Working Group on Education:

Digital skills for life and work

September 2017

BROADBAND COMMISSION
FOR SUSTAINABLE DEVELOPMENT

Working Group on Education:

Digital skills for life and work

September 2017

What are the educational implications of the 'broadband society' for the development of digital skills for life and work?

Foreword by Irina Bokova, UNESCO

The emergence of the digital world is creating vast new opportunities for exchange and cooperation. It is also raising sharp questions that we must address to advance progress toward the 2030 Agenda for Sustainable Development.

People speak of the emergence of a new generation of 'digital natives' as if this is inevitable. It isn't — we see new divides emerging and old gaps widening, notably for girls and women. To be truly empowering, new technologies must stand on two pillars. Firstly, they must be inclusive, bridging gaps, not widening them. Secondly, they must be underpinned by respect for human rights and dignity. In this context, the imperative of fostering digital literacy for all has never been so important.

Recent analysis shows that, within developed economies, 90% of jobs require some level of digital skills, while more than one third of the labour force has an extremely limited ability to use ICT productively. Digital skills are no less crucial in developing countries. In Kenya and India, for instance, an internet-connected device can serve as a bank, postal service, map, library, learning hub, translation utility and record keeper, all rolled into one.

In addition to helping people enter and excel in labour markets, digital skills also allow women and men to pursue personal interests. Music, art, sports and literature are usually just a few clicks away with broadband technologies. So are apps and other tools that facilitate creative expression. But these clicks are not obvious to first time users of technology, and too many people are being excluded from the enrichment opportunities offered by the broadband society. To move forward, we need to tackle complex questions. How can education support the equitable development of digital skills for all? How can we advance digital skills development continually, in the context of fast-changing technologies?

In response, this Report by the Broadband Commission for Sustainable Development examines how digital skills and competencies can be defined and developed within and beyond formal curricula. It underlines the importance of steadfast commitment to digital skills development for disadvantaged groups and the self-evolution of these skills within local communities. It offers recommendations on supporting sustainable and equitable development of digital skills for all stakeholders, showing the catalytic power of multistakeholder collaboration, the role of international cooperation and the importance of research and evaluation. The Report also includes a compendium of case studies, exploring how different organizations are forging digital skills for life and work in Africa, Asia, Europe and beyond.

In the place of 'digital natives,' I believe we need to support the rise of a new generation of 'digital citizens,' with the right skills for life, work and engagement in connected communities for today and tomorrow. This can only happen through concerted policies, drawing on strong political commitments and sustained investment. Digitally literate women and men form the foundations for the inclusive, knowledge societies we need for the twenty-first century.

Irina Bokova,
Director-General, UNESCO

Foreword by John Galvin, Intel Government and Education

In my position at Intel, I have the privilege of working with world leaders and touring hundreds of schools across multiple geographies. Throughout my travels, I consistently hear two questions: 1) How can we accelerate innovation to drive economic growth? and 2) How can we prepare citizens to thrive for the next 20-30 years?

The Broadband Commission's Education Working Group prepared this report to serve as a blueprint for change agents acting to close the digital divide. The report's compendium of case studies describes success stories — from marginalized toddlers in Myanmar gaining quality early learning opportunities and girls in Sri Lanka becoming empowered to attend universities, to Malaysian teens transforming into innovators and entrepreneurs. These stories illustrate some of the successful ways that corporations, governments and non-profits are coming together to ensure that people everywhere have the skills and competencies they need to fully participate and succeed in the knowledge-based economy of the future.

At Intel, we believe technology is a force for positive social impact and has the power to be a great equalizer, but only if everyone has access to it. We also recognize that the health of local economies — including those where our employees live and work — is improved by access to technology and quality education that prepares individuals for the jobs of tomorrow.

For these reasons, Intel is helping to spearhead efforts to catalyze ecosystem partners and bring together the best ideas, innovative practices, and action-oriented leaders committed to building a better future by accelerating progress for all. I am honoured to serve with my fellow Broadband Commissioners on our shared commitment to support the United Nations' Sustainable Development Goals. I look forward to increasing our collaboration to enable individuals everywhere to develop the twenty-first century skills required to thrive within our fast-changing broadband society.

John Galvin
Vice President and General Manager,
Intel Government and Education

ACKNOWLEDGEMENTS

This report has been created collaboratively, drawing on contributions and insights from the participants of the Broadband Commission Working Group on Education, under the auspices of the Broadband Commission for Sustainable Development.

The Broadband Commission Working Group on Education is co-chaired by Irina Bokova, Director-General of UNESCO and John Galvin, Vice President of Intel. This report explores the implications of the 'broadband society' for the development of digital skills for life and work. Alongside original desk-based research, the report reflects inputs from the members of the Broadband Commission Working Group and from other Commissioners. They provided the case studies that form the compendium of promising practices, included as an appendix.

UNESCO has coordinated the production of the document, under the guidance of David Atchoarena, with the overall drafting support of Neil Selwyn and contributions from Borhene Chakroun, Fengchun Miao, Mark West and Chrystelle de Coligny. Christina Chin, from Intel, and Mark West, from UNESCO, oversaw the preparation of the compendium, with the support of Glynnis Kaye. The process of completing the report was facilitated by Phillippa Biggs and Anna Polomska of the Broadband Commission Secretariat at ITU. Artwork for the report was created by Yacine Kaci.

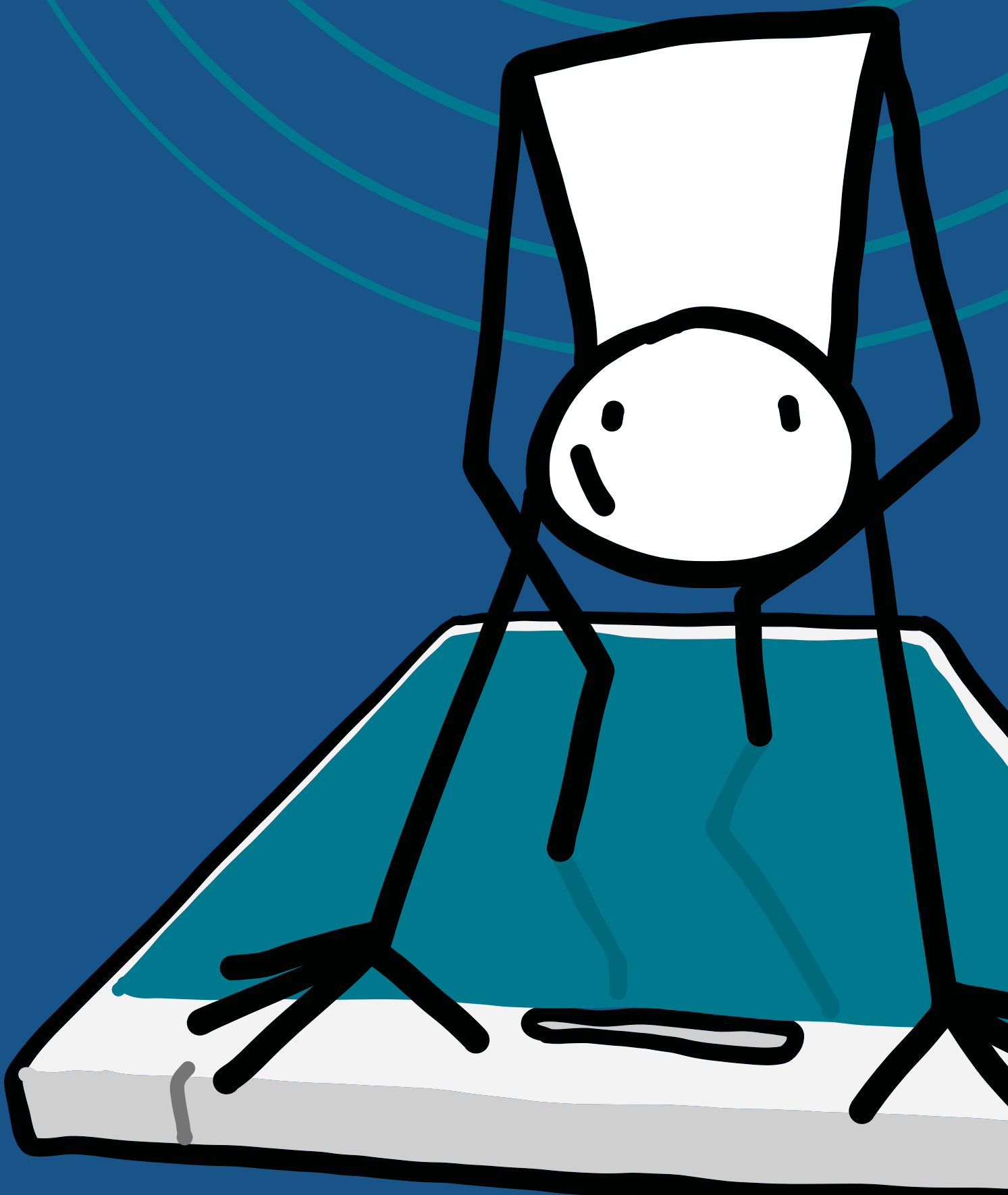
We wish to thank the Broadband Commissioners, the Commissioners' focal points, and in particular, the members of the Working Group for their invaluable contributions (listed in alphabetical order of institution):

- Dr Carlos Jarque, America Movil and FCC Servicios Ciudadanos
- H.E. Dr Siyabonga Cyprian Cwele, Minister of Telecommunications and Postal Services, Republic of South Africa
- Mr Börje Ekholm, Ericsson
- Mr Kevin Martin, Facebook
- Baroness Beeban Kidron, 5Rights
- Mr Sunny Varkey, GEMS Education
- Mr Mats Granryd, GSMA
- Mr Rupert Pearce, Inmarsat
- Mr John Galvin, Intel
- Mr Houlin Zhao, ITU
- Dr Dato Lee Yee Cheong, ISTIC
- Dr Chang-Gyu Hwang, KT Corporation
- Prof. Gloria Bonder, Latin American Postgraduate Institute of Social Sciences (FLACSO)
- Mr Paul Mitchell, Microsoft
- Mr Rajeev Suri, Nokia
- Dr Ann Aerts, Novartis Foundation
- Ms Irina Bokova, UNESCO
- Ms Phumzile Mlambo-Ngcuka, UN Women

TABLE OF CONTENTS

DIGITAL SKILLS FOR LIFE AND WORK

APPENDIX



DIGITAL SKILLS FOR LIFE AND WORK

EXECUTIVE SUMMARY

A continuum of 'digital skills'

Digital technologies now underpin effective participation in key areas of life and work. In addition to technology access, the skills and competencies needed to make use of digital technology and benefit from its growing power and functionality have never been more essential.

Although definitions vary, digital skills and competencies are best understood as existing on a graduated continuum from basic functional skills to higher level, specialist skills.

The term 'digital skills' refers to a range of different abilities, many of which are not only 'skills' per se, but a combination of behaviours, expertise, know-how, work habits, character traits, dispositions and critical understandings.

These skills and competencies are interconnected and broadly complementary. They are also, in today's technology-saturated communities, foundational to full participation in society and, as such, need to be developed and refined over time and according to the personal and professional circumstances of individuals.

Countries are increasingly seeking to map and define digital skills and competencies that change constantly because of technological advancements. These flexible maps and definitions provide a basis for the development of inclusive, equitable and sustainable educational interventions.

Current education practices and policies

The question of how digital skills and competencies can be developed by all people — young and old, girls and boys, rich and poor — on a sustainable basis is an ongoing challenge for governments around the world.

Clearly, education and training are key ingredients of efforts to develop digital skills. Digital skills development takes place across a full range of education contexts: from formal institutions such as schools, colleges and universities to non-formal provision and training, and various forms of self-directed and informal learning.

Promising trends that encompass both education provision and policy-making include efforts to:

- **Ensure digital literacy for all:** National 'digital literacy for all' initiatives; integration of digital skills development into school curricula; networks of information and communication technology (ICT) labs and community learning centres for out-of-school children and those without basic digital skills; and informal peer-mentoring programmes.
- **Teach computer programming and coding skills to children and young people:** Inclusion of coding in national school curricula; outside-school coding clubs; competitions and campaigns; and the subsidized distribution of low-cost computers with pre-loaded courses and applications.
- **Facilitate the development of digital skills needed to enter ICT professions:** National employability

strategies; enhanced TVET courses; industry-specific skills or re-skilling training for unemployed and other marginalized groups; boot camps and other forms of rapid skills development; and 'digital livelihoods' provision.

- **Foster 'soft' and 'complementary' digital skills:** Incorporation of 'twenty-first century skills' into national curricula; development and promotion of practical programmes that aim to inform and safeguard digital safety; implications of online activities; development of digital literacy and citizenship; knowledge of digital rights; and awareness of how digital technology, big data and algorithms shape society.

Laying foundations for equitable and high quality digital skills development

While digital skills education and training has evolved over the past 20 years, the quality and effectiveness of its provision remain inconsistent. Pronounced inequalities and disparities exist in terms of individuals' digital skills and competencies within communities, countries and regions. Reconciling these gaps will require more than technology alone. Holistic approaches — encompassing policy, implementation, funding and partnership — are needed to ensure that all learners have opportunities to cultivate relevant digital skills. Pillars of this broad and multifaceted approach include:

i) **Institutional capacity and continuity of provision:** Effective digital skills provision is reliant on well-functioning organizations that operate within stable and supportive conditions. Moreover, successful programmes and initiatives often build upon achievements of previous skills development efforts.

ii) **Appropriate involvement of government:** Government and state actors play a leading role in setting the conditions for sustainable and equitable provision of digital skills development. Governments should continuously enhance their digital capacities to establish and enable inclusive and equitable digital skills provision. This can be accomplished by developing regulatory frameworks; planning and coordinating national policies and strategies; creating and managing partnerships; evaluating outcomes; championing digital rights and safety; and promoting gender equality and inclusion.

iii) **Diverse and well-managed partnerships:** Most forms of digital skills provision benefit from drawing upon public and private sector resources and expertise, particularly the involvement of IT-related actors who have deep knowledge about digital skills, both those needed today and skills that are likely to be relevant in the future. Successfully combining public and private interests while maintaining a shared vision remains a challenging feature of work in this area. There are clear advantages to partnerships that are managed and coordinated through neutral bodies and delivered on a non-profit or philanthropic basis.

iv) **Context-specific planning and provision:** Successful digital skills programmes and initiatives are tailored to meet the needs of target beneficiaries and respond to local contexts; they avoid 'one-size-fits-all' approaches, privileging flexibility and iterative growth. Sensitivity to local languages, socio-cultural considerations, technology accessibility and challenges unique to disadvantaged groups, including women and people with disabilities, has helped ensure that interventions reach under-represented populations.

v) **Scaling up successful provision:** Many digital skills programmes are implemented on a small or local scale with activities that are relatively easy to adjust. It is important that governments and other involved organizations – including those with an international remit such as UNESCO – identify and work to convert local cases of promising practice into 'scalable innovations'. Open access databases and repositories of good practice offer a means of supporting the spread of successful programmes and policies.

vi) **Applying existing technologies in innovative ways:** Many successful forms of digital skills provision are notable for making use of relatively simple, established technologies and applying them in innovative ways. Cutting edge technology is not usually necessary to teach digital skills and some of the most innovative programmes make use of technologies already accessible to users, showing them how to fully harness the potential of existing digital tools.

vii) **Blending traditional 'non-digital' education approaches and digital applications:** Despite improvements in online learning and other digital modes of education, learner demand for digital skills education and training delivered in social settings remains strong. Activities that involve face-to-face interactions with others and engaging with physical resources have proven effective in a wide variety of contexts. Alongside ambitions to develop 'digital first' forms of provision, policy-makers and providers should not discount the benefits of traditional offline methods of teaching and learning.

viii) **Bridging formal and non-formal digital skills provision:** Schools, colleges and universities can benefit from appropriating successful aspects of digital skills development established outside of the formal education sector. Conversely, formal education institutions can contribute to the pedagogic design of skills development programmes delivered by non-education organizations.

ix) **Enhancing the digital competencies of teachers:** Teachers' digital skills and competencies underpin efforts to better integrate digital skills development in education, while ensuring sustainable, inclusive and equitable approaches. There is a continued need for teacher-focused skills development programmes, particularly for teachers working in schools and in non-technology subject areas.

x) **Building a rigorous evaluation and evidence base:** There is surprisingly little evaluation of the impact and outcomes of digital skills provision and policy-making. Enlarging the research and evidence base is essential to clarify best practices and build upon them. Such evaluations can be supported by government agencies and other coordinating bodies, especially those able to work across education and technology sectors.

Future challenges and issues

Digital skills and competencies constitute an area of education that is changing continually in tandem with the development of new technologies. The next decade will see the rapid growth of mobile internet access, cloud-based computing, the 'Internet of Things', digital data, artificial intelligence and an increase in computer-driven decision-making and other forms of automation.

Some of the most relevant 'digital skills' likely to arise from these developments may not involve the direct use of digital technology. Instead, they will relate to

people's awareness and understandings of digital technologies that they do not necessarily touch and control but which nevertheless influence their lives in profound ways. For example, there will be an increased need for employees and citizens to be able to understand and work with automated systems and machines as well as interact with data-based processes and decision-making systems.

Amid these changes will be a continuing need to ensure that all individuals are able to continually hone skills and competencies necessary to participate fully in societies increasingly reliant on digital technologies and processes. This will require expanding learning opportunities across life and reskilling workers when jobs change due to technology.

Salient priority areas that policy-makers and practitioners will need to address as the digital society evolves over the next decade include:

- **Continued public involvement in an increasingly commercially-driven sphere.** This will require governments to be digitally-skilled and digitally-engaged, and therefore able to take a leading role in the provision of digital skills and digital citizenship development.
- **Sustained efforts to address ongoing inequalities in skills and competencies.** This will require providing individuals with equal opportunities to cultivate and make use of the digital skills and capabilities they develop, as well as understanding the ways in which outcomes of digital skill development are linked to other types of advantage and disadvantage.
- **Rigorous data and indicators on digital skills across populations.** This will require the collection of superior and more nuanced data and statistics about digital skills and competencies in order to inform policy analysis and planning.
- **Promotion of 'open' resources, especially open educational resources (OER).** This will require incentivizing the creation of OER and Free and Open Source Software (FOSS) that can be tailored for specific digital skills needs not likely to be met by commercial providers.

Recommendations

Members of the Broadband Commission Working Group on Education RECOMMEND that governments and other stakeholders take actions to:

Ensure effective government support and multistakeholder cooperation

- Establish accountable agencies within governments to lead the development, regulation and implementation of national strategies and master plans for digital skills development.
- Under the competence of the accountable governmental agencies, develop strategies to broker, expand and improve multistakeholder partnerships that facilitate digital skills education.
- Incentivize IT firms, internet service providers and other private sector organizations to support inclusive and equitable digital skills development, including programmes to upgrade the skills of workers, ideally with oversight from neutral, non-commercial brokers.
- Develop and endorse policies to promote Free and Open Source Software (FOSS) and to openly license the digital skills development resources and other OER produced with public funds, as called for

in the Paris OER Declaration (UNESCO, 2012c).

Ensure inclusion, equity and gender equality

- Formulate education policies that promote and monitor the inclusion of digital skills development for disadvantaged groups irrespective of gender, age, race or disability.
- Encourage non-formal digital skills providers to deliver programmes for out-of-school children, youth and adults, especially illiterate or unemployed adults through flexible face-to-face programmes in well-established community spaces and through affordable digital technology, including mobile phones (UNESCO, 2013a).
- Prioritize public investment and incentivize the private sector to support gender equality in digital skills development with a particular focus on promoting girls' and women's participation, achievement and continuation in STEM studies and careers.

Promote quality and innovative provision

- Set up collaborative taskforce teams of education institutions, IT industries and academic institutes to enhance the development and provision of curricula and programmes for digital skills development.


© vgajic/iStock

- Set up quality assurance and accreditation mechanisms to monitor the quality of digital skills development programmes, and facilitate the recognition of skills across levels of studies, education providers and possibly across borders.

- Make digital skills a key component of teacher training, with reference to UNESCO's ICT Competency Framework for Teachers (2011). Guide the review and updating of programmes to enable teachers to benefit from digital technologies and improve the digital literacy of students.

- Enhance the digital skills of teachers and develop collaborative capacity-building mechanisms between education institutions and IT industries.

Develop appropriate measurement and monitoring strategies

- Support national statistics agencies and other agencies in regularly collecting disaggregated digital skills data, including through individual assessments, to facilitate a more robust and comprehensive understanding of digital skill divides.

- Explore the possibilities of aggregated usage of automatically generated data on the use of digital platforms and services as a means of mapping patterns of digital competencies and skills.

- Include, where relevant, questions in annual household surveys to gather self-reported information about individuals' digital skill levels and digital skill needs. Also, encourage countries to share collected data with relevant international organizations, including UNESCO and ITU, to facilitate global and regional analysis.

Members of the Broadband Commission Working Group on Education RECOMMEND that the Commission

- Provides adequate platforms for international exchange on policies, instruments and approaches through South-South and North-South cooperation.

- Explores the feasibility of setting up an international framework for digital skills and competencies in order to inform national policies, facilitate international comparisons as well as cross-border recognition and provide conceptual references for measurement of digital skills in collaboration with UNESCO and ITU.

- Supports the monitoring of Sustainable Development Goal 4 (SDG4) by identifying the percentage of youth and adults with ICT skills as called for in SDG Target 4.4.1. With the technical support of the UNESCO Institute for Statistics, ITU and other concerned organizations, the Commission should also facilitate the development of cross-national statistical frameworks and data platforms for both regional and global monitoring of digital skills acquisition.

1 Towards a broadband society for all: The centrality of education and skills

Introduction

We now live in a digital world with broadband and ICTs driving the ongoing reorganization and transformation of life and work experiences. It is estimated that nearly half of the world's population (that is, 3.7 billion people) make use of the internet. Youth are at the forefront of internet adoption with 70% of 15 to 24 year-olds online globally (ITU, 2017a). Worldwide smartphone users now exceed 2 billion. These individuals are living in an 'always-on' state of connectivity. Indeed, rather than switching between being either 'online' or 'offline', contemporary broadband users are perhaps more accurately described as operating in a permanent state of 'onlife' (Floridi, 2014).

Even the lives of people who do not have personal access to these technologies are also increasingly dependent on broadband because many of the significant institutions in their lives are centred on the use of digital systems and digital data. As we approach the 2020s, broadband and information and communication technologies (ICTs) are no longer an additional or optional aspect of everyday life. Instead, digital technology is now a 'total social fact' — a central determinant of modern life that affects 'most if not all areas of social life, and is itself generative of new social practices, ties and relations' (Marres, 2017).

The changing digital economy

The ongoing digitalization of society is certainly evident in economic terms. The past 30 years have seen the emergence and consolidation of a 'digital economy' based on the growth of global markets, accompanied by new organizations of labour, production and trade. These developments take many different forms. For example, financial trading is now an almost wholly 'virtual' affair, and the buying and selling of goods and services increasingly takes place online. Consumers are engaged in online banking and contactless payments. All economic sectors now involve some element of digitalization, from 'precision agriculture' to 'industry 4.0' to e-business and e-commence. As Bukht and Heeks (2017) observe, while 'the global North has had the lion's share of the digital economy to date', it is increasingly expected that the economic benefits of increased digitalization will become more evident within developing countries.

In most areas of the economy, ICTs are associated with significant productivity gains, the development of new markets and the innovation of new products and services. Amid these transformations, the ICT sector has itself become a dominant part of the global economy. The top three global companies by market capitalization in 2016 were all from the technology sector — Apple Inc. (with a market capitalization of US$604 billion), Alphabet Inc. (US$518 billion) and Microsoft (US$437 billion) (PwC, 2017). Whereas financial reports in the late twentieth century would celebrate the fortunes of General Motors, Walmart and Exxon, now the focus is on companies producing digital devices and services.

Even the lives of people who do not have access to digital technology are increasingly dependent on it.

The economic growth is also characterized by the increasing role played by start-ups, which are shifting the drivers of innovation from a focus on technology transfer, patents and trademarks to venture capital, co-working spaces, incubators and accelerators. This has seen the rise of an urban start-up cafe culture at odds with large ICT enterprises and government mega IT parks (ITU, 2016).

At the same time, many forms of work and employment have become more digital in nature (if not form), therefore requiring

ICT-related skills on the part of employees. For example, many occupations are now centred on the processing of data and information, with workers using digital technology to create and manipulate information-based products and services. These occupations are dependent on workers who are flexible and adaptable in terms of what they are able to do with a variety of technologies. ICTs are associated with various new work arrangements and organizations of labour across all levels and types of employment — from high-skilled specialist 'knowledge work' to the functional ICT skills now required across many sectors of the service economy. In this context, job displacement and changes to occupational structure will take place in addition to many jobs being added and redesigned. Automation and other processes facilitated by technology could prompt widespread unemployment or underemployment, and experts project that people with the lowest skill levels are likely to be the most disadvantaged (Ford, 2016). But the magnitude of these changes will vary from country to country, reflecting differences in industry structure, work organization and the skill mix of the workforce (OECD, 2016b). For instance, several studies have looked closely at the possible effects of digitalization on developing countries. One study argues because many jobs in developing countries exist in informal sectors and rely on inexpensive labour that is not easily automated, developing country economies may be slower to change as a result of increased digitalization (Maloney and Molina, 2016). Yet the study notes that digitalization will nevertheless impact these economies in due time.

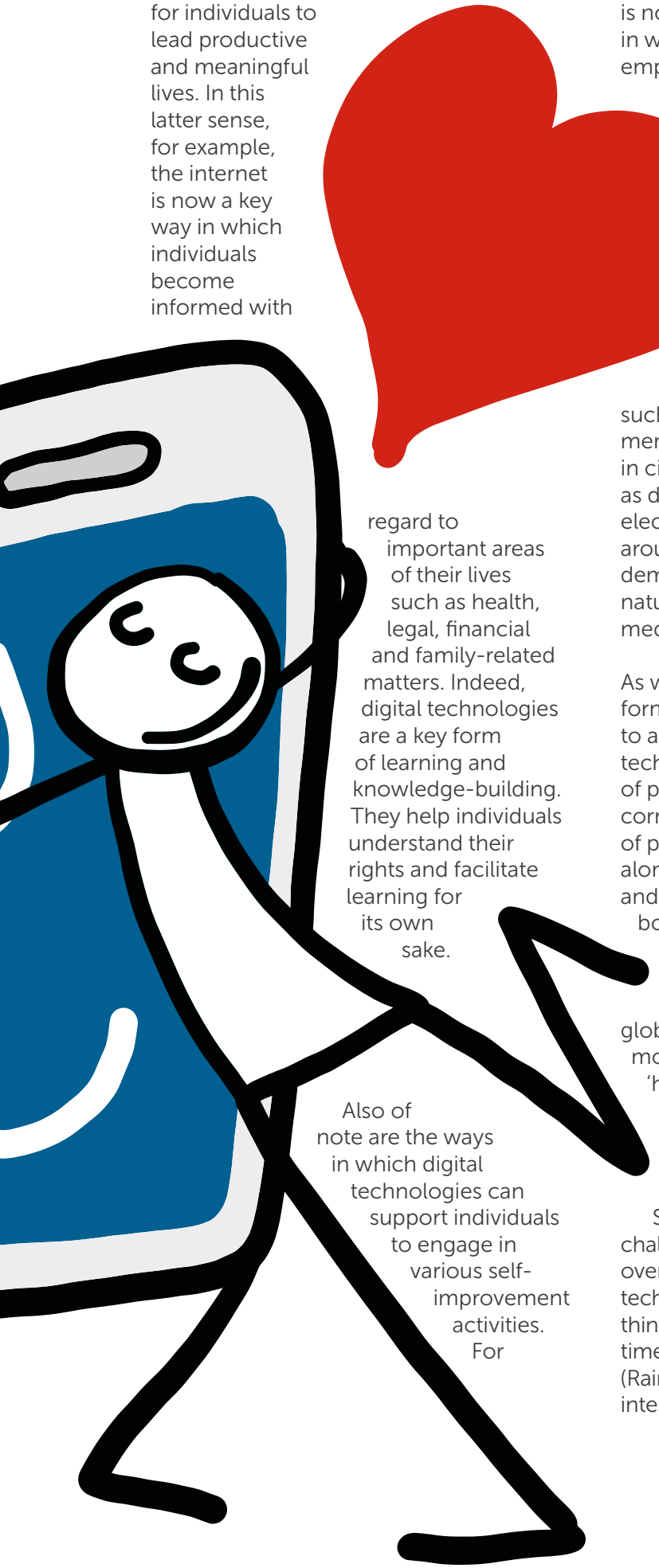
Besides the reorganization of established areas of the labour market, broadband and ICTs are also associated with new forms of work. Recent forms of 'virtual work' have emerged that involve flexible and fragmented patterns of engagement along the lines of the so-called 'gig economy' and 'micro-working'. Digital technologies are associated with the automation of various work tasks and, in some cases, the automation of entire jobs. Broadband and ICTs are therefore associated with the creation of a range of emerging occupations, while at the same time implicated in the 'displacement' of jobs between different sectors (World Bank, 2016). All told, there are few employment opportunities that now do not involve some form of ICT use and, therefore, some degree of ICT skills and competencies.

The changing digital society

Alongside these economic shifts is the far-reaching digitalization of societies. After decades of anticipation of the 'post-industrial society', 'knowledge society' and 'information age', the 2010s have turned out to be the decade where many aspects of society became substantially organized and administered through digital systems, services and applications. Education, health, legal and welfare systems in many countries are now being reconfigured along digital lines. Increasingly, public services are delivered and administered online in the form of 'e-government', 'e-health' and 'e-welfare'.

The rise of digitally-based public services reflects the fact that the day-to-day lives of many people are now arranged around various 'digital engagements' (Helsper, 2012). This includes online shopping, online communication, online news, internet-based entertainment and leisure. Digital technologies are therefore 'a mundane, essential part of daily living' (Green

et al., 2011), but also a potential means for individuals to lead productive and meaningful lives. In this latter sense, for example, the internet is now a key way in which individuals become informed with regard to important areas of their lives such as health, legal, financial and family-related matters. Indeed, digital technologies are a key form of learning and knowledge-building. They help individuals understand their rights and facilitate learning for its own sake.



Also of note are the ways in which digital technologies can support individuals to engage in various self-improvement activities. For example, the notion of 'digital livelihoods' is now used to describe the ways in which digital technologies can empower individuals who are otherwise economically excluded by offering access to financial and business opportunities.

The growing societal presence of broadband and ICTs is also seen to be altering the nature of citizenship and what it means to be a citizen. ICTs now augment many different aspects of 'traditional' citizenship, such as voting in elections, being a member of a political party, and engaging in civic and community work. Moreover, as demonstrated by recent national elections and parliamentary procedures around the world, many aspects of the democratic process are now digital in nature (from online polling to social media campaigning).

As well as transforming long-standing forms of civic participation, it is important to acknowledge the ways in which digital technologies underpin alternative forms of participation. Digital technologies correspond with a variety of new forms of political mobilization and organization, alongside reconfigured norms, identities and allegiances that cut across traditional boundaries of geography, social class and party politics (Vromen, 2017). For example, the internet supports the increased engagement in global 'subpolitical' organizations, online movements and networks, alongside 'hyperlocal' citizen reporting and open spaces for dialogue and debate (Jenkins et al., 2016; Couldry et al., 2014).

