TECHNOLOGY, BROADBAND AND EDUCATION

ADVANCING THE EDUCATION FOR ALL AGENDA

A REPORT BY THE BROADBAND COMMISSION WORKING GROUP ON EDUCATION

United Nations
Educational, Scientific and
Cultural Organization

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ABOUT

The Broadband Commission for Digital Development was launched by Dr. Hamadoun Touré, Secretary-General of the International Telecommunication Union (ITU), and Mrs. Irina Bokova, Director-General of the United Nations Educational, Scientific and Cultural Organization (UNESCO), in May 2010 in response to the call by the Secretary-General of the United Nations, Mr. Ban Ki-Moon, to step up UN efforts to help accelerate progress towards the Millennium Development Goals (MDGs). Its main aim is to highlight the importance of broadband in helping boost achievement of the MDGs. It comprises government leaders from around the world and top-level representatives and leaders from relevant industries and international agencies and organizations concerned with development.

This report is the result of the work of the Broadband Commission Working Group on Education, chaired by Mrs. Irina Bokova, Director-General of UNESCO.

More information about the Working Group on Education is available at: http://www.broadbandcommission.org/work/working-groups/education.aspx

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FOREWORD

The Broadband Commission for Digital Development was created in 2010 upon the initiative of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Telecommunication Union (ITU) with a clear goal – to advocate for harnessing the power of the internet and other information and communication technologies (ICTs) in efforts to reach the 2015 internationally agreed development goals.

This vision was embodied in the *Declaration of Broadband Inclusion for All* that was adopted in 2010 by the Broadband Commission in a run-up to the United Nations Summit on the Millennium Development Goals. This milestone declaration highlighted the innovative and strategic importance of broadband and ICT in providing effective and sustainable solutions to the global challenges of eradicating poverty, promoting health, advancing gender equality and ensuring quality education for all.

For UNESCO, broadband is a transformational technology, whose global roll-out carries vast potential for sustainable development – by enhancing learning opportunities, facilitating the exchange of information and increasing access to content that is linguistically and culturally diverse. In these ways, broadband can be a powerful accelerator for progress towards the Millennium Development Goals and the objectives of Education for All, and for furthering the outcomes of the World Summit on the Information Society.

Education is essential for reaching all of these goals. A quality education is an essential human right. It is a foundation for the well-being of societies and a motor for economic success. UNESCO's position is clear – education brings sustainability to all development efforts. Investing in education is the best way to invest *out* of poverty and *in* sustainable development.

Much progress has been made to reach the 2015 goals – but many countries are still not on track. In this respect, the digital divide continues to be a development divide. The ongoing mobile and internet revolutions provide all countries, especially developing and least developed ones, with unprecedented opportunities. We must make the most of broadband to widen access to quality education for all and to empower all citizens with the knowledge, skills and values they need to live and work successfully in the digital age.

As Chair of the Broadband Commission Working Group on Education, I am pleased to present this report, *Technology, Broadband and Education: Advancing the Education for All Agenda,* which provides concrete examples of how to harness the power of ICT and broadband for quality education throughout life, especially in the developing world.

The report is the fruit of outstanding collaborative work by Commissioners and other contributors from the ranks of government, international organizations, business and civil society. I thank them all for sharing their expertise and insight. I am sure this report will provide vital support to policymakers and other actors in the field of education and ICT to shape policies that drive forward the development agenda at the global and national levels. These policies are strong foundations for building the inclusive knowledge societies we need for the century ahead.

Irina Bokova
Director-General, UNESCO

FOREWORD

Broadband technologies continue to expand our horizons, pushing back frontiers of time and knowledge, and overturning long-established precepts and outdated ways of doing things. The ability of broadband to improve and enhance education, as well as students' experience of education, is undisputed. A good and well-rounded education is the basis on which future livelihoods and families are founded, and education opens up minds, as well as job prospects.

The power and reach of the virtual world is growing constantly. A student in a developing country can now access the library of a prestigious university anywhere in the world; an unemployed person can retrain and improve their job prospects in other fields; teachers can gain inspiration and advice from the resources and experiences of others. With each of these achievements, the online world brings about another real-world victory for education, dialogue, and better understanding between peoples.

I welcome this excellent and thought-provoking Report from the ITU/UNESCO Broadband Commission for Digital Development's Working Group on Education, chaired by Irina Bokova, UNESCO's Director-General. The Report offers in-depth focus and fresh insights into how education is being transformed by broadband. And just as basic mobiles are now bringing digital literacy, SMS and interactive apps within reach of over 90% of the world's population, so too will mobile broadband offer the potential for bringing education to life, and into the lives of children and young people everywhere.

While United Nations' Agencies such as UNESCO are continuously working to promote the importance of content, ITU and its constituency are ensuring that the next generation of broadband infrastructure will be in place to match the exponential growth of voice, video and data.

This Report is a strong contribution to the growing body of research and thought leadership by the Broadband Commission. It makes a strong case for the beneficial impact of broadband in transforming education, and outlines the different factors to be considered. It incorporates perspectives from many different stakeholders, and it is therefore my hope that governments and policy-makers, teachers and educationalists alike, can take inspiration from the different country examples provided here.

This Report also represents a fine example of inter-agency collaboration. ITU works closely with UNESCO on various issues raised by new and evolving use of Information and Communication Technologies (ICTs), and we welcome this report as another milestone in the special relationship between our two agencies.

Although universal primary education is a Millennium Development Goal in its own right, improved and more accessible education can also help achieve many of the other MDGs. Above all, this Report recognizes the vital contribution that broadband can make in bringing lifelong learning and dialogue into the lives of everyone by connecting the world.

Dr Hamadoun I. Touré
Secretary General, ITU

1 INTRODUCTION

In the year 2000, the majority of the world's governments adopted the Education for All (EFA) goals and the Millennium Development Goals (MDGs), the two most important frameworks in the field of education. As a fundamental human right and an enabling force for sustainable development, education plays a key role in helping countries meet their international development agendas and has prominently featured in all global landmark summits organized ever since. In broad terms, the EFA goals and the education-related MDGs call for every citizen to be empowered with the necessary knowledge, skills and values to lead a fulfilling and productive life.

Over a decade later, the global education landscape is still bleak: as of 2010, 61 million children of primary-school age and another 71 million of lower secondary-school age were out of school; close to 793 million adults – 64% of whom are women – still lack reading and writing skills, with the lowest rates in sub-Saharan Africa and South and West Asia (UIS, 2011); 200 million young people need a second chance to acquire the basic literacy and numeracy skills essential to learning further skills for work (UNESCO, 2012b); and 1.7 million additional teaching positions will need to be created to attain Universal Primary Education (UPE) by 2015 (UIS, 2012).

In the twenty-first century, education cannot be separated from technology. Rapid advances in information and communication technology (ICT) and expanding connectivity to the internet have made today's world increasingly complex, interconnected and knowledge-driven. Access to quality education for all – which includes access to ICT – is an imperative for building inclusive and participatory knowledge societies. However, disparities in access to technology and learning opportunities persist. Countries around the world are under pressure to bridge the digital, knowledge and gender divides by designing policies that enable access to the full potential of technology in a digital age.

With only two years away from the 2015 EFA and MDG targets, the International Telecommunication Union (ITU) and UNESCO have launched the Broadband Commission for Digital Development, comprising global government and education leaders and representatives from relevant industries, civil society, international agencies and development organizations, with the mandate to advocate access to broadband for all, especially for the world's developing and least developed countries, and to promote affordable and equitable access to high-quality online content and resources.

This is the first report of the Broadband Commission Working Group on Education, whose mission is to further Education for All goals. The purpose of the report is to provide an overall vision about what works well in the field of technology, broadband and education. By analysing current trends and data, the report aims to explain why certain strategies, plans and activities are effective while others are not, and offer guidance for better-informed decision-making at the school level and beyond.

The report is divided into four main parts. The first section, 'Setting the Stage', provides a brief overview of the rationale for expanding and improving the use of technology, including broadband, in education. The second section, 'Where Do We Stand?', describes the current situation in terms of access to technology and technology use in schools, and gives a snapshot of the policy environment for broadband and ICT in education. The third section, 'Strategic Directions', presents evidence for the ways in which new technology developments can increase the efficiency and efficacy of teaching and learning and increase equity in education. The fourth section, 'The Policy Agenda', advocates for policies and strategies that countries, particularly developing ones, should embrace in order to reap the full benefits of broadband in education. In the conclusion, 'Looking Ahead', the report makes recommendations for governments and policy-makers to leverage the power of technology and broadband to improve education. Finally, to highlight successful policies and best practices, examples of innovative uses of ICT and broadband in education are further illustrated by six case studies in the Appendix of the report.

Throughout the paper, the word 'technology' refers broadly to the group of networks, devices, applications and digital content used to communicate with others and obtain, generate or share information. For the purposes of this report, broadband internet access is defined as fixed or wireless high-speed access to public internet at download speeds of at least 256 Kbps (kilobits per second).

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SETTING THE STAGE

Any discussion of technology in education should begin with the rationale for using technology to promote learning throughout life. First, participation in the global economy is increasingly dependent on twenty-first century skills, which include the ability to effectively use technology and navigate the digital world. Second, technology has the potential to improve education by increasing the efficiency of school systems, transforming traditional pedagogical models, extending learning opportunities beyond the limits of schools and classrooms, and expanding educational access for disadvantaged groups. Lastly, as the pace of technological development accelerates, the digital divide between developed and developing countries deepens. Governments in developing countries in particular need to explore ways to bridge this gap and implement policies that call for increased investment in ICT in education.

Teaching twenty-first century skills

In a globalized economy with a high degree of competition among countries, the success of a nation depends on the educational level of its workforce. As rapid technological developments constantly drive and reshape the economy, it is vital for citizens to be highly proficient in the use of technology. This is true not only for those just entering or already integrated into the labour market but also for the unemployed, who may lack the qualifications required by a 'knowledge economy'. Governments should work to ensure that all citizens receive the technological training and experience necessary to participate in the global economy.

Traditional school curricula tend to prioritize the accumulation of knowledge over the application of knowledge, and many school systems fail to adequately train students in digital citizenship and literacy. Education reform is essential to provide learners with what are commonly called 'twenty-first century skills' – those competencies and values needed to become responsible citizens in a learning society and sustain employability throughout life in a knowledge economy.

What are 21st century skills?

The knowledge society and economy call for new skills that have not been fully addressed by most school systems. In its most recent definition, the Assessment & Teaching of 21st Century Skills (ATC21S) consortium (2013) describes these skills as:

- **Ways of thinking: creativity, critical thinking, problem-solving, decision-making and learning**
- **Ways of working: communication and collaboration**
- **Tools for working: ICT and information literacy**
- **Skills for living in the world: citizenship, life and career skills, and personal and social responsibility**

As the digital world becomes part of the broad cultural environment, technological literacy is increasingly vital for participation in daily life. Education should offer a vision of culture that empowers learners to interpret and actively engage in the new formats and contents of digital culture.

Using technology to improve education and increase equity

In addition to providing learners with the technological experience necessary to participate in the global economy, the use of technology in education can also improve the quality of teaching and learning. At the administrative level, technology can make education systems more efficient by helping teachers and administrators streamline routine tasks and improve assessment and data collection. In the classroom, technology can be a powerful catalyst for pedagogical change, as students use technology to take a more active role in personalizing their own education, and teachers take on new roles as facilitators of knowledge rather than knowledge transmitters.

Technology also has the potential to transform education by extending the learning space beyond the four walls of a classroom. Although brick-and-mortar schools will continue to play a leading role in education over the coming decades, technology offers a variety of learning opportunities beyond the physical limits of school. With the current accelerated growth in mobile devices, we are already witnessing the emergence of flexible, open learning environments which enable contextual, real-time, interactive and personalized learning. New technology and communication tools, enabled by a participatory and collaborative web (Web 2.0), have gradually blurred the boundaries between formal and non-formal education, with much learning now taking place outside traditional classrooms. Distance learning, cooperative work in virtual environments, online learning communities, and access to vast resources and databases are just some of the possibilities technology can offer to improve the quality teaching and learning worldwide.

Finally, with this new flexibility come increased opportunities for educational access. ICT in general, and broadband in particular, have the potential to create highly versatile education and training environments that can provide equal access to learners regardless of gender, geographic location, socio-economic or ethnic background, illness or disability, or any other circumstance that would normally hinder the provision of high-quality education.

Bridging the gap between countries

By the end of 2011, nearly 2.3 billion people were using the internet, suggesting that about a third of the world's population is now online (Broadband Commission, 2012). Although the global trend is towards universal access to technology, particularly the internet, there are still many areas where internet access is non-existent or extremely limited. According to ITU (2012a), only a quarter of people in the developing world were online by the end of 2011. In the world's least developed countries, that number drops to 6%, with fixed broadband penetration remaining low in regions such as Africa and the Arab States (Broadband Commission, 2012).

During the past thirty years, governments around the world have made important efforts to support school technology adoption. Typically, school technology policies have called for the acquisition of equipment and networks, the provision of teacher training programmes and teacher support schemes, and more recently the development of digital content, either by public institutions, the private sector or teachers themselves. There are no estimates on the total cost of these investments, although some data, like the ratio of students per computer, if compared internationally can provide a very rough indication. Nevertheless, it is clear that most developed and middle-income countries have made significant investments in ICT in education in recent years. In contrast, the level of ICT in education investment in low-income countries typically remains small. The challenges to be addressed in order to bridge this gap include:

- **Affordability:** Most developing countries are struggling to equip schools with basic ICT devices and digital resources. However, mobile phones offer a more affordable solution that makes use of existing devices to connect teachers, students, parents and administrators, as well as to promote literacy.

