches financing with a given recipient country's political will.

15. UNESCO (2017). Aid to education is stagnating and not going to countries most in need. UNESCO. Retrieved from **http://unesdoc.unesco.org/images/0024/002495/249568e.pdf**

This GEM policy paper analyses levels and trends of aid to education. It asserts that aid to basic education is currently based on trade and colonial history, and must be allocated according to need in order to make progress on targets.

16. UNESCO (2015). The Privatization of education in developing countries: Evidence and policy implications. Working papers on education policy. UNESCO. Retrieved from **http://unesdoc.unesco.org/images/0024/002438/243824e.pdf**

This report reviews evidence around the privatization of education. Teaching appears to be better quality in private schools, however it is unlikely to address education for all. The report establishes a link between quality of governance and quality of education. It concludes that raising the quality of education in public schools is the most inclusive approach.

Inclusive education

17. Independent Commission for Aid Impact (2016). Accessing, staying and succeeding in basic education – UK aid's support to marginalised girls. Retrieved from **http://icai.independent.gov.uk/wp-content/uploads/ICAI-review-Accessing-staying-and-succeeding-in-basic-education-UK-aids-support-to-marginalised-girls.pdf**

This review of DFID funded Girls Education Challenge (GEC) projects finds that the projects failed to meet their original objectives by digressing from a focus on marginalised girls. Significant improvement is required, particularly around clearer strategies, closer monitoring, and guidance.

18. Mariga, L., McConkey, R., & Myezwa, H. (2014). Inclusive Education in Low-income Countries: A Resource for Teacher Educators, Parent Trainers and Community Development Workers. Cape Town. Atlas Alliance and Disability Innovations Africa. Retrieved from **http:/www.eenet.org.uk/resources/docs/Inclusive_Education_in_Low_Income_Countries.pdf**

Based on interventions in Lesotho, Tanzania, and Zanzibar, this report covers key processes and stakeholder roles in implementing inclusive strategies. It details inclusive education approaches in schools.

19. Sperling, G.B., & Winthrop, R. (2015). What Works in Girls' Education: Evidence for the World's Best Investment. Brookings Institution Press. Retrieved from **https://www.brookings.edu/book/what-works-in-girls-education-evidence-for-the-worlds-best-investment/**

This paper provides evidence for the individual and societal benefit of girls' education. Evidence is also provided on addressing girls' needs, school affordability, health, time and distance to school, girl friendly schools, education quality, and community engagement.

20. UNESCO 2016. Global Education Monitoring Report 2016 - Gender Review. UNESCO. Retrieved from **http://unesdoc.unesco.org/images/0024/002460/246045e.pdf**

The Gender Review discusses global and regional trends in achieving parity in educational access, participation and completion and in selected learning outcomes, stressing that there is much room for progress. It presents evidence of relationships between education, gender and sustainable development.

21. Unterhalter, E., North, A., Arnot, M., Lloyd, C., Moletsane, L., Murphy-Graham, E., Parkes, J., & Saito, M. (2014). Interventions to enhance girls' education and gender equality. Education Rigorous Literature Review. London: Department for International Development (DFID). Retrieved from **https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/326205/Girls__Education_Literature_Review_2014_Unterhalter.pdf**

This report finds that the success of demand-side interventions is dependent on carefully targeting students who are least likely to attend school. Complementary interventions can enhance enrolment and learning gains; infrastructure (wash, school buildings) improves enrolment and potentially learning; institutional change interventions require well-trained teachers, gender equitable schools, and administrators; and interventions to shift gender norms are under researched, in particular girls' clubs and engaging faith communities need further research.

Education in conflict

22. Burde, D., Guven, O., Kelcey, J., Lahmann, H., & Al-Abbadi, K. (2015). What works to promote children's educational access, quality of learning, and wellbeing in crisis-affected contexts. Retrieved from **http://www.ineesite.org/en/lit-review-what-works-in-eie**

This is a review of 184 studies of interventions targeted at children living in crisis-affected areas. It synthesises evidence of effective ways of improving education quality and learning outcomes. It finds an absence of robust evidence and recommends investment in rigorous research.

23. Dryden-Peterson, S. (2016). Refugee education: The crossroads of globalization. Educational Researcher, 45(9), 473-482. Retrieved from **http://journals.sagepub.com/doi/abs/10.3102/0013189X16683398?journalCode=edra**

This report examines refugee education from World War II to present. It finds that refugees' abilities to access their rights to education and work are constrained by the misalignment of the global approach to universal human rights and the enforcement of rights within nation states.

24. Gladwell, C. & Tanner, L. (2014). Hear it from the children: why education in emergencies is critical. Save the Children UK & Norwegian Refugee Council. **Retrieved from http://www.savethechildren.org.uk/resources/online-library/hear-it-children**

This is a study on the role of education in conflict-affected communities in the DRC and Ethiopia. It finds that education is prioritised and valued by communities, saves and protects lives, and supports other sectors (e.g. healthcare). The study recommends the inclusion and prioritisation of education at the outset of emergencies, with increased and predictable funding.

25. Inter-Agency Network for Education in Emergencies (INEE): **http://www.ineesite.org/en/**

This is a global network of individuals and organisations that work together to ensure persons affected by crises have access to safe, quality and relevant information.

26. The Inter-Agency Network for Education in Emergencies (INEE) Toolkit: **http://toolkit.ineesite.org/**

This toolkit was designed to equip governments and humanitarian workers with tools that are needed to achieve educational quality and access in emergencies through to recovery.