Similarly, broadband and ICTs are challenging the authority of institutions over individual citizens. Indeed, digital technologies often support ways of doing things in everyday life that are at the same time networked but also individualized (Rainie and Wellman, 2012). Through the internet and personalized devices such


© kali9/iStock

as smartphones, growing numbers of processes and practices are now centred on the needs of individuals rather than the demands of large institutions and organizations. It has even been claimed that digital technologies are bringing people together in new ways that allow individuals to 'self-determine' and organize themselves without the involvement of official institutions (Zuckerman, 2013). It is further argued that digital technologies can support new forms of collectivity and communality — offering a basis from which to develop powerful forms of inter-cultural 'global citizenship' which transcend traditional structures and boundaries (Culver and Kerr, 2014).

Education in the broadband society

While the transformative potentials of broadband and ICTs are being realized across many areas of society, this report is concerned specifically with the changing nature and significance of education in the broadband society — particularly in terms of supporting the development of the skills and competencies necessary to achieve the Sustainable Development Goals (United Nations, 2015). In this sense, the relationship between broadband society and education needs to be approached in two ways.

On the one hand, it is important to recognize the significance of ICT access, skills and competencies for education. Indeed, digital technologies influence (and arguably transform) education practices, processes and provisions in a number of ways. For example, digital technology is widely perceived to support and enhance how individuals learn — from supporting cognitive processes and higher-order thinking skills to allowing learning to take place in collaborative and supportive social conditions. At the same time, broadband and ICTs also increase the ability of individuals to choose and arrange learning that is appropriate to their particular circumstances and needs. ICTs give individuals access to a wealth of information and communication, as well as contact with other learners, teachers and experts on a local and global basis. As such, ICT access, skills and competencies are heralded by many commentators as supporting more individualized forms of educational access.

On the other hand — and the primary focus for this report — is the significance of education in developing the skills and competencies required for the broadband society. Most obviously, schools, colleges, universities and other formal educational institutions are key sites where people learn to use ICTs. Education is therefore a significant way in which individuals develop technology-related skills, competencies

and dispositions required to gain employment in the digital economy *and* function as citizens in the digital society. These skills are taught intentionally as well as developed while using digital technologies for other activities. Crucially, educational institutions play a leading role in measuring, assessing and certifying digital skills and competencies — not least in the form of recognized academic and vocational qualifications.

Accompanying the development of ICT skills in formal education, is the growing provision of ICT skills and competency development from non-formal (and often 'non-traditional') providers. As will be explored in the later stages of this report, digital skills provision extends beyond the reach of traditional education institutions (such as schools, colleges and universities) to other providers such as commercial organizations, community groups and cultural institutions such as museums and libraries. Digital skills are also a key focus of vocational and work-based training. Digital technology has been welcomed by some (especially in the for-profit sector) as enabling more competitive and effective 'marketplaces' for all forms of education to develop, including training and learning provision aimed at cultivating digital skills.

This report takes a holistic view of digital skills education and training. It is concerned with both the development of functional skills and competencies and the role that education plays in supporting the 'socialization' and 'subjectication' of individuals in the broadband society (Biesta, 2016). This includes conveying specific social and cultural understandings of ICT use (for example notions of 'appropriate' or 'safe' use of technology), alongside developing individuals' abilities to think independently and critically about their personal use of digital technology, their role as digital citizens and the broader digitalization of society. Education, therefore, is an integral element of how individuals are able to develop a range of necessary life skills to survive and thrive within broadband societies.

The ongoing challenge of digital equality

The development of technology-related skills, competencies and dispositions is a key consideration when addressing the challenges of the broadband society. As such, education providers and policy-makers around the world are faced with a common challenge — that is, how can education support the development of digital skills for all individuals in their roles of citizens and workers?

How can education support the development of digital skills for all?

This emphasis on 'for all' relates to global concerns over continuing inequalities associated with the use of broadband technology and ICTs. Indeed, alongside all of the potential benefits and improvements just outlined, there is a growing body of evidence suggesting that people's ability to engage with digital technology is differentiated along a number of lines, notably socio-economic status, race, gender, geography, age and educational background (ITU, 2017a). While no longer a headline issue in popular and political discourse, the spectre of the 'digital divide' nevertheless underpins any discussion of the potential benefits of broadband technology and ICTs.

In global terms, digital inequalities continue to be well-documented and, in many instances, divides across lines of geography, gender, age, physical abilities, socio-economic status, language, and educational attainment are growing. As inferred at the beginning of this chapter, over half of the world's population (some 3.9 billion people) remain unable to connect regularly to the internet. Many of these people are living in sub-Saharan Africa and South Asia, with six countries (India, China, Indonesia, Pakistan, Bangladesh and Nigeria) accounting for around half of the world's offline population (ITU, 2017b). Underlying these headline figures are a number

of stark disparities. For example, those unable to access the internet include disproportionate numbers of women and girls, and people living in remote and rural areas, with low levels of education and living on low incomes (World Bank, 2016).

Indeed, gender continues to be a major differentiating factor in terms of ICT access and use (UNESCO, 2016c). This is highlighted in the recent 'Digital Gender Divide' report from the Broadband Commission (2017a) which reflected on a persistent gender gap in internet access rates in all regions of the world despite sustained policy and practical efforts to address these inequalities. Recent ITU (2017b) data suggests that males are now 12% more likely to make use of the internet than females — a figure that rises to 25% in Africa. Similar gendered disparities are evident in rates of mobile phone ownership (UNESCO, 2014c) and other basic forms of technology access (BMZ, 2017).

UNESCO programmes to develop the digital skills of girls and women

UNESCO, as the UN agency responsible for coordinating international cooperation in education, science, culture and communication, is harnessing its multisectoral expertise and leadership to ensure that all women and girls can fully participate in the online world and are empowered with digital skills for economic and social participation.

UNESCO recognizes that technology can reach those in remote places and outside of the formal education system, help to close gender gaps in science and maths, and offer new employment opportunities for women and girls. For example, in Nigeria, UNESCO has trained 60,000 illiterate women and girls in the use of ICTs, and with Procter and Gamble, will further deploy ICTs to empower an additional 50,000 illiterate women and girls facing difficulties accessing formal education. In Ethiopia, with support from the HNA Group and Cihang Foundation, UNESCO is strengthening the institutional capacity of teacher training institutions to harness the use of ICT for quality, gender-responsive science, technology, engineering and mathematics (STEM) teaching and learning, with wider application to other countries through UNESCO's International Institute for Capacity Building in Africa (IICBA). In Myanmar, UNESCO is working with Ericsson, the UK Department of International Development (DFID) and other partners to build teacher capacity to deliver ICT-enriched education, ensuring that girls and boys receive a quality education that can transform their futures (more information about this project can be found in Case Study 6 in the appendix of this report). UNESCO's YouthMobile Initiative, deployed in more than 20 countries worldwide, is also providing young girls and boys with the skills and confidence to become creators of digital innovations.

UNESCO is also co-leading with Gesellschaft für Internationale Zusammenarbeit (GIZ) the Skills Coalition of EQUALS: The Global Partnership for Gender Equality in the Digital Age, a coalition of programmes dedicated to promoting digital gender equality. The Skills Coalitions aims to equalize the tech industry and arm women and girls with the skills they need to change the world.

UNESCO recognizes that building the digital skills of girls and women requires holistic and integrated responses that reach across sectors and that engage girls and women in identifying solutions to persistent challenges. Doing so moves communities closer towards gender equality in education, ensuring that women and men, girls and boys can participate fully, develop meaningfully, and create a more inclusive, equitable and sustainable world.

The gender divide in ICT access and use is closely connected to education. A recent ITU report (2017a) shows a strong correlation between gender parity in enrollment ratios in tertiary education and gender parity in internet use. The only region where a higher percentage of women than men are using the internet is the Americas, where countries also score well on gender parity in tertiary education.

Globally, girls are less like to participate in science, technology, engineering and mathematics (STEM) subjects, areas of study that often spark an interest in broadband technologies and support the cultivation of intermediate- and advanced-level digital skills. This is true in developed and developing countries. UNESCO (2017a) has observed that gender differences in STEM education begin as early as primary school and become more visible at higher levels of education. Globally, female students represent only 35% of all students enrolled in STEM-related disciplines in higher education, and women who enter STEM professions leave in disproportionate numbers compared to men (UNESCO, 2017a).

Parallel to gender inequalities, there is also growing evidence that digital technology use for both men and women is not the equitable and democratic activity that it is often portrayed to be. Experts have called attention to distinctions between engaging 'meaningfully' and in 'capital-enhancing' ways with digital technology, as opposed merely to 'functioning' with technology (Pearce and Rice, 2017). For example, in terms of gender inequalities, a 'sizeable gap' persists in terms of the nature of ICT specialist professions:

> In 2014, 5.5% of male workers in OECD countries were ICT specialists compared to just 1.4% of female workers. While this is a relatively small group, it involves well-paid jobs in high demand and with good career prospects. (OECD, 2016c)

While it was being suggested at the turn of the 2000s that such digital divides were a temporary phenomenon that would diminish in a few years of their own accord (Selwyn and Facer, 2007), it appears that these inequalities are an enduring characteristic of the broadband society. Most of the gender inequalities outlined earlier, for example, remain prevalent among children and young people as well as in adult populations (Livingstone et al., 2017). Underpinning

International Girls in ICT Day

International Girls in ICT Day, an initiative backed by all ITU Member States, aims to create a global environment that empowers and encourages girls and young women to consider careers in the growing field of ICTs, enabling both girls and technology companies to reap the benefits of greater female participation in the ICT sector. Since 2011, International Girls in ICT Day has been celebrated on the fourth Thursday in April every year.

The initiative seeks to raise awareness and encourage girls and young women to take up studies and careers in the ICT sector. To celebrate the day various coding, programming, mobile app and website development as well as robotics workshops are organized worldwide, along with mentoring sessions with female role models and open days at IT companies. To date, over 300,000 girls and young women have taken part in more than 9,000 International Girls in ICT Day events held in 166 countries.

The event is regularly celebrated in Tanzania, a country which faces an acute shortage of workers qualified to assume jobs in a growing ICT sector. Jobs are often outsourced to people living in other countries. Women are at a particular disadvantage in Tanzania where men fill the vast majority of local ICT jobs and are overrepresented in other STEM fields. To address existing skills and gender deficits, the Universal Communication Access Funds (UCSAF), a Tanzanian government agency that seeks to promote the socio-economic development of rural and urban underserved areas, has partnered with She Codes for Change, an organization that works to encourage girls to enter STEM and ICT fields in Tanzania. Together these organizations are addressing gender disparities in schools at the 'classroom level'.

Under the umbrella of International Girls in ICT Day, UCSAF and She Codes for Change trained girls to develop and pitch mobile apps to build their technical and entrepreneurial skills. The Girls in ICT Day initiative the two organizations launched in 2016 has provided ICT training to 428 girls and 32 teachers across the country to date. The training consists of a three-day event held annually. On the first day, the participants learn the process of 'ideation' and follow steps to facilitate the formation of ideas and concepts related to an ICT topic. Participants are then divided into groups and asked to identify a challenge that faces Tanzania and can be addressed through a mobile app. On the second day, participants are taught to develop an app using the MIT App Inventor. On the third and final day, the girls learn how to pitch their app to peers. The best group is selected to participate in a national training session.

For the year 2017, Tanzania was mapped in six zones and events were conducted in each zone throughout the month of March. Young girls studying in public schools and with high scores in science and mathematics examinations were selected to participate in the three-day event in each of the zones. Zonal winners participated in the national finals in Dar-es-Salaam and the national winners represented their peers at the ITU Girls in ICT Day event organized in Ethiopia by the ITU Regional Office for Africa.

The initiative is just the first step in the long journey towards bridging the gender gap in ICT in Tanzania. Future events will include initiatives such as starting ICT clubs in participating schools and offering them infrastructural support to foster learning.

The Girls in ICT Portal,[1] developed and maintained by the ITU Telecommunication Development Bureau (BDT) provides a wide range of resources to organizers, including: promotional materials including banners and flyers; a toolkit with useful information on the kinds of activities that can be organized and how to make them more effective; a map and list of Girls in ICT Day events globally with details, pictures and videos for each event; a dedicated section on how to organize an event; a list of relevant publications and videos; contact details of the ITU Regional Focal Points; and access to the Girls in ICT Facebook page[2] and the *#GirlsinICT* Twitter feed. Another complementary resource is the ITU Digital Inclusion Newslog[3] which shares good practices on digital skills training and education.

1 http://www.itu.int/girlsinict
2 https://www.facebook.com/ITUGirlsInICT/
3 http://digitalinclusionnewslog.itu.int/

inequalities related to digital access and use are more systemic issues of poverty and other forms of disadvantage. For example, people's ability to access and use ICTs is clearly contingent on basic living conditions, meaning that digital technology use tends to be less frequent and less active among displaced and vulnerable populations, and those on low incomes, as well as those with low levels of literacy and numeracy.

Moreover, these patterns of inequality and disadvantage tend to repeat with successive technological developments. For example, the recent and rising importance of data-driven digital systems and services has led to corresponding concerns over a new 'big data divide' (Andrejevic, 2014) between classes of individuals who get to control and manipulate data, and those with little or no opportunity to influence how and when data are gathered and used at critical moments in their lives (O'Neil, 2016). While there is clearly scope to improve the current technological opportunities and outcomes for billions of currently disadvantaged people, digital inequalities are a recurring societal and economic problem.

Ensuring the development of digital skills through education

These digital inequalities and disadvantages raise the need for stakeholders across public and private sectors to pay close attention to broadband and ICT policies, especially as they relate to education. Having reached a point where the ability to make meaningful use of digital technology determines, to a significant extent, an individual's ability to participate in modern societies and economies, then the need for action and intervention is obvious. A central aim of policy is ensuring that people develop the skills and knowledge needed to benefit from ICTs (UNESCO, 2015b; UNESCO, 2017b). Clearly, ensuring the equitable development of digital skills through education lies at the heart of any efforts to increase societal and economic use of ICTs.

The equitable and sustainable development of digital skills through education is unlikely to occur without the deliberate and directed intervention of a range of stakeholders. As will be reasoned throughout this report, the IT industry and private sector clearly have important roles to play — not least in providing information about the functionality of technology and the different forms of ICT use that underpin the development of digital skills. Yet many other non-IT industry stakeholders also have a clear remit, including non-profit organizations, NGOs, universities, public sector institutions and governments. As such, the sustainable and equitable development of digital skills through education is most likely to occur through strong multistakeholder partnerships between public and private sectors.

While multistakeholder cooperation should underlie and support strategies to provide digital skills education, it should not obscure the central role to be played by governments and state organizations. For example, the UN's Special Rapporteur on the Right to Education recently stressed the continued importance of governments taking responsibility for the provision of 'enabling policies and a sound regulatory environment' (Singh, 2016) to guide and ensure equal opportunity as education is changed by technology. While acknowledging the difficulty of keeping pace with digital developments, the Rapporteur stressed the need for robust government oversight of education and technology policy-making, particularly in terms of ensuring that digitally innovative forms of education provision do not lead to socially restrictive outcomes.

While these comments were directed towards all forms of technology-based education, they resonate particularly with the development of digital skills through education. For example, the Special Rapporteur's statement contended that governments are a key means of safeguarding 'public good' concerns in the face of increased for-profit provision of online education. Such warnings underscore the role of government in balancing enthusiasm for new forms of digital education with principles of access, quality and equity.

The development of digital skills through education for economic and societal improvement has understandably emerged as a key concern for international organizations. Organizations such as the EU, African Union and World Bank have made strong commitments along the lines of the recent G20 directive for member states to 'promote digital literacy and digital skills in all forms of education and life-long learning' (European Commission, 2017b). Similarly, the 2016 OECD 'Ministerial Declaration on the Digital Economy' (the so-called 'Cancún Declaration') contained a strong commitment to:

> Strive for all people to have the skills needed to participate in the digital economy and society through policies that improve the capacity of educational and training systems to identify and respond to the demand for general and specialist digital skills; that facilitate up- and re-skilling through lifelong learning and on-the-job training; and that promote digital literacy as well as inclusive and effective use of ICTs in education and training (OECD 2016a).

Digital literacy has also been positioned as an enabler of rights. Unless people have choice and agency, they cannot act in their own interests. Digital skills help put information about rights and safety in front of users, better ensuring that these rights are known, exercised and respected. This is an area where standard setting is needed. UNESCO and ITU have an important role to play in this area, to fulfil their normative function in upholding rights as the world gets organized online. Both organizations should continue to promote governments' accountability to ensure that choice and agency are available to all.

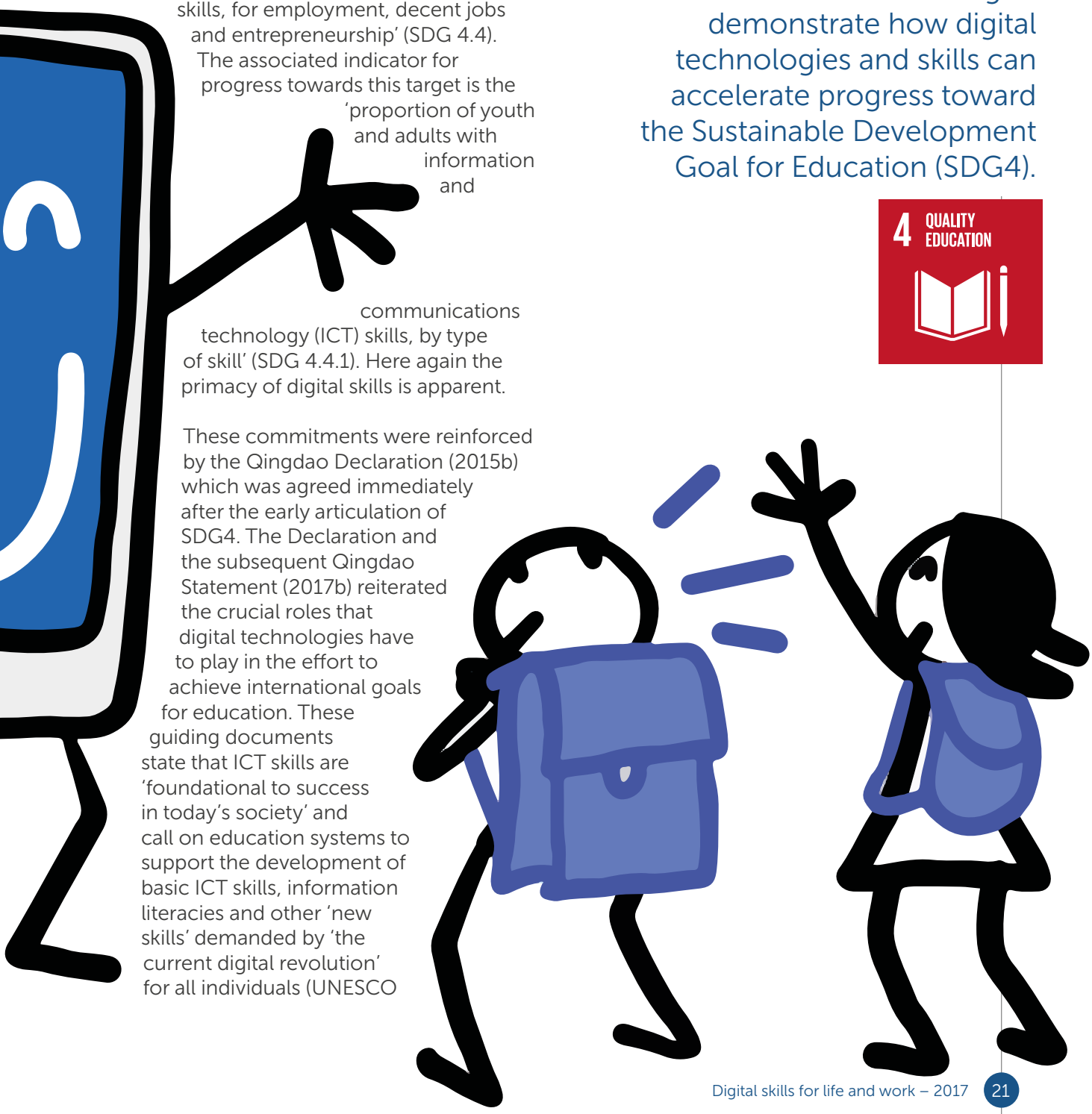
It is fitting that UNESCO takes a leading role in digital skills development, particularly in light of the Sustainable Development Goal for Education (SDG4). As the lead United Nations organization for education, UNESCO is working to demonstrate how digital technologies and skills can accelerate progress towards the Sustainable Development Goal for Education: 'Ensure inclusive and quality education for all and promote lifelong learning'. Digital skills can be seen to support progress towards most (if not all) of the specific SDG4 targets and indicators. As an example, classroom computers and internet access facilitate 'inclusive and effective learning

environments'. Digital skills can also help expand and mainstream global citizenship education and foundational goals of ensuring universal access to quality primary and secondary education, alongside equitable access to affordable and quality technical, vocational and tertiary education (UNESCO, 2016b).

The SDG4 target most specific to digital skills calls on countries to 'substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship' (SDG 4.4). The associated indicator for progress towards this target is the 'proportion of youth and adults with information and communications technology (ICT) skills, by type of skill' (SDG 4.4.1). Here again the primacy of digital skills is apparent.

These commitments were reinforced by the Qingdao Declaration (2015b) which was agreed immediately after the early articulation of SDG4. The Declaration and the subsequent Qingdao Statement (2017b) reiterated the crucial roles that digital technologies have to play in the effort to achieve international goals for education. These guiding documents state that ICT skills are 'foundational to success in today's society' and call on education systems to support the development of basic ICT skills, information literacies and other 'new skills' demanded by 'the current digital revolution' for all individuals (UNESCO 2015b; UNESCO 2017b). Indeed, ICT skills are necessary to succeed with ICT-based education and to work in 'ICT-rich environment[s]' (UNESCO, 2015b). Set against this background, the development of digital skills for life and work is understandably a guiding priority of UNESCO's and the Broadband Commission's work in education into the 2020s and beyond.

UNESCO is working to demonstrate how digital technologies and skills can accelerate progress toward the Sustainable Development Goal for Education (SDG4).



2 Digital skills and digital competencies: An overview

Introduction

As outlined in Chapter One, digital technologies now underpin effective participation across many aspects of everyday life and work. An individual's ability to make use of digital technology — and therefore benefit from this use — depends upon the possession of a range of skills and competencies. As discussed in Chapter One, these skills and competencies are often developed through a range of education contexts — from formal institutions such as schools, colleges and universities to non-formal provision and training, and various forms of self-directed, informal learning.

In order to foreground discussions of how education can best be an equitable and effective site of digital skills development, this chapter offers an overview of skills and competencies that are required by the digital society. This is not a straightforward undertaking. There is no one set of agreed definitions, with the literature referring variously to digital 'skills', 'competencies', 'aptitudes', 'knowledges', 'understandings', 'dispositions' and 'thinking'. This diversity of terms understandably reflects the different forms of 'digital technology' and their uses. As such, careful consideration needs to be given to the full range of what might constitute a 'digital skill' or 'digital competency' in various circumstances and contexts.

A set of basic functional competencies are required to operate a device or interact with a platform. These can be seen as foundational skills that are required to make use of any technology. More elaborate skills are needed to support individuals to achieve useful outcomes and make meaningful uses of technology. These can be seen as skills that result from the use of technology. Some of these skills are specific to interacting with digital devices and software. Other skills relate to the purposes for which the technology is being used. Some of these are complementary 'higher-order' skills that are integral to effective digital technology use yet are not necessarily specific to technology. This chapter develops an overview of all these skills and competencies.

Technological trends underpinning current digital skill requirements

Current definitions of digital skills and competencies are related closely to recent ongoing trends in ICTs. New devices, applications and genres of technology will often involve altered, sometimes additional, skills and competencies. They will also support different practices and activities which can lead to different forms of skill development. The demand for digital skills derives from technological changes; hence the section below briefly examines some of the major technical trends that give rise to new skills and competencies.

How can education become a site of digital skills development?

Networked computing: A key defining feature of current digital technologies is their networked nature. The idea of everything being connected to everything else to permit the transfer of data has introduced a 'networking logic' into most contemporary forms of digital technology. This logic assumes that users will be connected to other people, objects, organizations and information regardless of space, place or time. As a result, many contemporary digital technologies are built around 'interactive' rather than 'broadcast' forms of exchange, with content shared between 'many-to-many' rather than transmitted from 'one-to-many' (Jensen, 2015).

The networked nature of digital technologies relates to a range of new types of skill and competency that technology users have been required

to develop over the past decade. For example, online information skills now centre on the ability to identify, retrieve and make sense of information from non-linear and non-hierarchical sources, what is sometimes referred to as 'transmedia navigation (Jenkins et al., 2009). Similarly, online communication skills require awareness of the ongoing (re)circulations of content beyond original intended uses, and sophisticated understandings of (often unknown) audiences. Individuals are expected to develop, maintain and 'curate' a range of 'personal networks' that connect resources to contacts.

What distinguishes recent digital technologies is their capacity to support forms of 'mass socialization'.

Social and collaborative: Digital technologies are also increasingly social in nature, as evident in the popularity of the so-called social media. Of course, it can be argued that 'all media foster communication and by definition are social' (Papacharissi, 2015). Yet what distinguishes recent digital technologies is their capacity to support forms of 'mass socialization'. In this sense, the use of many digital technologies now depends upon the collective efforts of their users. Much digital technology use is therefore based upon an interactive and collaborative ethos. Danah Boyd (2015) observes that this ethos entails supporting and participating in mass interactions that 'help people connect and collaborate, socialize, and coordinate'.

The social and collaborative nature of much technology use demands a range of skills and competencies. These include working online with others, collaborative problem-solving and the social skills inherent in participating in online communities. This has led to increased emphasis on skills related to online 'performance' and identity formation, as well as negotiation, 'playfulness' and other affective skills that underpin successful engagement in social media settings.

Participatory (co)creation and 'making': Many popular online platforms and digital applications are reconfigured by large numbers of users. In this way, broadband brings an interactive and 'participatory' ethos to the way that digital technologies are used. The two main constituent elements of this 'participatory culture' (Jenkins et al., 2009) are: i) the involvement of technology users in the production and (co)creation of their own resources and content, and ii) the subsequent redistribution and sharing of these resources and content to others. This might entail the authoring of code-based digital content, or the technology-assisted 'making' and fabrication of material artefacts. These actions are accompanied by various forms of 'interactivity' such as practices of commenting, rating, liking and other interactions between users.

The participatory and creative nature of many digital technologies is linked to a range of skills and competencies. These range from practical skills such as multitasking, experimentation and learning through failing to skills of re-appropriating existing content (so-called modes of 'remixing', 'modding' and 'mashing-up'). They also include collaborative skills related to working creatively together with others in online contexts, and the ability to collate and make use of the collective intelligence of online groups working towards common goals.

Proprietary and open forms of technology provision: Many forms of digital technologies are provided on a commercial basis, with users paying for products and services, sometimes allowing personal data generated from their use to be sold to third parties. Many 'free' online services are offered on a 'no cost' basis, with revenue generated from advertising revenue and the reselling of data to third parties. There is also a trend for digital services to operate on a 'freemium' basis, where basic functions are accessible for no direct charge, while more advanced features are available at a cost. Understanding the


© subman/iStock

different 'business models' of services and engaging with them in an informed manner is now an important competency for all internet users.

In contrast to these proprietary models are so-called 'open' modes of technology use, generally assumed to encompass the use of products and services that can be freely and legally shared and reused. These resources are usually placed in the public domain at no cost for free use and repurposing by others and range from open source software and hardware designs to 'open education resources'. This philosophy of 'openness' is seen as an alternative mode of production and consumption, based on a model of commons-based peer production (Benckler, 2006). Key here is the idea of a mass of users altering, refining and producing new versions of the technology. Open principles and practices are argued to support the user-driven production of devices and software which are more efficiently, expertly and appropriately designed (UNESCO, 2016d). Again, the ability to participate in the co-production of open technologies requires technical skills, collaborative design capabilities, and understandings of shifting notions of ownership and intellectual property.

Data-based and computational: Another defining feature of current digital technologies is the generation and processing of data. Most forms of technology use involve the generation of data which are collected, (re)circulated and (re)used. Many popular consumer technologies are designed explicitly to create, transmit and view data and include wearable technologies such as activity trackers, smart watches and other sensor-based devices. Increasingly, the use of applications and platforms is predicted on the use of data by individuals and by 'third parties' such as technology providers, governments and public services, advertisers and other commercial entities.

Crucially, technology applications and services across most sectors of society and the economy are making increased use of large-scale computational techniques where data sets are joined together and analysed through complex calculations based around the use of algorithms, analytics and data mining. The outcomes of most technology use

People will need to develop understandings of how technologies have been programmed, how they are making calculations, and how they are making decisions.

are now underpinned by methods derived from mathematical modelling, statistical analysis, feedback and algorithms. Such techniques support everything from the results of internet search engines to the decisions made by 'automated' systems and the aggregation of large-scale 'big data' sets. As is further elaborated in this chapter, these forms of computing have increased the significance of various forms of numeracy and 'data literacy' skills, along with understandings of algorithms and other automated processes.

Remote and automated systems: The next decade is likely to see the establishment of the much anticipated 'Internet of Things' (IoT), with network-connected sensors, processors and other electronics becoming embedded in everyday objects (from refrigerators to clothing) and physical environments (from public outdoor spaces to homes and workplaces). Much of the social and economic significance of the IoT stems from the ongoing development of artificial intelligence, especially the increased integration of autonomous systems, algorithmic decision-making and a general blurring of functions carried out by humans and functions carried out by machines. Thus, the populations of many high- and middle-income countries will be living and working in environments with ubiquitous data analytics and connectivity — what has been termed the 'datacosm' (Rainie, 2017).

These emerging technological conditions are likely to have profound implications for the skills and competencies required to live and work within them. For example, current parameters of 'digital literacy' are likely to expand to encompass an individual's capacity to deal with automated systems, avatars and artificial intelligence agents. People will need to develop new forms of 'interpersonal' skills to collaborate with (and work alongside) machines and automated systems.

Another set of skills arises from the fact that these are remote technologies and autonomous systems that individuals will have increasingly less direct 'use' of and 'control' over. These are not technologies that necessarily require skilled input and manipulation by 'users'. Instead of practical operational skills, people will need to develop understandings of how these technologies have been programmed, how they are making calculations, and how they are making decisions. This will increase the importance of people developing a critical consciousness of how these technologies shape their actions. This also raises a range of security, privacy and ethical issues that currently are rarely considered (or even understood) in the implementation of such systems. These include questions such as who is accountable for the 'autonomous' actions of technologies, and the changing nature of individual privacy in light of fully connected systems (Douglas-Jones et al., 2017).

An overview of skills required for the digital society and digital economy

These trends and characteristics are all having a significant influence on the skills that are seen to be necessary for effective participation in the digital society and digital economy. In particular, the ongoing development of digital technology along these lines is associated with a diversifying and graduated set of skills, competencies and abilities. These can be described in terms of three broad but distinct areas:

1. **Basic functional digital skills:** Accessing and engaging with digital technologies

First are the important entry-level functional skills required to make rudimentary use of digital devices and applications. These can be seen as skills that are essential to being able to access and begin to use digital technologies. There are a number of such 'foundational skills' (World Bank, 2016) that allow an individual to operate devices, to connect to the internet, to set up accounts and profiles, and to access information and resources. The International Computer Driving License (ECDL) denotes these as basic 'start-up' and 'IT User Fundamental' skills encompassing competencies including understanding basic ICT concepts, adjusting settings and managing files.

These basic activities require a range of psychomotor skills such as the manual dexterity required to use keypads, and the gestural skills required to operate touch-screen technologies. Alongside basic numeracy and literacy skills is the growing prominence of 'visual literacy', commonly defined as the ability to make sense of and respond to visual cues and representations embedded in software and applications, as well as content created by other users (Spalter and van Dam, 2008). All these basic skills and competencies are integral to progressing from being a non-user of digital technology to a user.