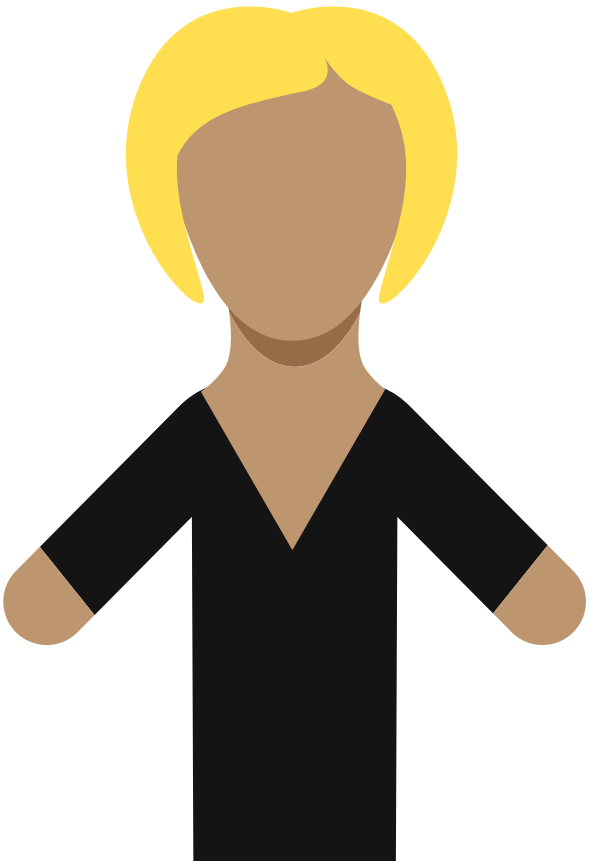
- **Capacities:** National policy-makers sometimes lack the capacity to formulate ICT in education policies. In developing countries, both the technical and pedagogical capacities of Ministries of Education for managing and implementing ICT in education programmes are often low. Teacher education

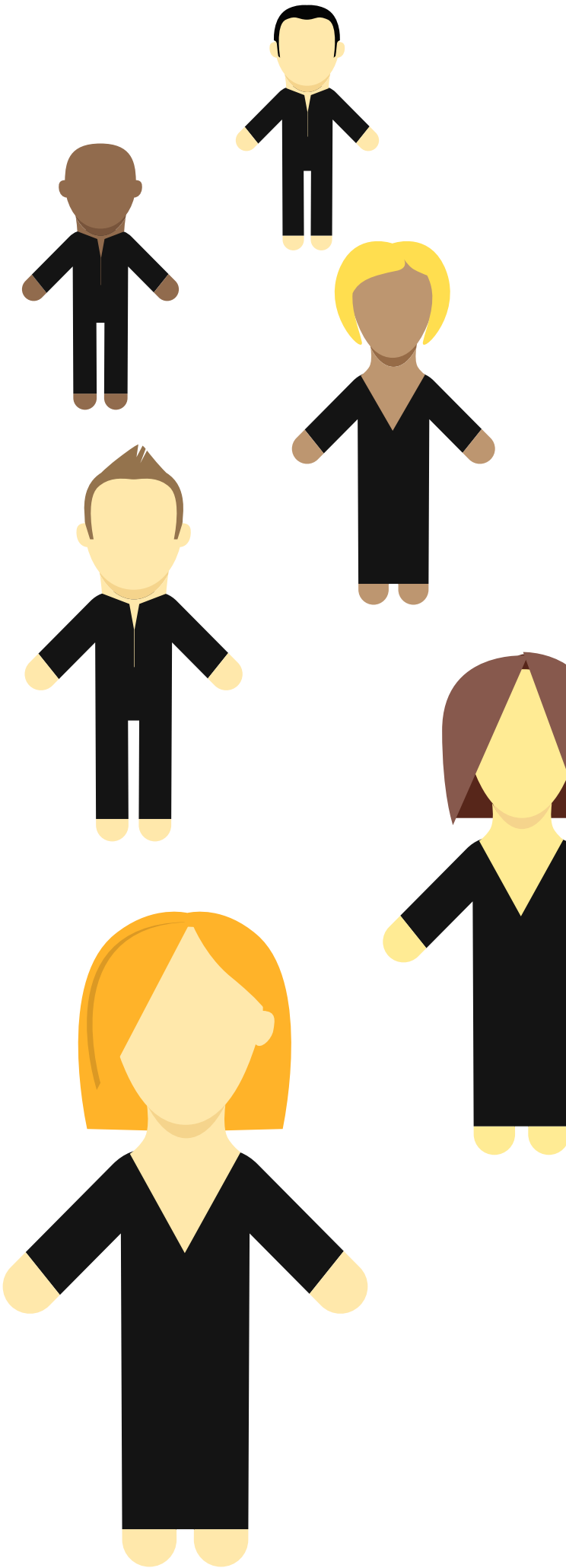
institutions also frequently lack institutional capacity, particularly qualified teacher trainers, to develop and provide training programmes for teachers on the use of ICT in education. At the school level, administrators may lack the capacity to provide the necessary support to teachers to effectively incorporate ICT into their teaching practices.

- **Inclusion:** Poor people, people living in rural areas, disabled people and other disadvantaged groups typically receive low-quality education, even though they have special educational needs. The challenge is to ensure that the introduction of ICT favours inclusive education and reduces inequalities.

- **Content:** ICT integration enriches the process of educational content development and dissemination by making far more content and teaching models available to learners and educators. Open Educational Resources (OERs) hold significant potential to accelerate free access to knowledge and facilitate the adaptation of content to local needs and languages.

- **Quality Assurance:** ICT can help foster knowledge deepening and creation, problem-solving, and other twenty-first century skills, but the curriculum systems of most developing countries have not been duly reformed to embrace those new learning outcomes. As reforms take place, issues such as the quality of ICT-based learning and the safety of children online need to be addressed.





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WHERE DO WE STAND?

Access to technology

While access to technology for educational purposes has increased significantly in recent years, such progress is uneven across countries and regions. When considering the potential impact of improved access to technology, it is important to distinguish between different types of access: access to a computer with or without a fixed or wireless internet connection; access to broadband internet, which offers higher speeds than a narrowband connection; and access to mobile broadband, via mobile devices such as standard mobile phones, smartphones and tablet computers. Each of these types of access carries its own educational potential and policy implications.

Internet access

The last decade or so has seen a significant increase in access to ICT in developed countries. In member countries of the Organisation for Economic Co-operation and Development (OECD), for example, 93% of 15-year-olds have access to a computer at school, and nearly the same percentage (92.6%) have access to the internet at school. The ratio of students to computers has also been improving in these countries; between 2000 and 2009, the student-to-computer ratio in schools attended by 15-year-olds dropped from 13:1 to 8:1 (OECD, 2011). In a number of these countries, such as Belgium, Germany, Italy and Korea, home access is even higher than at school.

In developing countries, on the other hand, on average only 25% of homes have a computer and 20% have access to the internet. In most African countries there are 150 students per computer (Kiptalam and Rodrigues, 2010). A commitment to reduce this ratio to 1:1, where each student is provided with a laptop, netbook, or more recently a tablet computer, has been undertaken by several countries, including Peru, Thailand, Turkey and Uruguay. Overall, though, access remains limited at school and at home.

Broadband access

While access to internet-connected ICT is essential, the type of connectivity afforded to learners and teachers is equally important. It is necessary to distinguish between types of internet access: narrowband and broadband. Broadband, because of its greater capacity to carry information at higher speeds, opens up many more teaching and learning opportunities – such as video streaming, easy downloading of podcasts and other audio-visual files, educational gaming, and live virtual tutoring. It also allows educational administrative tasks to be completed quickly and reliably, even in remote areas. Learners who only have access to narrowband internet connections have far fewer opportunities for online learning.

However, even within broadband, 'speed matters'. For example, service providers for data-intensive services, such as Video on Demand, recommend a minimum speed of 2 Mbps (megabits per second) (ITU, 2011). The level of broadband speed is a key determinant of the range of online educational activities possible.

Mobile broadband access

While fixed broadband infrastructure constitutes the bulk of high-speed connectivity for many countries, the ICT service with the steepest growth rate continues to be mobile broadband. In 2012, growth in mobile broadband services continued at 40% globally and 78% in developing countries (ITU, 2012b). Worldwide, there are now twice as many mobile broadband subscriptions as fixed broadband subscriptions. Whereas people in developed countries usually use mobile broadband networks in addition to a fixed broadband connection, in developing countries mobile broadband is often the only access method available (ITU, 2011).

In Africa, mobile broadband has made a significant contribution to increasing broadband access. Fourteen per cent of Ghanaians are now internet users (up from ten per cent in 2010), largely due to mobile broadband penetration, which more than tripled to reach twenty-three per cent in 2011 (ITU, 2012b). This increase in access is one of the reasons behind the impressive uptake of mobile social networking services, such as MXit in South Africa and Facebook Mobile across the African continent. While mobile devices are banned in many schools, outside of classrooms they are an indispensable tool for both fun and educational activities. Young Africans increasingly use their mobile phones to access information on the internet, connect with friends, receive tutoring, practice their mathematics skills and read mobile novels (for example, see the mobile learning case study – Nokia MoMath – in the 'Strategic Directions' section of this report).

Africa: The mobile revolution

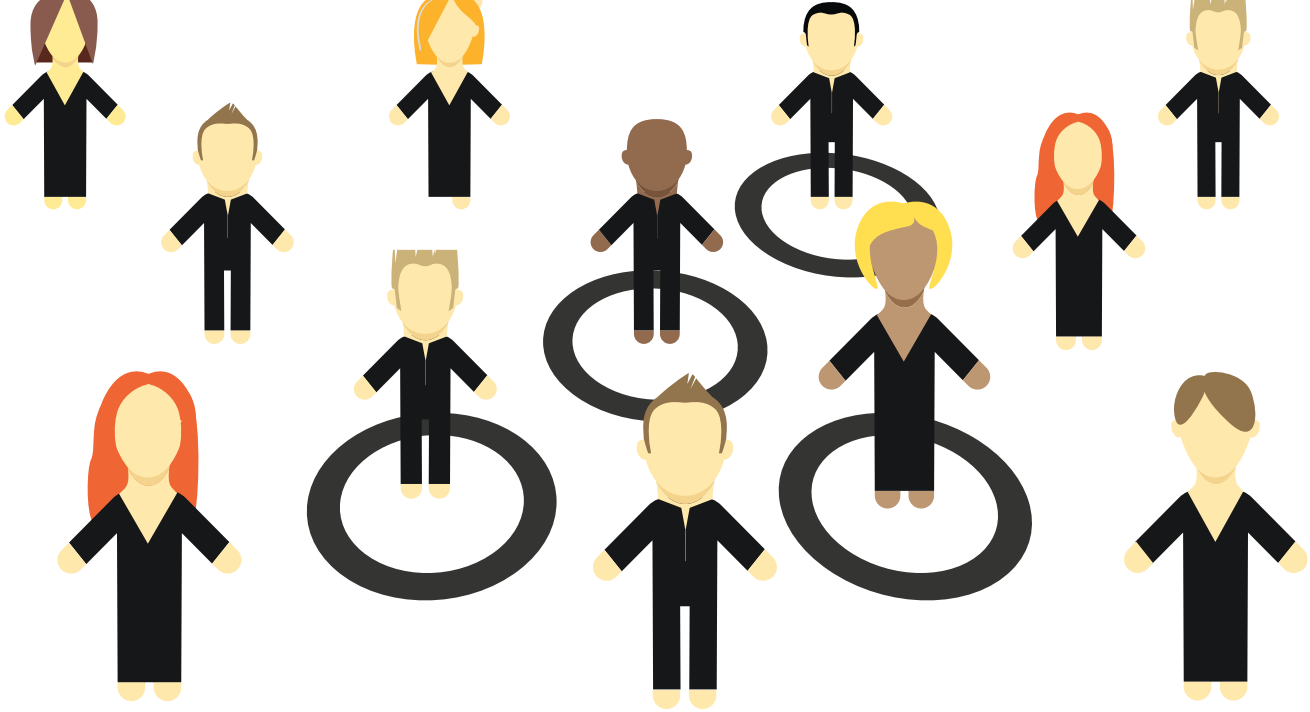
For the continent that has historically been largely unconnected via land-based telecommunications, the mobile telephony uptake of the last few years has been nothing short of a revolution. In 1995 there were an estimated 600,000 mobile phone subscriptions in Africa (Grosskurth, 2010). In 2005 this number rose to 87 million (ITU, 2011) and in 2012 it was estimated that there were 735 million mobile subscriptions on the continent (GSMA and A.T. Kearney, 2011). This last figure makes Africa currently the fastest growing and second-largest market for mobile phones. While in some countries – including Botswana, Gabon and Namibia – there are more mobile subscriptions than inhabitants, overall Africa still has the lowest mobile penetration of any market (GSMA and A.T. Kearney, 2011). This means that there is still more growth to come, supported by the number of undersea cables that have landed, and will continue to land, in Africa in the coming years. Such infrastructure fuels mobile data connectivity to the internet outside of Africa.

For the first time in its history, a large number of African people can communicate with each other over distance, receive information and access services via mobile devices. As a result mobile telephony has significantly impacted the way that people communicate, socialize, play, pay for things and interact with governments.