27. Winthrop, R., & Matsui, E. (2013). A new agenda for education in fragile states. Washington, DC: Center for Universal Education at Brookings. Retrieved from **https://www.brookings.edu/research/a-new-agenda-for-education-in-fragile-states/**

This is a broad review of education in fragile states, which charts a new agenda for maximizing the contribution of education to the development and well-being of people living in these contexts. It finds that education can accelerate progress in fragile states and recommends its integration across development, humanitarian, security and DRR actors.

2. Technology and basic education in low-resource environments: Annotated bibliography of noteworthy resources

Context

There are multiple factors leading to the increased integration of technology into education in low-resource environments. These include the spread of infrastructure such as electricity and connectivity, increased access to devices, new technical capabilities that facilitate new educational possibilities, the drive of government ministries to innovate, and the desire of all stakeholders to find new and effective ways to address education challenges. Early education technology interventions were often characterised by naïve optimism that simply providing access to software and hardware would enhance learning outcomes. Many of these initiatives failed to live up to initial expectations. It is now widely recognised that technology does not inevitably have a positive impact on education and that the use of technology in education is most effective when recognised as a tool to be integrated within holistic education programmes rather than viewed as an isolated driver of change.

There is an evolving body of literature regarding different aspects of education technologies and the positive and negative consequences they may have. Much of this research is collated and summarised in a DFID education technology mapping exercise (Muyoya, Brugha, and Hollow 2016) which shows that the majority of existing studies are observational and focused on qualitative accounts of impact (278 of the 401 studies mapped).

Structure of bibliography

The literature listed below includes publications from the DFID evidence gap map, as well as additional reports that had not met the inclusion criteria but are relevant and influential resources. The resources are organised into three categories:

1. Use of technology to support teaching and learning
2. Use of technology to improve planning and school management
3. Use of technology to promote awareness and advocacy for education
4. Within each category, resources are organised alphabetically, by author.

The bibliography concludes with short sections on frameworks and good principle guides for use of technology in education, and on other noteworthy resources.

Resources

Use of technology to support teaching and learning

1. Bando, R., Gallego, F., Gertler, P., & Romero, D. (2016). Books or Laptops? The Cost-Effectiveness of Shifting from Printed to Digital Delivery of Educational Content. Retrieved from **https://www.povertyactionlab.org/sites/default/files/publications/218_342_books_or_laptops_working_paper_paul_gertler_December2016.pdf**

This paper presents results from an RCT in which laptops replaced traditional textbook provision in elementary schools in high poverty communities in Honduras in 2013 through the programme 'Educatracho'. They show that at the end of one school year, the substitution of laptops for textbooks did not make a significant difference in student learning, however textbook substitution by laptops were shown to be a cost-effective manner to provide classroom learning content.

2. Byker, E. (2015). The One Laptop School: Equipping Rural Elementary Schools in South India through Public Private Partnerships. Global Education Review, 2(4), 126-143. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1080913.pdf**

This article reports on a Public Private Partnership (PPP) program in South India that provided ICTs to rural elementary schools. The article examines the status of rural, government-run elementary schools in India by reviewing reports. Challenges like teacher absences, student drop-outs, lack of electricity, lack of separate toilets for genders, and a lack of teaching resources is discussed. The case study offers a "thick description" (Geertz, 1973) of how the village school's students used the laptop for learning basic computing skills and for learning English.

3. Dahya, N. (2016). Education in Conflict and Crisis: How Can Technology Make a Difference? A Landscape Review. GIZ: Bonn. Retrieved from **http://www.educationinnovations.org/sites/default/files/20160315_landscape_review_ict4e_in_conflict_and_crisis.pdf**

The aim of this landscape review was to identify major trends, patterns, and lessons learned about the use of mobile technologies in crisis and conflict settings, and also to define gaps in the knowledge base.

4. EDC (2017). Vernacular Evaluation Report: A Cost-Effectiveness study of ICT in Zambian Community Schools. USAID. Retrieved from **http://idd.edc.org/sites/idd.edc.org/files/Vernacular%20Zambia%20RCT%20Evaluation%20Report.pdf**

This report is an evaluation of 'Vernacular' (a set of reading activities that Zambian primary students can complete using android tablets) - an RCT involving 30 Cinyanja speaking community schools around Lusaka.

5. 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. Retrieved from **http://medalliance.wpengine.com/wp-content/uploads/2016/07/Evans.pdf**

Various researchers have undertaken systematic reviews of these impact evaluation studies, yet the main results they highlight for improving learning appear inconsistent. Conn (2014) highlights pedagogical interventions as most effective,

while McEwan (2014) finds the largest effects for interventions involving computers and technology. Kremer, Brannen, & Glennerster (2013) highlight pedagogical reforms that match teaching to student learning levels as well as the incentives associated with hiring teachers on short-term contracts. Glewwe et al. (2014) emphasise the impact of teacher knowledge, teacher absenteeism and the availability of student desks on student learning. Krishnaratne, White & Carpenter (2013) underline the importance of learning materials. And Murnane and Ganimian (2014) emphasise providing information about school quality and returns to schooling, among other findings." This paper critically examines these recent reviews to understand the underlying reasons for the observed divergence in conclusions.