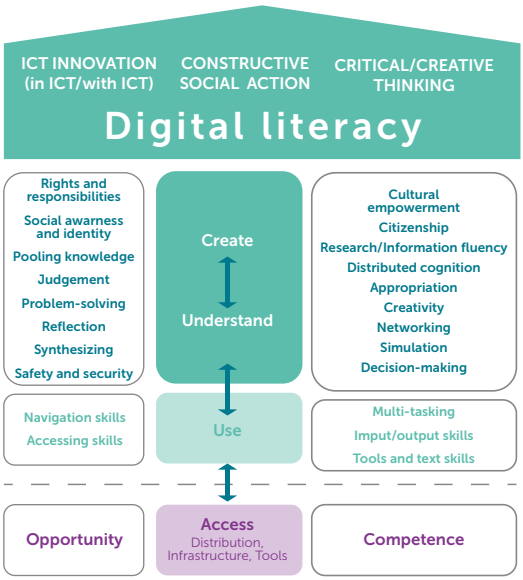
These skills and competencies are continually changing at a much faster rate than other areas of basic skills (such as numeracy, literacy and oral communication). For example, it is likely that the use of digital devices and systems over the next decade will involve a range of different modes of engagement and interaction. Devices that are increasingly haptic in terms of input and output will require a range of embodied, interactional skills involving touch, gesture and other psychomotor competencies. The rise of voice- (and perhaps even brain-) initiated commands will also necessitate new storage and are also likely to change as operating systems move away from 'desktop' interfaces, text-based and icon-based interactions. All these features will alter the nature of what are considered to be 'entry-level' digital skills required to access and make functional use of digital technologies.

2. **Generic digital skills:** Using digital technologies in meaningful and beneficial ways

A broad range of intermediate skills and competencies are required to make use of digital technologies in meaningful and beneficial ways. These skills often form the basis of national plans and strategies for 'digital skills' and 'digital literacies'. Indicative of these is the composite 'digital literacy model' collated by Canada's 'MediaSmarts' Centre for Digital Literacy. This model sets out four broad, interrelated elements, progressing from basic access, awareness and training to more sophisticated outcomes and critical understandings. The model highlights the foundational importance of 'technical fluency' required to use devices and software as well as to access information. It also highlights the importance of helping individuals comprehend, contextualize and critically evaluate what technologies are doing and towards what ends they are being used. It then shows the 'creative' skills that lie at the heart of making an active contribution to digital society. Taken as a whole, these can be seen as sets of digital 'life skills' that enable an individual to make substantive and beneficial use of online applications and services.

Digital skills and competencies are not static; they change rapidly due to technological advancements.

Digital literacy model: Canada Centre for Digital and Media Literacy



Source: MediaSmarts, 2017.

These intermediate capabilities are expanded upon in other frameworks and plans. For example, the European Digital Competence Framework for Citizens (European Commission, 2017) presents an elaborated series of components of digital competence and highlights eight levels of competency (from 'Foundation' to 'Highly Specialized'). Similarly, the OECD framework of digital skills outlines a range of 'ICT generic skills' to use such technologies for task-orientated purposes, such as using software and accessing information (OECD, 2016c). The current UK 'Basic Digital Skills Framework' (Tech Partnership, 2017) sets out five areas of 'digital capability' — encompassing information handling, online communication, transactions and financial management, creating digital content such as text posts and images, and making use of digital tools to solve problems. While there are variations in how these types of skills are described around the world, five areas of skill and competencies recur throughout these specific frameworks that merit attention:

i) First are the associated areas of **'information literacy'** and **'data literacy'**. Of course, these were well-established areas of competence prior to the widespread use of computers and the internet. Yet the ability to make use of information and data is acknowledged to assume a heightened prominence in the digital age. The European Digital Competence Framework identifies various aspects of information handling and use, including: an individual's awareness of their information needs; the ability to locate and retrieve digital information and content; ability to evaluate and judge the relevance and reliability of information sources; and ability to store, manage, and organize digital information and content.

These issues correspond with the growing importance of an individual's ability to 'handle' digital data. Competencies here range from basic issues of data storage, management and organization, to the ability to manipulate and use data to construct calculations and answer questions. Such forms of 'data literacy' also encompass an individual's capabilities to manage the digital data that is generated as a result of his or her technology use — what can be termed a user's personal 'digital legacy'. Capabilities here include awareness of the permanence of data gathering, data sharing and the publishing of personal information, together with an individual's ability to retain control of data and information in terms of data privacy and digital identity.

ii) Alongside these skills and understandings are the associated areas of digital **'communication'** and **'collaboration'**. In the European framework, these capabilities are defined in terms of what can be achieved through using digital technologies to interact and share with others, particularly what is described as 'participat[ing] in society through public and private digital services and participatory citizenship' (European Commission, 2017). Similar understandings of digital

citizenship are also widespread in Asia and the Pacific and are being codified into education policies and formal curricula (UNESCO, 2016a; UNESCO, 2014a). These digital citizenship and digital participation skills extend from the capability to be part of online communities and groups to contributing to a collective understanding of the responsibilities that digital users have towards each other. In this latter sense, the notion of digital citizenship has parallels to the concept of global citizenship and the importance it places on belonging to a broader community and common humanity, with emphasis on the interconnectedness between local, national and global issues (UNESCO, 2015a; UNESCO, 2014b). In the digital sphere it also reflects an awareness of the range of interests of vulnerable and less advantaged users, underpinned by a collective acknowledgement that different users have different needs.

iii) Third is what the European framework terms **'digital content creation'**. Acknowledgement of these capabilities reflects the importance of framing digital skills in terms of 'creation' skills as well as 'consumer' skills (European Commission, 2016). This notion of digital creativity therefore positions users as digital participants and makers, confident and skilled enough to publish content, contribute to existing platforms and build digital environments. In line with the participatory nature of many 'social' platforms and applications, emphasis is placed on collaborative co-creation and re-creation of existing content, as well as the individual authoring of original content. In this sense, the European framework highlights the capability to 'edit', 'improve' and 'integrate information and content into an existing body of knowledge' (European Commission, 2017). Other descriptions highlight the importance of patchwork and 'remix literacies' (Knobel and Lankshear, 2008).

iv) Underpinning many of these definitions and frameworks is an acknowledgement of what is often termed 'digital safety'. UNESCO (2014a) has traced how this issue has moved from marginal to primary importance within education systems in Asia and the Pacific. In Europe, policy-makers have attempted to develop a common Digital Competence Framework highlighting a wide range of issues relating to digital safety — from ensuring data protection and personal data privacy to awareness of issues of social well-being associated with technology use. It also specifically highlights the importance of understanding environmental impacts of digital technology use. Similarly, the UK 'Basic Digital Skills Framework' details 'safety' aspects for all five of its areas of digital competency. These include maintaining security tools and virus software as well as awareness of likely sources of online harm (such as consumer scams and malicious websites). This framework also draws attention to understanding the legal ramifications of online copyright.

The notion of digital creativity positions users as digital participants and makers.

v) Along with these concerns with online risks and hazards is the corresponding awareness of **digital rights**. Here, it is argued that users must understand their rights (including human rights, consumer rights and the right to equality irrespective of gender, age, race, sexual orientation or disability). An emerging issue here is the importance of children's digital rights (Third et al., 2014). In particular, it is increasingly recognized that the online rights of children must be transparent to users under the age

of 18. The UN Convention on the Rights of the Child (UNCRC) makes it clear that, due to their physical and mental immaturity, children under 18 require special safeguards, care and appropriate legal protection in all settings.

3. **'Higher level' skills:** using digital technology in empowering and transformative ways

These intermediate skills form the basis of most users' everyday engagements with digital technologies, and are therefore a significant focus for this report. However, many discussions around digital skills tend to concentrate on 'higher level' skills that allow users to make use of digital technologies in notably empowering and transformative ways. Most obviously, this includes the **advanced skills that form the basis of specialist ICT occupations and professions**. As highlighted in Chapter One, there is an ever-expanding range of digitally-related jobs that require specialist skills. These include 'ICT specialist skills to program or develop applications and manage networks' (OECD, 2016c). These occupations all require skills that usually result from advanced education and training, as well as extensive self-tuition and practical experience. Regardless of their provenance, these are high-level technical skills that are not developed through everyday technology use. These skills include proficiency in programming languages, data analysis, processing and modelling skills, and so on.

While the majority of these skills remain within the domain of professional ICT workers, significantly the 2010s have seen the increased promotion of **computer programming skills** (often referred to as 'coding') as a higher level digital skill that is relevant to all citizens, regardless of their professional role or vocational ambitions. Computer programming and coding skills are seen to support higher-order mental development as well as encourage under-represented groups to pursue advanced ICT education and enter science, technology, engineering and mathematics (STEM) fields (UNESCO, 2017a). Coding competence is also seen as an important life-skill, giving non-professional users an advanced understanding of the digital systems that they encounter and 'opening up the black box' of computer to laypeople (Rushkoff, 2010). As the World Bank (2016) reasons:

> Only a small share of the workforce will be involved in developing software or systems design, but exposing children to coding and basic ICT concepts can influence career choices for some and impart a basic understanding to many.

The past few years have seen a growing association of skills in the area of


© Rattham/iStock

programming, coding and other forms of so-called 'making' with the development of various forms of '**computational thinking'**. This has been defined as:

> the process of recognizing aspects of computation in the world that surrounds us and applying tools and techniques from computing to understand and reason about natural, social and artificial systems and processes (Royal Society, 2012).

The development of computational thinking through computer coding and technology-based 'making' is framed in various ways. It encompasses problem-solving, examining data patterns, decomposing problems, using algorithms and procedures, making simulations, computer-modelling and reasoning about abstract objects (Bocconi et al., 2016). These are seen as higher-level skills that initially arise from the advanced use of digital technology and are supported by the further use of advanced technology.

Beyond these specialist skills, much attention has been given over the past decade to so-called '**twenty-first century skills**'. Originating from a consortium of industry, practitioner and academic interests (the 'Partnership for 21st Century Learning'), definitions of twenty-first century skills tend to vary. The term generally encompasses areas such as communication, collaboration and teamwork, critical thinking and problem-solving, creativity, innovation and entrepreneurship. The OECD digital skills framework identifies these as 'ICT-complementary skills', essentially skills that allow people to 'process complex information, communicate with co-workers and clients, solve problems, plan in advance and adjust quickly' (OECD, 2016d).

While many of these competencies have underpinned educational provision for a number of years prior to the advent of computers, descriptions of twenty-first century skills are seen to correspond with the fast-changing nature of these skills in the digital society. As such, the US National Research Council (2012) produced a 'consensus report' identifying three broad domains of 'deeper learning' that are associated with digital technology:

- **An interpersonal domain** relating to teamwork, collaboration and leadership (includes competencies of communication, collaboration, responsibility and conflict resolution).
- **An intrapersonal domain** relating to intellectual openness, work ethic and positive core self-evaluation (includes competencies of flexibility, initiative, appreciation for diversity and metacognition).
- **A cognitive domain** relating to cognitive processes and strategies, knowledge and creativity (includes competencies of critical thinking, information literacy, reasoning and argumentation, and innovation).

Although questioned in terms of lack of specificity and supporting research evidence (Rotherham and Willingham, 2010), the notion of twenty-first century skills has proven influential in policy and industry circles. Most recently, these notions have been augmented by definitions of so-called **DQ (Digital Intelligence**). This is an emerging attempt from East Asia to synthesize many of the skills and abilities outlined above, alongside notions of 'digital emotional intelligence' to produce a description of the cognitive, social and emotional elements of contemporary digital technology use (DQ Institute, 2017).

Finally, alongside these continuing efforts to define the high-level 'soft' skills required for effective use of digital technology, are skills associated with developing 'critical' understandings and applications of digital technologies. Extending the previously discussed notions of information literacy and digital literacy are the areas of '**critical digital literacies**'. While definitions are

contested and evolving (Pangrazio, 2016; Emejulu and McGregor, 2017), 'critical digital literacy' is described as a set of specific understandings and a disposition towards the politics of the digital society and digital economy. This foregrounds the ability of individuals to analyse the political features of digital technology and manipulate these to achieve particular outcomes. In this sense, it is argued that individuals need to be able to recognize the motivations of actors in the digital spaces.

One specific focus here is the ability to critically assess information, its purposes and the methods by which it is organized and spread. For example, in terms of **critical information literacies**, an emphasis is placed on awareness of the socially contrasted nature of online information, and notions of authority and authenticity. These issues are extended in UNESCO's notion of 'media and information literacy', a composite set of competencies based around the development of knowledge and critical understandings of media and information providers (Grizzle et al., 2013). This approach is concerned with developing the capacity of individuals to be active consumers (rather than passive recipients) of information both online and offline. It includes developing understandings of how media and other information providers function, the ability to critically evaluate media content, and making informed decisions when using of information and media content.

A related concept of **critical data literacies** emphasizes awareness of alternative ways of generating and using digital data in beneficial or resistant ways. These approaches stress the need for individuals to explore alternative means of engaging with digital data in ways that are reflexive, self-aware and self-empowering. This relates to developing critical understandings of the data that users consciously 'give' to digital devices and systems, the data that systems surreptitiously 'extract' from users (either through direct monitoring or through inference), and the data that devices and systems 'feed back' to users.

Mapping the continuum of 'digital skills' and 'digital competencies'

As this brief overview demonstrates, the simple term 'digital skills' refers to a range of different abilities and an array of different and evolving concepts. In making better sense of this complexity, there are a few important overarching points to note. Firstly, the descriptions just outlined cover a range of different domains, including behavioural, technical, cognitive, social and ethical domains (World Bank, 2016; European Commission, 2017b).

Secondly, many of these previous descriptions are not 'skills' per se. For example, many of the explicitly labelled 'twenty-first century skills' are defined as a combination of skills, knowledge, work habits, character traits and dispositions. As Neelen and Kirschner (2016) reason, many of these 'skills' are more accurately defined as 'competencies'.

Thirdly, these competencies do not always involve the direct use of digital technology. While many of the competencies just described relate to individuals' direct, personal use of digital technology, there is a growing need for awareness, understanding and critical responses in relation to digital technologies that individuals might not be engaging directly with (or even be aware of), yet impact them nevertheless. This awareness of digital technology that is 'done to' an individual rather than 'done by' an individual is a particularly important element of the critical understandings, digital citizenship, safety and rights competencies just outlined.

Fourthly, these skills are all interconnected and broadly complementary. They can therefore be seen in terms of a graduated continuum from basic generic skills to higher-order, specialist skills. In an ideal situation, an individual will possess a combination of these skills, the nature of which is likely to alter over his or her life-course in response to changing circumstances and contexts. For example, during their peak working years, those individuals employed in digitally-related occupations will require specialist ICT skills alongside professionally-relevant generic digital skills and 'softer' communication, collaborative and problem-solving competencies. Similarly, as OECD (2016d) reasons, 'foundation skills, digital literacies as well as social and emotional skills are crucial to enable effective use of digital technologies by all individuals in their daily lives'.

Fifthly, few (if any) individuals would be expected to have all of these skills and competences. For example, recent descriptions of digital competence are often framed in terms of a 'T-shaped skill set and mindset' in which individuals possess depth in one area and good knowledge across many other areas (European Commission, 2016). This highlights the need for individuals to be versatile and adaptable in the face of ongoing digital changes. This versatility can be described in terms of digital 'disposition' or digital 'mindset' and is similar to what is referred to in the Nordic European countries as '*digital bildung*' and '*digital kompetanse*'. As Voogt et al. (2013) describe, this can be seen as:

> a complex competence that emerges as the sum of simple ICT skills (using software to search, locate, transform and control information) and more advanced skills (to evaluate, interpret and analyze digital genres and media forms, [including] through the creative and critical use of digital tools and media).

The challenges of developing digital skills for all

Chapter Two has set the scene for the question that is central to this report: How can digital skills and competencies be developed by all individuals on a sustainable basis? Clearly this is a complex problem, yet it is a crucial issue to address if the potential and ambitions of the broadband society are to be realized. As has been implied from the beginning of this report, this is an area that needs to be addressed by education at all levels and in all forms. Having established the range of skills and competencies relating to this question, the chapter concludes by reflecting briefly on the challenges of developing digital skills for all.

Women are 1.6 times more likely than men to report a lack of skills as a factor impeding their use of the internet.

Above all, the preceding overview is tempered by the pronounced disparities and inequalities in terms of individuals' ICT skills and competencies. These mirror the digital inequalities and 'digital divides' highlighted in Chapter One in terms of ICT access and ICT use. Inequalities in digital skills have been documented in both developing and developed regions. In Europe, a region where detailed data is available, it is estimated that 'around 45% of EU citizens still do not have basic digital skills' (European Commission, 2016).

Similarly, across OECD nations, the 2015 PIACC Survey of Adult Skills reported that 56% of the adult population 'have no ICT skills or have only the skills necessary to fulfil the simplest set of tasks in a technology-rich environment' (OECD 2016b). It is also recognized that these disparities follow entrenched fault lines of gender, social class and age. For example, in terms of gender disparities in OECD countries, while it is argued that there is 'no sizeable gender gap' in the share of people 'possessing good ICT generic skills', it is acknowledged that a 'sizeable gap' persists in terms of ICT specialist skills (OECD, 2016c). Globally, gender divides are severe; women are 1.6 times more likely than men to report lack of skills as a factor impeding their use of the internet (Web Foundation, 2016). Certainly, the restricted progression of girls and women into higher-level, higher-status forms of digital skills education remains a persistent trend and concern around the world (Accenture, 2016).

Any attempts to redress these inequalities face a number of challenges. For example, the sheer breadth of digital skills and competencies needed in today's broadband society eludes a concise, easily specified definition. This in turn compromises the development of comparable measures and modelling. These issues of definition and measurement are acknowledged to be key elements to any successful development of new education provision and practice. This prompted world leaders to call for 'a standardized, multidimensional definition of digital literacy' (European Commission, 2017b). While such a definition might be possible for specific regions that are broadly comparable in terms of social and economic contexts, it is unlikely to have universal relevance due to the enormously varied state of technological development globally.

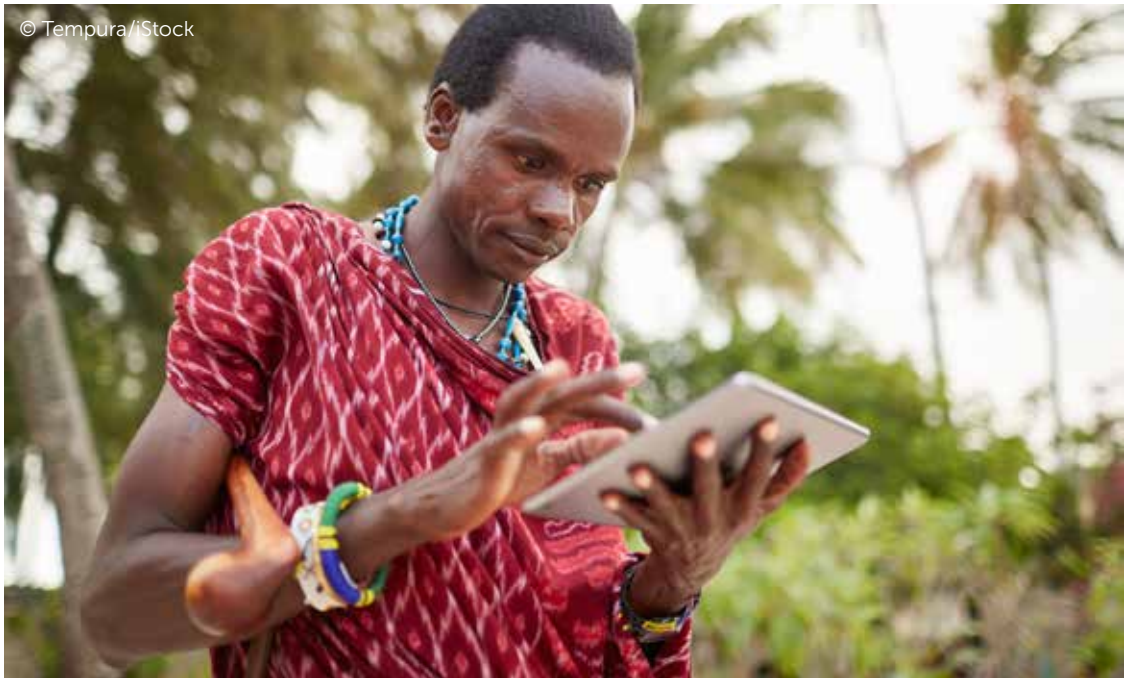
The forward-looking and ambitiously-pitched tone of many discussions of digital economy and digital society needs to be balanced with recognition of enduring fundamental disparities in basic, functional ICT skills. Debates over digital skills have to weigh concerns over 'upskilling' those who are already economically active with meeting skills needs that are more rudimentary. In this latter sense, providing relevant digital skills development opportunities for all involves

a continued emphasis on addressing the barriers and limitations some marginalized and vulnerable people face in terms of ability, capability, interest and motivation. It is also important to note that these disparities are enduring and applicable to younger as well as older generations. Indeed, as Livingstone et al. (2017) observe:

> Children are not 'digital natives' who need little support in making the best of digital media. Few have received much guidance from school or home, too many lack skills other than basic functional skills, with particular gaps in their critical information literacy skills that merit urgent attention, especially as part of any program that uses digital media to meet its objectives.

Above all, then, is the need to retain a focus on developing what could be termed the 'digital agency' of individuals — whether in terms of their development as digital citizens or as digital workers. This notion of digital agency relates to the technological support and societal freedom to act and to pursue chosen objectives or goals. Individuals must be empowered by all actors in the digital environment (state and commercial) to access digital environments knowledgeably, creatively and fearlessly.

Overcoming all these challenges will not simply be a technical matter of ensuring technological access and infrastructure. Alongside the essential technological components of the broadband society are a variety of 'analog components' (World Bank, 2016) that are necessary elements in developing a sustainable, inclusive digital society and thriving digital economy. One crucial component is an effective partnership between business, government and non-profit actors working towards the development of carefully targeted policies and initiatives (World Bank, 2016). Another component is the establishment of 'good institutions' in terms of accountability, innovation and ambition. In this sense, the most important components are not related to technology per se, but to issues of good governance and organization. With these issues in mind, Chapter Three will outline examples of promising practice and policy-making.



Investing in digital skills

The most significant sources of funding digital skills development include government funding, personal and household expenditures and for many developing countries, external financing usually in the form of official development assistance (ODA) or loans.

In France, the government is making major investments in digital skills. Since December 2012, the Ministry of National Education, Higher Education and Research has been developing an ambitious strategy to bring schools into the digital age. This strategy aims to make the most of the opportunities offered by digital technology to ensure pupils' success. One billion euros in public investment were earmarked for Digital Education development.

Other initiatives and large programmes are financed by the private sector, including IT multinational entreprises. For example, SAP is supporting Africa Code Week. Last year, the initiative helped 426,000 youth across 30 countries to either write their first lines of code or simply touch a computer for the first time.

Domestic entreprises are also involved in digital skills development. In Morocco and Tunisia, a payroll tax finances technical and vocational training (TVET) programmes that include digital skills development; in Brazil, the so-called 'S' system – in which organizations offering TVET among other social services are financed through levies paid by private companies – is funding a major initiative for digital skills development.

While these programmes are important, households routinely fill financing gaps and spend significant sums of money on education. In low-income countries, household spending on education is estimated to amount to almost half of total domestic public expenditures.

Additionally, many developing countries rely heavily on external resources. In Malawi, the World Bank provided a US$72.4 million International Development Association credit to help Malawi build the digital foundations needed to help the country connect to the global digital economy. The Malawi Digital Foundations Project, which is Phase I of the Digital Malawi Program, will significantly expand access to the internet by making it more affordable, reliable and available in all parts of the country. It also includes support for building the necessary infrastructure and skills for the government to scale up its online public services offerings.

At global level, providing digital skills to all will require a massive investment from all stakeholders, and in particular governments and industry, to scale up effective programmes. Public and private initiatives and efforts already active at education policy and operational levels need to be mobilized to finance digital skills development.

3

Creating conditions for the development of digital skills and competencies: Promising education practices and policies

Introduction

This chapter provides an overview of emerging trends and promising practice in the development of digital skills and digital competencies. It attempts to consider and address the wide range of contexts, needs, populations and forms of digital competency that constitute the globally broadband society. The chapter highlights a number of indicative programmes and initiatives around the world. Some of these examples relate to the formal education sector (schools, colleges and universities), others describe education provided by non-profit and for-profit organizations, and still others relate to informal or self-directed learning and work-based training.

The examples consist of projects seeking to impart basic digital skills and programmes that aim to teach more advanced skills required for ICT professionals. As a whole, these examples are used to indicate common factors and issues that underpin successful efforts to support digital skills development on a sustainable basis.

Efforts to teach digital skills are often aimed at people who are otherwise making little or no use of digital technologies.

The next four sections present a selection of cases of promising provision and policy-making in four broad areas of digital skills development. These areas are:

- Digital literacy for all or basic digital skills for low-level users of ICT.
- Computer programming and coding skills for children and young people.
- Specialized digital skills for professionals with ICT-related jobs.
- 'Soft' and 'complementary' skills, including 'twenty-first century skills', digital citizenship and digital rights, and critical digital literacies.

The development of basic digital skills

Efforts to teach digital skills are often aimed at basic or 'entry level' training for people who are otherwise making little or no use of digital technologies. These forms of provision are often targeted at specific groups such as older adults, people with low levels of education, people with disabilities, and other vulnerable or disadvantaged populations.

Government and state agencies in many developed countries have run basic digital skills initiatives and programmes over the past two decades. These vary in focus and form, reflecting specific technological imperatives of the time. Usually, these initiatives aim to raise public awareness of digital inclusion issues and publicize the need for digital skills. In terms of tangible provision, they often also involve 'low-threshold' tuition and teaching, the development of accompanying digital resources and, in some instances, shared access to digital devices. These initiatives can be run from within central government departments, by state-affiliated agencies, and by non-profit organizations endorsed by government.

One policy approach is the inclusion of digital skills as part of government-supported 'basic skills' provision. A well-established example is the Norwegian 'Skills Plus' programme, which has run since 2006 and was originally called the 'Programme for Basic Competence in Working Life'. This programme focuses on increasing numeracy, literacy, oral communication and digital skills among the adult population. It offers annual rounds of funding for learning provision and courses delivered by local public and private providers linked to a national skills framework. To date, over 30,000 participants have joined the programme, with between half to two-thirds of each

year's funded courses relating to the area of digital skills (Kompetanse Norge, 2017). While generally seen as a success, concerns have been raised over the ability of the programme to reach the most vulnerable and underprivileged groups. As Lakey (2012) observes, 'evaluation of the programme suggests that it has been successful, but that there are reasons to question whether it has managed to reach those with the lowest levels of competence. For a variety of reasons, those with the lowest levels of skills do not appear to have made full use of the program'.

The longevity of the 'Skills Plus' programme is rare, with similar programmes in other countries tending to be more short-lived, given inevitable changes in political administrations and corresponding shifts in political priorities. Many of the high-income countries that first began to address basic digital skills development during the 1990s have since developed devolved systems of digital skills provision, characterized by limited-term programmes and initiatives. The UK government, for example, currently has a Government Digital Service (GDS) which is responsible for ensuring the inclusive digital transformation of government through its 'Digital Engagement' and 'Assisted Digital' teams. While these official agencies are responsible for promoting the development of basic digital skills, they are supported by independently coordinated organizations. For example, 'The Tech Partnership' is a non-profit network of employers that promotes a common digital skills framework, provides tools and resources, and champions local initiatives designed to develop basic digital work skills. Another example is 'DotEveryOne', a charity supported by software companies, banks and other large employers. This organization also promotes its own basic digital skills framework, supports research and lobbies for basic skills development with a particular focus on social inclusion and digital rights.

When making sense of basic digital skills provision in any country, it is important to consider the history of previous policy-making and provision. In the UK, the above arrangements build on a decade of previous programmes, agencies and initiatives. One enduring legacy is the network of 'UK Online Centres' that was established in the 2000s. This continues to date in the form of 5,000 grassroots community organizations that have evolved to offer internet access and basic skills training under the guise of the 'Online Centres Network'. These centres are widely welcomed as continuing to offer a 'deep reach' for digital inclusion activities within communities (Tinder Foundation, 2016). That said, official evaluations during the centrally-funded phase of the programme raised concerns that 'many UK online centres are not reaching many people in the most excluded groups' (Wyatt et al., 2003).

State-supported digital skills provision tends to be a patchwork of policies, agencies and actions that operate on a devolved and community-specific basis.

Given this background, state-supported digital skills provision in the UK is very much a 'patchwork' of policies, agencies and provision. Indeed, similar collections of national programmes, strategies and initiatives continue to be developed with an objective of supporting the provision of tuition, resources and access to technology for those with little or no level of digital skills. Many of these initiatives operate on a devolved community-specific basis, with various local providers coordinated under larger nationwide programmes.

Indeed, successful attempts to scale up the delivery of basic digital skills development tend to involve the support of local provision through centralized funding for resources, infrastructure and teacher training. This distributed approach underpins the extensive 'She

Innovative initiatives support unstructured mentoring of digital skills between novices and experts whose relationships are primarily informal and fostered individually.

Will Connect' initiative in Nigeria, Kenya and South Africa (see Case Study 1 in the Appendix). A similar approach underpins Mozilla's partnership with UN Women to support a network of web literacy clubs in Kenya and South Africa specifically aimed at upskilling girls and women through face-to-face peer learning. Smaller-scale programmes exist across Africa, South Asia, Central and South America, such as Plan International's work in South Asia to establish ICT labs that have provided training for nearly 9,000 girls in Pakistan and digital learning centres that have provided training for 15,000 girls in Delhi.

Such programmes have proven successful in engaging large numbers of girls and women. However, they continue to face a range of practical barriers that are seen to limit inclusivity. For example, reflections from the pilot mobile-based version of the Mozilla Web Literacy programme note that enthusiasm for the project within communities does not necessarily lead to sustained participation, especially for older women and those with low levels of literacy. For example, enduring concerns relating to language and the cost of technology use still act as deterrents to participants, regardless of programme quality (Dhalla, 2016).

Aside from these (inter)national programmes and networks of local provision, another area of intervention is the support of peer-mentoring programmes where digitally-savvy individuals help others to develop ICT skills. Thus, rather than institutions providing formal tuition or teaching, the approach focuses on supporting informal mentoring relationships between individuals. Informal peer mentoring was a key element of the Reboot UK programme, which focused on providing basic digital skills training to families in poverty, people with mental health issues and homeless people (all groups that were perceived to self-exclude from mainstream digital skills development programmes). The programme evaluation shows that Reboot UK was successful in supporting nearly 1,000 vulnerable people over a six-month period to develop digital skills and observed that 'peer mentoring creates a non-hierarchical learning environment, which facilitates support and discovery learning' (Reboot UK, 2017).

Other programmes have deliberately used expert peers from different backgrounds. For example, the Swedish 'IT Guide' programme has trained digitally-skilled young migrants to act as ICT guides for elderly Swedes. The Swiss 'CompiSternli' programme similarly pairs digitally-skilled children (with an average age of 10 years) with older adults (with an average age of 70 years) who want to learn to use tablet computers and access the internet (Genner et al., 2012). Initiatives such as these are designed to support unstructured mentoring of digital skills between novices and experts whose relationships are primarily informal and fostered individually (Bakardjieva and Smith, 2001). This approach is considered to be particularly appropriate for 'non-users' who may lack confidence and motivation.