These connections also offer an opportunity for education. Mobile technologies are being used to distribute educational materials, support reading, and enable peer-to-peer learning and remote tutoring through social networking services (Vosloo, 2012). The last example happens over MXit, Africa's largest home-grown mobile social network. The South Africa-founded service not only allows its mostly young users to stay in touch by text chatting, it also facilitates live tutoring for mathematics homework. Dr Math on MXit, a project launched in 2007, has helped over 32,000 school-aged children work through math problems by connecting them with tutors for live chat sessions (eLearning Africa, 2012).

While the mobile revolution is taking off in Africa, it must be noted that the mobile landscape is spread unevenly across and within countries. Some areas have good mobile broadband in place, while in others access is unreliable and limited to basic services such as voice calls and SMS. To have a real impact on education, mobile learning initiatives must – and do in Africa – cater to a range of technology contexts. An example is Nokia Life, an information service with over 70 million subscribers in India, China, Indonesia and Nigeria. In Nigeria popular information channels deliver exam preparation tips for middle and high-school students, health education aimed at families, and English language learning. The service has traditionally used SMS to deliver the content. Nokia Life+, launched in late 2012, uses mobile data to offer an improved content experience. As mobile data connectivity infrastructure improves, additional services will come online across Africa.

The barriers to fully realizing the potential of mobile learning in Africa are often complex and significant. For example, while prices for mobile usage have dropped, they are still too high for many Africans, who spend on average 17% of their monthly income on mobile phones and connectivity plans (Grosskurth, 2010). In comparison, people in North America and Western Europe spend under 2%. Additional obstacles include a shortage of local-language content; low levels of literacy that make mobile learning difficult; and low, but growing, numbers of smartphones and digital tablets that could enable richer mobile learning experiences. School or district policies that ban mobile phone usage are another hindrance. Still, despite the challenges, which are increasingly being addressed, mobile learning, either alone or in combination with existing approaches, is supporting and extending education in ways not possible before on the continent.



Mobile broadband technologies have helped overcome infrastructure barriers and provided high-speed internet services to previously unconnected areas in many African countries. On the continent, mobile broadband penetration has reached 4%, compared with less than 1% for fixed broadband penetration (ITU, 2011). While the promise of broadband to support online teaching, learning and administration in Africa is significant, the broadband penetration levels are still too low; by contrast, the developed world average for mobile broadband penetration is 51% (ITU, 2012a). Much remains to be done in Africa to improve the extent and speed of the connections for the full educational potential of mobile broadband to be realized.

Broadband policy environment

Broadband internet is more likely to benefit the social and economic development of all members of society if it is supported by clear policy leadership and strategic frameworks. Over the past few years international ICT regulators and policy-makers have begun to recognize broadband as a policy imperative. At the 2011 Broadband Leadership Summit, 'making broadband policy universal' was one of the four Broadband Targets established for 2015 (Broadband Commission, 2011). In 2012, ITU and the Broadband Commission released data and evaluated these four targets in several publications (ITU, 2012b–c; Broadband Commission, 2012). By the end of 2011 there were 119 countries around the world with national broadband policies in place. The majority of these policies define various objectives for rolling out broadband infrastructure to the whole population, priority groups, or specific communities, as well as objectives for closing gaps in regional broadband infrastructure coverage.

In the education sector, policy-makers who promote the use of technology to support and improve teaching and learning have become increasingly cognizant of the need for not only internet access, but broadband access. A report prepared for the African Development Bank, the World Bank and the African Union recommends, as a strategic objective for ICT in education in African countries, 'affordable, broadband connectivity [that] enables all education institutions (schools, universities and government departments) to connect as many ICT devices as they require to the internet, ensuring that any online activities (managerial, administrative or educational) being undertaken by the educational institution can be done reliably and quickly' (Adam et al., 2011). The Economic Commission for Latin America and the Caribbean's 2015 Plan of Action (eLAC2015) on the Information Society in Latin America and the Caribbean (OSILAC) prioritizes universal access and inclusive education through ICT. One of its goals for education is to 'connect all educational establishments to broadband and increase their computer density, while promoting the use of convergent educational resources such as mobile phones, video games and open interactive digital television' (ECLAC, 2010).

While many countries have broadband policies in place and many Ministries of Education have called for broadband in all schools, progress towards reaching these goals is irregular and difficult to track, especially because many developing countries do not distinguish between connection types when collecting data related to ICT access and use. One of the few large-scale studies to use this level of precision was conducted by the UNESCO Institute for Statistics (UIS) in Latin America and the Caribbean in 2010 and 2011. The study found that of the twenty-two countries and territories in the region that provide data disaggregated according to bandwidth, some show impressive strides in broadband connectivity

in schools. Several small Caribbean countries with concentrated populations, including Barbados, the British Virgin Islands, Saint Kitts and Nevis, Saint Lucia and Saint Maarten report that 100% of primary and secondary schools have fixed broadband connections (UIS, 2012). Uruguay has been able to provide fixed broadband to 95% of primary schools and 100% of secondary schools in both urban and rural sub-regions. For larger countries in the region, though, connectivity remains a challenge. For example, in Colombia 75% of primary and secondary schools are connected to the internet, but only 9% of all schools are connected via fixed broadband.

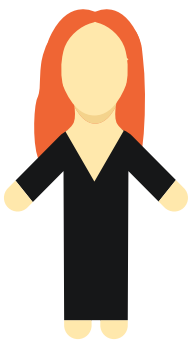
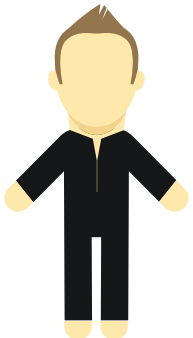
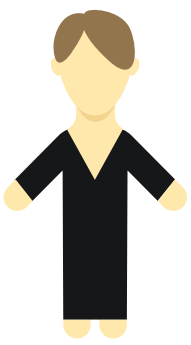
In terms of mobile broadband, the opportunity to support teaching and learning through mobile technologies is increasingly being explored by educational institutions. Some governments and school systems are leveraging the power of mass purchasing to negotiate lower prices for equipment and cheaper connectivity rates for schools. In Senegal, mobile network operators are key players in the extension of internet connectivity to schools by rolling out broadband GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access) networks (Adam et al., 2011). Exact figures on the penetration of mobile broadband in schools in developing countries, however, are extremely rare.

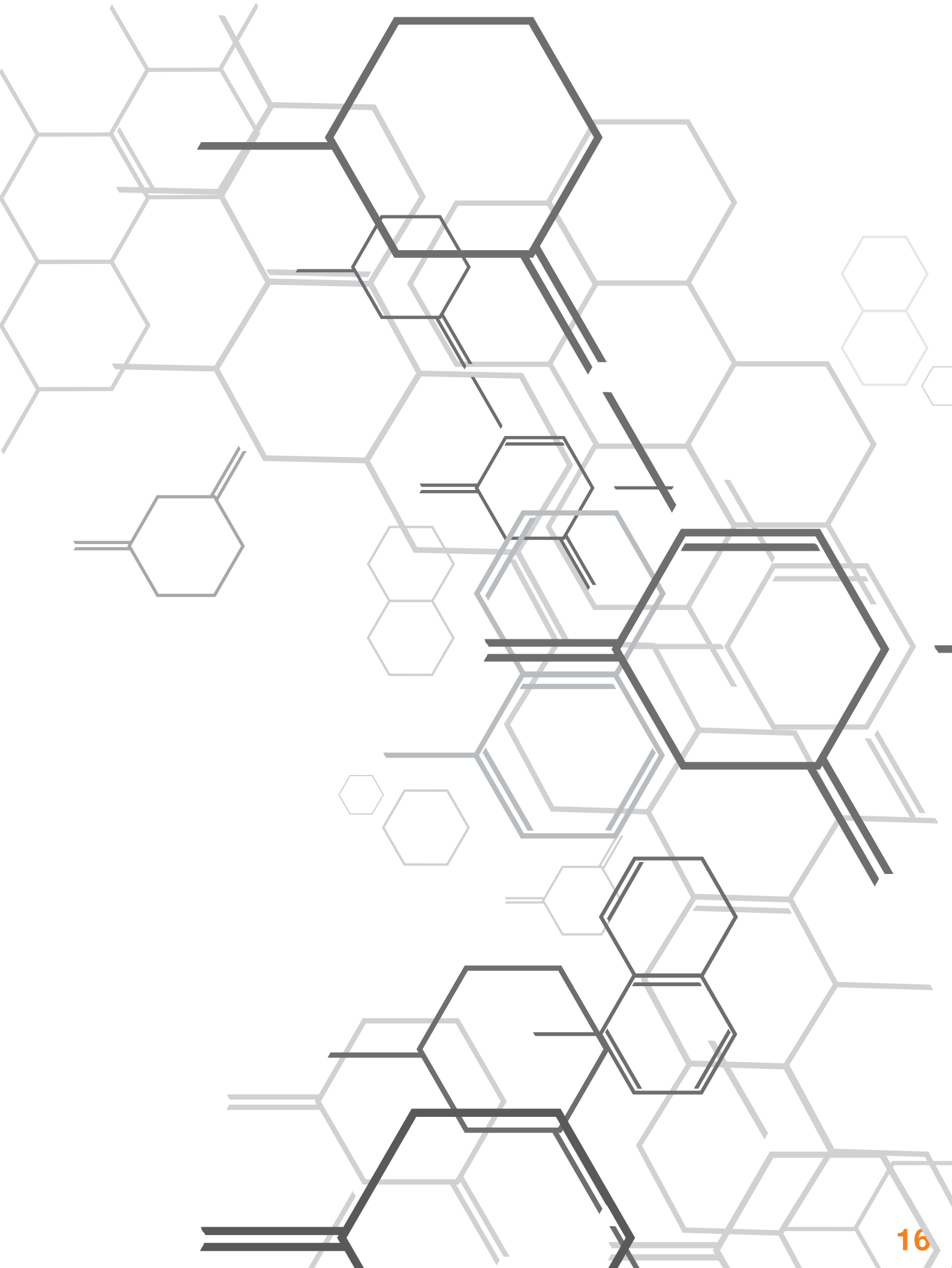
Overall, the political efforts made to facilitate access to technology in schools have been remarkable. It is also important to remember that many young people around the world already have better access to technology outside their schools than inside them, thus reversing the situation of a decade ago when access at home was lower than in school. However, in spite of the progress made, barriers to broadband coverage still remain for developing countries. These obstacles include broadband costs, which are higher than in developed countries; accessibility, which is limited by a lack of cost-effective infrastructure and equipment, particularly in rural and remote areas; a dearth of content and applications available in local languages and adapted to local contexts; and insufficient broadband literacy for all segments of the population (e.g. women, children, older people and people with disabilities).

How technology is used

As governments continue to push for greater technology integration in schools, it is important to note technology has not always been utilized in an effective manner to improve learning. Available data suggest that even in OECD countries both the intensity of usage (i.e. the amount of time technology is used) and the quality of usage (i.e. the variety and relevance of the technology used) are still low (OECD, 2011). The daunting task of integrating new and constantly evolving technologies into present teaching models and methods accounts for the relatively slow pace of ICT adoption in education. The role allocated to technology in schools is still marginal, both in terms of the quality and quantity of use by students and teachers. Evidence suggests that the use of ICT by students in the classroom is usually limited to searching for information rather than processing and sharing that information; ironically, this is the exact opposite of how students use the same technologies during their free time outside of school.

Broadband connectivity, in and of itself, will not improve the quality of education. Governments must go one step further than simply enabling the conditions for technology use in schools (i.e. networking classrooms, training teachers or supplying educational resources). The real challenge is to help teachers and students use technology and broadband in relevant and authentic ways that actually improve education and foster the knowledge and skills necessary for lifelong learning. As new technology is introduced, governments must support educators while they explore what works best in the particular contexts of their classrooms, schools or regions, and help them share their knowledge and experiences with others in the education community, to contribute to the growing body of evidence regarding best practices for ICT in education.



4

STRATEGIC DIRECTIONS

ICT in education has the potential to improve teaching and learning, make learning more flexible and accessible through mobile technologies, and promote gender equity in education and the workforce by empowering women and girls with ICT literacy and skills.

Improving teaching and learning

Technology can support teachers by increasing their efficiency in and outside the classroom; help teachers respond better to students' individual needs; and facilitate communication between teachers, students, parents and administrators. It can also support learners, particularly through the advent of 1:1 (one device per student) models of ICT in education, which aim to give each student continuous access to online educational content and resources in and outside of school.

Technology to support teachers

Technology can be used to support teachers in a variety of ways. First, using technological tools can enable teachers to be more efficient in preparing for their classes (Mominó et al., 2008). Data on the use of technology in the classroom show that the solutions by and large preferred by teachers are the ones that streamline their work and bring about efficiency gains, especially when it comes to the introduction of content. The success of digital blackboards, for example, can be attributed to their ability to optimize routines, content and materials that are part of the traditional work of the teacher in the classroom (Higgins, 2010). Digital blackboards allow teachers to be more efficient in their work by simplifying the tasks of searching for digital elements, ordering them and preparing them. They also make it easier to update material and share resources with students through an educational platform.