6. Hennessy, S., Haßler, B., & Hofmann, R. (2016). Pedagogic Change by Zambian Primary School Teachers Participating in the OER4Schools Professional Development Programme for One Year. Research Papers in Education, 31(4), 399-427. Retrieved from **http://eric.ed.gov/?redir=http%3a%2f%2fdx.doi.org%2f10.1080%2f02671522.2015.1073343**

This paper reports on a trial of a pioneering, multimedia programme supporting interactive mathematics and science teaching using open educational resources and classroom digital technology, where available. The programme was carefully adapted to the Zambian context and ran weekly for one school year with 12 teachers in a low-resourced primary school. The study examined the impact on teachers' thinking and classroom practices.

7. Ho, J., & Thukral, H. (2009). Tuned in to Student Success: Assessing the impact of interactive radio instruction for the hardest-to-reach. Education Development Center, Inc. Retrieved from **http://idd.edc.org/sites/idd.edc.org/files/EDC%20Tuned%20in%20to%20Student%20Success%20Report.pdf**

This study focuses on the use of Interactive Radio Instruction (IRI) in taxing circumstances and the outcomes it achieved as well as children learning in conventional school settings. It looks at the use of radio to teach children who are not in school, who are affected by conflict, who are orphans, who live in countries where most social systems have broken down or never existed. It also looks at IRI operating in systems of huge scale, such as the 20+ million learners in India. The data indicate that exposure to IRI is associated with higher levels of student achievement.

8. ILC Africa and Worldreader (2012). iRead Ghana study final evaluation report. Retrieved from **http://pdf.usaid.gov/pdf_docs/pnadz402.pdf**

The iREAD (Impact on Reading of E-Readers and Digital Content) Ghana Study was a pilot that aimed to give Ghana public school students access to books through e-reader technology. This final report serves as the official, summative assessment of the e-reader. Overall, the majority of students and teachers from the iREAD Ghana Study had positive experiences with the e-reader.

9. Levi, R., Chidanandan, A., Kulenguski, C., & Potter, L. (2014). Mobiles for Reading: A Landscape Research Review. USAID. Retrieved from **http://medalliance.wpengine.com/wp-content/uploads/2016/06/LandscapeReview_mobilesForLearning.pdf**

This landscape review of mobiles for reading (M4R) focuses primarily on the use of mobile ICTs designed to help children learn to read, practice reading, and acquire a broader range of learning skills that support a literate society.

10. Linden, L.L. (2008). Complement or substitute? The effect of technology on student achievement in India. infoDev: Working Paper No. 17. Retrieved from **http://documents.worldbank.org/curated/en/804371468034237060/Complement-or-substitute-The-effect-of-technology-on-student-achievement-in-India**

This study evaluates a computer assisted learning programme designed to reinforce students' understanding of material presented in the class. The results emphasise the importance of understanding how new technologies and teaching methods both interact with existing resources and differentially affect students with different needs and abilities.

11. Mohammed, A.A., Kanpolat, Y.E. (2010). Effectiveness of Computer-Assisted Instruction on Enhancing the Classification Skill in Second-Graders at Risk for Learning Disabilities. Electronic Journal of Research in Educational Psychology, 8(3), 1115-1130. Retrieved from **http://eric.ed.gov/?redir=http%3a%2f%2fwww.investigacion-psicopedagogica.org%2frevista%2fnew%2fenglish%2fContadorArticulo.php%3f454**

This study investigated the effectiveness of computer-assisted instruction on enhancing the classification skill in second graders at-risk for learning disabilities.

12. Natia, J.A., & Al-hassan, S. (2015). Promoting Teaching and Learning in Ghanaian Basic Schools through ICT. International Journal of Education and Development using Information and Communication Technology, 11(2), 113-125. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1074173.pdf**

Using data obtained by Connect for Change Education Ghana Alliance, this paper investigates the extent to which school administration, and teaching and learning are promoted through the use of ICT in Ghanaian Basic Schools.

13. Natividad, J.N. (n.d.). Summative evaluation of the ELSA text2teach project: Final report. Demographic Research and Development Foundation, Inc. Retrieved from **http://pdf.usaid.gov/pdf_docs/Pdack830.pdf**

This is a summative evaluation of the ELSA text2teach Project (an intervention strategy for improving the teaching of english, maths and science in grades 5 and 6 in the Philippines) two years into its implementation to assess learning gains.

14. OECD (2015). Students, Computers and Learning: Making the Connection. OECD Publishing, Paris. Retrieved from **http://www.oecd.org/education/students-computers-and-learning-9789264239555-en.htm**

This report examines how students' access to and use of ICT devices has evolved in recent years, and explores how education systems and schools are integrating ICT into students' learning experiences. Based on results from PISA 2012, the report discusses differences in access to and use of ICT that are related to students' socio-economic status, gender, geographic location, and the school a child attends.

15. Piper, B., & Kwayumba, D. (2014). USAID/Kenya Primary Math and Reading (PRIMR) Initiative: Kisumu Information and Communication Technology (ICT) Intervention. Endline Report. RTI International. Retrieved from **http://pdf.usaid.gov/pdf_docs/PA00K285.pdf**

The assessment of the PRIMR programme in Kenya, which studied the impact of tablets, used in a range of different ways, on student learning outcomes. Findings show the tablet use leading to a positive impact on student learning outcomes.