The development of computer programming and coding skills for children and young people

As highlighted in Chapter Two, computer programming and coding has emerged over the past five years as a high-profile area of digital skills development. Unlike

other areas of digital skills and digital competencies, coding has been quickly incorporated into formal education provision. This is due to growing concerns during the 2000s around the lack of skilled programmers in many countries, alongside the perception that coding is a ready means of developing higher-order skills such as problem solving, teamwork and computational thinking.

Indeed, the incorporation of coding in school curricula is compulsory in many developed countries. Education authorities around the world are following the initial lead of countries such as Denmark, Estonia, the UK and US to introduce computer programming, coding and software development into school curricula. Cohorts of teachers are being trained to teach computer science in classrooms, with these changes taking place across elementary and secondary school levels. The Singaporean 'Code@ SG' initiative, for example, aims to establish coding as a 'national capability' starting from early-grade education and continuing through secondary school.

A number of organizations have contributed to supporting (and shaping) government efforts to establish the teaching of coding in schools. These include various initiatives and resources from IT industry actors alongside national 'computer societies' and other computer science-related interest groups. One focus has been provision for the training of teachers in coding skills. In Australia, for example, Google has partnered with the University of Adelaide Computing Department to develop a MOOC (Massive Open Online Course) for primary and secondary teachers. The course is designed to help Australian teachers implement new national curriculum requirements for programming and coding. After the completion of the pilot phase, the project organizers were awarded US$6.9 million of government funding to support a nationwide rollout over a four-year period. Evaluations have shown high initial levels of teacher interest, but low levels of course completion. Fewer than 10% of enrolled teachers completed the online course (Vivian et al., 2014). This arguably reflects the general tendency for MOOCs to generate large initial numbers of participants, but low levels of eventual course completion.

Many of these offerings are notable in their focus on extending the development of coding skills among teachers and students who otherwise might lack confidence or motivation to engage. One example of this is the '1,2,3...Codez!' programme led by the French 'La main à la pâte' Foundation. This initiative has involved the development of free online and paper-based resources for teachers, providing a ready-made set of open pedagogical resources to be used in classrooms, alongside a bespoke collaborative website and network of face-to-face training sessions. The initiative involves multinational IT corporations (such as Microsoft and Google), publishing companies, non-profit educational technology associations and the French Institute for Research in Computer Science and Automation. This partnership stretches beyond industry and education sectors and has led to the production of easily accessible, high quality free resources that are being taken up across French-speaking regions.

The incorporation of coding in school curricula is compulsory in many developed countries.

Alongside these shifts in formal education provision, specifically-established organizations such as 'Code.org' and 'Code the Future' are offering out-of-school tuition and resources. These often take the form of after-school and holiday clubs that provide opportunities for students to develop simple programming skills and knowledge. A range of organizations now offer coding workshops — such as the '#Supercoders' programme organized by the Orange Group which has provided coding tuition to over 6,000 young people in

17 countries across Europe and Africa. Coding is also a popular element of many 'maker' technology programmes, such as the Malaysian 'Digital Maker Eco system'. A complementary approach has seen the recent popularity of annual 'Code Weeks' and coding competitions designed to promote the development of coding skills among young people (e.g. the 'Africa Code Week' initiative and the worldwide 'Technovation' competition). Provision such as this offers young people opportunities to develop coding skills unhindered by school curriculum, assessment and time constraints.

There is emerging evidence of the effectiveness of these non-formal offerings. For example, a recent controlled-trial evaluation of the 'CodeClub UK' network confirmed that participation improved students' coding skills and their attitudes towards further study in programming and computer science (Straw et al., 2017). However, there was no evidence of these clubs leading to transferable skills, such as improved computational thinking, problem solving or collaboration. Moreover, the inclusivity of this approach is compromised by the self-selecting, voluntary basis of programme participation.

Another trend in informal coding provision is the surge of interest in low cost mini-computers, such as the Raspberry Pi and Micro:Bit, as well as educational programming languages such as Scratch and Python. These devices, applications and programming languages are being adopted on a large scale as a means of helping students develop basic programming skills alongside increased understandings of the functionality and operations of computers. For example, there are an estimated 12.5 million members of the

online Scratch programming community, and Raspberry Pi estimates sales of over 14 million devices.

These resources are also being used in targeted local programmes around the world. For example, the Madanyu Foundation runs a number of programmes across South Asia for specially configured Raspberry Pi mini-computers, including creative coding programmes in India. Other pilot projects, such as work led by UNICEF in Lebanon, has involved the use of these devices with children and young people in refugee camps and settlements for displaced peoples.

Micro:Bit Foundation

The Micro:Bit programme aims to widen access to computer programming and coding education around the world. It is based around the US$20 Micro:Bit mini-computer. The Micro:Bit device measures 5 cm^2 with a small LED matrix screen, two programmable buttons, sensors and an array of plug-in options for various additional components. All hardware and software is provided in a state of 'open' development to allow easy modification and reconfiguration by users.

The programme was initiated by the UK national broadcaster, the BBC (the British Broadcasting Corporation). Initially, the BBC led a partnership of 29 organizations to oversee the development, production and distribution of devices to one million UK school students aged 11-12 years. This was accompanied by the production of online teaching resources, television programming and establishment of user communities to support the use of the Micro:Bit in school and out-of-school settings. These efforts involved a number of technology industry partners (such as ARM, Amazon Web Services, Microsoft and Samsung) alongside partners working to develop educational resources (BBC Learning, Institution of Engineering and Technology) and to promote the programme around the world through the British Council.

These initial efforts in the UK have now been scaled up through the establishment of a non-profit 'Micro:Bit Foundation' with a stated mission to 'lower barriers to technology invention' around the world. The Foundation is working with governments, public broadcasters and NGOs to distribute Micro:Bit devices in appropriate ways across different national and regional contexts. For example, a roll-out of devices is planned for all 11-12 year olds in Iceland, and plans to distribute 100,000 devices constitute part of Singapore's new Digital Maker Program. Other partnerships have been established in North America with non-profit organizations ('Project Lead The Way' and 'Fair Chance Learning'), aiming to distribute devices to two million US and Canadian elementary and middle school students by 2020.

Amid this mass distribution of resources, initial in-house evaluations suggest that the programme is positively influencing coding attitudes and skills among students and teachers, including the increased interest of girls in studying technology. This success is attributed to a number of factors. The device is a familiar concept to many educators, following the initial success of similar low-cost mini-computers such as the Raspberry Pi. Also important is the production of high-quality resources to aid the integration of the Micro:Bit into official school curricula.

As distribution widens, the Foundation has also recognized the importance of adapting resources to fit regional contexts. For example, the Foundation is currently exploring the possibility of larger arrays of LED screens to accommodate Chinese and Japanese characters, as well as the need to produce a mobile-only app-based simulation for African countries.

The development of specialized digital skills for professionals

A wide variety of programmes are focused on the development of specialist ICT skills required for the digital economy. While specialist digital skills are often expected to be developed informally 'on the job' or through ad hoc work-based training, the growing diversification of digital skills required for the different sectors of the economy has prompted the expanding provision of high-level skills training and education.

While many of these efforts are led by industry and education providers, the development of work-related specialist ICT skills is the focus of government policy agendas around the world. For the most part, policy strategies to develop workforce skills have tended to be exhortative in focus. For example, the Portuguese 'National Strategy and Action Plan for Digital Employability 2015-2020' emphasizes the need to reduce shortages in ICT professionals and to increase workforce opportunities to acquire employment-related ICT skills. This was developed through a consortium of private and public organizations (the 'Portuguese Coalition for Digital Employability') and detailed a number of 'concrete measures for promoting digital employability'. These include plans for nationwide initial skills mapping, appointment of 'digital ambassadors', development of teaching resources, the development of initial qualifications for young people, and mid-career 'requalification' for ICT professionals.

The increased provision of ICT-specialist training continues to be a growing area within the technical and vocational education and training sector.

In the Netherlands, 'National Technology Pact 2016-2020' is an expression of the government's effort to boost technology-related skills acquisition within schools as well as in vocational education systems. One focus of this strategy is on enhancing school- and college-based provision, with an emphasis on ensuring that students enrol in technology-related courses and progress into technology-related jobs. This includes strengthening the professional capacities of technology teachers and fostering collaboration between the education and business sectors in terms of course development, teacher training and industry placements for students (UNESCO, 2012a). Another focus is on supporting the reskilling of workers in technology occupations to ensure their retention in the technology sector, with particular attention paid to retraining individuals with a technology background 'whose jobs are under threat or who have been marginalized'.

The Netherlands government claims some initial success in the 2013-2015 iteration of this pact in broad terms, citing a 'growing number of young people opting for technology', 'greater commitment from the business community' and a 'broader' range of higher vocational programmes. However, the revised 2016 plan acknowledges the 'continued urgency' of addressing falling numbers of student enrolments in technology and science programmes (especially girls), and an emerging 'major shortage of qualified technology lecturers in the vocational education sector'.

The increased provision of ICT-specialist training continues to be a growing area within the technical and vocational education and training (TVET) sector (UNESCO and IBE, 2017). These TVET provisions are complemented by 'second chance' programmes and initiatives designed for young people with incomplete initial education or who lack professional training and employment opportunities. While these programmes tend to focus on lower-level generic ICT skills, they are also often targeted to support progression onto developing work-related skills that might support individuals to enter


© Zinkevych/iStock

employment (UNESCO, 2017d). There are many well-established examples of such programmes, often led by industry partners and delivered on a non-profit basis. One prominent example is Training for Employment ('Capacitate para el empleo' in Spanish), an online platform with rich skills development content. Supported by the Carlos Slim Foundation, this platform offers training, certification and job opportunities as well as options to obtain a diploma and access resources for self assessment. Content is developed in collaboration with leading employers to ensure the relevance of the training. The platform, regularly updated to reflect best practices in online training, is free to use and available to all. The Training for Employment website and similar programmes provide training in specific ICT skills identified by local employers. Programme organizers then work with these employers to place trainees into local workforces through apprenticeships or on a fully employed basis.

Other long-running programmes along these lines include the 'ICT Professionals' programme in Spain. This has been led for 15 years by the 'Fundación Tecnologías de la Información' and focuses on developing the digital skills of long-term unemployed participants. Similarly, the 'Interface3' initiative in Belgium has operated since 1984, providing training in specialist ICT skills for women, with provision ranging from initial orientation modules to fully certified qualifications. This programme reports around 70% of participants gaining employment after training. Specific attention is paid to arranging traineeships within ICT enterprises, with a particular focus on women returning to the workplace, those with low levels of education or from migrant backgrounds.

Another focus of programmes in middle- and low-income countries is the development of digital skills required for remote online work. 'Tech for Food' is one such programme, aiming to develop digital skills among displaced peoples with the intention of gaining employment in labour-intensive online work such as data entry, data cleaning and image annotation. This project was funded in 2016 by the UN World Food Program's Innovation Accelerator in conjunction with the American University of Beirut and WFP Lebanon. The programme consists of around six weeks of basic IT training, followed by six weeks of advanced training in web design, 3D modelling and image software. The pilot programme trained 100 Syrian refugees in Beirut, 60% of whom were women. The aim of this approach is therefore to increase employment-related digital skill levels among displaced peoples and their host communities.

In Gabon, UNESCO and the telecommunications provider Airtel are implementing the 'Train My Generation' programme. Running from 2015 until 2018, this programme aims to develop

professional ICT skills in young adults (aged 17 to 35), leading to job placements in occupations ranging from help-desk assistants to software development. While the majority of training has been in relatively basic-level skills, the programme has to date engaged over 4,800 participants.

Other programmes and initiatives are located outside the formal education sector designed to develop skills among groups of professionals. For example, Google's 'Growth Engine for Europe' programme supports a number of digital skills programmes in separate European member states, estimated to have reached over two million participants by the end of 2016. These programmes tend to be focused on specific countries or sectors of ICT-related employment. These 'Digital Garage' and 'Digital Workshop' programmes are aimed at students, aspiring start-up entrepreneurs and people working in small businesses, offering participants access to personalized learning plans, online tutorials and face-to-face tuition sessions and certification. Elsewhere, programmes such as Sweden's 'Professional Master in Software Engineering' (PROMPT) offers university-run master's level courses developed and taught in conjunction with industry partners. The emphasis here is on training that can be provided at home and in workplace settings. These courses are designed to attract individuals who otherwise might not participate in traditional computer-related education and training.

One high-profile trend is the expanding provision of 'coding boot camps'.

Another major trend is the rise of self-directed, 'rapid skills' opportunities for individuals with ambitions to develop ICT-related careers. One high-profile practice is the expanding provision of 'coding boot camps' and similar training programmes in the so-called 'code school' industry. These are fast-paced training programmes (often provided by for-profit organizations) designed to attract cohorts of adults who would not choose to study computer science at university level, but nevertheless aspire to high-status specialist jobs in IT-related sectors of the economy. Originating in North America, coding boot camps are now established in many countries and regions. Some programmes are fee-paying while others offer 'free' training with the proviso that participants repay a proportion of their initial salary once having gained employment. For-profit providers such as 'SheSkills' are now running coding boot camps for women in Pakistan (at a cost to participants of US$20 per week), supported by North American non-profit organizations such as 'Ladies Learning Code'.

Evaluations suggest that the boot camp model does offer individuals a second chance to develop skills that can lead to higher-status employment (CourseReport, 2016; ITU, 2016). However, it is noted that these programmes do not provide a guaranteed pathway to IT employment, and do not necessarily ensure an increased diversity of IT professionals (Thayer and Ko, 2017). Concerns have also been raised over the quick closure of non-profitable programmes, highlighting the precariousness of the 'rapid skills' approach (Fortune, 2017).

An alternative to the 'boot camp' approach is the innovative model of the '42' programme. This originated in France and now has a second official campus in the United States, as well as endorsed (but unaffiliated) institutions in South Africa, Ukraine and Romania. Established by a French internet entrepreneur looking to expand the programming workforce, '42' has no standard entrance requirements, although enrolment is keenly competitive. The programme is free of charge for those students awarded a place and has no fixed curriculum, opening hours or teaching staff. Instead, the 'school' is based around a combination of self-education and open access to high-grade computers, high-speed internet connectivity and high-capacity storage. Participants are expected to collaborate on predesignated

technology development projects and develop their skills through peer-to-peer learning.

Finally is the emergence of programmes aimed at encouraging ICT-supported entrepreneurial skills and 'digital livelihoods'. One leading example is 'Digital Livelihoods: Youth and the Future of Work at Scale', a US$15 million project running from 2015 to 2019 as a partnership between the Canadian government and the social enterprise organization Digital Opportunity Trust. The programme aims to engage up to 200,000 young people in eight African countries (Ghana, Kenya, Malawi, Morocco, Rwanda, Senegal, Tanzania and Zambia), providing digital skills development opportunities with a focus on using ICTs to start businesses, secure employment and access financial products and services.

The development of 'soft' and complementary skills

In addition to the extensive provision of basic digital skills and ICT-specialist skills outlined in Chapter Two, it is also worth considering promising cases that concern the 'softer' skills and critical understandings mentioned towards the end of the chapter. For example, while the topic of 'twenty-first century skills' has gained a high profile over the past decade, efforts to support the development of such competencies have tended to be incorporated into broader education reforms and initiatives. In particular, many countries are now introducing elements of 'twenty-first century skills' into school curriculum reforms, often under the label of 'transversal competencies', 'non-academic skills' and 'non-cognitive skills'. As a recent review of the Asia-Pacific region illustrates, these skills are being incorporated to varying degrees into the school policies and curricula of high- and middle-income countries that range from from Japan, the Republic of Korea and Australia to India, Malaysia, Thailand, Mongolia and the Philippines (ERI-NET, 2016). In part, the cross-curricular and 'non-academic' nature of these approaches reflect what are seen to be practical difficulties of integrating these skills into formal education systems, particularly as policy-makers and educators tend to perceive these skills as not linked directly to student success in comparison to traditional academic and workforce-related skills (Care et al., 2017).

These recent changes are often part of long-standing reforms. For example, Singapore has introduced a 'Framework for 21st Century Competencies and Student Outcomes' which reflects two decades of curriculum development through successive 'Masterplans for ICT in Education' and a long-standing focus on 'applied learning' and 'learning for life' (Tan et al., 2017). Similarly, the provincial government of Alberta, Canada has also fostered cross-curriculum competencies in twenty-first century skills since 2009. The Alberta curriculum now includes a range of 'competencies for engaged thinkers and ethical citizens with an entrepreneurial spirit', focusing on managing information, creativity and innovation, global citizenship, problem-solving and critical thinking (Alberta Ministry of Education, 2013).

Many countries are now introducing elements of 'twenty-first century skills' into school curriculum reforms.

Alongside the realignment of school curriculum, another notable twenty-first century skills project is the 'Assessment and Teaching of 21st Century Skills' programme funded by Intel, Cisco and Microsoft and led by the University of Melbourne. This project developed measurable definitions and pedagogies with a focus on developing new assessment methodologies for complex technology-related skills such as collaborative problem-solving (Griffin and Care, 2015). This resulted in a useful set of frameworks and resources, including a

Lessons learned in the health sector

This text has been contributed by the Novartis Foundation.

Ensuring the ongoing training of health professions is an acute problem in many regions, especially in sub-Saharan Africa and South Asia. Implementing long-term training programmes that provide health practitioners with consistent and replicable education is fundamental. Significant examples of such initiatives where mobile devices were used are the BBC Media Action Mobile Academy and Kilkari programmes, and Amref Health Africa Jibu and Leap programmes. 'BBC Media Action' programmes focus on providing reproductive, neonatal, maternal and child health education via mobile devices. 'Mobile Academy' is a free mobile-based training course designed to refresh community health workers' knowledge of twelve life-saving preventative health behaviours and improve their communication skills. 'Kilkari' delivers free, weekly audio messages directly to families' mobile phones about simple steps they can take to improve the health of new and expectant mothers and babies. Both services are delivered via Interactive Voice Response, which is easily accessible from any mobile phone. These programmes are now being provided on a mass scale. To date, nearly 260,000 community health workers have started the Mobile Academy training course in 9 states, with 170,000 graduated. Similarly, Kilkari has reached more than 5 million subscribers.

In 2016, Kilkari and Mobile Academy were adopted by the Government of India with the aim of helping 10 million women and up to 1 million CHWs on a national scale.[1] In 2005, Amref Health Africa[2] developed a cross-sector partnership with Accenture, the Nursing Council of Kenya (NCK), public and private nurse training institutions and the Government of Kenya to build an electronic learning (eLearning) solution for training nurses in Kenya.[3] The provision has been adapted to a number of mobile learning platforms, expanded to six other African countries and extended to different levels of health professionals (e.g. doctors, technicians and community health workers). The programme has reached over 50,000 health professionals and has been evaluated as equally (and sometimes more) effective as classroom based-approaches.[4]

These programmes' use of digital technology for health skills development might be seen to offer some parallels to the issues raised in this report with regard to the provision of digital skills development:

1. Developing content and functionality with (rather than for) target audiences. All these programmes benefitted from being designed in conjunction with the people by whom they were intended to be used. A 'human-centred design' approach allowed for the refinement and adjustment of the digital solutions to best fit the circumstances and needs of the target audiences.[5] For example, Kilkari went through four rounds of user-testing with pregnant women and new mothers in rural Bihar before content tested well. Lessons learned included the need to simplify content to include just one key piece of information per audio message, and the importance of re-stating this information in diverse ways in the same message to ensure recall. It was also found that most rural women in Bihar had access to a shared phone, which was constantly changing hands, and that the phone often had no battery life due to limited electricity. This meant that women missed their critical Kilkari calls. BBC Media Action therefore worked with its technical partners to configure an algorithm to repeatedly call over four consecutive days, which significantly increased the call success rate, and provided a toll-free number that women could call to hear the message they missed. Similarly, the e&mLearning from the Amref Health Africa programme for health professionals has relied on a collaborative approach to designing and developing content and platform specifications. In particular, efforts to scale up the programme relied on actively engaging subject matter experts from country to country to develop local content, rather than impose other content. While it would be easier to re-use content, this has proved to be a more acceptable approach and has increased ownership.

2. Leveraging partnerships with government. Involving government in the development of services from the outset has ensured a much greater level of buy-in. For example, BBC Media Action worked closely with the Ministry of Health and Family Welfare from India to design the technical health communications framework for the national versions of Kilkari and Mobile Academy to ensure compliance with government guidelines. Similarly, Amref Health Africa developed e&mLearning content to fit with the national curricula of countries such as Kenya, Uganda, Zambia and Tanzania. This proved to be an acceptable approach that has since led to the regular, classroom-based students using the content. Additionally, Amref Health Africa has built the capacity of government employees to run the programmes outside of donor funding. Working with governments and regulatory bodies has proven critical to ensuring alignment with Ministry of Health policies and guidelines, which in turn strengthens ownership and commitment. Government adoption makes it easier to achieve scale and sustainability for toll-free services for poor communities, particularly rural women, who may not have purchasing power or the authority to make payment decisions.

3. Setting up a neutral coordinating body to drive programme implementation. Programme Management Units (PMUs) can be helpful in balancing the objectives and priorities of the different stakeholders, and in coordinating work across partnerships.[6] For example, PriceWaterHouse Coopers staffed a PMU for the national scale-up of BBC Media Action's mHealth services by the Government of India. The PMU was responsible for liaising with the national government on behalf of a consortium of stakeholders, and for supporting government procurement processes. BBC Media Action participated in the PMU, providing expert input, while simultaneously leading the scale-up of the services. These experiences suggest that PMUs can play a critical role in coordinating the implementation of large-scale interventions by remaining neutral, nurturing trust, collaboratively establishing clear roles and responsibilities, and the creation of a governance structure. Similarly, Amref Health Africa played a facilitator role in the eLearning programme for nurses and built the capacity of nurse training institutions to implement the programme. To do this, they created a governance structure comprised of the Nursing Council, Ministry of Health and training institutions who own and drove the process. This has made it easier to resolve issues and find solutions that are workable for all parties.

4. The importance of an integrated approach. Kilkari and Mobile Academy are designed to work together: Mobile Academy refreshes community health workers' knowledge of preventative health behaviours and improves their interpersonal communication skills, which in turn can lead to improved quality of engagement between community health workers and the families they serve. Kilkari delivers guidance directly to the phones of new and expectant mothers, reinforcing the guidance being communicated by community health workers. In Bihar, BBC Media Action also worked with community health workers to effectively promote Kilkari to women, incentivizing them via talk time credit transfers directly to their phones.[7] Similarly, Amref's Leap mLearning platform was designed to not only train community health workers, but also increase their engagement with their supervisors who are based in health facilities, thereby strengthening links between the community and the formal health system.

1 BBC Media Action, 2017.
2 Formerly the African Medical and Research Foundation (AMREF).
3 AMREF Health Africa, 2017. http://training.amref.org/index.php/amref-courses-and-training-programmes/ehealth-programme (Accessed June 2017).
4 AMREF Health Africa, "E-learning in Kenya: Experiences and Lessons Learned", Nairobi, 2013.
5 USAID "Mhealth Compendium", Volume Four, Oct. 2014. http://www.rethink1000days.org/wp-content/uploads/2015/06/USAID-mHealth-Compendium-Vol.-4.pdf.
6 AMREF Health Africa, "Kenya eLearning Nurses Upgrading Programme: A Summary" Nairobi, 2013.
7 GSMA, "Case Study Kilkari: a Maternal and Child Health service in India Lessons Learned and Best Practices for Deployment at Scale, Oct. 2016. http://www.rethink1000days.org/wp-content/uploads/2016/10/GSMA_Kilkari_v9.pdf.

MOOC hosted on the Coursera platform for practising teachers on the topic of 'Assessment and Teaching of 21st Century Skills'.

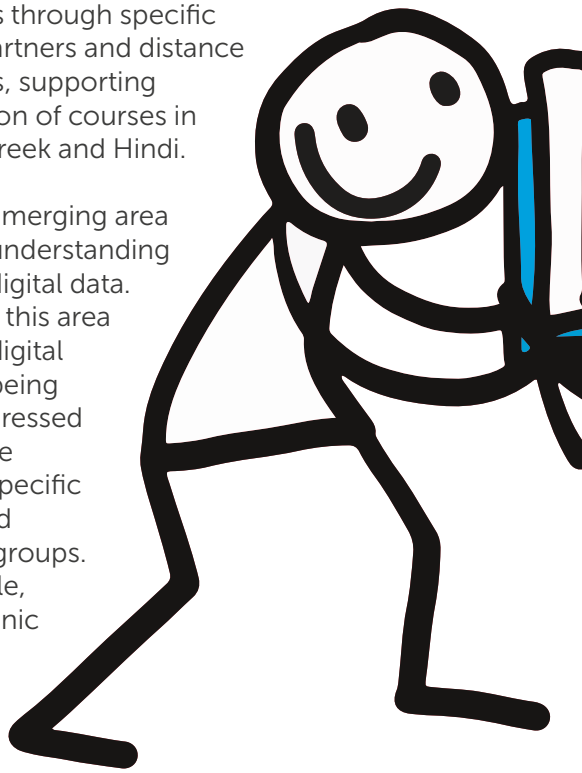
Several online resources have been developed to help individual users develop critical understandings of the data implications of their technology use.

Similar sets of resources have been developed to support the teaching and learning of computational thinking skills in schools and universities. Alongside resources from national computer associations and universities, one prominent example of this is Google's 'Exploring Computational Thinking'. This comprises a set of free-to-use online resources featuring lesson plans, videos, demonstrations and programmes that are specifically developed in accordance with various international curriculum requirements and standards. A number of other online platforms offer portals to computational thinking resources in languages other than English, including Aprende.org which contains extensive learning content in Spanish.

As these latter examples illustrate, efforts to support the development of such 'softer' or 'complementary' skills often take the form of the production and dissemination of online resources. For example, efforts to support the development of digital citizenship and digital rights understandings have so far tended to involve the provision of free-to-use resources for teachers, parents and young people. One leading organization in this area is the US non-profit Common Sense Media. As part of its remit to advocate for children's media use, Common Sense Media's education programme has developed a range of resources in conjunction with education partners such as Harvard University and youth organizations such as Global Kids with the aim to 'raise a generation of kids who think critically, act responsibly, and interact positively in the digital world'. These resources include the 'Digital Passport' online curriculum that uses online games, videos and lesson plans to help young people to develop critical understandings of their internet use. Similarly, the 'Digital Compass' roleplaying game is designed to develop digital citizenship skills for students aged between 11 to 15 years.

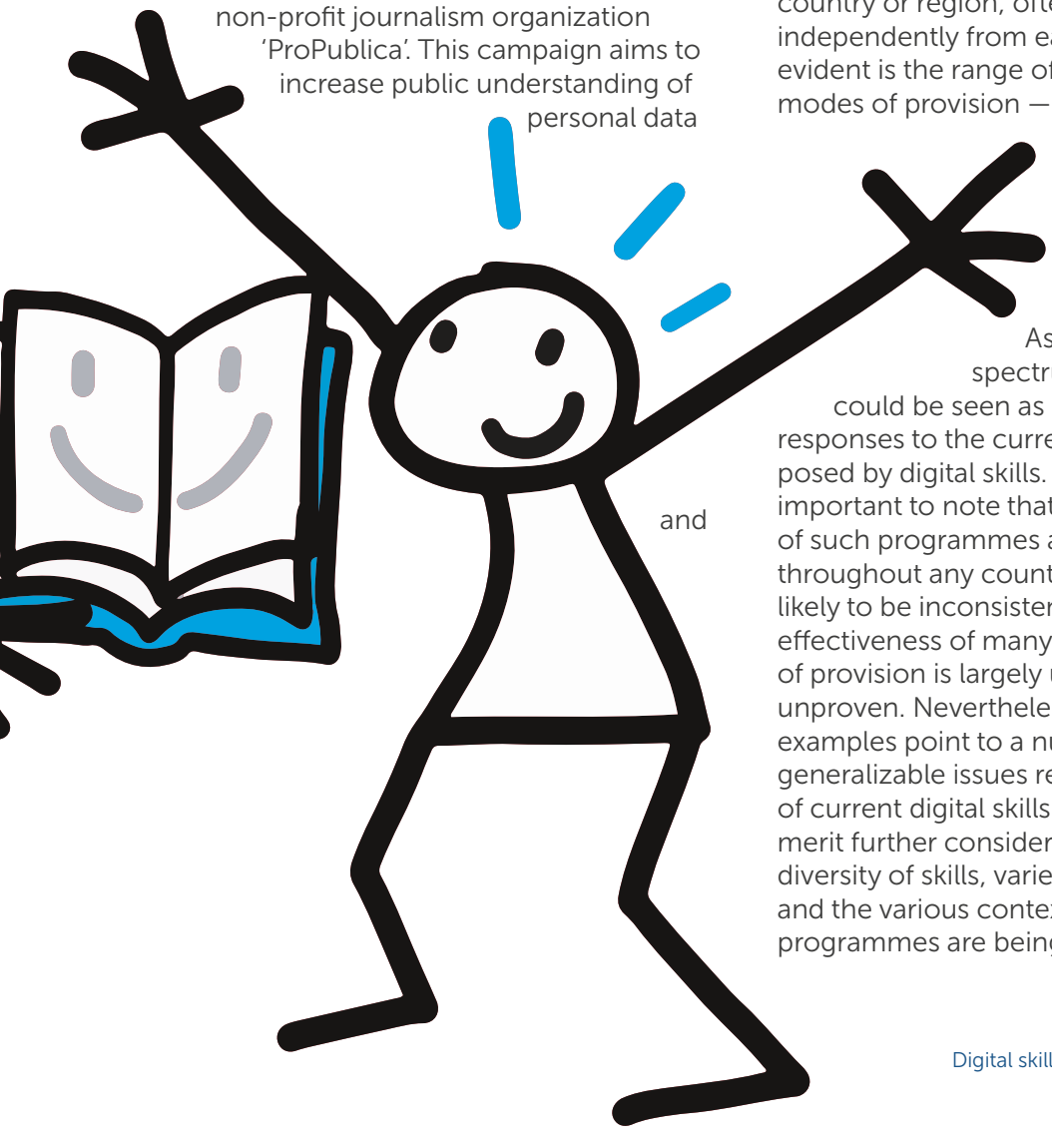
Alongside the production of online classroom resources is the development of MOOCs related to digital literacy and similar issues. For example, the development of young people's critical understandings of Media and Information Literacy (MIL) is being supported through English and Arabic language MOOCs produced by UNESCO, Athabasca University and with support from organizations such as the Swedish International Development Agency and the European Commission. These online courses are designed to support participants' critical understanding of mass media and digital media. The MIL MOOC provision is designed to support consideration of a variety of issues such as intercultural dialogue, freedom of expression, gender stereotyping, commercial ethics, and the relationship between civil society and advertising, as well as the use of digital technologies for social activism. This model is being adapted for a growing number of contexts through specific national partners and distance universities, supporting the provision of courses in Spanish, Greek and Hindi.

One final emerging area of critical understanding relates to digital data. At present, this area of critical digital literacy is being largely addressed through the efforts of specific interest and advocacy groups. For example, the Electronic Frontier



Foundation has produced a series of 'surveillance self-defence' online tutorials and resources to help individuals to develop critical understandings and counter-practices when using digital technologies. In particular, several online resources have been created to help individual users develop critical understandings of the data implications of their technology use. These apps, plug-ins and programmes are designed with educational and practical outcomes in mind. For example, Mozilla developed the 'Lightbeam' add-on for its Firefox web browsers to provide graphical displays of the interactions and connections between websites visited and the tracking sites to which they are providing information. This is intended to educate users of the data implications of their online activities, and prompt more informed uses of the internet.