Second, technology can help teachers customize their teaching materials and methods according to individual students' needs. For example, there are many cases of technology facilitating new teaching and learning strategies for students with special educational needs (Maora et al., 2011). Technological solutions have led to significant improvements in learning by allowing teachers to adjust the proposed activities to the specific needs of a certain student. The main reason such solutions are not universal is the high cost per student compared to traditional teaching models. Technology can also be used to improve the collection of student data to inform instruction. Using an online platform, for instance, teachers can follow student progress and view data for individual students. Information can easily be shared with administrators and teaching teams to increase communication about students and expedite decision-making regarding interventions and teaching strategies.

Finally, technology can facilitate communication between teachers, students, parents and administrators. For example, parents can often access a school's educational platform to follow their child's progress, potentially increasing parental involvement in education (Anderson et al., 2010). In some countries, school platforms are becoming increasingly common, though their use often remains limited to sharing static information (e.g. the school calendar, schedule of courses, curricula and grades) or to publishing digital materials and resources to make them available to students on a '24/7' basis. However, platforms can also be used to support distance learning, by allowing teachers to communicate with students who cannot attend physical classes. In addition, teachers can use platforms to communicate and share ideas with other educators at their school or in their discipline.

Technology to support learners

There is still little concrete evidence that new technologies improve learning outcomes. However, this may be due to the fact that the ratio of students to computers at schools has traditionally been quite high, with an entire class full of students sharing one computer or many classes vying for time in the school's computer lab. It is only recently that 1:1 initiatives have been implemented on a large scale. The reduction in the cost of equipment, the advent of new and more economical technological solutions (such as netbooks and tablets) – some of them, like XO, specifically targeting younger children – and other innovative approaches, such as using several mice for a single computer (Infante et al., 2009), have all contributed to a more student-centred approach to technology in education (Severin and Capota, 2011).

One-to-one policies

One-to-one (1:1) polices refer to massive computer distribution policies aimed at reaching a ratio of one computer per student in schools. And they are multiplying everywhere. Although they may seem like recent initiatives, the first movement towards 1:1 distribution began several decades ago with the pedagogical principles of Seymour Papert, a Massachusetts Institute of Technology (MIT) professor who pioneered the use of computer systems for teaching and learning by creating Logo, a computer programming language used in education. Papert's work, which emphasizes the importance of the individual relationship between the student and technology, inspired the Governor of the US state of Maine to initiate a massive programme to distribute free computers to all students in the state. The main goal of the programme was to achieve full democratization of technology access and improve the quality of education. Ten years in the making, the Maine initiative began distributing computers to students in 2002 until a universal 1:1 ratio was reached, first in the seventh and eighth grades, followed by a distribution to all students aged 6 to 14 and their teachers. The Maine initiative is still today the international benchmark in this field.

Nicholas Negroponte, also from MIT, made a significant contribution to the popularity of 1:1 policies through his vision of a low-cost computer to be used by students, the so-called OLPC (One Laptop per Child). The OLPC was initially designed to keep the cost below USD100 per student – approximately ten times less than the cost of the computers used in Maine – in order to extend the benefits of 1:1 technology to students in developing nations. Negroponte's project has definitely boosted the popularity of 1:1 policies. Distribution of these low-cost computers started in 2007; as of 2011 more than 2 million units had been distributed worldwide.

1:1 policies have boomed in Latin America over the past years thanks to the success of Plan Ceibal in Uruguay, the only country so far where universal 1:1 distribution is complete. The Inter-American Development Bank (IDB) and the World Bank regularly contribute to finance 1:1 projects in developing countries. In Africa, Rwanda has the fastest-growing OLPC project. Since its launch in 2008, the project has distributed around 80,000 laptops to 145 schools and trained some 1,500 teachers around the country. In the next phase around 100,000 laptops are expected to be distributed and 1,200 teachers trained.

There are many justifications for these policies. First, 1:1 policies directly address the digital divide. It has been suggested that they are the best model to combat access inequality, especially in developing countries. Second, 1:1 programmes may create new working dynamics inside the classroom, which place more emphasis on individual rather than whole-class work and help prepare students for the demands of a knowledge-based economy. Third, when students take their computers home, it has a secondary impact on their community, enabling family members and neighbours to become more familiar with technology. Fourth, such massive distribution plans can have a positive impact on local industry. In Brazil and Portugal, for example, the computers are made only with locally manufactured equipment, which significantly benefits the economy. Finally, these policies have a strong symbolic component, by virtue of being a public contribution that is visible, material, free of charge and closely linked to modernization. Beyond its practical applications, a 1:1 policy is a symbolic gesture by the government that public opinion will construe as a political commitment to improving the quality of education through technology.

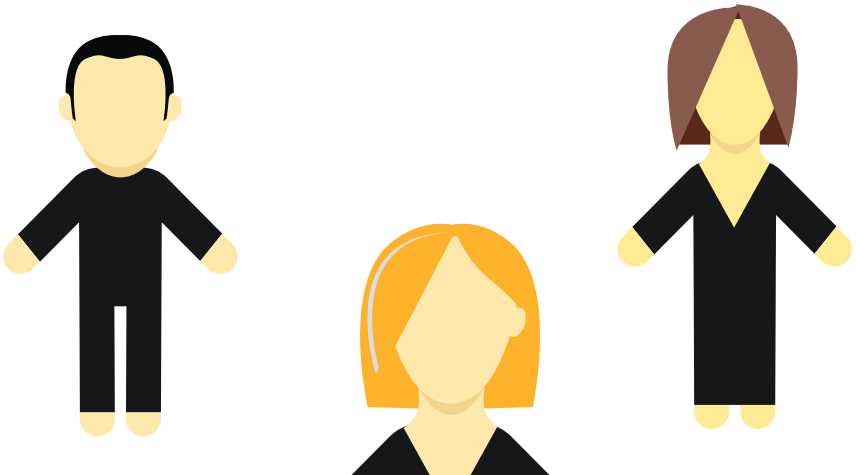
According to the 1:1 model, all students have a device at their disposal both inside and outside the classroom, which allows them to access school resources, communicate with teachers and classmates, and of course connect to the internet. This vision of education is gaining momentum, with examples of 1:1 implementations cropping up all over the world. In developing countries, public administrations such as governments or school systems are expected to finance the purchase of these devices, while in developed countries, families are generally expected to shoulder the costs. In countries where most students own a mobile device, many high-school seniors, like their university counterparts, come to class with their own laptop or netbook. If school policies encourage this model, often referred to as BYOT, or 'bring your own technology', it could soon become commonplace in compulsory education. In countries where the penetration of devices at home is nearly universal, public policies could then be refocused on improving connectivity and educational content, while saving on hardware and maintenance costs. For such a model to be feasible, however, policies must be in place to ensure equitable access for all students. Students who cannot afford devices or have inferior devices should be provided a comparable device by the school.

Mobile learning

In recent years the promise of 1:1 ICT solutions have shifted from laptops to newer and more mobile technologies, namely tablet computers and mobile phones. The past decade has seen a surge in the number and types of physical devices that can support digital platforms. Where it was once possible to categorize devices into three broadly delineated 'classes' – mobile phones, tablet computers, and desktop computers – the lines between these devices have shifted and blurred, and today technology that fits comfortably in a person's pocket or handbag can open a plethora of educational opportunities previously restricted to stationary technology.

Small devices are hardly limited in terms of power. A high-end smartphone has the same computing power and many of the same multimedia functionalities as mid-range desktops computers that are twenty times as large. Additionally, high-resolution touch screens, intuitive operating systems and applications designed specifically for use on small screens have mitigated, if not eliminated, many of the disadvantages of mobile technology vis-à-vis traditional desktop computers. Simultaneously, the numerous advantages afforded by these devices – most notably their anytime and anywhere usability, comparatively low cost, and robust functionality – have increased. Well-equipped tablet computers like the Aakash 2, currently available in India, now sell for under USD50, a price that was unimaginable just two years ago (BBC, 2012). In the past two years many countries have begun exploring the possibility of provisioning tablet devices directly to students in lieu of textbooks. Republic of Korea, Thailand and Turkey have all announced large-scale programmes to gradually replace physical textbooks with digital textbooks, generally accessed from a tablet computer. Apart from being easy to update, digital textbooks carry a potential to facilitate self-directed and customizable learning by offering rich content, tools and resources that can be tailored to learners' abilities and interests. Digital textbooks can also provide additional educational opportunities to learners who are unable to attend regular school lessons due to health and disability-related issues, as well as to learners living in communities with a dearth of media-rich learning resources or a shortage of school teachers.

As mobile hardware and the networks that support them become more powerful, more dynamic and more affordable, the mobility of ICT offers new options for teaching and learning. ICT in education studies have historically conceptualized technology as existing in two separate spheres – at schools and in learners' homes – but this dichotomous view is changing and does not fully describe how many young people use and conceive of technology. Today, learners are



likely to have ICT with them constantly: at home, at school, on public transportation, at work and even in bed. Technology use is no longer, to a large extent, geographically constrained.

Given the changing technological landscape, education specialists have begun investigating how governments and other stakeholders can best leverage increasingly ubiquitous mobile technologies to advance EFA goals. The widespread availability of ICT has sparked important societal changes, and these changes are beginning to ripple into education. People are rightfully asking what easy and instant access to powerful ICT means for education. UNESCO (2012c) has explored this question in depth and recently articulated some of the unique ways mobile technology (and mobile phones and tablets in particular) can benefit education. The benefits identified by the Organization include:

- Expanding the reach and equity of education
- Facilitating personalized learning
- Powering anywhere, anytime learning
- Providing immediate feedback and assessment
- Ensuring the productive use of time spent in classrooms
- Building new communities of learners
- Supporting situated learning
- Enhancing seamless learning
- Bridging formal and informal learning
- Minimizing educational disruption in conflict and disaster areas
- Assisting learners with disabilities
- Improving communication and administration
- Maximizing cost efficiency

Mobile learning case study: Nokia MoMath

The MoMath project in South Africa illustrates how mobile learning initiatives can be implemented on a large scale to support teaching and learning within formal school contexts.

MoMath commenced in 2007 after the President's Office of the South African Government approached Nokia about a mobile learning intervention to support math education. The project was collectively designed by representatives of Nokia and provincial officials from South Africa's Department of Education (DOE). The project uses mobile phones to provide students in Grade 10 with access to math content and support. The initial phase began with 260 learners in 3 provinces of South Africa who used their own mobile phones to access content, participate in competitions based on multiple-choice questions, and engage in peer support and interaction.

The math content is aligned with the country's national math curriculum and is approved by the DOE. The content is freely available to participating learners and to teachers who have received appropriate training to support the learners. More than 10,000 math exercises covering all aspects of the math syllabus are available to learners and teachers. The content is accessed via a low-cost proprietary chat platform hosted by a private company called MXit that is very popular among South African youth. Free access is also supported by South Africa's three local mobile network operators. Learners use the platform to complete math exercises, take tests sent by their teachers and participate in competitions. Students receive reminders about their required work via SMS.

The project moved on to a second phase in 2010, after having expanded to reach 4,000 learners, 72 teachers and 30 schools in 3 provinces of South Africa. By the end of 2011 the project had reached 25,000 learners, 500 teachers and 172 schools in 4 provinces. Preliminary findings suggest that the educational objective of improving math performance is being reached. An evaluation of the project in 2010 revealed a 14% increase in mathematics competency, with 82% of learners using the MoMath application outside of school hours, during holidays and weekends (McCormack, 2010).

Several factors seem to contribute to MoMath's success. First, the project provides an educationally rich service to learners and teachers that supports the national mathematics curriculum. Second, the project has a diverse partner ecosystem that includes official support from the DOE nationally and provincially, and the active involvement of DOE district officials, a local NGO, three major mobile network companies, Nokia, a local textbook publisher, and MXit, a chat platform company. Third, at the institutional level, the project enjoys active participation from teachers, learners and school management in all the schools where it is based. Fourth, the project has integrated independent monitoring and evaluation to encourage continual improvements in project implementation. Finally, the project enables independent learning, with students using their mobile phones to engage in learning at their own pace, as well as teacher-facilitated and peer-supported learning via the mobile chat platform.

These factors, combined with the project's low cost and ease of use, bode well for MoMath's sustainability, scalability and replicability with other subjects. A partnership with the Commonwealth of Learning, an intergovernmental organization dedicated to promoting and delivering open and distance education, plans to extend the project to three additional African countries.

Source: Isaacs (2012, pp. 16–17)

Empowering women and girls

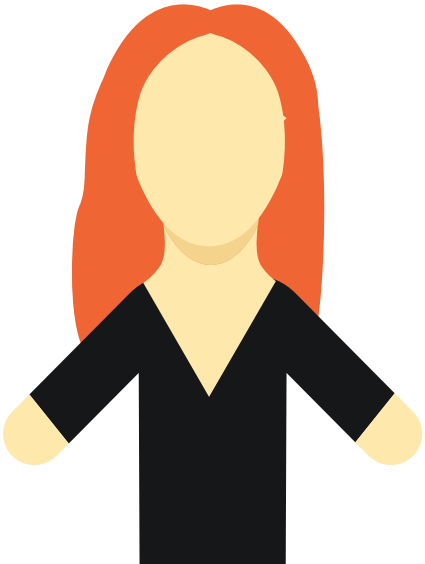
Although ICT and internet access with high-speed connectivity are making education and learning opportunities more widely available, there are still many challenges to overcome, including gender inequality in ICT literacy, skills and use. For many women and girls, access to ICT is a challenge. A recent study found that across the developing world, on average, nearly 25% fewer women than men have access to the internet, and the gender gap increases to nearly 45% in regions such as sub-Saharan Africa (Intel, 2013). While mobile phone ownership is widespread throughout the world, in low to middle-income countries about 300 million more men than women own mobile devices (GSMA Development Fund and Cherie Blair Foundation for Women, 2010). A woman is 21% less likely to own a mobile phone than a man in these countries.