16. Pitchford, N.J. (2015). Development of early mathematical skills with a tablet intervention: a randomised control trial in Malawi. Frontiers in Psychology. Retrieved from **http://journal.frontiersin.org/article/10.3389/fpsyg.2015.00485/full**

This study reports on an RCT to evaluate the effectiveness of a tablet intervention for supporting the development of early maths skills in primary school children in Malawi. Significant effects of the maths tablet intervention over and above standard face-to-face practice or using tablets without the maths software were found in Standards 2 and 3. In Standard 3 the greater learning gains shown by the maths tablet intervention group compared to both of the control groups on the tablet-based assessments transferred to paper and pencil format, illustrating generalisation of knowledge gained.

17. Porter, G., Hampshire, K., Milner, J., Munthali, A., Robson, E., de Lannoy, A., Bango, A., Gunguluza, N., Mashiri, M., Tanle, A., & Abane, A. (2015). Mobile Phones and Education in Sub-Saharan Africa: From Youth Practice to Public Policy. Journal of International Development. Retrieved from **http://onlinelibrary.wiley.com/doi/10.1002/jid.3116/full**

Findings presented in this paper indicate how the downside of mobile phone use in African schools is becoming increasingly apparent. Drawing on mixed-methods field research in 24 sites across Ghana, Malawi and South Africa and associated discussions with educational institutions, public policy makers and network providers, this report examines the current state of play and offers suggestions towards a more "satisfactory" alignment of practice and policy which promotes the more positive aspects of phone use in educational contexts.

18. Pouezevara, S., & King, S. (2014). MobiLiteracy-Uganda Program. Phase 1: Endline Report. RTI International. Retrieved from **https://www.researchgate.net/publication/303444658_MobiLiteracy-Uganda_Program_Phase_1_Endline_Report**

This is an endline evaluation of MobiLiteracy in Uganda that targets parents through their mobile phones and encourages them to engage their early primary-school aged children in literacy skill-building activities outside of school hours.

19. Pouezevara, S., Mekhael, S.W., Darcy, N. (2014). Planning and Evaluating ICT in Education Programs Using the Four Dimensions of Sustainability: A Program Evaluation from Egypt. International Journal of Education and Development using Information and Communication Technology 10(2), 120-141. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1071282.pdf**

This paper presents the findings from a program evaluation of an ICT in education project within the USAID-funded Girls Improved Learning Outcomes (GILO) programme. The findings suggest that ICT in education projects must favour neither the hardware nor the pedagogical aspects of the technology. Instead they layer the pedagogical use of technology on top of a deliberate technology infrastructure. The technical and pedagogical aspects of the program should be treated as two distinct efforts with separate, but complementary goals. Paying attention to social, political, economic, and technological dimensions during the process can make a difference in sustainability and, ultimately, success of the initiative.

20. Shadreck, M. (2015). Integrating ICTs into the environmental science primary school classroom in Chegutu District, Zimbabwe: problems and solutions. European Journal of Science and Mathematics Education, 3(1), 90-96. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1107801.pdf**

This study investigated primary school teachers' perceptions of the barriers and challenges preventing them from integrating ICTs in the environmental science classroom. According to the findings of the study, primary school environmental science teachers are not yet ready to integrate ICTs into their classrooms due to a number of obstacles that include unavailability of infrastructure, equipment and web based resources in the classrooms. Teachers also lacked competence, in-service training and technical support, as well as technological pedagogical content knowledge on how to integrate ICTs into teaching and learning of environmental science. Teacher education programs should therefore adequately prepare new teachers and equip them with pedagogical skills necessary to integrate ICTs into their teaching.

21. Spencer-Smith, G., & Roberts, N.A. (2014). Landscape Review: Mobile Education for Numeracy: Evidence from interventions in low-income countries. GIZ: Bonn. Retrieved from **http://medalliance.wpengine.com/wp-content/uploads/2016/06/landscape_review_Numeracy.pdf**

This GIZ-commissioned landscape review focuses on mNumeracy (mobile numeracy) interventions in early grades in low-income countries. The projects found were mapped to four key areas of focus: maths instruction and teaching and learning materials; teacher professional development; learning outcomes assessment; and parents and community involvement.

22. Tonui, Betty; Kerich, E.; Koross, R. (2016). An Investigation into Implementation of ICT in Primary Schools, in Kenya, in the Light of Free Laptops at Primary One: A Case Study of Teachers Implementing ICT into Their Teaching Practice. Journal of Education and Practice, 7(13), 12-16. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1102802.pdf**

This paper presents literature on the possibilities and challenges of integrating ICT into teaching and learning, the rationale of and key factors that influence the adoption and use of ICTs in teaching and learning. The paper outlines and discusses findings from a study in ICT and teaching-learning in primary schools in Kenya.

23. UNESCO (2011). UNESCO ICT Competency Framework for Teachers. Retrieved from **http://unesdoc.unesco.org/images/0021/002134/213475e.pdf**

UNESCO's Framework sets out the competencies required to teach effectively with ICT and is arranged in three different approaches to teaching: technology literacy, knowledge deepening, and knowledge creation.

24. Unwin, T. (2017). Reclaiming Information and Communications Technologies for Development. Oxford University Press

This book explores the interests that have underlain the dramatic expansion of ICTs in recent years in order to account for why there are still those who are left without access to the latest technologies, and have become increasingly disadvantaged and marginalised. It is considered that unless these interests are fully understood, it will not be possible to reclaim the use of

these technologies to empower the world's poorest and most marginalised. The book espouses the view that development is not just about economic growth, but must also address questions of inequality.