Another notable effort along these lines is the public awareness campaign ('Breaking the Black Box') run by US non-profit journalism organization 'ProPublica'. This campaign aims to increase public understanding of personal data and algorithms. It includes a series of investigative reports, online video and audio material produced in collaboration with US public radio, and — most innovatively — a citizen-journalism project reporting on the aggregate results from a web browser designed to let users know how Facebook is generating data from their personal profiles.



Lessons learned

All the cases highlighted in this chapter are indicative of what is a quickly changing and expanding area of education provision. These cases certainly reflect the prominence of provision for certain areas of skill development such as 'functional' skills over soft competencies and understandings. Moreover, these examples give a sense of the large number of different programmes and initiatives that can be found in any one country or region, often operating independently from each other. Also evident is the range of providers and modes of provision — from formal institutional programmes to informal methods of self-directed learning.

As a whole, this spectrum of provision could be seen as a range of possible responses to the current challenges posed by digital skills. However, it is important to note that the distribution of such programmes and initiatives throughout any country or region is likely to be inconsistent. Moreover, the effectiveness of many of these forms of provision is largely untested and unproven. Nevertheless, the above examples point to a number of important generalizable issues relating to the nature of current digital skills development that merit further consideration. Given the diversity of skills, variety of providers, and the various contexts in which programmes are being implemented,

there is clearly no 'one-size-fits-all' set of conclusions. The cases in this chapter highlight a number of lessons that can guide the design and implementation of other initiatives:

1. The importance of institutional capacities and continuity of programmes

Effective and sustained provision of digital skills development is reliant on well-functioning organizations that are working within stable and supportive conditions. The success of the programmes and initiatives highlighted in this chapter is clearly dependent on the capacity of organizations involved in planning and provision. Typically, successful programmes and initiatives build upon the legacy of earlier programmes and initiatives, and many of the cases highlighted in this chapter continue the momentum and expertise gained from previous programmes and initiatives. For example, the Micro:Bit draws directly on the BBC's initial forays into increasing public understanding of computer programming during the early 1980s. Similarly, 'She Will Connect' marks a continuation of Intel's well-established philanthropic programme in Africa.

Successful programmes and initiatives build upon the legacy of earlier programmes and initiatives.

2. The leading roles of government

Many of the cases highlighted in this chapter are not government-led or state-initiated. Yet government and state actors clearly play pivotal role in setting up the fundamental principles of inclusive and equitable digital skills development for all, highlighting the importance of lifelong learning and re-skilling the workforce, and setting the conditions for sustained provision of digital skills development. As the example of basic digital skills provision in the UK shows, government can assume different roles — sometimes as a central, directive component of a programme and at other times playing a background, enabling role.

Some of the cases in this chapter are supported by direct government involvement. The examples of current promising practice in Singapore, for example, are being driven by the country's 'Infocomm Media Development Authority'. However, many of the other cases highlighted in this chapter in other countries appear to benefit from a less directive 'enabling' approach where government policies help establish enabling environments for digital skills development to take place. Hence, governments are often well-positioned to take responsibility for overseeing and establishing connections between disparate forms of provision on a regional or national basis (UNESCO, 2012a). Governments can also play a leading part in promoting public and industry awareness of digital skills needs. One recent example of this was the German government's '#eSkills4girls' initiative as part of its presidency of the G20 during 2017. Governments might also be well-placed to support and, where necessary, coordinate partnerships, as well as monitoring and evaluating outcomes, especially in terms of sustainable development issues around equity, rights and inclusion.

3. The power of strategic partnerships

Most — if not all — of the cases of promising practice highlighted in this chapter are built upon collaborations between a number of different stakeholders. For example, the Training for Employment programme is able to ensure the relevance of its online training content through collaborations with different industries and employers. Other larger-scale cases involve education and industry organizations partnering with stakeholders from civic and community sectors, universities, international

governmental organizations, NGOs and other civil society organizations

Given the confluence of technology, economic and social issues, most forms of digital skills provision benefit from drawing upon public and private sector areas of expertise. While the area of digital skills development is not unique in benefiting from multistakeholder collaborations, it does seem particularly dependent upon the involvement of relevant industry actors. In part, this need for IT industry involvement stems from the technical requirements of programmes that are arranged around complex and often expensive technical resources. However, it might also highlight a lack of confidence on the part of 'non-technology' organizations.

As such, the involvement of IT industry actors seems to be a key element of most (if not all) areas of digital skills development. Successfully combining public and private interests remains a challenging but integral feature of work in this area. In this sense, there are many different modes of public-private partnerships — all of which might be appropriate for specific contexts and circumstances. Yet while there is no one 'best' model of partnership, many of the cases in this chapter appear to benefit from being managed and coordinated through 'bodies that are positioned outside of any one partner'. A 'neutral' coordination is key in balancing different objectives and priorities of different stakeholders, and maintaining project momentum. Moreover, in many cases, establishing skills development programmes on a non-profit or philanthropic basis with the central involvement of public-sector actors seems to be a key factor in ensuring long-term involvement of private sector actors.

In terms of investment, the cases presented suggest that investment in digital skills will rely on a mix of sources including government funding, private resources and household; for many developing countries, this would also include external financing. Government and national stakeholders should continuously review their financing efforts and assess the need for scaling up digital skills development. While domestic public spending will remain the most important source of finance for digital skills, the contribution of non-state actors, particularly those from the private sector, will play an important role. There is also a need to monitor the amount of aid that targets digital skills development.

4. The importance of context-specific planning and provision

There are a number of cases in this chapter that highlight the benefits of digital skills programmes and initiatives being able to respond flexibly to the different local contexts in which they are being implemented. For example, the scaling-up of some cases benefitted from having recognized the need for mobile-based provision in African contexts (Micro:Bit), adapting resources to reflect local language needs (MIL MOOC), or developing gender-relevant content (She Will Connect, Interface3).

Sensitivity to local languages, socio-cultural considerations, technology accessibility and challenges unique to disadvantaged groups has helped ensure that interventions reach under-represented populations.

Such instances highlight the benefit of programmes and providers being flexible in their provision — both in terms of the nature of what is being provided, and the intended outcomes. This need for sensitivity to local 'contexts, needs, interests and perspectives' (Livingstone et al., 2017) avoids 'one-size-fits-all' approaches, privileging flexibility and iterative growth. Sensitivity to local languages, socio-cultural considerations, technology accessibility and challenges unique to disadvantaged groups, including women and people with

disabilities, has helped ensure that interventions reach under-represented populations.

5. The challenge of scaling up

The capacity to expand and extend promising practice from small-scale, local projects to a broader regional, national and international basis remains a challenge. While the perceived success and effectiveness of many programmes may stem from their relatively small scale, the challenge remains to identify instances of promising practice that are appropriate to expand to a broader scale of delivery (for example, across school systems or between countries).

As some of the large-scale cases in this chapter suggest, the impetus for this is most likely to derive from organizations able to identify and convert local cases of promising practice into 'scalable innovations'. The scaling-up of the worldwide 'Micro:Bit Foundation' is one instance. Another potentially useful approach is the development of 'innovation-brokering' platforms, following the lines of recent initiatives such as the Finland-based 'hundrED' programme, which aims to scale promising innovations across school systems. Open access databases and repositories of good practice offer a possible means of supporting the spread of programmes and approaches between regions and countries.

It would be a mistake to overlook the benefits and demand for traditional offline modes and methods of teaching and learning.

6. The innovative application of existing technology

Many of the featured cases in this chapter are notable for their relatively straightforward technological approaches. Some programmes and initiatives are making use of relatively simple, established technologies and applying them in innovative ways. The model of '42', for example, marks a radical rethinking of the organizational nature of a 'school', with relatively conventional computers and programming languages. Similarly, the technical capacities of the Micro:Bit mini-computers and Scratch programming language are relatively low-cost and 'low-tech'. Thus, rather than being driven by the 'leading-edge' digital innovations, the innovative aspects of these cases stem from their design, delivery and pedagogic approach, which aim to fully harness the potential of technologies that are accessible for users.

Moreover, while technological configurations vary according to the nature and context of the programme, it would seem that programmes are successful when they can be flexible in terms of technology accessibility. For example, offering resources in a variety of forms (e.g. pre-loaded *and* cloud-based content, computer *and* mobile-based) allows for increased accessibility and take-up (UNESCO, 2013b). Similarly, the benefits of free-to-use and easily reconfigurable resources indicates a need to make use of open access and open standards where possible.

7. Blending traditional 'non-digital' education approaches and digital applications

Many of the highlighted cases in the chapter are also notable for their incorporation of non-digital methods and modes of provision. While a range of innovative, wholly online mechanisms of delivery exist, there does seem to be an enduring demand among many individuals for forms of education and training that involve face-to-face interactions with others as well as engaging with physical resources and in social settings. For example, as the case of '1,2,3...Codez!' illustrates, the provision of paper-based books and other physical resources continues to be a key element of successful teacher-focused programmes.


© SolStock /iStock

In part, this might be attributed to a continued preference for traditional methods among current generations of teachers and students (UNESCO, 2017c). Yet it also reflects the convenience of non-digital resources and the learning benefits of face-to-face, group-based methods. Indeed, the popularity of coding boot camps, code clubs and the '42' model all reflect the social, face-to-face nature of how many people prefer to learn. While there are clear opportunities to increase 'digital first' forms of skills development, it would be a mistake to overlook the benefits and demand for traditional offline modes and methods of teaching and learning. In this way, it has been argued that attempts to establish 'digital-by-default' provision should not 'switch off' other methods of contact between providers and citizens, 'but instead work with citizens to make digital the primary method of interaction' (Fink, 2012).

8. Bridging formal and non-formal education

All of the cases highlighted in this chapter suggest ways in which formal education providers (such as schools, colleges and universities) might become more flexible and responsive to forms of digital skill development that are being established outside of the education sector. On the one hand, formal education institutions need to be supported in appropriating the informal modes of skill development provision highlighted in this chapter. For example, there are likely to be opportunities for schools to adopt approaches that underpin the after-school clubs that take place on their premises (e.g. in terms of content, resources, ways of organizing and arranging activities). In this manner, the ability for schools to adapt the best elements of digital programmes that are being provided 'externally' is likely to increase the accessibility of these provisions to students who are otherwise not attending coding clubs.

On the other hand, formal education institutions need to be supported in contributing to the forms of skill development provision outlined in this chapter. For example, there are likely to be ways in which the formal education sector can contribute to the pedagogic design of programmes being delivered by non-education organizations (e.g. highlighting continuities with prior school-based learning, focusing on strategies for differentiation). Indeed, while many successful and innovative forms of digital skills development appear to be taking place outside the traditional confines of formal education institutions, it is important to acknowledge the contribution of the formal education

sector in these programmes. For example, 'after school' coding clubs are reliant on school contexts and organization. Similarly, universities remain important partners in programmes such as Micro:Bit and PROMPT.

9. The centrality of teacher capacity and digitally-relevant pedagogies

Teachers, trainers and tutors are an integral element of the programmes and initiatives highlighted in this chapter. As such, the digital competencies and digital capacities of teachers are a key enabler for scaling up promising practices while ensuring sustainability and equality. For example, one of the issues underpinning the integration of programming skills into national school curricula is the skills and competencies of teacher workforces. Similarly, issues of teachers' digital skills, confidence and knowledge underpin the reforms in the TVET sector outlined earlier. These issues highlight the continued need for teacher-focused skills development programmes such as the Google MOOC for Australian teachers and the 1,2,3...Codez! initiative.

Alongside the provision of additional technology-related training and resources for teachers, there are also opportunities for formal education to gain pedagogic insights from the fast-developing forms of informal provision highlighted in this chapter. For example, teachers in formal education institutions can be encouraged to (re)appropriate teaching approaches and pedagogies currently being developed in the emerging non-traditional informal provision of skills development.

10. The need for rigorous evaluation and evidence base

While this chapter has been able to point to a range of examples of policies, programmes and initiatives, there is surprisingly little evidence of the outcomes of these interventions (UNESCO, 2012b). Indeed, the literature in this area tends to focus on examples of best practices that have garnered publicity through association with prominent partners or sponsors. There is little reporting of what does not work, or what has been unsuccessful.

There is little incentive for short-term programmes with limited funding to devote additional time and resources to evaluation and monitoring of their progress. The collection of evaluation data can be an unwelcome impediment to the actual delivery of programmes, particularly where devolved providers and local community sites are required to collect data on their activities in centralized programmes (Reboot UK, 2017). However, these impediments notwithstanding, there is a clear need to improve the evidence and evaluation base for all of these types of skills provision. The controlled trial evaluation of the 'Code Club UK' network described earlier offers an example of the insights that can be gained from rigorous and objective evaluation. Yet such evidence-building efforts remain rare. Despite the extensive provision of after-school coding programmes around the world, as acknowledged in the introduction to the Code Club evaluation: 'This is, to our knowledge, the only randomized controlled trial of an after-school computing programme that has ever been commissioned' (Straw et al., 2017).

The increased use of such evaluations might be best achieved through coordinating organizations such as government agencies and cross-sector bodies. One exemplar in this sense is Norway's 'Skills Plus' programme which has maintained an open access database of progress reports, evaluation results, competence test results and data on participation since 2013. This was designed to support the programme's quality assurance and transparency, as well as making it easier to evaluate its long-term impact.

4 Future challenges and recommendations for action

Emerging digital trends and issues

As illustrated throughout this report, digital skills and digital competencies constitute an area of education that is changing continually. Therefore, before reaching any firm conclusions and recommendations it is important to give some thought to the 'near future', including trends, opportunities and challenges likely to emerge over the next five to ten years. With these perspectives in mind, it is important to 'look ahead' to educational opportunities and challenges that are likely to shape digital skills development within the broadband society of the 2020s.

Digital technology has lowered the threshold for technology-driven growth in developing countries.

Many aspects of the 'future' broadband society will be shaped by the continued development of current technologies and established trends. For example, it seems likely that the 'next billion' internet users will be largely gaining access through mobile devices. The GSMA (2017) anticipates that by 2020, the number of mobile internet users will have risen from 3.6 billion to 4.7 billion (that is, around 60% of the world population). In this sense, it is reasonable to anticipate ongoing growth in the following areas of digital technology:

- wireless connectivity, including the next generations of mobile broadband (5G), satellite and fixed broadband systems;
- the convergence of personal computing devices in 'phablet' and smartphone-like devices;
- cloud-based computing and data storage;
- large online 'platforms' functioning as intermediaries between individual users and major services.

Accompanying these continued areas of development, substantial changes to the nature of generic digital skills and competences are also likely to arise from the following areas of emerging technology development:

- the 'Internet of Things' (IoT), with over 20 billion connected devices forecast to be in operation by the start of the 2020s (Gartner 2016; Ericsson 2017);
- the growing prevalence of digital data and so-called 'big data' analytics;
- new forms of artificial intelligence and the increase of computer-driven decision making and other forms of automation;
- new forms of augmented reality.

These developments will have further implications on the structure of labour markets and forms of work and, according to many observers, are likely to accelerate the polarization of the occupational structure into high-skilled and low-skilled jobs, a reduction in routine jobs and the creation of new, more lucrative high-tech jobs. However, as noted in the first chapter, the magnitude of changes will differ from country to country. The expected effects will probably take hold more slowly in developing countries, but will impact these countries as well (World Bank, 2016). Digital technology has lowered the threshold for technology-driven growth in developing countries and is creating opportunities to leapfrog technologies, creating access to previously unavailable services and markets.

Implications for policy and education provision

These technological developments are likely to have a range of implications for how we live and work over the next decade (Kelly, 2016), and, consequently the skills and competencies required in the digital society. These developments will have implications for policy-makers and education providers during the 2020s. All of the technological trends just outlined will open new opportunities for education as well as additional challenges in ensuring that all individuals have the skills and competencies to participate fully in digital society. Above all is the challenge of ensuring that all individuals have equal opportunities to develop essential digital skills and competencies, regardless of their personal circumstances and contexts.

A key challenge here will be developing more distinctive modes of formal education provision to support the inclusive and equitable development of digital skills and awareness of the social, cultural and economic implications of digital technologies. As illustrated in Chapter Three, 'softer' forms of digital competency have so far tended to be catered for through non-formal and self-selecting means. Thus few — if any — countries have felt the need to introduce compulsory critical digital literacy throughout the school curriculum (as has been the case with coding). Instead, these forms of critical understanding, critical literacies and the like have tended to involve the ad hoc provision of online resources, MOOCs, public journalism campaigns and so on.

While these approaches are likely to appeal to 'already interested' and 'already knowledgeable' individuals, they are unlikely to lead to the widespread, equitable development of competencies. This is clearly a concern, as these forms of critical digital understanding become a more central element of one's ability to live and work within the digital society.

More scrutiny therefore needs to be given to the limitations of what are currently seen as innovative and 'personalized' means of supporting the development of digital competencies. For example, while the provision of education and training through MOOCs has obvious advantages of flexibility for participants, research has documented that MOOC participation and outcomes are skewed in favour of individuals with college-level education and people from higher-income backgrounds (Hansen and Reich, 2015; Lee, 2017). Similarly, the provision of online resources for individuals to use at their own discretion also tends to engage individuals who are well-resourced, well-motivated and already competent in the area they are developing further. Overall, self-directed forms of online learning tend to benefit those individuals who have higher levels of previous education experience and come from higher income and well-resourced backgrounds. As a result, these offerings do very little to assure education equity by benefitting underprivileged learners (White and Selwyn, 2012; Head et al., 2015).

Policy-makers will face a growing challenge to ensure that critical awareness and understandings of new data-based systems and algorithmically-based platforms are developed across populations. This suggests the need for collectively-focused forms of education and training provision that have minimal social barriers to access and use. In light of the above discussion, this implies the increased integration of these aspects of digital competency development into formal education settings, and in accessible, face-to-face, 'traditional' formats.

Self-directed forms of online learning tend to benefit those individuals who have higher levels of previous education experience and attainment.

Of paramount importance will be providing lifelong learning opportunities to adults who will need to develop new skills and competencies throughout their careers.

Another challenge is (re)skilling and (re) training individuals for the emerging digital economy and the digital workplace. The next decade will inevitably see shifts in the digital skills required in workplaces characterized by increased automation of work tasks, reliance on 'precision' and 'predictive' data-based processes (Ross, 2017). Amid anticipation of the continued growth of digital commerce and smart manufacturing, estimates relating to the automation of work and creation of new forms of employment are sobering. For example, the World Economic Forum (2016) estimated the likely labour market impact of the next wave of labour automation combined with other socio-economic and demographic changes. Focusing on fifteen major developed and emerging economies, this report predicted the production of 2.1 million new jobs, offset by the elimination of 7.1 million jobs (WEF, 2016).

While the scale of changes to employment are relatively straightforward to anticipate, the digital skills required for these new forms of employment and altered working conditions are largely uncertain. As outlined above, the 2020s will certainly see an increased need for employees to have the ability to work with automated systems and machines, interact with data-based processes and decision-making systems. More forms of work will be carried out on a remote or outsourced basis. This will undoubtedly have implications for traditionally important employability skills such as teamwork, complex problem-solving, decision-making and systems analysis. However, the exact nature of these skills in light of the impending technological changes described earlier is not wholly certain.

Nevertheless, it does seem reasonable to expect that these largely unknown changes will necessitate ongoing reorganization and realignment of education systems. Of paramount importance will be providing lifelong learning opportunities, in particular to adults who will need to develop new skills and competencies throughout their careers. Indeed, it is reported that nearly 90% of current US workers believe it will be essential for them to get training and develop new job skills throughout their working life in order to keep up with changes in the workplace (Pew, 2016). Similarly, as the WEF reasons 'ageing countries won't just need lifelong learning — they will need wholesale reskilling of existing workforces throughout their lifecycle' (2016).

The continuing education that is likely to be most relevant will provide adults with opportunities to upgrade skills inside their existing fields. It will also be increasingly important to support forms of education provision to (re)educate 'those whose skills are obsolete' (Rainie, 2017). This need for updating existing skills, retraining and reskilling clearly implies the continued importance of responsive, flexible and equitable forms of public education.

Recommendations

While the exact nature of these future developments remains uncertain, it is clear that issues relating to the continued development of relevant digital skills and competencies will remain a priority over the next few decades. The notion of 'continued' and 'lifelong' development is an important distinction. Regardless of how well-skilled an individual might be at the present time, all of the future trends and issues just outlined will require the acquisition of distinctly different skills, competencies and understandings.

Thus it is important to retain the issue of digital skills as a policy priority. As the Broadband Commission's Digitization

Scorecard Report (2017) warned, 'regardless of whether a country is of high, middle or low income, there is no room for complacency'.

In addition to the specific challenges, a number of tensions are likely to persist, particularly between public and private involvement, different models of financing and subsidization, tensions between market responses and regulation, the relative importance of supporting work-relevant skills as opposed to skills required for life and society, and the relative importance of functional skills and critical understandings.

With this in mind, the **Members of the Broadband Commission Working on Education Group RECOMMEND** that governments and other stakeholders consider implementing the following actions in response to the challenges identified and lessons learned:

Ensure effective government support and multistakeholder cooperation

- Establish accountable agencies within governments to lead the development, regulation and implementation of national strategies and master plans for digital skills development.
- Under the competence of the accountable governmental agencies, develop strategies to broker, expand and improve multistakeholder partnerships that facilitate digital skills education.
- Incentivize IT firms, internet service providers and other private sector organizations to support inclusive and equitable digital skills development, including programmes to upgrade the skills of workers, ideally with oversight from neutral, non-commercial brokers.
- Develop and endorse policies to promote Free and Open Source Software (FOSS) and to openly license the digital skills development resources produced with public funds, as called for in the Paris OER Declaration (UNESCO, 2012c).

Ensure inclusion, equity and gender equality

- Formulate education policies that promote and monitor the inclusion of digital skills development for disadvantaged groups irrespective of gender, age, race or disability.
- Encourage non-formal digital skills providers to deliver programmes for out-of-school children, youth and adults, especially illiterate or unemployed adults through flexible face-to-face programmes in well-established community spaces (e.g. community centres, libraries) and through affordable digital technology, including mobile phones (UNESCO 2013a).
- Prioritize public investment and incentivize the private sector to support gender equality in digital skills development with a particular focus on promoting girls' and women's participation, achievement and continuation in STEM studies and careers.

Promote quality and innovative provision

- Set up collaborative taskforce teams of education institutions, IT industries and academic institutes to enhance the development and provision of curricula and programmes for digital skills development.
- Set up quality assurance and accreditation mechanisms to monitor the quality of digital skills development programmes and

facilitate the recognition of skills across levels of studies, education providers and possibly across borders.

- Make digital skills a key component of teacher training, with reference to UNESCO's ICT Competency Framework for Teachers (2011). Guide the review and updating of programmes to enable teachers to benefit from digital technologies and improve the digital literacy of students.

- Enhance digital skills of teachers and develop collaborative capacity-building mechanisms between education institutions and IT industries.

Develop appropriate measurement and monitoring strategies

- Support national statistics agencies and other agencies in regularly collecting disaggregated digital skills data, including through individual assessments, to facilitate a more robust and comprehensive understanding of digital skill divides.

- Explore the possibilities of aggregated usage of automatically generated data on the use of digital platforms and services as a means of mapping patterns of digital competencies and skills.

- Include, where relevant, questions in annual household surveys to gather self-reported information about individuals' digital skill levels and digital skill needs. Also, encourage countries to share collected data with relevant international organizations, including UNESCO and ITU, to facilitate global and regional analysis.

The **Members of the Broadband Commission Working Group on Education RECOGNIZE** that the active engagement of the international community, including multi- and bi-lateral actors as well as private institutions and civil society, is of vital importance to addressing the policy challenges related to digital skills for life and work. They **RECOMMEND** that the Commission:

- Provides adequate platforms for international exchange on policies, instruments and approaches through South-South and North-South cooperation;

- Explores the feasibility of setting up an international framework for digital skills and competencies in order to inform national policies, facilitate international comparisons and cross-border recognition and provide conceptual references for measurement of digital skills in collaboration with UNESCO and ITU.

- Supports the monitoring of Sustainable Development Goal 4 (SDG4) by identifying the percentage of youth and adults with ICT skills as called for in SDG Target 4.4.1. With the technical support of the UNESCO Institute for Statistics, ITU and other concerned organizations, the Commission should also facilitate the development of cross-national statistical frameworks and data platforms for both regional and global monitoring of digital skills acquisition.

REFERENCES

Accenture. 2016. *Cracking the gender code*. London, Accenture Research. https://www.accenture.com/us-en/cracking-the-gender-code.

Alberta Ministry of Education. 2013. *Alberta Ministerial Order on Student Learning (#001/2013)*. https://education.alberta.ca/media/1626588/ministerial-order-on-student-learning.pdf.

Andrejevic, M. 2014. Big data, big questions: the big data divide. *International Journal of Communication*, Vol. 8, No. 17 pp. 1673-1689.

Bakardjieva, M. and Smith, R. 2001. The internet in everyday life. *New Media & Society*, Vol. 3, No. 1, pp. 67-83.

Biesta, G. 2015. What is education for? *European Journal of Education*, Vol. 50, No. 1, pp. 75-87.

BMZ. 2017. *Women's Pathways to the Digital Sector*. Bonn (Germany), Federal Ministry for Economic Cooperation and Development (BMZ). https://www.bmz.de/en/publications/type_of_publication/weitere_materialien/study_eSkills4girls.pdf.

Bocconi, S., Chioccariello, A., Dettori, G., Ferrari, A., Engelhardt, K., Kampylis, P. and Punie, Y. 2016. Exploring the field of computational thinking as a 21st century skill. *EDULEARN16 Proceedings*. IATED Academy, pp. 4725-33. https://library.iated.org/view/BOCCONI2016EXP.

Boyd, D. 2015. Social media: a phenomenon to be analyzed. *Social Media+ Society*, Vol.1, No.1. http://journals.sagepub.com/doi/full/10.1177/2056305115580148.

Broadband Commission. 2017a. *Digital Gender Divide*. Paris, Broadband Commission for Sustainable Development. http://www.broadbandcommission.org/workinggroups/Pages/digital-gender-divide.aspx.

Broadband Commission. 2017b. *Working Group on the Digitalization Scorecard: Which Policies and Regulations can Help Advance Digitalization*. Paris, Broadband Commission for Sustainable Development. http://www.broadbandcommission.org/Documents/publications/WG-Digitalization-Score-Card-Report2017.pdf.

Bukht, R. and Heeks, R. 2017. *Defining, Conceptualising and Measuring the Digital Economy*. Manchester (UK), Centre for Development Informatics (Working paper 68.). https://diode.network/2017/07/10/defining-conceptualising-and-measuring-the-digital-economy/.

Care, E., Kim, H., Anderson, K., and Gustafsson-Wright, E. 2017. *Skills for a Changing World: National Perspectives and the Global Movement*. Washington DC, Brookings Institute. https://www.brookings.edu/wp-content/uploads/2017/03/global-20170324-skills-for-a-changing-world.pdf.

Couldry, N., Stephansen, H., Fotopoulou, A., MacDonald, R., Clark, W. and Dickens, L. 2014. Digital citizenship? *Citizenship Studies*, Vol. 18, No. 6-7, pp. 615-29.

CourseReport. 2016. *Coding Bootcamp Market Sizing Report 2016*. www.coursereport.com/reports/2016-coding-bootcamp-market-size-research.

Culver, S. and Kerr, P. 2014. *Global Citizenship in a Digital World*. Nordicom.

Dhalla, A. 2016. *Developing a Learning Platform for Women: Exploring the intersection of gender and equity online*. https://medium.com/read-write-participate/case-study-developing-a-learning-platform-for-women-afa4d2096bc.

Douglas-Jones, R., Shklovski, I., Powell, A., Nemorin, S. and Fritsch, E. 2017. *An ethical IoT?* https://virteuproject.eu/an-ethical-iot.

ECDL Foundation. ND. *International Computer Driving Licence certificate*. www.ECDL.ch.

Emejulu, A. and McGregor, C. 2017. Towards a radical digital citizenship for digital education. *Critical Studies in Education*.

ERI-Net. 2016. *ERI-Net Regional Study on Transversal Competencies in Education Policy and Practice (Phase III)*. Paris and Bangkok, UNESCO. http://unesdoc.unesco.org/images/0024/002468/246852E.pdf.

Ericsson. 2017. *Ericsson Mobility Report*. www.ericsson.com/en/mobility-report.

European Commission. 2016. *The e-Skills Manifesto*. http://eskills4jobs.ec.europa.eu/manifesto.

European Commission. 2017a. *Digital Competence Framework for Citizens (DigComp 2.1)*. Publications Office of the European Union. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/digcomp-21-digital-competence-framework-citizens-eight-proficiency-levels-and-examples-use.

European Commission. 2017b. *G20 Leaders' Declaration: Shaping an interconnected world*. www.europa.eu/rapid/press-release_STATEMENT-17-1960_en.pdf.

Fink, S. 2012. *Simple Things, Done Well: Making practical progress on digital engagement and inclusion*. London, Policy Exchange. https://policyexchange.org.uk/publication/simple-things-done-well-making-practical-progress-on-digital-engagement-and-inclusion/.

Floridi, L. 2014. *The Fourth Revolution: How the Infosphere is Reshaping Human Reality*. Oxford, Oxford University Press.

Ford, M. 2016. *Rise of the Robots: Technology and the Treat of a Jobless Future*. New York, Basic Books.

Fortune. 2017. Some coding boot camps stumble in a crowded field. Fortune, 9 August. http://fortune.com/2017/08/09/coding-boot-camps-stumble/.

Gartner. 2016. *Forecast: Internet of Things — Endpoints and Associated Services, Worldwide, 2016*. www.gartner.com/doc/3558917/forecast-internet-things--endpoints.

Genner, S., Suter, L. and Süss, D. 2012. *Neue Medien — neue Generationen- beziehungen? Eine Studie gestuẗzt auf das Projekt CompiSternli*. Zürich (Switzerland), ZHAW Zürcher Hochschule für Angewandte Wissenschaften.

Green, E., Singleton, C. and Davies, P. 2011. Sustaining digital inclusion in everyday life. Paper presented to the iCS - OII 'A Decade in Internet Time' symposium, Oxford University, September.

Griffin, P. and Care, E. (eds) 2015. *Assessment and Teaching of 21st Century Skills: Methods and Approach*. Dordrecht (Netherlands), Springer.

Grizzle, A., Moore, P., Dezuanni, M., Asthana, S., Wilson, C., Banda, F. and Onumah, C. 2013. *Media and Information Literacy: Policy and Strategy Guidelines*. Paris, UNESCO.

GSMA. 2017. *The Mobile Economy 2017*. London, GSMA.

Hansen, J. and Reich, J. 2015. Democratizing education? Examining access and usage patterns in massive open online courses. *Science*, Vol. 350, No. 6265, pp. 1245-48.

Head, A., Van Hoeck, M. and Garson, D. 2015. Lifelong learning in the digital age: a content analysis of recent research on participation. *First Monday*, Vol. 20, No. 2.

Helsper, E. 2012. A corresponding fields model for the links between social and digital exclusion. *Communication Theory*, Vol. 22, No.4, pp. 403-26.

ITU. 2016. *Coding Bootcamps: a Strategy for Youth Employment*. Geneva, International Telecommunication Union. http://www.itu.int/en/ITU-D/Digital-Inclusion/Youth-and-Children/Documents/CodingBootcamps_E.pdf.

ITU. 2017a. *Fast-forward progress: leveraging tech to achieve the global goals*. Geneva (Switzerland), International Telecommunication Union. http://www.itu.int/en/sustainable-world/Pages/report-hlpf-2017.aspx.

ITU. 2017b. *Measuring the Information Society Report*. Geneva (Switzerland), International Telecommunication Union. http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFacts-Figures2017.pdf.