Despite this access challenge, which is a symptom of broader gender inequalities throughout societies, in recent years a number of successful initiatives have sought to improve educational opportunities for women and girls through ICT. For example, UNESCO's 'Developing Literacy through Mobile Phones – Empowering Women and Girls' project has studied initiatives from around the world aimed at empowering women and/or girls through education via innovative mobile technology-based learning and information programmes. The study is particularly interested in the retention and improvement of literacy skills for neo-literate women and girls. Successful cases have emerged, such as the Literacy Promotion through Mobile Phones project in Pakistan, a partnership between UNESCO, Nokia, the Bunyad Foundation and Mobilink that provides literacy support via mobile phones to adolescent female learners living in rural areas (So, 2012). This project is described in detail as Case Study 4 in the Appendix of this report. Another example is an initiative run by the Afghan Institute of Learning that offers a literacy development course for women. Completion of the first level of the course usually takes students about 9 months; using mobile technology to reinforce the coursework, 83% of the women in the pilot programme were able to test into the third level of literacy courses after only 5 months (Catapult, n.d.). Improving their literacy skills means that women can communicate more broadly with their communities and distant relatives, and access online educational materials. For both of these projects, it was particularly important to first engage in dialogue with the local communities to help them understand the benefits of technology use. While many of the projects in the UNESCO study do not use broadband connectivity per se, the benefits of high-speed internet would only strengthen the efforts of the projects by providing women greater access to educational and learning opportunities, the chance to participate in dialogue with online communities, and the potential to express themselves through user-generated content such as blogs and videos.

In spite of these successes, using technology to bridge the gender gap in education is not sufficient to achieve gender equality in society. Another challenge relates to women's integration and participation in the labour market. Research consistently shows that girls and young women are 'turned off' by careers in technology due to a range of factors – from the field's 'geek' image to entrenched notions that technology careers are unfeminine, too challenging or just plain boring. The lack of trained female professionals means that most developed countries are forecasting an alarming shortfall in the number of

skilled staff to fill upcoming ICT jobs. The European Commission, for example, has predicted a skills gap of over half a million ICT jobs in Europe, and countries like Brazil expect to run short of about 200,000 professionally trained ICT workers by 2013. Overall, too few students are preparing themselves for careers in math, engineering, computing and science. Compounding this problem, the number of female technical students is disproportionately low. The ICT sector is currently male-dominated, a fact which is reflected in the structure of ICT companies and government agencies around the world. Women are present in low-level, low-skilled jobs while men are employed at senior-level positions. Fortunately, many ICT companies are looking to attract and promote women because achieving greater workforce diversity is good for business. A broad range of organizations and companies have concluded that increasing the number of women in high-level positions positively impacts financial performance, whereas companies that ignore diversity issues risk ongoing labour shortages.

The ITU has been making a concerted effort to promote increased engagement with ICT among women and girls. International Girls in ICT Day is an initiative backed by ITU Member States in ITU Plenipotentiary Resolution 70 (ITU, 2010) to create a global environment that empowers and encourages girls and young women to consider careers in the growing field of ICT. It is celebrated on the fourth Thursday of April every year. In 2012 more than 1,300 activities in nearly 90 countries were organized, involving more than 30,000 girls worldwide. Along these same lines, the launch of Tech Needs Girls, ITU's three-year communications campaign, created a movement for young women and girls to embrace technology and 'invent' their future (Tech Needs Girls, n.d.). In 2012 ITU also launched, via its Development Sector, the Girls in ICT Portal. This new web portal focuses on helping girls and women access training, job opportunities and career information in the fast-growing ICT sector (Girls in ICT, n.d.).



5

THE POLICY AGENDA

Broadband policy formulation

Initial results of a policy survey conducted by ITU and the Broadband Commission indicate that broadband strategies are being used as a vehicle for cross-sector collaboration to maximize the impact of ICT. Most of the policies analysed showed a convergence of education, health, energy and climate sectors with ICT.

The midterm results of the analysis reveal that out 54 policies evaluated, 42 of them (78%) include references to the use of broadband for improving education. Since the analysed policies come from developed and developing countries alike, this figure suggests a strong connection between broadband and ICT policies and education worldwide.

Within the policies analysed, the references to education fall into four main categories: (1) actions to promote education about the use of ICT; (2) actions to improve access to education through broadband and ICT (this includes increasing access in remote locations and removing social barriers to education); (3) actions to improve the quality of education through the use of broadband and ICT; and (4) actions to promote continuing education and lifelong learning (e.g. career development) through broadband and ICT.

In order to reap the full benefits of broadband in education, it is important that governments have a consistent policy in place as well as a sustained financial commitment. The example below from the Republic of Korea illustrates the effectiveness of this kind of cohesive policy directive.

Republic of Korea: Stimulating broadband by spending on e-education

The government of the Republic of Korea, in an effort to achieve higher uptake of its very fast broadband infrastructure, has established a Presidential Committee for e-Government with a key focus on e-education. The country will spend USD2 billion over the five-year period between 2011 and 2016 on an education revolution that will see a full transition from paper textbooks to e-books.

Most students already have their own mobile device. These devices are usually purchased by the students themselves or by their parents; however subsidies are available for those who cannot afford one. This will give all students access to a comprehensive selection of digital textbooks.

As most students will purchase their own devices, the bulk of the programme's money will be spent on developing digital content. The government will work with online educational content developers to create cloud-based applications that will stimulate students to utilize the national high-speed broadband infrastructure already in place throughout the country.

Like the government's early investment in high-speed broadband infrastructure, this movement to e-textbooks could have a profound impact on economic development – and not just by increasing broadband use. The Republic of Korea will become a global leader in the production and utilization of e-textbooks. Not only will this create opportunities for companies domestically, it could position the most innovative companies – especially those creating interactive content – to capture a significant share of the global market, which should boom over the next decade.

Source: Paul Budde Communication Pty Ltd, 2012, Digital Media – E-Education and E-Learning Insights

Obviously, equipment and infrastructure are a prerequisite to enacting any large-scale ICT in education plan: the presence of high-speed broadband infrastructure and the prevalence of student-owned devices allowed the Republic of Korea to implement its digital textbook policy relatively quickly. Once these elements are in place, policies aimed at fostering the use of technology in education should focus on activities in the following areas: training teachers in the use of ICT; developing education portals and digital content, particularly Open Educational Resources; creating support networks for educators to communicate and share resources and experiences; improving education system management; and evaluating and monitoring the effectiveness of ICT in education programmes.

Teacher training

According to available research, the cost of broadband and ICT is getting lower and lower every year, making broadband a cost-effective investment for education. Anytime, anywhere access to teaching and learning, thanks to the proliferation of mobile technology (e.g. low-cost laptops, tablets, e-readers and smartphones), has revolutionized the delivery of education that was previously confined to physical schools. However, without proper training on how to use these technologies, teachers will not be able to effectively employ them to improve student performance, nor will they be able to teach students to use ICT and navigate the digital world. The lessons learned from mobile learning deployments around the world show that teacher preparation and motivation to use this technology are essential for ensuring long-term sustainability and benefits for students. Both intense technical and pedagogical training prior to the implementation of ICT in education and ongoing training and support are crucial factors for success (Näslund-Hadley et al., 2009).

In addition to helping educators teach more effectively, new technologies and broadband internet can also be used to deliver teacher training. Teachers are central to achieving MDG and EFA targets by 2015 and beyond. According to the UNESCO Institute for Statistics, 1.7 million additional teachers are needed to deliver UPE by 2015. The global teacher crisis is compounded by a lack of well-trained teachers and poor teacher training, especially in rural or remote areas. Broadband has the potential to give teachers access to high-quality teaching resources and collaborative professional development online.

Several internationally recognized benchmarks have been set to help countries struggling to meet EFA and education-related MDG targets improve the quality of teacher training on a large scale. The UNESCO ICT Competency Framework for Teachers (ICT-CFT) (2011), developed by UNESCO and several partners, is intended to inform educational policy-makers, teacher educators, providers of professional development and working teachers on how to help students and teachers utilize technology effectively and develop ICT skills enabling them to live and work successfully in the twenty-first century.

The UNESCO ICT-CFT has served as a conceptual reference for the development of national ICT teacher competency frameworks in countries such as Guyana, Nigeria and Tanzania. In Guyana, the UNESCO ICT-CFT was initially used to spread awareness about the potential role of ICT in education. Subsequently it formed part of the curriculum review process and significantly shaped the development of national educational materials. In Tanzania and Nigeria, the Teacher Development for the 21st Century (TDEV21) Pilot project was established to help the governments contextualize the UNESCO ICT-CFT and establish a national competency framework for pre-service and in-service teachers. As a result, drafts of localized ICT competency standards for teachers have been developed in these two countries.

Digital content, OERs and education portals

Broadband internet has accelerated access to high-quality digital learning and teaching resources. Perhaps the most extraordinary advancement that broadband has enabled over the last ten years is the rise of Open Educational Resources, a term that was first adopted at UNESCO's 2002 Forum on the Impact of Open Courseware for Higher Education in Developing Countries. OERs are teaching, learning or research materials that are in the public domain or released with an intellectual property license that allows for free use, adaptation and redistribution. Open sharing and collaboration offer real potential for enhancing both learning and teaching, and for closing the knowledge divide between countries.

The OER projects of the last decade have made thousands of high-quality educational resources available to teachers, students, professionals and self-learners around the world. Although much of the existing material is designed for higher education and in English, the numbers of K–12 resources and non-English materials are increasing. Several major initiatives have been launched to strengthen capacity-building in developing countries for the effective use of OERs. One of the most successful of these initiatives is the Teacher Education in Sub-Saharan Africa (TESSA) project, a research and development initiative that creates OERs and provides course-design guidance for teachers and teacher educators working in Sub-Saharan African countries. TESSA has produced a large bank of materials directly aimed at enhancing and improving access to, and the quality of, local school-based education and training for teachers. These materials (including audio files and other media) are modular in format. They focus on classroom practice in the key areas of literacy, numeracy, science, social studies and the arts, and life skills. All the materials are available through a dedicated website in a variety of different formats and languages (TESSA, n.d.). It is estimated that by 2010 more than 400,000 teachers in 19 teacher education programmes had benefitted from their engagement with TESSA (TESSA, 2012).

The OER movement is gaining traction worldwide, and an increasing number of countries are trying to incorporate OERs into their education policy agendas. A survey of governments' OER policies conducted by the Commonwealth of Learning (COL) and UNESCO found that 40% of governments surveyed want to design dedicated governmental action plans related to OERs, 38% intend to explicitly encourage initiatives in this field, and 29% plan to introduce subsidy programmes or project funding to stimulate OER activity (COL/UNESCO, 2012). In June 2012, UNESCO organized the first World Open Educational Resources Congress, with the goal of forging new partnerships for sharing digital content, implementing OERs into national education policy and catalysing improvements in education across the globe. The Congress adopted the 2012 Paris OER Declaration, which calls on governments to foster OER awareness and use, and to develop policies and strategies directly related to OERs (UNESCO, 2012a).

It is also increasingly important to design digital educational content, platforms and applications optimized for mobile access. With around three-quarters of the world's inhabitants now having access to a mobile phone (World Bank, 2012), the ability to connect to OERs and participatory learning through such devices would enable the widest possible access to quality digitized applications, tools and resources.

Many countries have already implemented large-scale initiatives to promote digital content development, OERs, and educational platforms and applications. Canada's GrassRoots Program, for example, has helped both students and teachers become highly qualified users of technology and created networks for cooperative projects between different classrooms and schools. Significant progress has also been made in Latin America. Both Argentina and Chile have created large education portals – Educar and Educarchile, respectively – which are funded in large part by entrepreneurs. These websites offer a vast range of learning resources both for students and teachers (Educar, n.d.; Educarchile, n.d.). Colombia's Colombia Aprende network is one of the most comprehensive education portals in Latin America, offering its users services such as email, a virtual hard disk, discussion forums and interactive real-time chatting (Colombia Aprende, n.d.). All of these websites offer their educational services free of charge. Even countries with lower economic development levels have educational websites, such as the Dominican Republic's Educando portal, which allows teachers, students and school principals to start their own blogs (Educando, n.d.). Other pedagogical resources and links to regionally relevant digital tools can be found on the educational websites of the Organization of American States and the Organization of Ibero-American States (OAS, n.d.; OEI, n.d.).

A good example of a robust educational network in Latin America is the Red Latinoamericana de Portales Educativos (Latin American Network of Education Portals, RELPE), established in August 2004 according to an agreement reached between the Ministers of Education of sixteen countries at a meeting in Santiago, Chile. This network, whose main goal is the free exchange of educational resources among member countries, is made up of autonomous national, public and free websites developed by each of the participating states. Every country designs its own website according to its particular education agenda and national interests. The technological platform and digital content is unique to each country but is freely accessible to all of the other member states.