25. Walsh, C.S., Power, T., Khatoon, M., Biswas, S.K., Paul, A.K., Sarkar, B.C., Griffiths, M. (2013). The "Trainer in Your Pocket:" Mobile Phones within a Teacher Continuing Professional Development Program in Bangladesh. Professional Development in Education, 39(2), 186-200. Retrieved from **http://eric.ed.gov/?redir=http%3a%2f%2fdx.doi.org%2f10.1080%2f19415257.2013.766232**

This report outlines English in Action's (EIA) model for providing 80,000 teachers with CPD to improve their communicative language teaching in Bangladesh over nine years. EIA's CPD program is delivered face to face and supported through open distance learning (ODL).

26. West, M. & Chew, H.E. (2014). Reading in the mobile era: A study of mobile reading in developing countries. UNESCO. Retrieved from **http://unesdoc.unesco.org/images/0022/002274/227436E.pdf**

Drawing on findings from a year-long study, this report explains the habits, preferences and demographic profiles of mobile readers in 7 developing countries. By painting a picture of how mobile reading is practiced today and by whom, it offers insights into how mobile technology can be leveraged to better facilitate reading in countries where literacy rates are low.

27. Winthrop, R., McGivney, E., Williams, T.P., & Shankar, P. (2016). Innovation and technology to accelerate progress in education. The Center for Universal Education at the Brookings Institution. Retrieved from **https://www.brookings.edu/wp-content/uploads/2017/02/global_20170223_innovation-and-technology.pdf**

This report describes the major gaps in education and the need for innovation to meet ambitious goals. This study surveyed the current landscape of innovations in education by conducting a scan and compiling an inventory of programmes, schools, and tools currently being used around the globe to achieve these aims.

Use of technology to improve planning and school management

28. Bisaso, R., Kereteletswe, O., Selwood, I., & Visscher, A. (2008). The Use of Information Technology for Educational Management in Uganda and Botswana. International Journal of Educational Development, 28(6), 656-668. Retrieved from **http://eric.ed.gov/?redir=http%3a%2f%2fdx.doi.org%2f10.1016%2fj.ijedudev.2007.09.008**

This paper reports on a study of the implementation of a Computerised Information System (CIS) at the Ministry of Education in Botswana, and the use of CISs in secondary schools in Uganda. The findings portray the levels of use, the impact of CIS use, and the factors that influence the utilisation of the CISs in both countries. Although both countries have recognised the potential of CISs for managing educational institutions, the utilisation of these information systems were still at an early stage.

29. Bridge International Academies (2015). The Bridge Effect: A Comparison of Early Grade Learning Gains in English and Maths 2013-14 Impact Evaluation Report. Retrieved from **http://medalliance.wpengine.com/wp-content/uploads/2016/08/EGRA-EGMA-2013-2014-White-Paper-latest.pdf**

This report highlights the results from the 2013-2014 administrations of EGRA / EGMA (early grade reading and maths assessments).

30. Haßler, B., Hennessy, S., Lord, T., Cross, A., Jackson, A., & Simpson, M. (2011). An investigation of appropriate new technologies to support interactive teaching in Zambian schools (ANTSIT). A joint report from Aptivate and the Centre for Commonwealth Education (University of Cambridge). Retrieved from **http://www.educ.cam.ac.uk/centres/archive/cce/initiatives/projects/antsit/DfIDANTSITReport_FINAL_2Mb-2.pdf**

The project explored what kinds of mobile devices and uses can create an environment supportive of learning through active participation and collaborative inquiry within under-resourced and under-privileged school communities. It also examined the constraining factors. The specific focus was on using netbook, tablet and laptop computers, e-Book and wiki readers, digital cameras and mini-projectors along with Open Educational Resources and Open Source software to support students' learning in mathematics and science.

31. Iyengar, R., Mahal, A.R., Liya, A., Sweetland, A., Karim, A., Shin, H., Aliyu, B., Park, J.E., Modi, V., Berg, M., & Pokharel, P. (2014). The Use of Technology for Large-scale Education Planning and Decision-making. Information Technology for Development, 22(3). Retrieved from **http://www.tandfonline.com/doi/full/10.1080/02681102.2014.940267**

This paper discusses the evolution of NMIS as a data repository and describes its uses. NMIS maps and visually displays school-related data that can be used for education planning.

32. Riep, C. & Machacek, M. (2016) Schooling the Poor Profitably: The Innovations and Deprivations of the Bridge International Academies in Uganda. Education Internaytional.

A review of the Bridge International Academies introduction of 63 private for-profit schools in 2015 and 2016. It identifies three main shortcomings: neglect of governmetns legal and educational standards; automation and mechanisation of curriculum and pedagogy which are delivered by unlicensed and underpaid teachers; and failure to bring affordable, quality education for all.

33. Omwenga, E., Nyabero, C., Okioma, L. (2015). Assessing the influence of the PTTC principal's competency in ICT on the teachers' integration of ICT in teaching science in PTTCs in Nyanza region, Kenya. Journal of Education and Practice, 6(35), 142-148. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1086387.pdf**

This study was conducted to assess the influence of Primary Teacher Training College (PTTC) principal's competency in ICT on the teacher's integration of ICT in teaching science in PTTC's in Nyanza region, Kenya.