Jenkins, H., Purushotma, R., Weigel, M., Clinton, K. and Robison, A. 2009. *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. Cambridge MA, MIT Press.

Jenkins, H., Shresthova, S., Gamber-Thompson, L., Kligler-Vilenchik, N. and Zimmerman, A. 2016. *By Any Media Necessary. The New Youth Activism*. New York, NYU Press.

Jensen, K. 2015. *What's social about social media?* Social Media + Society. Vol. 1, Issue 1. http://sms.sagepub.com/content/1/1/2056305115578874.full.

Kelly, K. 2017. *The Inevitable: Understanding the 12 Technological Forces that will Shape our Future*. New York, Viking.

Knobel, M. and Lankshear, C. 2008. Remix: the art and craft of endless hybridization. *Journal of Adolescent and Adult Literacy*, Vol. 1, pp. 22-33.

Kompetanse Norge. 2017. *Statistikkbanken*. http://status.vox.no/webview/index.jsp?catalog=http%3A%2F%2Fstatus.dmzvox.local%3A80%2Fobj%2FfCatalog%2FCatalog26&submode=catalog&language=en&mode=documentation&top=yes.

Lakey, S. 2012. *Analysis of Foundational Learning and Implications for Northern Alberta*. Northern Labour Market Information Clearinghouse. http://www.nadc.gov.ab.ca/media/1018/ch123.pdf.

Lee, K. 2017. Rethinking the accessibility of online higher education: a historical review. *The Internet and Higher Education*, Vol. 33, pp. 15-23.

Livingstone, S., Nandi, A., Banaji, S. and Stoilova, M. 2017. *Young Adolescents and Digital Media*. London, GAGE Programme.

Marres, N. 2017. *Digital Sociology*. Cambridge (UK), Polity Press.

MediaSmarts. 2017. *Digital Literacy Model*. http://mediasmarts.ca/digital-media-literacy-fundamentals/digital-literacy-fundamentals.

Neelen, M. and Kirschner, P. 2016. *21st century skills don't exist: so why do we need them?* https://3starlearningexperiences.wordpress.com/2016/11/01/21st-century-skills-dont-exist-so-why-do-we-need-them/.

OECD. 2016a. *Ministerial Declaration on the Digital Economy ('Cancún Declaration')*. https://www.oecd.org/internet/Digital-Economy-Ministerial-Declaration-2016.pdf.

OECD. 2016b. *The Survey of Adult Skills*. Paris, OECD. http://dx.doi.org/10.1787/9789264258075-en.

OECD. 2016c. *Skills for a Digital World: Policy Brief on the Future of Work*. Paris, OECD. www.oecd.org/els/emp/Skills-for-a-Digital-World.pdf.

OECD. 2016d. *Skills for a Digital World: Working Party on Measurement and Analysis of the Digital Economy*. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/IIS(2015)10/FINAL&docLanguage=En.

O'Neil, C. 2016. *Weapons of Math Destruction*. London, Penguin.

Pangrazio, L. 2016. Reconceptualising critical digital literacy. *Discourse: Studies in the cultural politics of education*, Vol. 37, No. 2, pp. 163-174.

Papacharissi, Z. 2015. We have always been social. *Social Media+Society*, Vol. 1, No. 1, pp. 1-2.

Pearce, K. and Rice, R. 2017. Somewhat separate and unequal: digital divides, social networking sites, and capital-enhancing activities. *Social Media+ Society*, Vol. 3, No. 2.

Pew. 2016. *The State of American Jobs*. Pew Research Center. October 17. http://www.pewsocialtrends.org/2016/10/06/the-state-of-american-jobs/.

PwC. 2017. *Global Top 100 Companies by Market Capitalization.* London, PricewaterhouseCoopers Global IPO Centre. www.pwc.com/gx/en/audit-services/assets/pdf/global-top-100-companies-2017-final.pdf.

Rainie, L. 2017. Technological innovation? That's the easy part. *Trend* Summer, pp.8-15.

Rainie, L. and Wellman, B. 2012. *Networked: The New Social Operating System*. Cambridge MA, MIT Press.

Reboot UK. 2017. *Reboot UK Final Evaluation Report*. www.goodthingsfoundation.org/sites/default/files/research-publications/rebootukphase1finalreportjanuary17_1.pdf.

Rotherham, A. and Willingham, D. 2010. '21st-century' skills: Not new, but a worthy challenge. *American Educator*, Vol. 34, No. 1, pp. 17–20.

Royal Society. 2012. *Shut Down or Restart?* London, Royal Society. https://royalsociety.org/~/media/education/computing-in-schools/2012-01-12-computing-in-schools.pdf.

Rushkoff, D. 2010. *Program or be Programmed: Ten Commands for a Digital Age*. Berkeley CA, Counterpoint.

Selwyn, N. and Facer, K. 2007. *Beyond the Digital Divide: Rethinking Digital Inclusion for the 21st Century*. Bristol (UK), Futurelab.

Singh, K. 2016. *Right to Education in the Digital Age - Report of the Special Rapporteur on the Right to Education*. OHCHR. www.right-to-education.org/sites/right-to-education.org/files/resource-attachments/Report_UNSRRTE_HRC_the_Right_to_Education_in_the_Digital_Age_2016_En.pdf.

Spalter, A. and Van Dam, A. 2008. Digital visual literacy. *Theory into practice*, Vol. 47, No. 2, pp. 93-101.

Straw, S., Bamford, S. and Styles, B. 2017. *Randomised controlled trial and process evaluation of Code Clubs*. Slough (UK), NFER.

Tan, J., Koh, E., Chan, M., Costes-Onishi, P. and Hung, D. 2017. *Advancing 21st century competencies in Singapore*. Asia Society, Center for Global Education. http://asiasociety.org/files/21st-century-competencies-singapore.pdf.

Tech Partnership. 2017. *Basic Digital Skills Framework*. www.thetechpartnership.com/globalassets/pdfs/basic-digital-skills-standards/basic_digital_skills_framework.pdf.

Thayer, K. and Ko, A. 2017. Barriers faced by coding bootcamp students. *Proceedings of the 2017 ACM Conference on International Computing Education Research*. New York, ACM.

Third, A., Bellerose, D., Dawkins, U., Kelti, E. and Pihl, K. 2014. *Children's Rights in the Digital Age*. Melbourne (Australia), Young and Well Cooperative Research Centre.

Tinder Foundation. 2016. *Future Digital Inclusion: Programme Evaluation Findings 2015-16*. Tinder Foundation. https://www.goodthingsfoundation.org/sites/default/files/research-publications/bis_fdi_end_of_year_report_2015-16_final_version.pdf.

UNESCO. 2011. *UNESCO ICT competency framework for teachers*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0021/002134/213475e.pdf.

UNESCO. 2012a. *Mobile learning for teachers: Global themes*. Web only: http://unesdoc.unesco.org/images/0021/002164/216452E.pdf.

UNESCO. 2012b. *Mobile learning and policies: Key issues to consider*. Web only: http://unesdoc.unesco.org/images/0021/002176/217638E.pdf.

UNESCO. 2012c. *Paris OER Declaration*. Paris, UNESCO Publishing. http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/Events/Paris%20OER%20Declaration_01.pdf.

UNESCO. 2013a. *Mobile learning policy guidelines*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0021/002196/219641E.pdf.

UNESCO. 2013b. *The future of mobile learning: Implications for policy makers and planners*. Web only: http://unesdoc.unesco.org/images/0021/002196/219637E.pdf.

UNESCO. 2014a. *Fostering digital citizenship through safe and responsible use of ICT*. Web only: http://www.unescobkk.org/fileadmin/user_upload/ict/SRU-ICT/SRU-ICT_mapping_report_2014.pdf.

UNESCO. 2014b. *Global citizenship education: Preparing Learners for the challenges of the 21st Century*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0022/002277/227729E.pdf.

UNESCO. 2014c. *Reading in the mobile era*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0022/002274/227436e.pdf.

UNESCO. 2015a. *Global citizenship education: Topics and learning objectives*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0023/002329/232993e.pdf.

UNESCO. 2015b. *Qingdao Declaration*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0023/002333/233352m.pdf.

UNESCO. 2016a. *A policy review: Building digital citizenship in Asia-Pacific through safe, effective and responsible use of ICT*. Web only: http://unesdoc.unesco.org/images/0024/002468/246813e.pdf.

UNESCO. 2016b. *Education 2030: Incheon Declaration and Framework for Action*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0024/002456/245656E.pdf.

UNESCO. 2016c. *Global Education Monitoring Report: Gender Review*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0024/002460/246045e.pdf.

UNESCO. 2016d. *Open Educational Resources: Policy, costs and transformation*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0024/002443/244365e.pdf.

UNESCO. 2017a. *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0025/002534/253479E.pdf.

UNESCO. 2017b. *Qingdao Statement*. Web only: http://unesdoc.unesco.org/images/0025/002530/253061e.pdf.

UNESCO. 2017c. *Supporting teachers with mobile technology*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0025/002515/251511e.pdf.

UNESCO. 2017d. *Using ICTs and blended learning in transforming TVET*. Paris, UNESCO Publishing. http://unesdoc.unesco.org/images/0024/002474/247495e.pdf.

UNESCO and IBE. 2017. *A Resource pack for gender-responsive STEM education*. Geneva, UNESCO-IBE Publishing. http://unesdoc.unesco.org/images/0025/002505/250567e.pdf.

United Nations. 2015. *Sustainable Development Goals: 17 goals to transform our world*. Web only: http://www.un.org/sustainabledevelopment/education/.

US National Research Council. 2012. *Report from the Committee on Defining Deeper Learning and 21st Century Skills*.

Van Deursen, A. and Helsper, E. 2015. The third level digital divide: who benefits most from being online? *Studies in Media and Communications*, Vol. 10, pp. 29-53.

Vivian, R., Falkner, K. and Falkner, N. 2014. Addressing the challenges of a new digital technologies curriculum: MOOCs as a scalable solution for teacher professional development. *Research in Learning Technology*, Vol. 22, No. 1, pp. 1-19.

Voogt, J., Erstad, O., Dede, C. and Mishra, P. 2013. Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of Computer Assisted Learning*, Vol. 29, No. 5, pp. 403-13.

Vromen, A. 2017. *Digital Citizenship and Political Engagement*. London, Palgrave.

White, P. and Selwyn, N. 2012. Learning online? Educational internet use and participation in adult learning, 2002 to 2010. *Educational Review*, Vol. *64, No.* 4, pp. 451-69.

World Bank. 2016. *World Development Report 2016: Digital Dividends*. http://www.worldbank.org/en/publication/wdr2016.

Worldwide Web Foundation. 2016. *Women's Rights Online Digital Gender Gap Audit*. https://web-foundation.org/research/digital-gender-gap-audit/.

World Economic Forum. 2016. *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*. Geneva (Switzerland), World Economic Forum. http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf.

World OER Congress. 2017. *Second World OER Congress: Background Document*. Second World Open Educational Resources (OER) Congress, Ljubljana, Slovenia, 18-20 September 2017. http://www.oercongress.org/.

Wyatt, J., Allison, S., Donoghue, D., Horton, P. and Kearney, K. 2003. *Evaluation of CMF Funded UK Online Centres - Final Report*. London, DfES.

Zuckerman, E. 2013. *Digital Cosmopolitans*. New York, WW Norton and Company.

APPENDIX

Case Study 1

She Will Connect: Africa

Intel

Introduction: The changing skills needed for the Fourth Industrial Revolution

As the pace of technological progress accelerates, the world is entering a 'Fourth Industrial Revolution', with breakthrough innovations like self-driving cars, autonomous robots, machine learning and smart factories. This revolution has broad implications for the workforce of tomorrow; today's youth — in every part of the world — will need technology skills and experience to succeed in the future.

Information and communication technologies (ICTs) can be a force for positive social impact and have the power to reduce inequalities, but only if everyone has access to them. Intel Corporation collaborates with governments, nonprofits, educators and others to help empower people through technology, including working to accelerate the closure of gender gaps in technology access and career paths. In 2013, the company launched the Intel® She Will Connect initiative, which is equipping millions of women across Africa with twenty-first century ICT skills and enabling them to connect to a wealth of health, government, and educational information, and new economic and entrepreneurship opportunities.

Part I: The technology gender gap and barriers to adoption

Research indicates that economic opportunities for women are limited by a lack of access to technology.[1] A recent International Telecommunication Union report revealed that one of the most pernicious aspects of the global digital divide is the internet user gender gap, which remains at 33% across the world's least developed countries in 2017. While the internet user gender gap has narrowed in most regions since 2013, it has widened in Africa.[2]

The technology gender gap has three primary drivers: illiteracy, affordability and awareness.[3]

Illiteracy: The Women and the Web report published by Intel in 2013 noted that across all developing countries, only about 75% of women are literate, compared to 86% of men. The difference is much greater in some countries; in India, for example, only 51% of women can read and write, compared to 75% of men. The internet will remain out of reach for those without this fundamental skill.[4]

Affordability: The Alliance for Affordable Internet defines 'affordability' as 1 gigabyte (GB) of broadband priced at 2% or less of monthly income. Only 19 of the 58 countries studied in the Alliance's 2017 Affordability Report met this target.[5]

Because women on average earn 25% less than men globally, high internet prices discriminate disproportionately against women.[6]

Awareness: Lack of interest and awareness of the internet's benefits keep women from going online. Fully a quarter of non-users expressed a general lack of interest in the internet and nearly a quarter said they did not believe they need it. Even women with internet access were unaware of its potential uses beyond serving as gateway to sites such as Facebook and YouTube.[7]

The Intel® She Will Connect Mobile Caravan connects rural women in Africa to opportunity.

Part II: Intel® She Will Connect in Africa

In 2013, Intel and several partners launched a programme to accelerate closure of the technology gender gap in a part of the world where the gap is greatest: sub-Saharan Africa. The Intel® She Will Connect initiative — introduced initially in Kenya, Nigeria, and South Africa — is helping women acquire digital skills and become more aware of the benefits of connectivity and technology. The programme's goal is to enable the social and economic empowerment of women by giving them access to educational, financial, health, and gender-specific information; e-government services; national and global news; and economic opportunities.

For holistic enablement, the programme includes three components: digital literacy skills training, a peer network and gender-relevant content, and access to income-generation opportunities.

Digital literacy skills: Through Intel She Will Connect, Intel partners with non-governmental organizations (NGOs) across Kenya, Nigeria, and South Africa, to help them integrate digital literacy training into their gender and development programmes targeting women and girls. With a focus on entrepreneurship, the initiative enables participants to gain the skills they need to succeed in a knowledge-based economy — those related to the internet, e-mail, social media, online safety, productivity applications such as word processing and spreadsheets, and multimedia. Face-to-face training leverages Intel® Learn Easy Steps, a free, basic digital literacy curriculum. The sessions provide women with resources they can use during and after training, including information about accessing learning websites that are available for free without data charges through the Free Basics platform provided by internet.org.

Over time, Intel has evolved aspects of the programme to increase its impact. For example, face-to-face training was initially completed at community centres, but many women in rural areas were not able to travel to attend the sessions. In response, Intel added two new delivery models in 2016: the **Intel® She Will Connect Mobile Caravan**,[8] an ICT lab on wheels; and the **BRCK Kio Kit**[9] — a 'digital classroom' in a hardened, water-resistant, lockable case that can reach women in areas where the caravan cannot go. The BRCK kio kit contains 40 tablets, headphones, and relevant local and international content.

Early feedback on the two new delivery methods has been positive; in Kenya, Intel's nonprofit partner is already

finalizing plans to fund additional mobile caravans to broaden the programme's reach.

Peer network and gender-relevant content: Research shows that the internet can empower women by providing opportunities to connect with people outside of their communities.[10] These connections can reinforce digital literacy skills and increase the continued use of ICTs. For these reasons, Intel She Will Connect includes a peer network for participants.

Two critical partners, World Pulse and UN Women, also support mentorship sessions for programme participants, and advocate for government support of organizations focused on increasing digital literacy.

To generate interest, engage more women, and share the value of connecting online, Intel has brought in ambassadors to whom participants can relate — well-known, accomplished women such as Nigerian civil engineer and actress Titilope Sonuga and Kenyan radio personality Adelle Onyango — to serve as Intel She Will Connect spokespersons and share their experiences through events, radio shows and blogs.

Income-generation opportunities: Through partnerships with organizations that provide additional skills training and job placement, Intel She Will Connect is enabling women to access opportunities to increase their incomes. For example, the programme collaborates with South Africa's **CareerBox**[11] and other organizations that focus on business process outsourcing (BPO), in an effort to help participants link to online work opportunities that leverage their newly acquired ICT skills.

Connection equals opportunity

In Nigeria, few women are connected to the internet; Jessica was no exception. Her enthusiasm for hairdressing and makeup led her to a government training institute to pursue a career as a beautician. While attending courses, she discovered and enrolled in the Intel She Will Connect programme. Jessica had never used a computer and was surprised to learn that technology is more than just a tool for the young men in her community to promote illicit pictures. She acquired many skills in the programme, but understanding how to use the internet to improve her business has had the greatest impact on her and her seven siblings' lives. Watching YouTube videos, Jessica learned new braiding techniques that have enabled her to offer more services to her customers and increase her prices. She has also expanded her customer base by leveraging her social media skills to create and maintain her Facebook business page.

Watch her story at:

https://www.intel.com/content/www/us/en/corporate-responsibility/impact/connection-equals-opportunity-video.html

Part III: Results and impact

Intel is on track to achieve its goal of reaching 5 million women in sub-Saharan Africa through the programme by the end of 2020. At the end of 2016, the Intel She Will Connect initiative had reached 1.3 million women in Africa through its web portal, programme ambassadors, and Free Basics participation, including 200,000 who received face-to-face training.

Participants are not only gaining awareness of the benefits of ICT, but also using their knowledge to secure jobs and to start or expand existing businesses that create job opportunities for others. A number of women have launched businesses focused on training others in digital skills.

Participants who have increased their income as a result of gaining valuable digital literacy skills are not only benefiting themselves and their families, but also their communities, through increased spending at local businesses.

In 2016, Intel launched an effort to gather more detailed information related to the programme's impact. Intel now works to track whether participants have subsequently:

- Gained employment;
- Started or expanded a business;
- Received a microloan;
- Continued education or skills training; or
- Volunteered to practice and expand skills.

Partners who have gathered these metrics since 2016 reported that 700 women have improved their socio-economic position following training.

Part IV: Components for success

Strong Partnerships: Critical to the programme have been collaborations with a broad range of organizations. To date, more than 30 global and local partners have supported implementation, co-funding, and marketing/outreach activities. To accelerate progress toward closing the internet gender gap in Kenya and Nigeria, Intel also helped form the **Women and the Web Alliance**[12] to leverage Intel She Will Connect assets in partner programmes, with the goal of reaching 600,000 women. The alliance secured US$1.5 million in co-funding for partners.

Face-to-Face Delivery: Since the programme officially launched in 2013, Intel and its partners have shifted their strategy to address evolving needs and the 'high reach, low impact' vs. 'low reach, high impact challenge': To achieve the goal of reaching a large number of women, Intel needed to rely on a relatively low-touch solution, but truly transforming the lives of women required high-touch (face-to-face) training. One component of the initial strategy relied on a custom-built digital learning platform and a separate mobile learning application. However, face-to-face training proved to be the preferred method of initial engagement by partner organizations, so Intel made the decision to halt development of the digital learning platform and focus on content delivery, including the development and scaling of offerings through the mobile caravan and BRCK kio kit.

Affordability: The cost of internet connectivity prevents many women from going online after the training. To help address this issue, the programme includes instruction on accessing content without data charges through internet.org's Free Basics.

In addition, many women have feature phones that can access the internet, but they are not aware of programmes

offered through their mobile operators, such as Free Basics or free access to social media. The programme's inclusion of this information in its face-to-face training has enabled women to take better advantage of their existing devices' capabilities.

Offline learning: Many participants with smartphones also must be shown how to download and use applications — especially learning apps that can be used offline. Effective learning takes time and practice, which the programme's offline learning tools can provide.

Conclusion

Intel She Will Connect offers much more than basic digital literacy training. Through the programme, Intel and its partners are providing mentorship and a path for women to gain advanced technology and job readiness skills, and to connect to crucial social, education, health, and economic opportunities.

> Intel is confident that the women who participate are gaining the knowledge and technology experiences they need to succeed in the future.

Endnotes

1 Malhotra, A., Schulte, J., Patel, P., and Petesch, P. Innovation for Women's Empowerment and Gender Equality. International Center for Research on Women (2009). https://www.icrw.org/wp-content/uploads/2016/10/Innovation-for-Womens-Empowerment.pdf.

2 International Telecommunication Union. 2017. ICT Facts and Figures. http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf.

3 Intel Corporation, Dalberg Global Development Advisors, GlobeScan. 2013. Women and the Web: Bridging the Internet gap and creating new global opportunities in low- and middle-income countries. https://www.intel.com/content/dam/www/public/us/en/documents/pdf/women-and-the-web.pdf.

4 Ibid.

5 Alliance for Affordable Internet. 2017. Affordability Report. http://a4ai.org/affordability-report/report/2017/.

6 Alliance for Affordable Internet. 2016. Five Barriers to Women's Online Empowerment. http://a4ai.org/five-barriers-to-womens-online-empowerment-new-digital-gender-audit-released/.

7 Intel Corporation, Dalberg Global Development Advisors, GlobeScan. 2013. Women and the Web: Bridging the Internet gap and creating new global opportunities in low- and middle-income countries. https://www.intel.com/content/dam/www/public/us/en/documents/pdf/women-and-the-web.pdf.

8 https://www.intel.com/content/www/us/en/corporate-responsibility/intel-she-will-connect-caravan-video.html.

9 http://education.brck.com/kiokit/.

10 GSMA. 2015. Bridging the gender gap: Mobile access and usage in low- and middle-income countries. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/02/GSM0001_03232015_GSMAReport_NEWGRAYS-Web.pdf.

11 https://www.careerbox.co.za/.

12 http://www.womenandtheweballiance.org/.

Case Study 2

1,2,3...Codez!: Enquiry-based computer science for France and beyond

La main à la pâte

Introduction: Building interest in computer science

In an effort to encourage more students to pursue careers in science and technology fields, La main à la pâte, a foundation for scientific cooperation based in France, promotes enquiry-based science education based on the active adoption of knowledge through reasoning, guided investigation and experimentation. The teacher helps pupils make discoveries, and uses as little top-down rhetorical teaching as possible. This approach stimulates analytical and critical thinking skills, and deepens students' understanding of the world.[1]

Enquiry-based learning requires that educators develop good skills in both science and teaching. La main à la pâte fosters these skills by providing resources and professional development for teachers. In 2016, the Foundation and its partners launched a pedagogical programme aimed specifically at enabling teachers to fully integrate enquiry-based computer science education across multiple disciplines and multiple grades, starting at the kindergarten level.

Part I: Barriers to effective science education

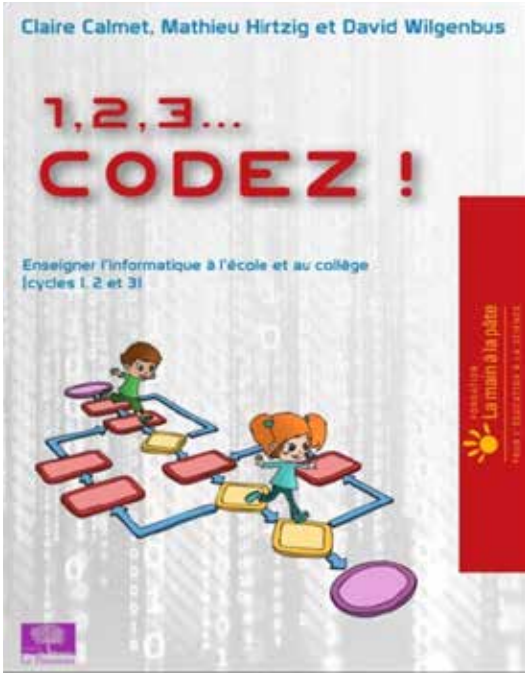
Research indicates that student interest in science declines after the transition from primary to secondary school.[2] At the same time, demand for science, technology, engineering and maths (STEM) workers continues to rise. In the European Union, some 7 million STEM job openings are forecast by 2025,[3] and the US could face a shortage of 1 million STEM professionals by 2022 if the number of students who receive undergraduate STEM degrees does not dramatically increase in the interim.[4]

Enquiry-based educational methods have been shown to increase students' interest in and positive attitudes toward pursuing STEM fields,[5] but teachers who wish to integrate such approaches in their classrooms face difficulties such as:

- lack of easy-to-implement classroom resources;
- lack of initial and in-service training;
- lack of communities of practice to rely on; and
- lack of equipment.

Part II: 1, 2, 3...Codez!

To address these barriers, the French foundation La main à la pâte and its partners[6] launched a project entitled '1, 2, 3...Codez!' (1, 2, 3... Code!) in 2016. The project addresses different themes of computer science: history, techniques, algorithms, languages, programming, robotics, and more. The three-fold initiative includes a free pedagogical guide, teacher training and a collaborative website.



Pedagogical guide: The Foundation's initial guide was designed to assist both beginning and veteran teachers working with students at the kindergarten to junior high school levels. The 360-page volume is available online or in print, and is offered for free to teachers who register on the programme's website. The guide is the first of its kind in France to offer a complete pedagogical sequence on computer science. Pedagogical and computer science overviews are included, and all of the activities in the guide were tested in classrooms prior to the project's launch. Activities are included both for classrooms with and those without computers, robots or tablets.

The Foundation printed 9,000 copies of the initial guide. Produced under a Creative Commons licence, the content is an open educational resource that can be re-used and disseminated freely by any partner, trainer or teacher.

In June 2017, the Foundation introduced a second, 400-page volume aimed at secondary school teachers. The new volume follows similar guidelines to the initial guide, but is designed specifically for maths and technology teachers, who are generally charged with teaching computer science in secondary schools in France.

Teacher training: As part of the 1, 2, 3... Codez! programme, the Foundation offers comprehensive teacher training sessions at a national level, regionally within its 'Maisons pour la science' (Houses of Science) network of training centres, and locally on demand by local educational authorities.

From June 2016 to June 2018, La main à la pâte and its network have scheduled over 100 such training sessions. In addition, the Foundation was invited to two colloquia on computer science, reaching more than 300 teachers.

In the first year alone, trainers and teachers logged more than 2,500 computer science training days as part of the programme. Trained teachers who subsequently train other educators have multiplied the project's impact.

Collaborative website: The programme website, www.123codez.fr, enables educators and students to browse through additional resources, ask for pedagogical advice or help with computer science topics via a network of consultants and experts, collaborate with other classes, and review testimonies from the 50 classes that tested the programme prior to its launch.

Additionally, the website offers free access to the pedagogical guides, pedagogical and computer science topic overviews, and interactive exercises (developed by the Foundation and a partner organization) that enable students to delve more deeply into algorithms, information representation, or programming.

Also on the website are collaborative tools — including a map showing the locations of registered users (the map does not include private addresses or locations of those who decline to share their coordinates), a forum and a blog. These collaborative tools improve and facilitate interactions among classes studying computer science, forming the base of a large community of practice.

La main à la pâte supports this community of practice by:

- monitoring the registrations and printed guide orders;
- moderating the forum;
- moderating the blog; and
- responding to questions and requests submitted via a 'contact us' form accessible from the programme website.

Part III: Results and impact

The Foundation has far surpassed its initial goal of reaching 10,000 classrooms in two years. During the first week after launch, 4,000 printed guides were distributed. As of June 2016, one year into the programme, 18,000 teachers and trainers had registered on the 1, 2, 3...Codez! website, and 75% of them had ordered the printed guide.

By far the majority of members come from France (95.6%) and its overseas territories (1.3%). This geographic distribution is not surprising, since the guide is available only in French. The remaining members come from 44 additional countries, with the highest concentrations in other countries where French is widely spoken, such as Switzerland, Belgium, Canada and Italy.

Distribution of the website's registered members in France, as of June 2016.

Teachers represent 72% of the registered members, while trainers, directors, and inspectors account for about 21%.

Member Profiles	%
Other	3.47%
Director	**8.36%**
Pupil	0.12%
Primary school teacher	**52.31%**
Jr high school teacher	**19.78%**
Student	2.53%
Trainer	**11.22%**
Inspector	**1.46%**
Scientist	0.76%
Total	**100.00%**

Members eligible for free printed guides shown in **bold**.

Beneficiary	Registered to '1,2,3... Codez!'	Total in France*
Primary schools	6,000	52,000
Primary school teachers	12,000	330,000
Pupils (est.)	**250,000**	**6,800,000**
Jr. high schools	1,800	7,800
Jr. high school teachers	5,000	64,000**
Students (est.)	**400,000**	**5,497,100**

*Provided by the French Ministry of Education.
**Mathematics and technology teachers only

A full impact evaluation of the project has not yet been conducted. However, data from small-scale studies indicates that approximately 80% of participating teachers have effectively implemented earlier Foundation projects in their classrooms. A similar implementation rate across the full 1, 2, 3...Codez! programme would indicate that about 400,000 students have benefited from the project to date, as illustrated in the table above.

The **www.123codez.fr** website has received more than 600,000 hits since its launch, and the Twitter hashtag #123codez has been regularly retweeted at each training session. More than 260 messages have been posted on the website forum, and more than 2,000 messages have been received on the contact form.

Part IV: Lessons learned

Scientific community involvement: The Foundation worked with the scientific community — specifically, Inria, a public research body dedicated to digital science and technology — during the conception and dissemination phases of the project. Such collaboration is critical because it ensures that the concepts discovered by the pupils correspond to up-to-date science facts. Additionally, it brings the pedagogical and scientific communities closer to each other, opposing recurrent prejudices and bringing up new synergies.

Content testing: All class activities were thoroughly tested in real conditions. Doing so ensures that proposed activities are well-received by students, are easy to implement in classrooms, and convey the right concepts for pupils to remember

Activity sequencing and scripting: The activities follow a consistent thread, with new concepts building upon previous ones, and each new activity relating to a new stage of a consistent plot. The Foundation believes that a lack of this type of staging was a flaw in previous initiatives that targeted computer science education. Pupils are more involved when following the story of a hero than when accumulating raw and unrelated exercises on an abstract topic. With activity staging, students build the whole scenario, and are interested in predicting the content of the next session and answering questions that come naturally during a session.

Unplugged activities: The availability of activities that do not require computers, robots or tablets enables learning opportunities for more classrooms, while helping to crystallize new concepts for all students. Such 'unplugged' activities help students verbalize key concepts in computer science, independent of hands-on activities with robots and computers. Outside the playful environment of digital tools, the pupils can concentrate more on the ideas that they are discovering — for example, they may discover that they are using loops and conditions when following a kitchen recipe, and then they use such loops and conditions when programming a video game.

Printed format: In France, the availability of printed guides (in addition to e-publications) was important. The printed format served to underscore the seriousness of the project, and eased adoption of 1, 2, 3...Codez! in classrooms. The printed guide also allowed teachers to more easily share the resource with

their colleagues. To date, 9,000 printed guides have been distributed, and the Foundation is researching funding options to print more copies for the thousands of additional teachers who have requested them.

Training and resources: The combination of training sessions and free resources is probably the most crucial feature of the project. Teachers who are trained on a specific resource and then have easy access to that resource are more likely to implement it in their classrooms.

Conclusion

With 1, 2, 3...Codez!, the Fondation La main à la pâte has developed a successful model to facilitate the integration of computer science into classroom curricula from kindergarten to high school. Computer science is no longer introduced as a separate discipline but as a field of study at the crossroads of several disciplines. The programme's enquiry-based learning approach stimulates students' scientific spirit, understanding of the world, and capacity for expression, encouraging and helping to better equip them for the jobs of the future.