Teacher support networks

In addition to creating and expanding portals for students to access educational content and applications, it is equally important for governments to promote educational networks for teachers to share resources, knowledge and experiences. Although these types of networks vary widely in scope and approach, they exist in some form in all countries. The networks are financed and supported by governments, educational organizations, or, increasingly, by teachers themselves, and a growing number of them span countries and regions to create international links between educators. This phenomenon is particularly pronounced in Europe, where international organizations such as the European Commission have already contributed large quantities of resources to facilitate international cooperation in education, and political programmes tend to emphasize the importance of collaboration between countries to improve the quality of teaching and learning throughout the region. Each country has its own agenda for developing teacher support networks. Finland, Germany and Sweden, for example, are currently focusing on the development of networks for sharing educational content and pedagogical knowledge. Austria, Belgium and Italy are working on interconnecting their networks through European initiatives, while Denmark, Greece and Spain are still in the process of building their own national networks.

System planning and management

As in any other sector, technology and connectivity can play a major role in improving system-level processes, particularly activities related to planning, monitoring and management. Even in poor areas, technology-enabled solutions can significantly increase the efficiency of education systems, as the examples from Ghana and Nigeria below demonstrate.

Using technology for education sector spatial planning: Case study from Nigeria and Ghana

It is standard practice in education to consult a map of the district showing roads and schools prior to conducting any kind of education planning exercise. The typical questions asked by an education planner are as follows: What is the distribution of the schools? Do all communities have schools or are there remote communities that do not have access to primary schools? Is there a functional water point near the school? This type of data could also be represented in a spreadsheet, rather than a map, but a spreadsheet for each school will not give planners a sense of the needs or coverage of the district. Maps are helpful to see the coverage of school facilities, while spreadsheets can supplement maps with data about the magnitude of the needs in each area or school. Maps are also helpful to clearly outline the boundaries of the district, so that government education administrators at the local level have a sense of the number and locations of schools that fall under their jurisdiction. However complications arise when new schools or roads are built, or sometimes when the district itself needs to be divided. In these cases, all maps suddenly become redundant and new maps must be created to reflect the updated information. This exercise is generally done manually, which requires personnel time and cost to travel throughout the district and mark each school on the new map. This might take days depending on the size and population of the district.

The Earth Institute at Columbia University is making spatial planning for education much more convenient and effective through the use of cutting-edge technology. Recently, the Earth Institute, in conjunction with Modi Labs at Columbia University, conducted a nationwide data collection exercise in Nigeria in which all schools, water points and health centres were geo-referenced. An Android-based data collection platform was used to conduct 'real-time' surveys which included geo-referencing of schools. A similar method of school geo-referencing was replicated in the Millennium Villages Project site in Bolgatanga, Ghana. The maps generated using the geo-points of schools can be updated within minutes. Android phones are used to take a photograph of the school and record the geo-points. Updating the maps electronically using the geo-points, rather than creating new paper-based maps, significantly reduces the manual labour required to update maps. The electronic maps also have the added advantage of situating the schools within population clusters and defining the infrastructure needs accordingly. Similar strategies could be used to track whether or not the funds sanctioned for the construction of a new school at a particular site ever reached fruition. Tracking the status of a sanctioned school and its construction is now possible within a few minutes. The maps are also useful as a reference point for any planning exercise, especially when it involves multiple stakeholders. For instance, the Water Ministry may need to get an updated list of schools to check if each school has a borehole; the State Teacher Training Institute may want to conduct trainings on two separate days and invite teachers on different days depending on their proximity to the training site; or the National Education Planning and Administration division might want to get a sense of the need for new schools based on the distribution of schools rather than just anecdotes. In each of these cases, the stakeholders involved could refer to the maps to quickly locate the data they need.

This type of technology could help make the education planning process more effective and serve as a platform for engaging different stakeholders at the local level. Low-cost technology that can be used to aid large-scale local-level planning processes will lead to real-time data collection matched with real-time data use.

Source: Education Sector, Millennium Villages Project / Modi Research Group Earth Institute, Columbia University

Nigeria: Use of technology for developing data systems on a large scale

Nigeria recently made history by launching one of the world's largest poverty elimination campaigns aimed at achieving the Millennium Development Goals by 2015. The Nigerian government collaborated with the Earth Institute at Columbia University to develop a web-based, real-time performance/project tracking system to aid in informed decision-making at the local level. Cutting edge technology on data-gathering and display was used for large-scale planning and budgeting to address locally identified educational gaps. This integration of technology and education is an example of the efficient use of real-time data by planners and administrators at the local level to facilitate data-driven budgeting, planning and implementation.

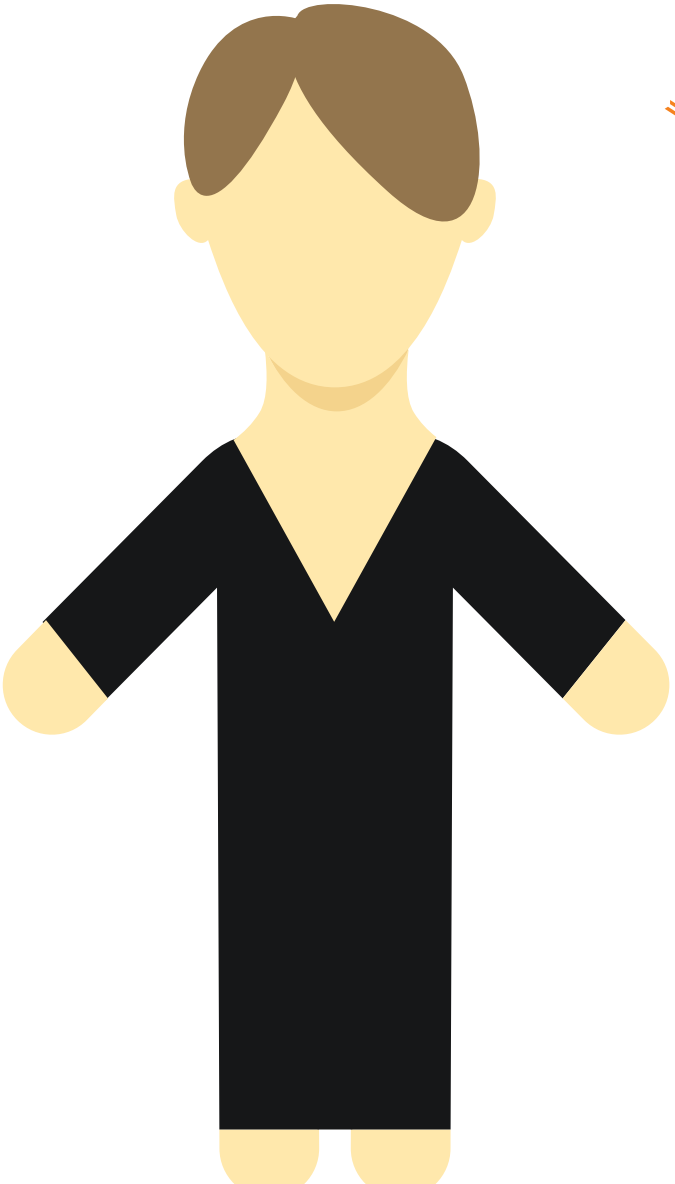
Data were gathered through an extensive baseline survey of all education facilities in the country, beginning with a subset of 113 local government areas (LGAs) and later expanded to the remaining 661 LGAs in Nigeria. Detailed questions at the school level were compiled into a baseline education survey, including specific queries as to each school's physical condition, infrastructure, proximity to the catchment area, teachers, and availability of teaching tools and books at each school. These surveys were then programmed into Android phones for data collection, which made it possible to link all data to specific GPS coordinates to enable school mapping and performance across each local government. Using smartphones to automate the data collection process, when compared to the traditional use of paper-based surveys, conferred several advantages, the most salient of which was efficiency. By automating the process, the usually time-intensive step of data entry was entirely eliminated; data entry was completed at the time of the survey with built-in skip patterns and checks to ensure higher data quality at the time of entry.

The data, once cleaned for errors and outliers and analysed in the form of indicators, were then displayed in a web-based platform created by a group of engineers at Modi Labs at Columbia University. The Nigerian MDG Information System (NMIS) is built with the capacity for real-time data entry via web-based platforms or mobile phones, geo-referencing of facilities with the ability to visualize dynamic status updates, and a logic-based display interface that allows for rapid progress assessments and the triggering of alerts for potential problems. NMIS supports the spatial display of school locations as well as the identification of LGA and facility level gaps, such as a shortage of desks, inadequate infrastructure, or a lack of qualified teachers at a particular school. NMIS allows users to quickly access MDG-related status and performance indicators at the LGA and facility level, as well as aggregate indicators at the national level (using national level data) or LGA level (using facility inventory data).

Source: Education Sector, Millennium Villages Project / Modi Research Group Earth Institute, Columbia University

Evaluation and monitoring

As educators and policy-makers explore new and innovative ways to use technology in education, empirical data must be gathered regarding the efficacy of different approaches and strategies. Specifically, there is a need for research on new pedagogical models that involve technology and the conditions under which teachers and students are motivated to adopt technology for teaching and learning. Other issues in need of investigation include the actual value of virtual environments vis-à-vis face-to-face instruction, and how technology can assist in the development of new methods of assessment. Overall, educational policies related to ICT, and broadband in particular, should be closely monitored and evaluated throughout the planning and implementation process to determine the most effective and cost-efficient strategies for improving teaching, learning and education system management.




6
LOOKING AHEAD

Broadband is a key factor for socio-economic development. As the examples in this report aim to demonstrate, the urgent education needs and challenges faced by most developing countries cannot be solved without addressing the broad policy issues related to accessible and affordable technology and broadband connectivity. There can be no education for all without inclusive broadband for all.

With two years to go until the 2015 deadline, the world is still not on track to achieve EFA goals. Global inequality in learning outcomes remains stark. Faster progress is needed in raising adult literacy levels, improving the quality of education and making equity a measure of educational goals at all levels (UNESCO, 2012b). As the present challenges in some countries, particularly developing ones, will persist beyond 2015, priority action should gradually shift from increasing educational access and participation to improving the quality of education for all members of society. To help achieve this goal, the Broadband Commission Working Group on Education is putting forward the following recommendations for governments and all stakeholders concerned with education:

1. Increase access to technology and broadband

Policy-makers should continue efforts to implement cross-sectoral policies ensuring affordable and equitable access to technology and broadband connectivity for all citizens, particularly women and girls and marginalized groups.

2. Incorporate technology and broadband into job training and continuing education

Given the rapid pace of technological change and the pressing need to address socio-economic challenges such as high unemployment among youth, governments should provide the necessary financial incentives to support technology and high-speed broadband adoption in all activities designed to create new jobs and open up prospects for lifelong training and employability in the emerging knowledge society.

3. Teach ICT skills and digital literacy to all educators and learners

Governments should prioritize the redesign of education systems in their national education agendas so as to better respond to the challenges of the ongoing digital revolution. Empowering teachers and students to use technology is central to improving education and the assessment of learning.

4. Promote mobile learning and OERs

Policy-makers should introduce policies and incentives promoting the development of OERs and encouraging the wide-scale use of mobile technology at all levels and in all forms of education, thereby facilitating access to quality learning and teaching resources.

5. Support the development of content adapted to local contexts and languages

Governments and organizations should invest in an ecosystem, not just in technology, by supporting online educational applications and services with local content and in local languages.

6. Work to bridge the technological divide between countries

Policy-makers should continue efforts to bridge the digital and knowledge divides between developed and developing countries by promoting international collaboration and partnerships.

There is no doubt that broadband is a great education enabler and that the future of education at all levels and in all forms is inextricably linked to the benefits offered by affordable high-speed connectivity. The fact that a number of developing countries are not on track to achieve their internationally agreed goals in education by 2015 shows that more efforts than initially anticipated will have to be deployed by all stakeholders involved – international organizations, governments, education authorities, IT providers, telecommunications operators, civil society and the private sector. We sincerely hope that the examples provided in this report will encourage more and more developing countries to enact comprehensive plans and initiatives that leverage the potential of broadband to promote lifelong learning and achieve high-quality and inclusive education for all.

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8

APPENDIX

CASE STUDY 1: THE DIGITAL SCHOOL PROJECT (SERBIA)

The Digital School Project is the largest national project in the Republic of Serbia to have comprehensively supported digital inclusion in education by equipping all elementary schools with computer labs. This project also provided a basis for strengthening the overall digital literacy of elementary-school students, as well as their teachers, through learning and competition. Additionally, a solid foundation was created for these students to safely and effectively use ICTs in their work, studies, extracurricular activities and free time.

The project's objective was to raise the e-skill set of the students and teachers in primary schools. The aim was to make education in primary schools more accessible, innovative, creative and fun, and to foster a more inclusive education system for all. The underlying goal was to raise the quality of the elementary-school curriculum and enhance student performance in order to improve the employment prospects of future generations of Serbian youth, locally, regionally and globally. The project to date has cost over 15 million euros and has consisted of four key components: (1) establishing computer labs, (2) producing digital educational content, (3) enhancing online safety, and (4) ensuring sustainability.

1. Establishing computer labs

The establishment of computer labs, the first and key component, was the most complex and resource-intensive portion of the project. The project aimed to provide an integrated hardware and software platform for all elementary schools in the country. Specifically, the project planned to equip all 2,910 elementary schools in Serbia with modern ICT equipment and secure a digital lab to be used during class. To date, 1,589 large schools have been equipped with modern computer labs (5 to 30 seats), while 1,321 small schools in rural areas (with less than 40 students per school) received a laptop and a projector. This project component also included support for the installation of needed infrastructure for each school (LAN and electricity installations in classrooms) as well as basic training for teachers managing the digital lab equipment. This component was carried out over two periods, in November 2010 and December 2011, during which time the project solicited applications from schools.