34. RTI International (2012). TangerineTM - Electronic Data Collection Tool for Early Reading and Math Assessments January 2012 – Kenya Field Trial Report: SUMMARY. Retrieved from **http://www.educationinnovations.org/sites/default/files/Tangerine%20Kenya%20field%20trial%20report.pdf**

In 2009, Tangerine electronic data collection software was conceived of as a solution to address some of the challenges encountered in paper-based administration, particularly for large, labour-intensive national samples. This report summarises the findings from trialling the software in reference to its functionality, usability and comparing it with paper assessments.

35. Swaffield, S., Jull, S., & Ampah-Mensah, A. (2013). Using Mobile Phone Texting to Support the Capacity of School Leaders in Ghana to Practise Leadership for Learning. Procedia - Social and Behavioral Sciences, 103(26), 1295-1302. Retrieved from **http://www.sciencedirect.com/science/article/pii/S1877042813039049**

Weekly text messages were sent to the programme's 175 initial participants. During the year of the pilot project, different forms of messages were tried, and feedback from recipients suggested their value. This paper reports the experience and findings from the pilot, and considers plans for scaling-up to reach all 18,000 Basic schools across the country.

Use of technology to promote awareness and advocacy for education

36. Ale, K., & Chib, A. (2011). Community Factors in Technology Adoption in Primary Education: Perspectives from Rural India. Information Technologies and International Development, 7(4). Retrieved from **http://itidjournal.org/index.php/itid/article/view/791**

his article aims to investigate the influential factors that affect the introduction of technology in an Indian rural primary school. The objective was to address current gaps in research by illuminating specific community factors that influence technology adoption. Anchored in the Technology-Community-Management (TCM) theoretical framework as a guide to analysis of community aspects, the main research question investigated the factors that contributed to, or detracted from, technology impact on education in a developing country context.

37. Pal, J., Lakshmanan, M., & Toyama, K. (2009). "My child will be respected": Parental perspectives on computers and education in rural India. Information Systems Frontiers, 11(2), 129-144. Retrieved from **http://link.springer.com/article/10.1007%2Fs10796-009-9172-1**

This report presents the results of a qualitative study of computer-aided learning centers in schools catering primarily to Below Poverty Line (BPL) families in four districts of rural Karnataka, South India.

38. Roy, A., Kihoza, P., Suhonen, J., Vesisenaho, M., & Tukiaianen, M. (2014). Promoting Proper Education for Sustainability: An Exploratory Study of ICT Enhanced Problem Based Learning in a Developing Country. International Journal of Education and Development using Information and Communication Technology, 10(1), 70-90. Retrieved from **http://files.eric.ed.gov/fulltext/EJ1071197.pdf**

This study aimed to develop an Information and Communication Technologies (ICT) supported pedagogical framework "Children as Agents of Social Change" (CASC) as a possible vehicle to facilitate proper education about social issues. This article analyses the first implementation of the CASC framework carried out at schools in Tanzania.

38. Unwin, T., Tan, M., & Pauso, K. (2007). The Potential of e-Learning to Address the Needs of Out-of-School Youth in the Philippines. Children's Geographies, 5(4), 443-462. Retrieved from **http://www.tandfonline.com/doi/abs/10.1080/14733280701631940**

This paper reports on the findings of focus group discussions designed to explore the learning and skills-based needs of out-of-school youth in the Philippines, particularly addressing their reasons for leaving school, their current activities and employment, how they acquire skills and knowledge, what they want to learn about, their use of Information and Communication Technologies, and their future employment plans.

Frameworks and good principle guides

There are many guides that draw together summaries of good practice in education technology and attempt to synthesise the overall learning of the sector (GBC 2014). These provide guidance regarding overall policy and delivery principles that programmes can benefit from.

1. Cambridge Education (2016). Go innovate! A guide to successful innovation for education. Retrieved from: **http://www.camb-ed.com/article/227/go-innovate-a-guide-to-successful-innovation-for-education**

This guide identifies the conditions that have led to successful outcomes when introducing or supporting innovative approaches for education.

2. Center for Education Innovations, 2014. Education Technology Database at a Glance. Retrieved from **http://educationinnovations.org/sites/default/files/CEI%20Education%20Technology%20DAG.pdf**

The Center for Education Innovations provides a valuable education technology database that profiles and analyses relevant programmes.

3. mEducation Alliance: **http://medalliance.wpengine.com/?page_id=231**

mEducation Alliance is a network and resource site that works to connect relevant stakeholders and collate evidence regarding education technology in low-resource environment.

4. MIT (no date). A framework for evaluating appropriateness of educational technology use in global development programs. Retrieved from **http://cite.mit.edu/system/files/reports/Summary%20Report_A%20Framework%20for%20Evaluating%20Appropriateness%20of%20Educational%20Technology%20Use%20in%20Global%20Development%20Programs.pdf**

MIT's framework for assessing the appropriateness of education technology use is structured under eight main categories: teachers; students; culture; sustainability; community, social, political; learning; infrastructure; scalability and market impact.

5. Trucano, M. (2016). SABER-ICT Framework Paper for Policy Analysis: Documenting national educational technology policies around the world and their evolution over time. World Bank Education, Technology & Innovation: SABER-ICT Technical Paper Series (#01). Washington, DC: The World Bank. Retrieved from **http://wbgfiles.worldbank.org/documents/hdn/ed/saber/supporting_doc/Background/ICT/112899-WP-SABER-ICTframework-SABER-ICTno01.pdf**

The SABER-ICT policy framework provides a useful tool for policymakers to make well-informed decisions regarding the use of technology in education. The framework identifies either overarching themes that those involved in forming and implementing education technology policies (and by implication also large scale implementations) should be cognisant of: vision and planning; ICT infrastructure; teachers; skills and competencies; learning resources; EMIS; monitoring and evaluation, assessment, research and innovation; and equity, inclusion and safety.