Endnotes

[1] www.fondation-lamap.org/en/page/27852/about-la-main-a-la-pate.

[2] Tröbst, S., Kleickmann, T., Lange-Schubert, K. et al. 2016. Instruction and students' declining interest in science. American Educational Research Journal, February. http://journals.sagepub.com/doi/abs/10.3102/0002831215618662.

[3] Caprile, M., Palmén, R., Sanz, P. et al. 2015. Encouraging STEM Studies for the Labour Market. Directorate General for Internal Policies, Policy Department A: Economic and Scientific Policy. European Parliament. http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU(2015)542199_EN.pdf.

[4] Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics. President's Council of Advisors on Science and Technology (2012). http://www.ewa.org/sites/main/files/pcast-executive-report-final_2-13-12.pdf.

[5] Christidou, V. 2011. Interest, attitudes and images related to science: Combining students' voices with the voices of school science, teachers, and popular science. International Journal of Environmental & Science Education, Vol. 6, No. 2, pp. 141-59. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.4608&rep=rep1&type=pdf.

[6] Inria, France IOI, Pasc@line, Google, Microsoft, Mobsya, École Polytechnique Fédérale de Lausanne (EPFL), Educaland, and Editions Le Pommier.

Case Study 3

mydigitalmaker: Fostering digital skills in and out of the classroom in Malaysia

Malaysia Digital Economy Corporation and the Ministry of Education Malaysia

Introduction: Collaborating to build the workforce of tomorrow

The future of Malaysia as a high-income and competitive nation largely depends on its pool of highly skilled human capital. Digital innovations are disrupting all sectors and creating new job opportunities. The digital economy is expected to contribute 18.2% of Malaysia's gross domestic product by the year 2020,[1] and an estimated 90% of all future jobs will require digital competencies.

In response, the Malaysian government is working to nurture curious and passionate problem-solvers, producers and innovators who can think critically analytically and creatively to help transform Malaysia into a digital nation. Collaborating with multiple partners, the government has launched the mydigitalmaker initiative, which integrates technology training, digital literacy and cybersafety awareness into the national curriculum while also building a strong digital maker ecosystem outside classroom walls.

Part I: The case for change

The Malaysia Education Blueprint 2013–2025 has been developed to transform the country's education system to meet the challenges and opportunities brought about by the increasingly competitive global economy. The blueprint's aim and the purpose of Malaysia's education system is to equip students holistically with the attributes they need to succeed in the twenty-first century.

Six key attributes of a globally competitive student.

Curriculum at both the primary and secondary levels is being revised to embed a balanced set of knowledge and skills such as creative thinking, innovation, problem solving and leadership. Curriculum will still stress student-centred and differentiated teaching, but with a greater emphasis on problem- and

project-based work, a streamlined set of subjects or themes and formative assessments, and a shift toward higher order thinking skills.

While digital technology use is widespread in Malaysia, particularly among young people, few students see the potential of pursuing education and careers related to this area.

The following points illustrate the current situation in Malaysia:

- 75% of Malaysian youth (aged 15-24) have a minimum of five years of active internet use.[2]
- Student enrollment in STEM subjects has declined, especially in science at the secondary school level.[3]
- Initiatives exist to encourage digital innovation, but they lack emphasis in the formal curriculum due to the academically inclined school culture.
- Allocations for digital technology still focus on providing and maintaining basic ICT infrastructure.
- Policies and guidelines for students bringing their own devices to schools are still being debated, primarily because of device security concerns.

Based on these points, it appears that Malaysian youth are good consumers of technology, and that more must be done to nurture them to become producers and innovators of technology who are equipped to contribute to the nation's competitiveness.

Part II: mydigitalmaker

In response to this situation, the Malaysian Digital Economy Corporation (MDEC) — the lead government agency driving Malaysia's digital economy — and the Malaysia Ministry of Education (MoE) partnered with industry and universities to launch the mydigitalmaker initiative in August 2016.

The initiative aims to:

- Cultivate interest and skills in digital innovation and creativity among Malaysian youth;
- Encourage students to study STEM subjects in upper secondary schools and institute of higher learning undergraduate courses; and
- Transform Malaysian youth from being consumers to producers and innovators of digital technology.

The mydigitalmaker initiative comprises two strategies: the full integration of STEM education in the national school curriculum, and mobilization of a complementary digital maker ecosystem to provide youth with co-curricular and extra-curricular project-based learning opportunities.

Curriculum integration: With the support of MDEC, in January 2017, the MoE began deploying a revised ICT curriculum for primary schools and a new computer science curriculum for secondary schools across Malaysia. In primary schools, the curriculum integrates computational thinking and computer science concepts across all disciplines, whereas in secondary schools, computer science courses are offered as elective subjects. Teaching and learning materials have been benchmarked against those of the **United Kingdom's Computing at School organization**[4] and **General Certificate of Secondary Education**,[5] the **Barefoot project**,[6] and the **U.S. Computer Science Teachers Association**.[7] The learning materials are customized for the Malaysian education system via intensive review sessions with the Curriculum Development Division of MoE, industry partners, and teachers.

To ensure that the country's 400,000 educators are prepared to deliver the new curriculum, mydigitalmaker includes the deployment of a range of train-the-trainer programmes, such as the B**ritish Computing Society (BCS) Certified Master Training** for lecturers of teacher training colleges and universities; and the

International Society for Technology in Education (ISTE) Certified Coaches[9] for lecturers of the Aminuddin Baki Institute, which trains school principals and administrators. The MOE and MDEC are also partnering with selected universities to make continuing professional development courses on computer science available for teachers.

Maker ecosystem: MDEC is galvanizing a network of public sector players, private sector partners, non-governmental organizations (NGOs), and universities to build a strong digital maker ecosystem. To date, 60 public-private-academic members have committed to join this effort to nurture and groom Malaysian youth to become digital innovators.

The ecosystem includes co-curricular activities offered through digital technology clubs at schools, which are structured to provide digital skills to members, and encourage them to create their own digital inventions and submit them to competitions. Universities and private organizations are also establishing or hosting Digital Maker Hubs — physical spaces equipped with digital making tools and learning resources. Malaysia currently has 31 such hubs, which augment the new national curriculum and bring local community members — students, educators, parents and industry experts — together to play, learn and create digital artifacts and innovations.

Youth who have mastered digital skills and excel in the programme are groomed to become in-school 'Student Digital Champions', or student leaders who act as change agents to support their teachers and other students in leading, managing and carrying out digital maker projects. In 2016, for example, MDEC invited 33 talented students to participate in a rigorous, three-month entrepreneurship programme. The programme culminated in 10 students traveling to the US, where they had the opportunity to present and pitch their prototypes to CEOs and venture capitalists in California's Silicon Valley. The young people received valuable feedback that they were encouraged to share when they returned home, in the hope of inspiring other students to follow in their footsteps.

Part III: Results and impact

To measure students' outcomes, MDEC and the MOE jointly developed the Digital Competency Standards (DCSs) based on selected local and international standards. The DCSs cover three key domains:

- **Technology:** Measures students' understanding of technology concepts and operations.
- **Cognition:** Measures the skills used to formulate issues; identify problems; provide solutions; make decisions; and plan, conduct and manage projects using digital tools and resources.
- **Digital citizenship:** Measures competency in using information and technology ethically, responsibly and legally.

Students are ranked at five levels of competency: Digital Beginner, Digital Novice, Digital Intermediate, Digital Advance, and Digital Innovator. Students are considered digitally competent if they rank at Digital Intermediate and above. In 2016, 88.6% of Malaysian students were digitally competent, with the highest percentage (50.6%) achieving the Digital Intermediate level (rank 4). These results will serve as a baseline to measure the outcomes of the mydigitalmaker initiative as it moves forward.

To date, more than 30,000 students were reported to have participated in co-curricular or extra-curricular activities related to the following topics:

- Coding/programming
- Robotics
- 3D design and printing
- Arduino
- Game development
- App development
- Digital storytelling

Currently, no national mechanism exists to measure the levels of participation or the skills students acquire as a result of participation in digital maker activities. However, the movement has enabled students across Malaysia to expand their ideas and become innovators, as described in the 'Success stories' box.

Success stories

Lim Wern Jie, age 14. While many boys his age are just learning about computers, Wern Jie, from Penang, has already developed over 50 digital applications. Fourteen of his applications have been published on the Apple App Store, and downloaded some 600,000 times. Since joining the mydigitalmaker initiative, he has expanded his interests to robotic programming. One of his robotics innovations was featured at the 2017 Consumer Electronics Show in Las Vegas, Nevada, US.

Manojkumar Subramaniam, age 18. The mydigitalmaker initiative helped Manoj, another self-taught programmer, secure a scholarship to complete a 12-week extreme coding course taught by a local training institute. He has also received scholarships from two Malaysian universities, and plans to pursue a degree in electrical engineering starting in 2017.

Khairul Amrin Syahrean and Mohd Naimi Abdul Rahim, age 17. Khairul and Naimi, both mydigitalmaker participants, developed Sint Terra, a prototype hygienic waste disposal system for public areas such as shopping malls, parks and schools. The robotic system enables people to dispose of waste without touching a contaminated dustbin lid. The system also features a fire sensor, and it compresses waste to maximize storage capacity.

Nanson Mat Aaron Anak Dublin and Gary Lanyuk Anak Imusraidel, age 15. Nanson and Gary live 30 kilometres from their school in rural Sarawak. They do not have PCs at home, but they arrive two or three hours early for school to use their teacher's computer to code. As part of mydigitalmaker co-curricular activities, they created an intelligent colour vision system to identify when local palms should be harvested to maximize oil production.

Part IV: Requirements for success

Reaching all students: Digital learning opportunities are more accessible to students in urban areas than those in underserved rural communities across Malaysia.[10] To address this gap, MDEC and a partner, the Pintar Foundation, have outfitted a bus with a range of digital making tools, and information about digital jobs and the safe use of technology. The bus aims to expose an additional 100,000 students, teachers and parents in rural and underserved communities to digital innovation and the jobs of the future. The MoE, supported by MDEC, has also introduced Digital Maker Club modules in all schools nationwide. These modules, which include robotics, coding, digital photography and videography, allow students to acquire digital making skills, regardless of their location.

Infrastructure readiness: ICT infrastructure must be present in all schools to support the implementation of e-learning and the integration of technology in teaching-learning processes. To date, the MOE has used various initiatives and strategies to ensure adequate infrastructure readiness. Schools are provided with facilities such as computer labs, mobile computer labs and Schools Access Centres. Allocations for infrastructure maintenance are also set aside annually to maintain and sustain the devices so that they are in good condition and support teaching and learning. In addition, all schools are provided with internet access through various technologies. The Virtual Learning Environment (VLE) platform is also provided to all students and teachers to facilitate teaching and learning in and outside of classrooms, both during and after school hours.

Sustainable partnerships: Symbiotic partnerships between industry and academia benefit students and undergraduates in terms of curriculum, scholarship, and eventual job placement. The partnerships increase academic enrolment, while helping students to develop the specific talents they need for employment. A continuum approach provides interventions for students, from school through to placement in the workforce. A mechanism to track the students' performances in digital making and skills is being discussed with partners so that students have a head start on employability.

Conclusion

With the coming of the Fourth Industrial Revolution,[11] digital technology will be integral to how people live, work and play. The mydigitalmaker initiative aims to equip Malaysia's youth with the drive, confidence, skills and knowledge they need to embrace and become producers of technology. Key to the initiative's successful launch have been concerted, coordinated efforts by government, the private sector and universities to shift policies appropriately and ensure educator readiness.

While the initiative is off to a good start, more remains to be done to ensure that Malaysia has a sustainable, high-quality talent pool prepared to leverage future digital opportunities. In the years to come, mydigitamaker will be scaled to groom more talented students via a holistic approach to ensure a sustainable pipeline of digital workers for future jobs. By doing so, Malaysia will continue to keep pace in an increasingly competitive global economy.

Endnotes

[1] Economic Planning Unit, Office of the Prime Minister of Malaysia.

[2] International Telecommunication Union. 2013. Measuring the Information Society.

[3] Education Planning and Research Division, Ministry of Education Malaysia.

[4] https://www.computingatschool.org.uk/.

[5] https://www.gov.uk/government/collections/gcse-subject-content.

[6] https://barefootcas.org.uk/.

[7] http://www.csteachers.org/.

[9] https://www.iste.org/.

[10] Pintar Foundation, Malaysia.

[11] https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/.

Case Study 4

Connect To Learn: A global initiative for scaling access to quality education

Ericsson, the Earth Institute at Columbia University and Millennium Promise

Introduction: Leveraging ICT to educate the workforce of the future

At all levels of education, large numbers of learners — especially girls — are failing to acquire the skills they need to transition to work, realize opportunities in the information age, and participate in their communities as global citizens. Quality education prepares young people for economic and personal empowerment and can strengthen national economies.

As mobile broadband becomes more ubiquitous, reaching the most remote regions of the world, it offers opportunities to transform and improve education. Connect To Learn, a collaborative effort launched in 2010 by Ericsson, the Earth Institute at Columbia University, and Millennium Promise, harnesses the transformational power of information and communications technology (ICT) to deliver high-quality education to students everywhere.

Part I: The call for universal education

Despite considerable progress over the past several decades to guarantee universal access to education, over 260 million children, adolescents and young adults are out-of-school, according to UNESCO.[1] More than half of all excluded children and youth are between the ages of 15 and 17.[2] In addition, many students who are enrolled in formal education are not acquiring the skills and competencies they need to succeed in knowledge-based economies.

Girls, in particular, face considerable barriers to education in many countries, which leaves them more vulnerable to HIV/AIDS, early and forced marriage, and acts of violence. With quality education, girls have a much greater chance to earn a decent living, raise a healthy family and improve their quality of life. In fact, a World Bank study found that every year of secondary school education completed by a girl correlates with an 18% increase in her future earning power.[3]

At the same time, the availability of mobile broadband has increased tremendously around the world in recent years. Harnessing the power of mobility, broadband and the cloud is key to driving improvements in the quality of education and delivering universal primary and

secondary schooling. For many schools around the world, especially those in marginalized communities, the only chance to access online educational resources, share knowledge assets and lesson plans, and communicate and collaborate with fellow teachers is via mobile broadband. Currently, mobile broadband subscriptions are growing by around 25% year-on-year, with an increase of approximately 240 million in the first quarter of 2017 alone. The total number of mobile broadband subscriptions is now around 4.6 billion.[4]

Part II: Connect To Learn

The Connect To Learn initiative launched in 2010 by Ericsson, the Earth Institute at Columbia University, and Millennium Promise invites a range of additional partners to advance secondary school education in three key ways: implementing mobile broadband and cloud solutions in schools so that both students and teachers have access to global education resources; supporting the establishment of global support for education to raise awareness about the importance of secondary education, especially for girls; and raising funds to provide school scholarships.

Specific programme objectives include:

- Removing barriers to the use of ICT in the classroom by providing a cloud-based, remotely managed solution designed to avoid IT complexity for teachers, who can instead focus on the quality of education;
- Improving the quality of education and connecting school children globally through ICT;
- Delivering quality education content and resources, especially to areas with low bandwidth or connectivity challenges;
- Leveraging public-private partnerships to advocate for policies that support universal primary and secondary education, with a focus on United Nations Sustainable Development Goal (SDG) 4: Ensure inclusive and quality education for all and promote lifelong learning; and
- Providing scholarships in some cases, especially for girls.

Connect To Learn implements ICT in schools to enhance access to quality teaching and learning resources in a safe, cost-effective, and user-friendly way. The programme uses the power of technology to provide students and teachers with access to global libraries and information sources while connecting schools to schools, students to students, and teachers to teachers around the globe to support collaborative learning, social awareness, and cultural sharing.

The Connect To Learn technology infrastructure has multiple layers, consisting of the following four components:

Infrastructure and cloud
The technology required to connect schools to the internet and to manage mobile broadband subscriptions and content.

Enabling technology
The hardware that must be installed in local schools.

Teacher training kits
The physical equipment and tools required by teachers to utilize the Connect To Learn platform.

Student devices
The physical devices that are used by the students, for example laptops and tablets.

There are considerable challenges in introducing mobile broadband technology to schools in developing countries. These include logistical difficulties in bringing connectivity to rural areas; access to electricity; security; low levels of IT knowledge among teachers; and the lack of a strong business model

to ensure efforts are sustainable. Connect To Learn is helping to meet many of these challenges by demonstrating business opportunities to operators, and by engaging governments in dialogue to promote the inclusion of ICT in national education policies and budgets.

Ericsson is also deploying a cloud-based ICT solution in schools, which lowers both initial costs and the total cost of ownership of technology solutions, while significantly reducing complexity for teachers and students alike. Initial costs can be lowered, as schools do not need expensive hardware or software licenses to get started. Software costs are kept to a minimum through the use of open source solutions such as Ubuntu and Libre Office. Hardware costs are also kept down by removing the need for local servers and enabling the use of lower cost netbooks and Android tablets. Using cloud technology to remotely manage the devices and software eliminates the need for teachers to perform local ICT support functions. As a result, teachers do not have to become experts in technology and they do not need to spend valuable time supporting the technology. Remote support also lowers total cost of ownership because, for example, a small global support team can run batch software updates to multiple devices in schools in different projects across the globe.

The Connect To Learn scholarship programme enables more girls to attend secondary school, and is currently active in projects in sub-Saharan Africa and Myanmar. Scholarship recipients include girls whom local education authorities identify as having passed entrance exams to secondary schools, but whose parents don't have the financial means to send them to school. Using the knowledge of local partners, the scholarship programme also targets girls who have dropped out of secondary school or are at risk of dropping out. In Myanmar, each scholarship covers a minimum of two years. The first scholarships were awarded in late 2014, and to date 600 girls have received scholarships to continue their secondary schooling.

Part III: Progress to date

Connect To Learn has been launched in 23 countries, benefiting over 80,000 students. For detailed information about one of the deployments, please see the 'Connect To Learn: Mobile broadband transforms learning in rural Myanmar' case study included in this compendium. The following are brief examples of deployments in a few other locations:

India: Ericsson is working with child development organization Plan India with the goal of increasing self-development opportunities for 15,000 girls aged 15-25. To date, the effort has included the establishment of 15 Ericsson Digital Learning Centres in and around Delhi. The centres use technology solutions to provide tutorial support on subjects like maths, science and English, and were established to reach girls and young women within their own communities to avoid the challenge of limited mobility. The centres also work to raise awareness among girls on issues related to their safety and security.

Sri Lanka: In a partnership with Mobitel, the Commonwealth of Learning, and the Open University of Sri Lanka, Ericsson is working to equip teenage girls in farming communities with the ICT skills required to empower them to pursue further university education and secure future employment. The programme includes delivery of laptop computers, broadband internet access, online educational resources, and other relevant training. To date, the programme has benefited around 100 girls in four different communities around Sri Lanka. At least one participant in the programme has shared that the certificate she earned through this programme gave her the opportunity to be hired for an office administration job for which she otherwise would not have been qualified. Ericsson Sri Lanka is currently working

with the Commonwealth of Learning and the Open University of Sri Lanka to expand the content to include more training to enable students to work in office IT environments.

Iraq refugee camp: As part of a global partnership with the International Rescue Committee (IRC), Ericsson and telecommunications provider AsiaCell are deploying Connect To Learn in the Domiz refugee camp in Iraq. The goal of the project is to provide educational support to internally displaced people, refugees, and their host communities. The IRC purchases equipment and trains teachers, AsiaCell provides equipment and data packages, and Ericsson provides technical solutions and remote computer support. Ericsson also delivers connectivity and cloud-managed software at no cost so that the IRC can bring quality educational content to the refugee camp.[5]

Part IV: Lessons learned

The implementation of Connect To Learn in 23 countries to date has provided valuable insights into how ICT can best be implemented in secondary schools in resource-poor settings around the world. Key learnings include:

- School leadership is vital to drive the integration of ICT tools and an enabling environment for ICT in classrooms. Without their consent, school leaders can be blockers to the introduction of ICT into the classroom and may, for example, prioritize other issues over the training of teachers on the use of ICT. It is also important to secure the endorsement of the local authorities at the onset of a project, and ensure that partners have a good understanding of the country's context and regulations to facilitate the smooth implementation of the project on the ground.
- As teachers become more skilled, their perceptions of using ICT in teaching shifts. As they become more confident, an early maturity step is their use of ICT to create lesson plans. This is often followed by their use of basic technology such as a laptop and projector to improve the quality of teaching. A further maturity level is allowing students to use technology in the classroom, for example, allowing students to work in pairs and share an Android tablet. As the teachers' skill level grows, so does their view of what is possible in the classroom with ICT. Building the confidence and skill of teaching staff and encouraging innovation in teaching styles through the integration of ICT takes time and persistent effort. Sustaining progress requires continued and consistent support for teachers.
- Weak connectivity severely hinders teachers' efforts to find online resources. School servers populated with resources can supplement Wi-Fi routers. Despite the growth of mobile broadband, it is still a valuable and limited resource in many parts of the world. Connect To Learn implements low-cost content servers that can be reached over the cloud and updated with new learning content. This makes good use of the available connectivity, for example, by enabling the download of a new educational video once to the school content server, where it can then be accessed and viewed many times by teachers and students.
- Public-private partnerships are key to delivering ICT-based education. New models are needed between the private sector and governments to find innovative ways to finance digital education to achieve scalability.

Conclusion

ICT has the power to raise the quality of education by increasing the efficiency of education systems, innovating pedagogical practices, expanding learning and teacher professional development opportunities beyond the

limits of schools, and building students' twenty-first century skills.

Further, mobile technology enables real-time collection of data on learning outcomes, which can be used to inform education policy decisions related to curriculum, teachers' professional development, and making content more relevant and responsive to the needs of learners and their teachers.

An unprecedented global effort is required to achieve the bold education agenda set out by SDG 4, that by 2030, all girls and boys have the opportunity to complete free, equitable, and quality primary and secondary education. With its focus on public-private partnership and innovative use of mobile broadband and the cloud, Connect To Learn showcases paths to achieving that promise.

Endnotes

[1] UNESCO. 2017. Reducing Global Poverty through Universal Primary and Secondary Education. http://uis.unesco.org/sites/default/files/documents/reducing-global-poverty-through-universal-primary-secondary-education.pdf.

[2] Ibid.

[3] World Bank. 2016. World Bank Group to invest US$2.5 billion in education projects benefiting adolescent girls. Press release, April. http://www.worldbank.org/en/news/press-release/2016/04/13/world-bank-group-to-invest-25-billion-in-education-projects-benefiting-adolescent-girls.

[4] Ericsson. 2017. Ericsson Mobility Report. https://www.ericsson.com/assets/local/mobility-report/documents/2017/ericsson-mobility-report-june-2017.pdf.

[5] Ericsson. Reaching refugee children. https://www.ericsson.com/en/about-us/sustainability-and-corporate-responsibility/technology-for-good/sustainable-development/access-to-education/connect-to-learn-deployments/reaching-refugee-children.

Case Study 5

Digital solutions for managing early childhood care and development centres: Myanmar

Nokia and Save the Children

Introduction: Giving marginalized children a chance at a better life

Investing in early childhood care and development is critical, as the formation of the brain architecture related to language and cognitive development is most sensitive in the first five years of life. It is now well understood that early learning and well-being greatly impact a child's opportunities later in life. Still, only half of the world's children have access to early learning opportunities. Exclusion from early learning and development for disadvantaged children further deepens inequalities in learning, which fosters deeper inequalities in life opportunities.[1]

Since 2015, Save the Children and Nokia have been developing and deploying technology solutions to help ensure community-managed Early Childhood Care and Development (ECCD) centres in Myanmar are sustainable and continue to effectively prepare children for school well into the future. As a result, thousands of Myanmar's most disadvantaged children now have better access to higher quality ECCD and kindergarten classes.

Part I: Context and background

In Myanmar less than 25% of children in the 3- to 5-year-old age group have access to ECCD services.[2] Those who lack such services are at greater risk of school failure later in life. Investing in early learning opportunities is one of the smartest investments a society can make to address inequality and poor learning outcomes.[3]

Save the Children, a leading NGO in the field of ECCD, has been present in Myanmar since 1995. Over the years, the organization has developed rich contextual experience and expertise in ECCD and early grade programming in the country, working closely with the Myanmar Department of Social Welfare and the Ministry of Education.

Since 2006, Save the Children has supported the establishment of over 850 community-based ECCD centres across 21 townships in Myanmar. The centres focus on helping children aged 3-5 develop gross and fine motor skills, cognitive skills, and emergent literacy and maths skills. Community-managed ECCD centres are key to sustainability, and investment in expanding ECCD services is crucial to narrowing inequity gaps between upper and lower income populations.[4]

Over time, Save the Children will phase out its support of the centres, enabling them to become 100% community managed. To ensure the sustainability of ECCD services over the long term, Save the Children has established an ECCD network group in each township, composed of local leaders, caregivers and members of an ECCD management committee. The network groups regularly monitor the quality, attendance, sustainability of existing centres, and recommend locations for additional centres. They also help communities manage the centres, provide trainings, and coordinate ECCD services in each of the townships.

As the centres were established, it became evident that the townships could benefit from a system that allowed the network groups to work together to more efficiently share information to monitor and improve the quality of ECCD services. The various network groups were using their own paper-based methods for collecting data, and struggled to collate and share their data during monitoring visits. Data was only shared at meetings, meaning that information often came too late to influence ECCD services in a timely manner.

Part II: A mobile solution

To address these issues, the Save the Children education team worked with global technology leader Nokia to create a web-based database with a synchronized Android mobile application for each township. An external consultant trained local staff to use the solution, which helps the network groups collect and collate data, and share it in real time with the other network groups. Data can be saved to a mobile phone even when the phone is offline. As soon as the user is back online, stored data is shared across the different network groups. This feature is particularly critical because many parts of Myanmar do not have network coverage.

Collection and dissemination of reliable information is a key to development. With the data the network groups are collecting, they can better understand and fine-tune ECCD services. The ministries in Myanmar will also use the data to improve planning and resource allocation, directing resources to areas of acute need to improve access to ECCD services by Myanmar's most marginalized children. Good quality data on ECCD services also supports the government's reporting against Sustainable Development Goals.

Part III: Results and impact

To date, the mobile application has been deployed and users have been trained in three townships. With Save the Children's and Nokia's support, 60 ECCD centres have been established and 30 kindergarten classrooms have been constructed. As a result, more than 28,000 disadvantaged children are now attending ECCD and kindergarten classes, and 1,700 kindergarten teachers and caregivers have been trained to provide quality early learning.

Because the implementation was recent, full evaluation of the technology solution's impact is not yet available. However, anecdotal evidence already shows that the mobile application is playing an important role in ensuring accurate, easy data recording and transfer between the ECCD network groups, and that collating data from different townships is easier than before.

Part IV: Lessons learned

Using experts from different fields was critical to the successful deployment of the ECCD solution used in Myanmar. While Save the Children had a strong understanding of ECCD data collection needs, it did not have the expertise to develop the mobile application.

Collaboration enabled Nokia and Save the Children to develop a tool that meets the needs of the ECCD network groups and other stakeholders.

Save the Children would like to expand use of the mobile application to network groups across all 21 townships, thereby enabling the real-time capture and sharing of data from over 850 ECCD centres, improving information flow, and enhancing the quality of ECCD centres and learning outcomes for children. The organization hopes that having additional and more accurate data will also help the government better allocate resources for ECCD. Save the Children also hopes that the government of Myanmar will replicate this data collection solution for ECCD services countrywide. In addition, the organization plans to apply the knowledge gained from this implementation to benefit Save the Children projects in other locations where quick and accurate data collection across large geographical areas is required.

Conclusion

Collection and dissemination of reliable information is critical for sustainable development. Good quality data on ECCD services supports the Myanmar government's reporting related to the Sustainable Development Goal on education (SDG4). The data produced by this project will also be used to improve resource allocation and planning of ECCD services by the ministries in Myanmar. The goal is to ensure that resources go where the needs are most acute, so that the most marginalized children in Myanmar can gain access to crucial ECCD services.

Endnotes

1 Save the Children. 2017. Windows into Early Learning and Development. https://i.stci.uk/sites/default/files/libraries/IDELA%20REPORT.pdf.

2 Government of Myanmar. 2014. Myanmar policy for early childhood care and development.

3 Save the Children. 2017. Windows into Early Learning and Development. https://i.stci.uk/sites/default/files/libraries/IDELA%20REPORT.pdf.

4 Ibid.

Case Study 6

Connect To Learn: Transforming learning with mobile broadband in Myanmar

UNESCO, Ericsson and partners[1]

Introduction: Addressing education barriers to development

As the second largest country in South-East Asia, Myanmar has huge economic growth potential. According to the Asian Development Bank, the country's annual GDP growth rate hit 6.4% in 2016, and was forecast at 7.7% in 2017,[2] the highest among all South-East Asian countries. Still, Myanmar remains one of the least developed countries in the world, with significant impediments to sustainable development,[3] including low secondary school attendance and lack of quality education.

At the same time, Myanmar's telecommunications market has experienced significant growth in recent years. As broadband access expanded across the country, Ericsson and partners introduced the Connect To Learn initiative in Myanmar in 2015, with the goal of using mobile technology to improve learning opportunities and outcomes for high school students in rural Myanmar, including marginalized girls.

Part I: Status of education in Myanmar

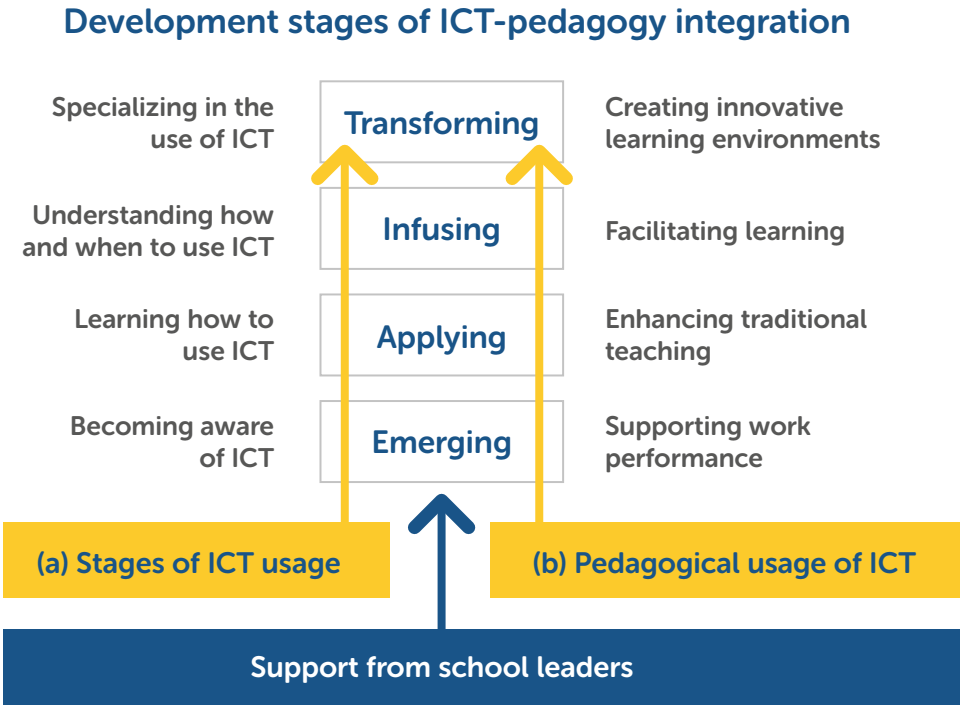
Low school enrolment, lack of awareness of the internet, and a shortage of opportunities to acquire digital skills have put young people in Myanmar at great risk of economic and social exclusion.