2. Producing digital educational content

For the second component, a competition for teachers called 'Digital Class' was designed to encourage the use of the computer labs by all teachers in primary schools, no matter what subjects they teach. The project gave out a number of cash prizes, and all participants received certificates. In 2010 and 2011 there were two calls for teachers to submit the e-materials they used to teach their subjects. To date teachers have submitted approximately 500 e-materials. All of the materials that met the criteria now comprise an e-knowledge database, available to all teachers to use as-is or adapt to the specific needs of their classes and students.

3. Enhancing online safety

The third component was implemented in parallel to the first two phases and is still ongoing. Called 'Click Safely', it focuses on educating students, teachers and parents about online safety through a nationwide promotional campaign of round-table discussions, panels, numerous specially designed educational materials, televised promotional videos and a national school competition. The project's goal was to ease the anxiety that many parents and teachers felt, especially in rural areas, about the use of technology in school, and to educate children on the basics of online safety. The Click Safely website has separate pages for children, teachers and parents. In addition to information the children's page also contains games and an online quiz. Whenever activated, the quiz generates a unique set of questions from the question database and randomizes the order of answers to choose from. In addition to being available online to anyone interested in taking it, the quiz was also the basis for a very popular national school competition. Schools registered for the competition, and every month the school with the best average quiz score would win a laptop and a projector. The quiz was widely used in IT classes when teachers introduced online safety topics.

4. Ensuring sustainability

The fourth component involved follow-up activities to ensure project sustainability. It consisted of annual supervisory visits to each digital lab and interviews with the teachers using them over a three-year period. The project also provided operating system upgrades and additional trainings for teachers.

Conclusions

Managed and financed by the Ministry of Telecommunications and Information Society, in close partnership with local governments and schools, this project has substantially contributed to enhancing the information society in the Republic of Serbia by increasing the digital literacy of primary education teachers and students, reducing technology fear and anxiety among first-time ICT users, facilitating inclusive education and innovative approaches to teaching, reducing the rural-urban digital literacy gap (currently 11.4% versus 38.9% respectively, with a computer-use rate of 38.3% versus 58.7%), as well as educating all members of society about online safety.

The impact of the project was greater than expected because the official promotional campaign was supplemented by an unofficial, word-of-mouth campaign via electronic media (especially on Twitter and Facebook), mainly led by school staff who were active on social media and shared their positive experiences teaching with the programme's new equipment and materials.

The initiators of the project believe that it can be easily scaled or replicated for use in any national, regional or local setting and would be an ideal model for an initiative focusing on e-inclusion infrastructure in schools at all levels of education.

References

All content from the project is available online in the Serbian language. The Digital School public call documents are available at:

- www.digitalnaskola.rs/javni_poziv.html

Many details of the project are also described on the website above. The documents relating to the last call for the Digital Class contest are available at the bottom of the following page:

- www.digitalnaskola.rs/konkurs/dc2/zbornik/brojPrijavaPoPredmetuIRazredu/

This page includes detailed requirements and selection criteria. Any interested parties are free to use these criteria for similar initiatives.

All content relating to the Click Safely campaign is available on the campaign's website:

- www.kliknibezbedno.rs

Again, this information can be shared with all interested parties. All documents are in the Serbian language, so translation may be necessary.

To promote the project, the following website was created with an interactive clickable map which shows progress reports on the installation of each digital lab (the colour of map changes with the percentage of project completion), as well as data on the calls for schools to apply for lab upgrades, rules and information on how to use the labs, calls for teachers for the Digital Class competition, photos of all digital labs, and other useful information:

- www.digitalnaskola.rs

A promotional campaign consisted of numerous informational advertisements on national and local TV and radio stations, as well as printed and internet media. This campaign was complemented by the promotion of all project activities through posts on the project's Facebook page and Twitter feed:

- www.facebook.com/DigitalnaAgenda
- www.twitter.com/DigitalnaAgenda

Further promotional materials specifically focused on internet security issues covered in the Click Safely campaign, including the Click Safely promotional TV video, can be found here:

- www.kliknibezbedno.rs

CASE STUDY 2: THE IMPACT OF BROADBAND AND ICT IMPLEMENTATION IN EDUCATION (PORTUGAL, ARGENTINA, TURKEY AND NIGERIA)

The objective of this multi-country case study is to showcase recent research in the education sector regarding the influence of broadband and ICT on education in Portugal; San Luis, Argentina; Kocaeli municipality in Turkey; and Nigeria. The research was conducted by local university researchers aiming to understand the impact of technology on education.

Portugal

In Portugal, the modernization of the Portuguese education system has been a priority on the political agenda since Portugal joined the European Union in 1986. The Ministry of Education and the Ministry of Public Works, Transportation, and Communications led the planning and execution of the Plano Tecnológico de Educação (PTE), the country's comprehensive national ICT plan for education, published in 2007. The PTE was intended to help Portugal become one of the five most advanced European countries in terms of technological modernization in schools. The e.Escolinha programme, which aims to equip all Portuguese students with a computer and internet access, is just one of five e-learning programmes being implemented as part of the PTE. The other four programmes are intended to expand ICT access for students and adults, increase mobile internet connections, promote computer literacy, and improve digital skills. The initial financing for the e.Escolinha programme and all of the PTE's technology integration programmes came from the government's sale of 3G mobile licenses through a spectrum auction, which raised €460 million. Part of the e.Escolinha programme is the Magellan project, one of the largest 1:1 e-learning initiatives in Europe, which enabled nearly every student in Grades 1–4 to purchase and own a laptop, with broadband internet access provided to schools and, optionally, to families. The parents bought the devices at a cost of €0, €25 or €50 depending on their income. From 2008 to 2011, more than 700,000 Magellan personal computers (PCs) were delivered to families across Portugal. The students owned the 'Magalhaes' and brought them back and forth to school, allowing access to technology not only at school but at home. The ability to take the PCs home had a very positive social effect by promoting digital literacy as well as increasing social mobility for students and their parents.

San Luis, Argentina

The province of San Luis, Argentina, had an ambitious goal of providing digital literacy and equal access to all its citizens. To meet this objective, the province built an 'Information Highway' (IH), planned a fibre-optic network and established twenty radio links to provide broadband internet and IP telephony to every town with a population of twenty or more residents. In 2003 San Luis inaugurated the centrepiece of the IH, its data centre and primary network. Wi-Fi connectivity is now ubiquitous and free in the province. La Punta University, headed by university president Alicia Bañuelos, took the lead in guiding, coordinating and executing implementation of the Digital Agenda. As part of San Luis's digital inclusion plan, the All Kids Online Initiative established 1:1 e-learning, delivering one Classmate PC with educational support software to each child between the ages of 6 and 12. The results were very promising. Within one quarter, the implementation of the All Kids Online project had managed to improve learning in language arts and mathematics by an average of 10%, according to evaluations performed by Argentina's Centro Interdisciplinario para el Estudio de Políticas Públicas (Interdisciplinary Centre for Public Policy Studies, CIEPP).

Kocaeli, Turkey

In Turkey the nationwide Movement to Increase Opportunities and Technology (FATİH) Project, sponsored by the Ministry of Education and the Ministry of Transportation, has teamed up with Türk Telekom and several local companies to provide technology in classrooms. Through this project, 42,000 schools and 620,000 classes will be equipped with the latest information technologies, eventually reaching 17 million students and approximately 1 million teachers and administrators. Fifty-five per cent of the funds for the FATİH project come from Universal Service Funds (USFs); the total project costs are approximately USD8 billion.

The project began in the Kocaeli municipality of Turkey, which served as a model for subsequent deployments throughout Turkey. Now in its fourth year, the initiative has led to the distribution of 81,000 Classmate PCs that have helped students and their families develop the ICT literacy and skills necessary to prosper in an increasingly technology-dependent economy. This project was one of the first implementations of 1:1 e-learning in Turkey. Students bring the computers home, which has led to an increase in DSL (digital subscriber line) subscriptions. According to Türk Telekom's figures, Kocaeli now has the highest rate of home DSL connections of any city in the country. A study conducted by the Education Technology department found that 82% of students reported their siblings used the computers, 55% reported their fathers used the computers and 33% reported their mothers used the computers.

Nigeria

In Nigeria, funding (USD 100,000 for each school) and support from the Universal Service Provision Fund (USPF) was used for Intel Learning Series Solution (Intel LS) deployments in over 1,000 schools from 2008 to date. One of the mandates for the USPF was to promote the connection of government schools, libraries and institutions across the nation to broadband internet for underserved and rural areas. Because the 1:1 e-learning environment, which is the underlying framework for Intel LS, was not possible in these schools – where often only 100 computers are available for 500–800 students – it is currently being implemented in a lab environment. Students use the computers for specific subjects such as science and English and go to the computer room for these subjects a few times per week.

This model, although limited, has already produced some encouraging results. Teachers report that there has been an increase in attendance, so students are spending more time in school. They are collaborating more via technology, thereby learning and using twenty-first century skills. The schools sampled also saw tremendous gains in students' performance in biology, with the pass rate increasing from 26% to 90% between 2008 and 2011. These are great strides for the Nigerian education system given the poor state of infrastructure throughout the country, specifically the absence of stable electricity supply and affordable internet access. Internet costs are daunting, with 1 MB (megabyte) of bandwidth costing between USD3,500 and USD4,000 per month.

Conclusions

These examples from Portugal, Argentina, Turkey and Nigeria provide several lessons for stakeholders considering e-learning initiatives. A robust education and technology plan, strong infrastructure, high-speed connectivity, sustainable education programmes and locally relevant content have the potential to deliver sustainable social and economic gains for communities and ensure equal access for all.

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CASE STUDY 3: THE INTEL TEACH PROGRAM (GLOBAL)

Why education reform? Why now?

The education of a nation's citizens directly impacts a region's economic competitiveness and its residents' quality of life. Today, a nation's most important natural resource is the intellectual capacity of its citizenry – a natural resource that can be developed over time through education. More than ever, a good education matters. Today's student lives in a vastly different world from prior decades, a world unprecedented in its complexity, rate of change, social networking and democratization of power. To navigate it successfully, students need to be independent, critical and creative thinkers, confident in their ability to adapt, solve problems, communicate and work collaboratively in teams. Preparing today's students calls for learning experiences that are different from those of yesterday, which in turn requires preparing teachers to deliver those experiences.

Intel® Teach

Research indicates a causal link between a school system's engagement of K–12 students in complex, intellectually stimulating learning and a country or region's higher economic viability. The Intel® Teach professional development programme paves the way for such education reforms.

Intel Teach helps teachers redesign their classrooms to meet new educational challenges. The programme focuses on classroom practices that advance K–12 students' critical thinking, problem-solving and collaboration skills using today's technologies. These are the key twenty-first century skills required if students are to thrive in the innovative, networked society in which they live.

Teachers are the professionals who breathe life into their school district's vision for twenty-first century learning. Research confirms that the quality of the teacher is the single largest influence on student achievement. The success of any change in a school or district depends on the effectiveness of the teachers in redesigning curriculum, instruction and assessment. A decade ago Intel designed its Intel Teach programme with this in mind.

Today, Intel Teach comprises a series of professional development courses designed to build the capacity of teachers to use technology effectively to advance their students' learning.

Intel works with ministries and state departments of education worldwide to support the individual educational goals of countries. Intel Teach has reached over ten million educators in ten years in seventy countries around the world.

Evidence of impact

With a decade of proven results, Intel Teach has positively impacted K–12 classrooms worldwide. The goals for the programme are to integrate technology into teachers' lessons and to promote problem-solving, critical thinking and collaboration among students in those integrated classrooms. Over the last decade Intel has commissioned objective, third-party evaluations of Intel Teach to assess the degree to which the goals of the programme are being attained.

Based on surveys from 13 countries, participants indicated that 93.9% of the teachers who take the Intel Teach Essentials Course report meeting at least one of the programme's success indicators.

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CASE STUDY 4: LITERACY PROMOTION THROUGH MOBILE PHONES (PAKISTAN)

Context

This project, based on a proposal by the Islamabad Polytechnic Institute for Women, has been implemented by UNESCO and Mobilink Pakistan together with the Bunyad Foundation. It is monitored by the Federal and Provincial Ministries of Education, the Ministry of IT and Telecom, and the boards of technical education. The aim of the project is to address the low literacy rate of rural females.

Target audiences

The project focuses particularly on gender equity, with the goal of increasing literacy rates of rural females through the use of mobile phones. The reasons for using mobile phones to promote the literacy education of women and girls are as follows:

• The total number of mobile phone users in Pakistan surpassed 99 million in 2010.

• It is possible to use mobile phones for learning anytime and anywhere.

• The use of mobile phones is fun and habitual even for rural females.

• New approaches to literacy education tend to increase learners' enthusiasm.

• SMS is a short, simple and interesting format for illiterate and newly literate people.

• The programme duration is short (only 5 months), allowing costs to remain low.

The mobile solution

First, a cheap mobile phone is procured by the project. A SIM card is also procured, with pre-paid service fees for SMS messages during the period of the project. The content developer, managed by the UNESCO Islamabad Office, sends the mobile learning content to the local project implementation agencies through the Nokia Education Delivery (NED) application. Memory cards with learning content are provided to the local project implementation agencies and distributed to each of the target participants, together with mobile phones and SIM cards. The main content developed includes more than 800 SMS messages over the course of the 5-month project (6 to 8 messages per day delivered 3 times per day on 20 topics concerning life skills).