6. Trucano, M. & Dykes, G. (2017). Building and sustaining national educational technology agencies: Lessons, Models and Case Studies from Around the World. The World Bank: Washington, DC. Retrieved from **http://www.worldbank.org/en/topic/edutech/publication/building-and-sustaining-national-educational-technology-agencies-lessons-models-and-case-studies-from-around-the-world**

Trucano, M. & Dykes, G. (2016). Building and sustaining national ICT / education agencies: Lessons from international experiences. The World Bank: Washington, DC. Retrieved from **https://openknowledge.worldbank.org/bitstream/handle/10986/26086/112754-NWP-ADD-SERIES-AUTHORS-PUBLIC-ICTedAgencies-SABER-ICTno02.pdf?sequence=1&isAllowed=y**

The World Bank (Trucano and Dykes 2016) also identifies a set of lessons that can be identified from the experiences of national agencies working in education technology. This emphasises the importance of leadership, legislation, sustainability, communication, integration with a holistic vision of education, and the need to focus on supporting and meeting the needs of teachers. The intention is to help national governments to learn from the experiences of other contexts as they embark on large scale implementation of education technology programmes.

7. USAID, 2011. First Principles: Designing Effective Education Programs Using Information and Communication Technology (ICT) Compendium. Retrieved from **http://www.equip123.net/docs/E1-FP_ICT_Compendium.pdf.**

USAID provides a compendium of principles for effective programming. This provides an important overview guidance for designing and implementing education programmes that use technology.

Other noteworthy resources

1. EduTech: **https://blogs.worldbank.org/edutech/**

A World Bank blog on all things ICT4E.

2. J-PAL: **https://www.povertyactionlab.org/**

This MIT research centre's site has policy briefs, training resources, and guidance for policy makers, educators, and researchers.

3. Muyoya, C., Brugha, M., & Hollow, D. (2016). Education technology map: guidance document (DFID). Jigsaw Consult, United Kingdom. Retrieved from **https://jigsawconsult.com/sites/default/files/files/Education-technology-evidence-mapping-guide.pdf**

An evidence gap map collating 401 resources on education technology in low- and middle-resource environments and an accompanying guidance document.

4. Strategic Impact Evaluation Fund (SIEF): **http://www.worldbank.org/en/programs/sief-trust-fund**

A World Bank fund website with tutorials, toolkits, evidence reviews, and helpful videos on impact evaluation.

5. The International Initiative for Impact Evaluation (3ie): **http://www.3ieimpact.org/en/about/**

A good resource for finding evaluation resources, including evidence gaps and meta-analyses

ANNEX 4: VALIDATION OF PRELIMINARY FINDINGS THROUGH CONSULTATIONS WITH SAVE THE CHILDREN STAFF, 15TH AND 17TH AUGUST 2017

Basic education and primary schooling in 2025 (compared with 2017)

Please score the following predictions according to the following scheme:

1 = very unlikely, 2 = unlikely, 3 = unsure, 4= likely, 5 = very likely

Scores	1	2	3	4	5	Total responses
Increasing diversity in quality	0	0	21.43%	57.14%	21.43%	14
Continued importance of qualified teachers, but undervalued	0	0	0	69.23%	30.77%	13
Increasing tensions in content provision	0	0	20%	33.33%	46.66%	15
Increasing importance of learning rather than schooling	0	8.33%	8.33%	50%	33.33%	12
Increasing importance of holistic approach to basic education	0	21.43%	14.29%	42.86%	21.42%	14
Increased role of private sector in delivery of learning	0	6.25%	18.75%	31.25%	43.75%	16
Increasingly pervasive use of technology in learning	0	8.33%	16.67%	33.33%	41.67%	12

ICTs in deprived areas in 2025 (compared with 2017)

Please score the following predictions according to the following scheme: 1 = very unlikely, 2 = unlikely, 3 = unsure, 4= likely, 5 = very likely

Scores	1	2	3	4	5	Total responses
Increasingly all-pervasive	0	6.67%	13.33%	53.33%	26.67%	15
The future is mobile	0	7.14%	14.29%	21.43%	57.14%	14
ICTs increasingly unequally distributed	0	8.33%	0	58.33%	33.33%	12
Decline in costs of devices and connectivity	0	0	7.14%	50%	42.86%	14
Growing significance of data and security	0	0	13.33%	42.86%	42.86%	14
Increased personalisation	0	7.14%	28.57%	28.57%	35.71%	14

Use of ICTs for primary learning in deprived locations 2025 (compared with 2017)

Please score the following predictions according to the following scheme:

1 = very unlikely, 2 = unlikely, 3 = unsure, 4= likely, 5 = very likely

Low-income areas	1	2	3	4	5	Total responses
Significant diversity	0	7.69%	7.69%	76.92%	7.69%	13
Increasingly successful use of ICTs to facilitate learning	0	9.09%	36.36%	54.55%	0	11
Teachers using technology more effectively	0	0	46.15%	46.15%	7.69%	13
Learners more readily accessing relevant content	0	8.33%	25%	58.33%	8.33%	12
Increased automation of administration and assessment	0	9.01%	18.18%	54.55%	18.18%	11