Main stages

• **Months 1 and 2:** Participants take a basic literacy course and receive a reading and writing primer (textbook). Mobile phones are handed out at the end of the second month and training on using the phones is provided.

- **Month 3:** In the first half of the month, participants begin to receive SMS messages. In the second half of the month, participants also write in a notebook and read aloud, listen to teachers via mobile phones, and compose sentences.
- **Months 4 and 5:** Participants reply to SMS messages and answer questions.

Monthly exams and a final exam are administered throughout the process.

Cost per participant in USD

Mobile phone	**$33**
SIM card	**$2**
Stationery (primers, notebook, etc.)	**$4**
800 messages sent over 4 months	**$7.2**
Reply messages by the learner	**$4.8**
Hiring a teacher for 5 months	**$4.7**
Total	**$55.7**

Impact of the project

- Literacy skills were retained at a much higher rate after the initial literacy class.
- The literate women are able to better manage their lives, form support groups, take leadership roles and improve their own quality of life and of that their children (for example, they are more likely to send their daughters to school).
- Literate women are better equipped to self-advocate on health issues such as maternity care and immunization.
- Literate women gain earning capacity to enable them to contribute to their family's income and plan for the future.

Lessons learned

About 50% of learners and their family members initially held negative attitudes towards the project, and it is clear that great efforts in social mobilization are needed to break through the cultural and religious barriers preventing women from freely accessing technology.

The participating females reported that they were worried about phone calls from strangers, which highlights the importance of protecting women's safety when using mobile phones.

The limitations of the SMS format require the innovative design of mobile learning content. Mobile learning content and the supporting mobile solutions should also be adapted to local languages and cultural contexts.

CASE STUDY 5:
CONNECT TO LEARN (GLOBAL)

Connect To Learn, a global education initiative

Connect To Learn (CTL), a partnership founded by the Earth Institute, Ericsson and Millennium Promise in late 2010, harnesses the transformative solutions of the ICT industry to address global educational issues through the building of powerful public–private partnerships. The initiative aims to help extend twenty-first century secondary schooling to everyone through the strategic implementation of mobile broadband technologies that provide access to teaching and learning resources in schools. CTL targets underserved segments of the population with a special emphasis on girls, due to the extraordinary challenges they face to stay in school globally and in particular in rural areas.

CTL tackles the global issue of universal access to secondary education, using mobile broadband technology and cloud-computing as the key building blocks to enable this access. To bring a twenty-first century education to all students everywhere requires a new way of thinking and new partnership models. A key innovation of the CTL initiative is the partnership that has been forged between the ICT industry, academia, non-governmental organizations (NGOs) and international organizations.

Until recently the telecommunications sector has not played a significant role in global ICT deployments in education. But for many schools around the world, the only viable connection to the internet is via mobile broadband networks. CTL draws on the technical and business skills and global reach of Ericsson and its business partners, guided and shaped by the development and scientific expertise of Millennium Promise and the Earth Institute, to create an innovative cloud-based ICT solution for schools.

The CTL solution for schools is designed as a scalable, telecom-grade solution that uses mobile communications networks to reach schools in emerging markets. The solution can be applied anywhere with network coverage and cloud services that have been optimized to run on low bandwidth. The solution is designed as a service for teachers and students who have little or no technical competence. The service removes the complexities of virus protection, software updates, application installation and maintenance, by moving them away from teachers and students to servers in the cloud. The service, including client hardware, is remotely managed end-to-end by experts. With the right support, offering such a model for schools will help remove one of the main barriers to scaling up ICT solutions for schools, namely the competence barrier.

The majority of the ICT industry focuses on schools that are already technology-driven, located in developed countries with fixed broadband access to the internet. In contrast, CTL's solution increases access to technology for schools that want and need internet and computers and helps address the typically low competence threshold. The aim is to maximize the quality of education through teaching and learning practices that integrate ICT with minimal effort, in order to leapfrog the usual heavy personal involvement in the technology cycle itself.

To date the initiative has been deployed in schools in Ghana, Tanzania, Kenya, Uganda, Senegal, Chile, Brazil, South Sudan, Djibouti, India and Malawi, covering over 10,000 students and their teachers.

Ongoing teacher professional development is key

As observed in many of the African contexts where CTL operates, meeting the need for more competent, qualified teachers is among the greatest challenges for education systems in Africa, particularly with regard to the integration of ICT (Olakulehin, 2007). In a study of secondary-school teachers in Nigeria, it was found that even if a school has the necessary computer hardware and connectivity, teachers' lack of ICT skills and knowledge, combined with a lack of technical support at the schools, serve as the major barriers to integrating ICT into teaching practices (Tella et al., 2007).

In order to address these challenges, CTL provides a comprehensive package that includes the initial classroom resources of 10–50 netbook computers and connectivity in each school; the critical component of teacher training and professional development support; a basic set of starter software (e.g. LibreOffice,

the internet browser Firefox, Skype, a calculator, Thunderbird email, etc.); and pre-installed links to web-based resources (e.g. Wikipedia, Khan Academy, Discovery Education Teacher Resources, etc.), all aimed at helping teachers at CTL schools improve teaching and learning outcomes. CTL's professional development support for teachers works to maximize educator uptake of computer and cloud-based solutions through the expansion of teachers' ICT skills and pedagogical breadth.

Millennium Villages Project Education Coordinators overseeing the implementation of CTL in six schools across Tanzania, Uganda, Ghana and Kenya report that teachers and students have shown much enthusiasm for the new resources over the initial twelve to eighteen months of implementation. For example, in Mbola, Tanzania, where forty laptops were provided to each of the two CTL schools, students participated in the School-To-School Connections programme with a classroom in Connecticut, USA, that helped improve students' English language skills. Teachers have also begun searching online for teaching materials and creating email accounts.

In Bonsaaso, Ghana, teachers at the two CTL schools participated in a pilot professional development series, developed and facilitated by CTL and Millennium Villages Project staff in collaboration with ICT-focused and other lead teachers at the schools. These sessions were designed based on the needs and interests of teachers as they described them through survey responses.

In Sauri, Kenya, teachers have recently begun participating in a series of workshops facilitated by CTL partners at the Millennium Villages Project and the University of Nairobi as part of the ICT in Education Impact Study. These workshops are based on survey responses from teachers regarding their challenges, needs and interests. Initial workshops have focused on practice exercises using LibreOffice Writer for lesson planning, and the integration of ICT into school management. Teachers have also begun using the computers to track student performance with LibreOffice Calc.

As mentioned above, one practical way that teachers are being supported in the use of their emerging ICT skills is through CTL's School-To-School Connections programme, which connects classrooms in CTL communities with classrooms in other countries to foster cross-cultural learning and cultivate global awareness. Activities undertaken to date between schools in Connecticut and Tanzania and in New York and Uganda have included a language exchange, the sharing of pictures from the students' neighbourhoods and schools, and an exchange of news headlines from each schools' local newspaper. CTL is exploring with teachers ways to expand this popular programme from classroom to classroom and to create important connections for girls in rural communities to other girls and role models in their communities and/or abroad.

CTL also provides ongoing support to teachers through an Online Resource Library. Currently in its initial phase, the website is being built as an interactive space where teachers can search for resources to enhance their teaching. Teachers will also be able to share their own resources and participate in discussions with other teachers through the website. CTL is working with African university and secondary-school partners on this project to identify locally relevant resources, resources on girls' leadership and life skills, and teacher training resources on issues such as ICT integration and gender sensitivity in teaching. This work will help CTL understand how best to support teachers in maximizing their use of the computers and cloud-based technologies provided by the programme. CTL will continue to optimize these resources for effective use and integration in the classroom, with the ultimate goal of improving learning outcomes through access to quality educational resources.

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CASE STUDY 6:
THE HARMONIZER PROGRAM (NORTHERN UGANDA)

The Harmonizer Program in Northern Uganda targets young people who are motivated to be pioneers in peace-building and agents of positive change within their communities. The programme educates youth in conflict resolution, leadership, community-building, and ICT and social media skills so that they can spearhead peace and development efforts.

The challenge

Northern Uganda has suffered a civil war for more than twenty-two years. The fight between the Government of Uganda and the Lord's Resistance Army (LRA) is among the longest running conflicts in Africa. This chronic instability has caused a dramatic surge in internally displaced persons, with 1.6 to 2 million people uprooted from their homes, and has produced countless orphans and refugees. The conflict has also created tens of thousands of child soldiers, who have been abducted and forced to serve in militias. Among the many uphill challenges that these youth face are being ostracized from their communities as well as lacking access to education and resources. The conflict has also created a technology gap in the region, causing youth to be cut off from modern technologies such as computers and internet connectivity.

The response

The PeaceEarth Foundation (PEF) is an international NGO founded by Forest Whitaker, UNESCO Goodwill Ambassador for Peace and Reconciliation, which is dedicated to peace-building and community empowerment in areas of conflict everywhere. In response to the dire need for support and recovery among youth in Northern Uganda, in 2012 the PeaceEarth Foundation established the Harmonizer Program, a three-year programme that seeks to strengthen the leadership capacity of former child soldiers, orphans and youth impacted by conflict so that they can influence their peers and communities. These youth receive training in conflict resolution, leadership, peace and community-building skills including mediation, and ICT and social media skills. The programme aims to enable youth to engage in online community practices, developing skills which will be valuable in times of crisis, when they can access in real time tools to brainstorm, address and solve pressing issues and conflicts. In addition, they are trained and poised to improve their communities by taking positive action and tackling problems such as gender-based and domestic violence, high youth dropout rates, and health issues. The programme also includes long-term mentoring and skills development to bolster employment opportunities for these youth. These activities are complemented by microfunding initiatives that will build economic resources in the region.

Partners

- **Hope North**

Hope North is a 40-acre rehabilitation campus in Masindi, Northern Uganda, that is home to refugees, orphans and former child soldiers. In this safe and vibrant cultural setting, resident students rebuild their lives through education and vocational training, while celebrating their Acholi heritage.

- **Ericsson**

Ericsson brings the education initiative Connect To Learn to the Harmonizer Program. This collaborative effort between Ericsson, the Earth Institute at Columbia University, and Millennium Promise leverages the power of ICT to bring a high-quality education to students everywhere. Connect To Learn targets underserved segments of the population with a specific focus on girls and students living in rural areas.

- **UNESCO**

The United Nations Educational, Scientific and Cultural Organization (UNESCO) is a specialized agency of the United Nations with a mission to contribute to the building of peace, the eradication of poverty, sustainable development, and intercultural dialogue through education, the sciences, culture, communication and information.

Strategic goals

The Harmonizer Program of Northern Uganda has five primary goals:

1. To equip youth participants of the programme with communication and conflict-resolution skills, and an understanding of peace-building principles

2. To enable participants to become aware of their own environment and respond in emotionally and culturally sensitive ways as they engage in day-to-day activities

3. To create a personal space of security for participants, as individuals and as community members, within their environment

4. To offer mentoring and tools to aid in interpersonal engagement to promote conflict resolution in appropriate areas of reconciliation

5. To provide microfinance tools and support to promote vocational training and income generation

Achievements to date

The PeaceEarth Foundation has taken significant steps to accomplish the goals of the Harmonizer Program:

1. A PEF field office was established at Hope North with the recruitment of a Country Director and two Program Coordinators.

2. A computer centre was created at Hope North for the youth involved in the programme.

3. A pilot workshop was implemented at Hope North in December 2012 with 30 youth (13 female, 17 male) between the ages of 15 and 22.

4. The following training components were delivered:

- Introduction to Conflict
- Introduction to Information and Communication Technology (ICT)
- Meditation and Breathing Techniques
- Underlying Needs
- Social Media, E-mail, and PeaceEarth's Online Community
- Creation of Action Plans

At the end of the workshop, the youth were invited to establish a plan of action sharing their personal views and commitments on how to catalyse positive change in their communities. They brainstormed and agreed to work on a specific issue within their districts, and strategized how they could work side by side with local and grassroots organizations or community leaders to achieve their specific group objectives. As a whole they expressed eagerness to begin employing their new-found knowledge among their peers and in their respective communities, and to tackle problems in their communities ranging from preventing other youth from dropping out of school, lowering gender-based and domestic violence, encouraging activity rather than idleness among youth, and increasing education about sanitation.

Lessons learned

During the course of the workshops, it became apparent that the lack of access to computers and internet connectivity in Northern Uganda is a major obstacle to the continuation of communication between the youth and the programme partners. In order for the youth to communicate directly with one another and with PeaceEarth, they would face hours of travel from their hometowns to a computer centre. Furthermore, given the age of the youth, it is important for them to have constant support and mentoring as they implement their specific action plans. At this time, PeaceEarth is exploring options to provide internet connectivity to these youth so as to ease their travel burden. PeaceEarth is also exploring options to enhance the infrastructure and the premises of the PeaceEarth field office at Hope North by providing solar electricity as opposed to a generator to allow for continued and reliable power for the programme participants, Program Coordinators and Country Coordinator.

With regard to educational instruction, the programme participants gained the essential understandings of the core concepts in each of the workshop modules. However, the language barrier and lack of familiarity with computers and the internet did pose a challenge to some of the programme participants. For this reason, the participants will regularly receive ICT training from Ericsson throughout the year, and a computer centre has been established at Hope North for the programme participants based in districts close to Masindi. The Program Coordinators and Country Coordinator will maintain constant communication with the youth and provide them on-the-ground support and guidance as required. PeaceEarth Foundation will continue to monitor the progress of this programme and will provide the necessary educational support to Hope North and the programme participants through online methods.

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