Crisis affected areas	1	2	3	4	5	
Increasing crises	0	0	9.09%	36.36%	54.55%	11
Mobile devices enabling mobile people to learn	0	0	16.67%	58.33%	25%	12
"Learning in a box" flexible solutions	0	0	40%	60%	0	10
Digital hubs for learning in refugee camps	0	0	54.55%	18.18%	27.27%	11

Key:

Scores: 1 = very unlikely, 2 = unlikely, 3 = unsure, 4= likely, 5 = very likely

Shadings for percentage of respondents scoring in each category

0	0.01-9.9%	10-19.9%	20-29.9%	30-39.9%	40-49.9%	50-59.9%	60-69.9%	70-79.9%

ENDNOTES

1 We draw especially on the following documents for our understanding of the policy context within Save the Children: Save the Children International (2017) *The Quality Learning Framework, London*: Save the Children International, and Save the Children (no date, c.2016) *Education Strategic Direction 2016–2018*, (no publication details, London: Save the Children). We are also grateful for sight of internal documents (which are not here cited) and conversation with Save the Children staff.

2 The three-hour workshop brought together representatives from academia, government, the private sector, and civil society; 15 people participated face-to-face in London, with 14 others joining through video link from 6 other countries.

3 Interviews were mostly in the form of VoIP calls, although some were face-to-face; a standard template was used that focused on the three main themes of basic education, ICTs, and the use of ICTs for learning; most interviews were approximately 60 minutes in length; interviews were not recorded, so that interviewees could speak more freely (rich-text analysis was not being used so there was also less need for transcribing the precise text); detailed notes were taken for all interviews; interviewees were told they need not answer questions that they did not want to; and all responses have been reported anonymously.

4 Case studies are presented in a standard format, with the data at the start of each of them drawn from World Bank and ITU databases and annual reports.

5 Lord Avebury (Sir John Lubbock) *Peace and Happiness*. London: Macmillan, p.172

6 UNESCO (2015) *Education for All 2000-2015: Achievements and Challenges*, Paris: UNESCO.

7 For updates, see also UNESCO (2016) *Global Education Monitoring Report 2016. Education for People and Planet: Creating Sustainable Futures for All*, Paris: UNESCO

8 UN Sustainable Development Goals, **http://www.undp.org/content/undp/en/home/sustainable-development-goals.html**, accessed 14 August 2017.

9 Finnish National Agency for Education (2016) Subject teaching in Finnish schools is not being abolished, **http://www.oph.fi/english/current_issues/101/0/subject_teaching_in_finnish_schools_is_not_being_abolished** , accessed 14 August 2017

10 Andrews, J., Robinson, D. and Hutchinson, J. (2017) *Closing the Gap? Trends in Educational Attainment and Disadvantage*. London: Education Policy Institute.

11 The Philippine Star (2015) Education reform advocates divided on K to 12 program, **http://www.philstar.com/headlines/2015/11/22/1524562/education-reform-advocates-divided-k-12-program**, accessed 14 August 2017.

12 UNESCO (2015) *Education for All 2000-2015: Achievements and Challenges*, Paris: UNESCO.

13 **http://oer.educ.cam.ac.uk/wiki/OER_teacher_education_resources**, accessed 15 August 2017

14 For a good example, see the eSkwela programme in the Philippines, designed to use ICTs to support out of school youths gain educational certification: **https://als-eskwela.wikispaces.com/About**, accessed 25 Setepmerb 2017.

15 Department for Children, Schools and Families (2008) *The impact of Parental Involvement on Children's Education*, Nottingham: DCSF, **https://www.ucy.ac.cy/nursery/documents/ThemaVdomadas/DCSF-Parental_Involvement_1.pdf**, accessed 15 August 2015.

16 Barber, M. (2013) *The Good News from Pakistan: How a Revolutionary New Approach to Education Reform in Punjab Shows the Way Forward for Pakistan and Development Aid Everywhere*, London: Reform.

17 Bridge International Academies, **http://www.bridgeinternationalacademies.com/**, accessed 15 August 2015.

18 **http://globalinitiative-escr.org/wp-content/uploads/2017/07/Civil-society-call-on-investors-to-cease-support-to-Bridge-International-Academies.pdf**, accessed 15 August 2017

19 **https://www.weforum.org/agenda/2015/01/17-quotes-on-the-future-of-technology-from-davos-2015/**, accessed 15 August 2015.

20 ICT Facts and Figures 2017, **http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf**

21 Unwin, T. (2017) *Reclaiming Information and Communication Technologies for Development, Oxford*: Oxford University Press.

22 Unwin, T. (2017) *Reclaiming Information and Communication Technologies for Development*, Oxford: Oxford University Press.

23 Cox, J. (2017) US tech company becomes first to microchip employees, **http://www.independent.co.uk/news/business/news/us-tech-company-microchip-employees-first-three-square-market-wisconsin-a7856971.html?cmpid=facebook-post**, accesses 14 August 2017.

24 GSMA (2016) *2016 Mobile Industry Report: Sustainable Development Goals*, London: GSMA, **https://www.gsma.com/betterfuture/2016SDGImpactReport/**, accessed 16 August 2017; Earth Institute Columbia University and Ericsson (2016) *ICT and SDGs Final Report: How Information and Communication Technology can Accelerate Action on the Sustainable Development Goals*, New York and Stockholm: Earth Institute Columbia University and Ericsson, **https://www.ericsson.com/assets/local/news/2016/05/ict-sdg.pdf** accessed 17 August 2017.

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