World Bank and UNESCO data from 2013 showed that only 54% of secondary school-aged children in Myanmar were enrolled in secondary school.[4] The Myanmar Ministry of Education (MOE) also reported high drop-out rates: data for the 2011 academic year showed that 1.2 million students were enrolled in the first grade, compared to only 292,899 students in the last grade.[5]

In 2013, only 1 million out of 50 million people in Myanmar enjoyed the benefits of a mobile phone, and fewer than 400,000 had internet access.[6] In addition, according to a 2010 Southeast Asian Ministers of Education Organization (SEAMEO) study, Myanmar fell into the lowest (emerging) stage in regard to information and communications technology (ICT) integration in education.[7]

Because of recent rapid growth in investments in the telecommunication sector, by early 2017, 93%[8] of Myanmar's total population had mobile connection and 55% used mobile broadband

connection (3G/4G). A January 2017 report showed that internet penetration had grown an impressive 97% during the prior year,[9] and is expected to continue to rise. More significantly, 80% of the mobile connection is via smartphones.[10] The fast development and growing popularity of mobile broadband connection using smartphones has resulted in opportunities to make effective use of ICT in education in Myanmar.



Part II: Connect To Learn – Myanmar

With awareness of the opportunities that mobile broadband availability makes possible, Ericsson, UNESCO, the Myanmar Ministry of Education (MOE) and other partners launched the Connect To Learn initiative in Myanmar in 2015. Ericsson was the overall programme and technology lead, and UNESCO was the lead partner for coordination with the MOE and the implementation partner for the education components of the initiative in Myanmar.

With its unique constellation of collaborators, the initiative was designed to bring scale and impact to secondary education in Myanmar by improving access to mobile broadband internet, delivering context-specific teacher professional development, and enabling students to acquire twenty-first century skills. The initiative was implemented in 31 rural and semi-urban government schools, which generally fall behind schools in more urban areas in terms of teacher supply, quality of facilities, availability of educational materials, and perceived quality of instruction.

Based on an evaluation of school needs, the Connect To Learn initiative in Myanmar was designed with the following interdependent components:

Technology deployment: Ericsson provided installation of ICT hardware, mobile broadband technology, and cloud computing services in schools. Many of the schools lacked a stable electricity

supply, functioning power outlets, safe electric wiring, or secure ICT equipment storage rooms. As such, prior to the deployment of technology, Ericsson put a lot of effort into helping schools become ICT-ready through measures such as providing solar panels, installing power outlets and safe electrical wiring, and giving technical advice about safe and secure storage of ICT equipment.

Teacher professional development: UNESCO designed comprehensive teacher training modules to include the development of ICT skills, internet research skills, ICT-pedagogy integration on student-centred teaching, and support for teachers to develop their own digital, locally relevant teaching and learning materials adapted from existing online resources. Capacity development was also provided for school leaders and government counterparts to effectively manage ICT development in the schools.

Other components of the initiative include utilizing mobile technology to assist students in learning the English language and life skills, and providing stipends to female students and grants to schools to address inadequate funds.

Part III: ICT-pedagogy integration

Prior to the implementation of the Connect To Learn initiative, target schools lacked relevant, high-quality teaching aids. Teachers were generally enthusiastic about the idea of using ICT and the internet for educational purposes. While few teachers owned desktops, laptops or tablets, most teachers owned an Internet-enabled smartphone with a touchscreen and had some experience in using mobile applications. However, teachers were not accustomed to using their internet-enabled smartphones to identify relevant and useful online materials to support teaching and learning. In addition, lack of school leadership and management capacity, limited ICT knowledge by school leaders and teachers, and a historical emphasis on teacher-centred pedagogical approaches posed implementation challenges for the initiative's partners.

As a result, the initiative incorporated in-service teacher professional development aimed at strengthening teachers' ICT literacy and helping them to integrate ICT into their classrooms. Capacity development for school leaders and government counterparts to effectively manage ICT development in the schools was also a key part of the implementation.

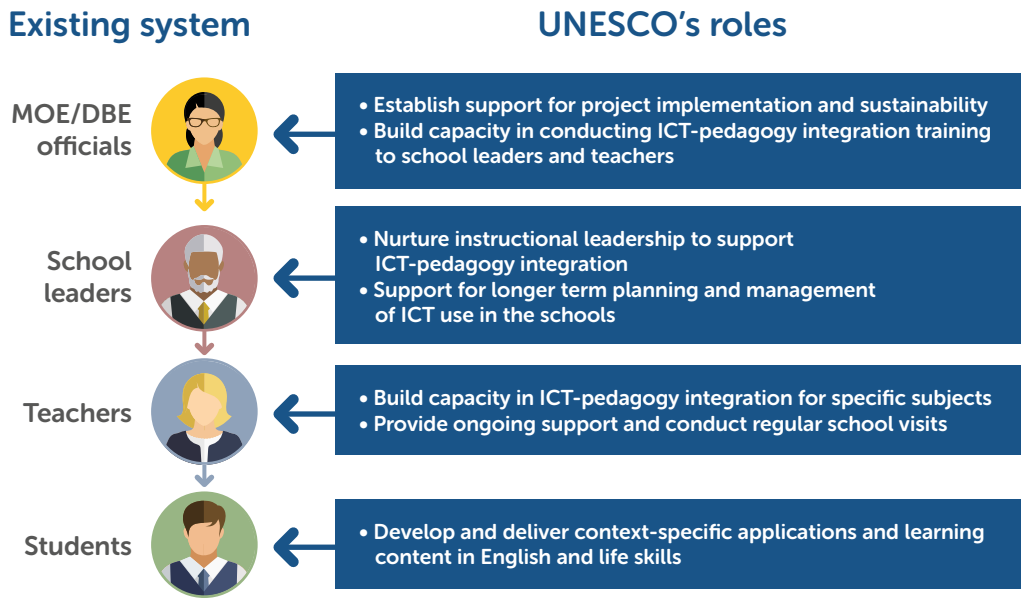
The teacher professional development comprised the following components:

- Training of local trainers from the Department of Basic Education (DBE) of the MOE, who would share knowledge of ICT-pedagogy integration with school leaders and teachers.
- Training of selected school leaders and teachers to strengthen subject-specific ICT-pedagogy integration knowledge. Five teachers of grades 7-10 from each of the 31 schools participated. The selected teachers taught different subjects and always included one English language teacher, one life skills teacher, one maths teacher, one Myanmar language teacher, and one teacher who had a postgraduate diploma in multimedia arts or good ICT knowledge.
- ICT-pedagogy integration support and monitoring of teachers' progress through:
    - phone calls, Facebook messages and e-mails;
    - regular school visits to monitor the teachers' learning process in the use of ICT through interviews, classroom observations and review of ICT-generated output; and
    - reporting mechanisms through Kobo Toolbox and e-mail to identify support needs.

- School leadership training for the DBE project team and school leaders, so they could understand what ICT skills and knowledge the teachers had learned and support longer term planning and management of ICT use in the schools.

- A conference for all project stakeholders to facilitate sharing of successes and challenges in integrating ICT and related pedagogies in the classrooms.

UNESCO's support for ICT in education development at different levels within the government helped ensure efficiency and sustainability:



Part IV: Results

Major progress of the initiative to date includes:

Technology deployment:

- 21,000 students in 31 schools now have internet access.
- Six teacher laptops and accessories have been deployed at each of the 31 schools.
- 3,100 tablets have been distributed to schools.
- Cloud-managed solutions have been developed and deployed.

Teacher professional development:

- 155 teachers have been directly trained and have further transferred the ICT-pedagogy integration knowledge to other teachers in their schools.
- Materials and activities for teacher professional development have been developed for six workshops.
- Training of DBE trainers for six workshops has been completed.
- Capacity-building of instructional leadership, which has been provided to the DBE project team and school leaders.

In addition, context-specific applications and learning content in English and life skills have been developed for use. Six hundred female students have received scholarships

and the 31 schools have received grants to improve the learning environment, which has benefited all students attending the schools.

With the short timeframe since implementation — less than 1.5 years since the first ICT training — the impact of the initiative cannot be fully measured yet, as teachers and students are still growing accustomed to the new ICT ecosystem. According to preliminary qualitative research conducted by the Earth Institute at Columbia University, an overwhelming majority of responses from teachers, school leaders, parents and students regarding the main benefits of ICT in the classroom pointed to increased student interest, engagement and excitement for learning.

Part V: Lessons learned

The initiative's deployment in Myanmar — the largest Connect To Learn deployment to date — has yielded multiple insights in ICT-pedagogy integration, including the following:

Adopting student-centred pedagogy: For decades, teachers in Myanmar have been trained using teacher-centred pedagogical approaches. To help teachers become accustomed to active learning strategies using ICT, UNESCO first trained teachers about student-centred pedagogy without ICT, and then, at a later stage, showed how ICT can support student-centred approaches to teaching and learning. This gradual approach helped build teachers' confidence in adopting active learning strategies.

Fears about classroom control: Using tablets effectively in classrooms changes teacher-student dynamics. Students are expected to use tablets to explore internet resources and learn at their own pace. Educators trained using teacher-centred approaches may fear losing control of their classrooms. UNESCO provided practical and effective classroom management training that gave teachers a chance to practice maintaining classroom order while gradually providing more freedom for students to complete individual work on tablets. In addition, teachers were equipped with a child-friendly interface that gave students a safe environment to search for information online.

Lack of prep time: Most of the participating teachers reported that they did not have enough time to prepare lessons using ICT. Allocating time for teachers of the same subject to hold collaborative sessions to prepare lessons was uncommon in most of the schools. UNESCO and DBE communicated the importance of such sessions to school and township education leadership. Future planning might also include regional conferences that would enable educators to share and collaborate on the development of ICT lesson plans.

Minimizing cyber risks: Many teachers were new to online risks such as phishing, viruses, scams and fake news. As such, UNESCO included tailor-made training sessions on cyber wellness and digital citizenship.

Part VI: Conclusion

As mobile broadband reaches the most remote regions of the world, it offers promising opportunities to transform education. The Connect To Learn initiative in Myanmar is being implemented successfully as a result of concerted efforts by multiple project partners. While the initiative has received positive feedback for changing initial perceptions and increasing the abilities of the MOE, school leaders and teachers to effectively integrate ICT into teaching and learning, longer term practice is required to support teachers becoming accustomed to active learning strategies using ICT. Continued efforts will be made to support the schools and the MOE in formulating policies and plans to guide the integration of ICT into Myanmar's classrooms and ensure that the infusion of technology strengthens learning opportunities for all.

Endnotes

[1] Other partners included the UK Department for International Development (under the Girls' Education Challenge), which provided funding support; Qualcomm® Wireless Reach™, which provided funding and project management; the Earth Institute at Columbia University, which managed student stipends and school grants, and conducted implementation research; Finja Five, which provided child-friendly computing solutions; EduEval Educational Consultancy, which conducted monitoring and evaluation; and Myanmar Posts and Telecommunications (MPT), which supported network roll-out and provided SIM cards for the schools. The initiative also received support from the Ministry of Transport and Communications and the Ministry of Education in Myanmar.

[2] Asian Development Bank. 2017. Asian Development Outlook 2017: Transcending the Middle-Income Challenge. https://www.adb.org/publications/asian-development-outlook-2017-middle-income-challenge.

[3] United Nations Development Policy and Analysis Division. Least developed countries (LDCs). https://www.un.org/development/desa/dpad/least-developed-country-category.html.

[4] The Government of the Republic of the Union of Myanmar. 2014. Ministry of Education. National EFA Review Report. http://unesdoc.unesco.org/images/0022/002297/229723E.pdf.

[5] Asian Development Bank. 2015. Technical Assistance Consultant's Report - Republic of the Union of Myanmar: Support for Post Primary Education Development. https://www.adb.org/sites/default/files/project-document/201636/47177-001-tacr-02.pdf.

[6] Internet World Stats. 2017. Asia Internet Use, Population Data and Facebook Statistics. http://www.internetworldstats.com/stats3.htm#asia.

[7] SAMEO. 2010. Report: Status of ICT Integration in Education in Southeast Asian Countries. http://www.seameo.org/SEAMEOWeb2/images/stories/Publications/Project_Reports/SEAMEO_ICT-Integration-Education2010.pdf.

[8] This does not take into account the fact that one may own more than one mobile SIM card. However, it shows the significant increase in mobile SIM card ownership in Myanmar over recent years.

[9] Internet in Myanmar. 11 April 2017. https://www.internetinmyanmar.com/internet-users-myanmar-2017/.

[10] Digital in Asia. 9 January 2017. https://digitalinasia.com/2017/01/09/myanmar-33-million-mobile-users-smartphone-usage-80/.

Case Study 7

Personalized Learning Initiative: Fresno Unified School District

Microsoft, Fresno Unified School District and California State University, Fresno

Introduction: Equipping students with future competencies

Educators around the world are working to prepare students for learning, work, life and citizenship in societies that are rapidly changing, highly interconnected, and immersed in technology. Education systems need to quickly and radically shift to close equity gaps and better equip youth for dynamic futures that will require individuals to continuously lead their own learning and innovatively solve real-world problems in their communities and beyond. To thrive beyond school, students will need creative, social, collaborative, analytical and digital competencies.

In 2016, Fresno Unified School District — in partnership with Microsoft and California State University, Fresno — launched a Personalized Learning Initiative aimed at equipping students with these 'future competencies'. During the first year, the initiative reached some 12,000 of the district's 75,000 students. Early signs show that the initiative is facilitating significant improvements in academic and socio-emotional outcomes of learners.

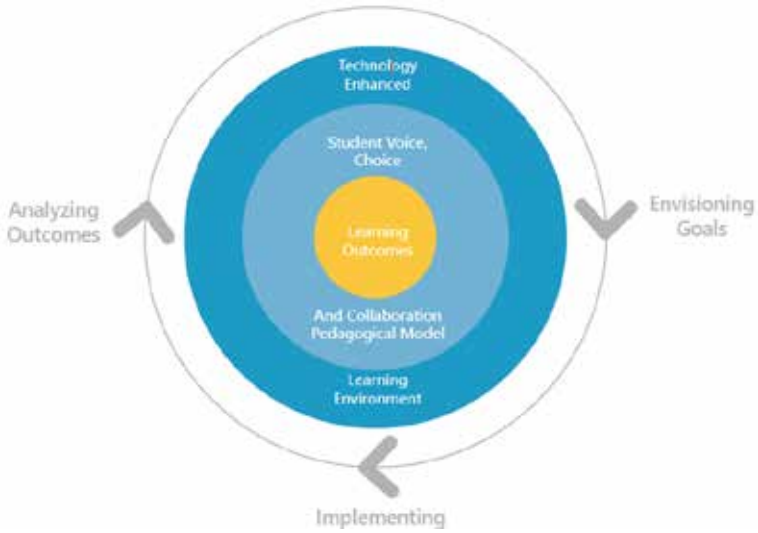
Part I: The education equity gap

With 75,000 students, Fresno Unified School District is the fourth largest district in California. Fresno Unified's pupils are among the most economically disadvantaged students in the US; 78% of them are low income and 22% are English learners.

Students in high poverty schools or districts in the US often lack opportunities to develop the competencies they will need to thrive in the future.[1] There is growing evidence that student-centred, socio-emotional and competency-based approaches, which require high-quality instructional practices, can have a significant impact on learning outcomes.[2]

Part II: Fresno's Personalized Learning Initiative (PLI)

Microsoft, the Fresno Unified School District and California State University, Fresno, partnered to launch the Personalized Learning Initiative (PLI) with the goal of bridging the education equity gap. At the heart of Fresno's PLI is a pedagogical model centred on student voice, choice and collaboration. The initiative calls for: 1) collaborative learning cycles moving toward this model, 2) leveraging technology more consistently and intentionally, and 3) continuous analysis and reflection upon collective progress.



Launched with 220 teachers distributed evenly across 89 different schools in the district, the PLI touched over 12,000 students during the 2016/17 academic year, and is set to expand each year to 2021.

The core implementation elements of the initiative include:

- A pedagogical model that focuses on student voice, choice and collaboration;
- Up to 20 hours of PLI formal professional learning;
- Membership in online and site-based PLI learning communities;
- Devices and digital tools for every student in classrooms of PLI teachers; and
- Additional technology training and tech support from the district.

The PLI is not fundamentally about technology: The pedagogical model is the core. PLI professional learning provides teachers with strategies, and more importantly, experiences that mirror those of students in a PLI classroom. PLI teachers learn together, and commit to taking their experiences not only into their own classrooms, but also sharing them with colleagues.

The initiative's partners are strongly committed to using data and analytics to drive continuous improvement. Microsoft's Education Solutions Team and Data Science Teams from across the company have integrated district data sources with data on student and teacher technology use, as well as learning outcome data. This unique data model will be used in the coming years to conduct network analysis, machine learning and predictive analytics as part of the partnership.

Part III: Results and impact

While implementation of the PLI is ongoing, indications from the first year of implementation show significant progress in terms of pedagogical transformation, future competencies, digital collaboration and academic acceleration. These areas of growth are explained below:

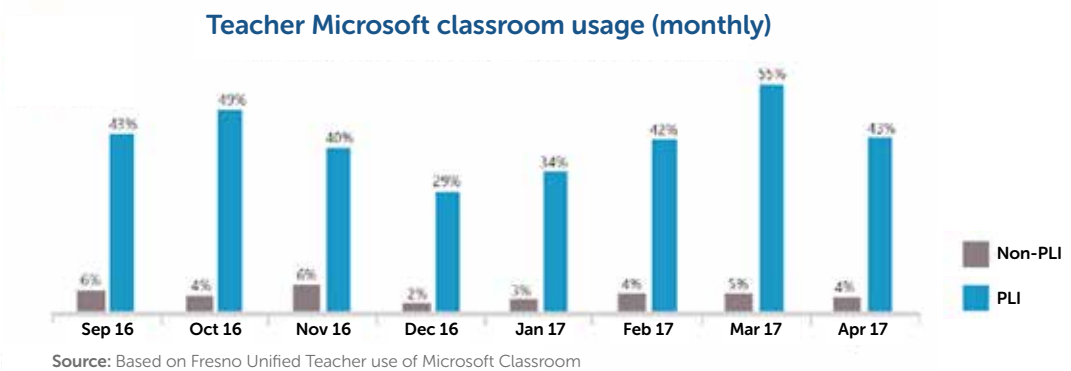
Pedagogical transformation: The PLI has helped prompt the transformation of teaching practices in schools across the district. Students in PLI classrooms use technology to design cars using physics, to explore careers in science, to measure their own heart rates, and to make video 'talk shows' featuring characters from literature. Before the PLI, most Fresno students — especially those in elementary and middle schools — were using technology primarily to take standardized assessments. PLI teachers say their students are now beginning to use technology to enhance and proactively manage learning:

> 'Now that students have computers on their table, they can help each other, look at others' screens when they are blocked, and share. I hear a lot more of "let me show you", and students ask more questions to each other and become proactive. They are really looking for answers, and for that, they are not necessarily coming to me anymore'.
>
> **-Fresno PLI teacher**

PLI teachers are using technology more intentionally to provide feedback to their students. One of the most immediate impacts that teachers in focus groups described was how the PLI framework enables them to use technology to provide rapid student feedback. Technology is allowing these teachers to gauge students' progress in real time, and then adjust teaching to meet student needs in the moment.

Microsoft Classroom, a platform for teachers and students to digitalize the assignment workflow, is one of the primary tools Fresno teachers are using to enable this rapid feedback cycle. Microsoft Classroom enables teachers to organize class sections, create and grade assignments, collaborate with other teachers in professional learning communities, and provide feedback to students. The following chart compares the PLI vs. non-PLI teacher use of Microsoft Classroom in the first year of the initiative's implementation:

Teacher Microsoft classroom usage (monthly)

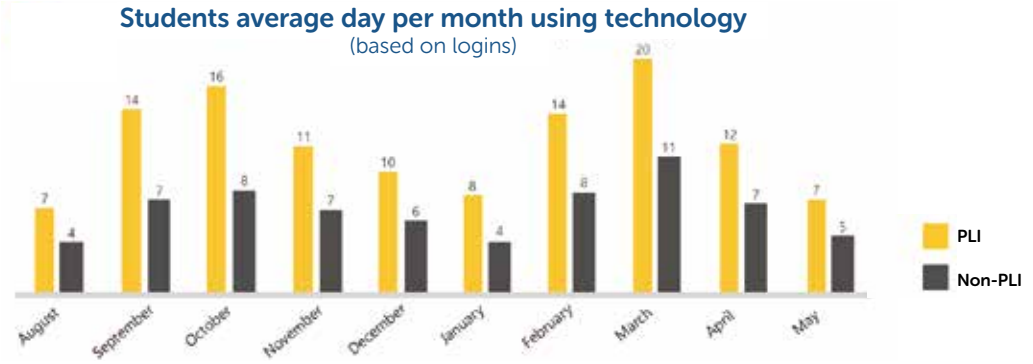


Source: Based on Fresno Unified Teacher use of Microsoft Classroom

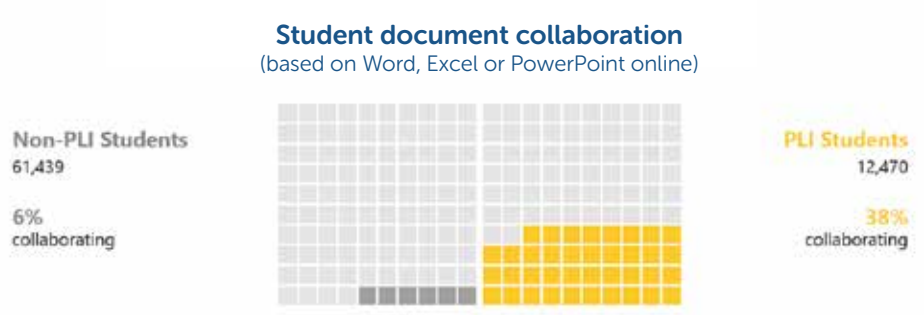
Data also shows that PLI teachers are collaborating online significantly more than their non-PLI peers, and that they are using digital tools to creatively design their learning activities. Teachers are using apps, content and assessments in a wide variety of ways that offer their students new modalities for learning. Pedagogical shifts are of primary importance, and combining them with the intentional use of technology establishes a foundation for improving learning outcomes.

Growth in students' future competencies: The PLI theory of action explicitly focuses on students' development of the kinds of competencies — collaboration, digital, self-efficacy and self-management — that are increasingly acknowledged as necessary ingredients for success beyond school. It is also broadly acknowledged that such competencies are hard to measure. PLI partners hope that the initiative's strong emphasis on data collection and analysis will yield innovative new measures of competencies in future years.

Fresno, like almost all US districts, has had technology in classrooms for decades, but its use has been varied and, too often, perfunctory and inconsistent. Because every student in the PLI has a device as well as digital tools and online curriculum materials, project organizers assumed that PLI students would use technology significantly more than peers not in PLI classes. Indeed, data show that technology use is far greater and more frequent in PLI classrooms and this is likely positively influencing students' digital competencies:[4]



Student digital collaboration: Increasing student collaboration is often seen as a starting point for transforming teaching and learning practices. Collaboration is believed to engage students more deeply in learning, while also preparing them for the workforce of the future. The Fresno PLI measured students' digital collaboration based on two or more students working together on a Microsoft Word, Excel or PowerPoint file, and students collaborating with teachers on files. On these measures, students in the PLI demonstrate significantly higher levels of digital collaboration (6% non-PLI versus 38% PLI), indicating that the initiative appears to be facilitating student cooperation.



Source: Student to student document collaboration in Microsoft Word, Excel or PowerPoint online. Based on an average over four 28-day time windows, from January to April 2017.

'I really like hearing other people's opinions and solving problems together. I get a better understanding of what I'm learning when working with other people'.

-Fresno PLI Student

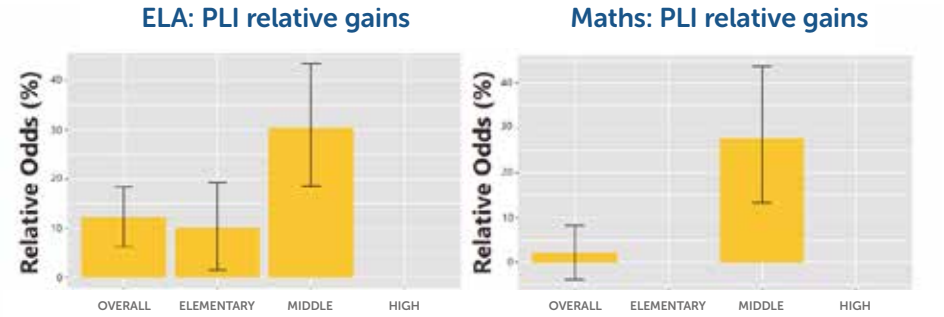
Inclusion, participation and self-efficacy: Students' future competencies also include important 'socio-emotional learning' (SEL) dimensions, such as self-management, social awareness and self-efficacy. PLI teachers consistently described elements of these competencies as important outcomes of their implementation of the PLI. Specifically,

they said the PLI enables students who often face challenges of inclusion, such as Special Education and English Language learners, to participate in more social learning:

> 'I had students collaborate on making and peer-assessing PowerPoints. Every time we do this, there is an extremely high level of engagement. One class with 60% SPED (Special Education) – they were the most engaged. ... They make more progress than any other group. SPED students are able to explore in a different way with technology'.
>
> **-Fresno PLI Teacher**

> 'A couple of ELD [English Language Development] kids, they got in front of the camera and had personality. It was the first time I had heard their voices in the classroom'.
>
> **-Fresno PLI Teacher**

Academic acceleration: When teachers introduce new practices into the classroom, assessment scores often dip as teachers learn how to implement new practices. That was not the case for the district-wide spring interim assessments in English language arts (ELA) and maths during the first year of the Fresno PLI. In fact, PLI students overall had 12.21% higher odds of meeting or exceeding standards in ELA, and 2.02% higher odds in maths. The following charts show the relative gain of PLI students compared with non-PLI students. These gains were the highest among middle school students, and for elementary students in ELA.



Sources: Sprint Interim Common Assessment, Fresno Unified, All Grades. These analyses adjust for student attendance, ethnicity, gender, homelessness, school type, special education status, language learning status, low income status, school climate and having an ELA and/or Math teacher in the PLI programme.

Part IV: Essential reflections

For school and district leaders, first-year data provided compelling evidence that the type of holistic approach represented by the Fresno PLI is necessary for realizing the return on investments in technology in terms of learning outcomes. The pedagogical model centred on student voice, choice and collaboration — combined with the intentional deployment of technology for every student — enabled substantive, meaningful student use of technology that is leading to improved learning outcomes. The pedagogical model is the core of the PLI. The analysis of outcomes from the first-year learning cycle shows that this combination is effective, though further investigation and programme refinements are needed.

The PLI is helping students develop future competencies, but currently it reaches only a segment of learners in Fresno Unified School District. Investments are needed to significantly expand the PLI and related programmes to more teachers, and to extend pedagogical models to more explicitly develop evidence of students' future competencies. Expanding the PLI quickly and broadly enough to meet teachers' and students' needs, while maintaining implementation fidelity, is the next big challenge for the Microsoft-led initiative.

Endnotes

[1] Herold, B. 2017. Poor students face digital divide in how teachers learn to use tech. Education Week. Technology Counts. https://www.edweek.org/ew/articles/2017/06/14/poor-students-face-digital-divide-in-teacher-technology-training.html.

[2] Hattie. J. 2009. Visible Learning: A Synthesis of over 800 Meta-Analyses Relating to Achievement. London, Routledge. See also: Pane, J., Steiner, E., Baird, M. and Hamilton, L. 2015. Continued Progress: Promising Evidence on Personalized Learning. RAND, http://www.rand.org/content/dam/rand/pubs/research_reports/RR1300/RR1365/RAND_RR1365.pdf; and Bransford, J., Brown, A., and Cocking, R. (eds). 2000. How People Learn: Brain, Mind, Experience and School. Washington, DC, National Academy Press.

[3] Kautz, T. et al. 2014. Fostering and measuring skills: Improving cognitive and non-cognitive skills to promote lifetime success. OECD Education Working Papers, No. 110. OECD Education Working Papers, No. 110, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/5jxsr7vr78f7-en.

[4] Note that the table does not take into account variations in student access to technology. In the future, initiative partners expect to be able to compare schools that have 1:1 student computer ratios, but do not have PLI-like practices, with PLI partner schools where teachers are implementing PLI teaching practices.

Case Study 8

Train My Generation: Gabon

UNESCO, Airtel and the Government of Gabon

Introduction: Fostering youth innovation and entrepreneurship

The Central African nation of Gabon has experienced strong economic growth over the past decade, driven in large part by oil production.[1] Still, more than a third of the country's citizens live in poverty, overall unemployment tops 20%, and youth unemployment exceeds 35%.[2] Economic diversification is crucial for the nation's growth, particularly with the decline in oil prices in recent years.[3]

As part of a strategic plan to improve youth employment rates and to promote economic diversification, the government of Gabon is focusing on the development of vocational skills among youth to encourage innovation and entrepreneurship.[4] Partnering with UNESCO and mobile telecommunications company Airtel, the government has developed and launched initial components of the Train My Generation – Gabon 5000 Project in 2015, with the goal of training more than 5,000 young Gabonese men and women in the use of information and communications technologies (ICTs) over a three-year period.

Part I: Context and background

The Ministry of Education in Gabon reports that young people across the nation generally have a low level of computer literacy. A 2015 assessment of 1,400 youth aged 17-35 revealed that 70% had not mastered basic skills.

A generation of Gabonese students have performed poorly on secondary school examinations in the sciences, notably in math, physics, chemistry, biology, and life and earth sciences. Only 13% of the country's students choose science as their field of study at the secondary (baccalauréat) school level, and just half of those obtain their diploma.[5] Technical skills are lacking, and ICT professions are under represented in the Gabonese labour market.[6]

Part II: Preparing a new generation of workers

To address the need for basic computer skills and vocational training of Gabonese youth aged 17-35, UNESCO and Airtel, along with the Gabonese Ministry of Education, Ministry of Digital Economy, and Ministry of Vocational Training have developed and started implementation of the Train My Generation – Gabon 5000 project. The initiative is aimed at boosting ICT skills and improving science education, and — because the project uses e-learning courses — to provide the Ministry of Education with a new tool and pedagogical model to improve education across Gabon.

The project, launched in October 2015, is scheduled to run for three years. The African Institute of Informatics has designed educational content for the initiative, and other businesses, including energy and logistics companies, are providing additional support.

Train My Generation – Gabon 5000 provides for the establishment of technical training centres across Gabon, each equipped with at least 20 computers with appropriate content, software and accessories. The initiative has been designed with four components:

- Computer training;
- Tutoring through distance learning (e-learning);
- Mobile applications and entrepreneurship; and
- Support for specific professions.

Computer training: This component of the initiative aims to facilitate access to work for young people aged 17 to 35.

The training, offered at school-based training centres in the nine provinces of Gabon, is available for youth who can read and write, and who are in or out of school. The African Institute of Informatics accredits the computer training courses. Participants can attain three levels of certification: Beginner (Level 1), Intermediate (Level 2) and Expert (Level 3).

At the Expert level, participants may be awarded an IT Support Assistant Certificate in one of seven specialties:

- Computer data entry operator
- Helpdesk assistant
- Computer maintenance assistant
- Web/multimedia assistant
- Assistant bookkeeper
- Computer network assistant
- Graphic designer assistant

Tutoring through distance learning (e-learning): Through this component, initiative partners aim to train at least 100 science teachers to design distance-learning e-courses. The training covers the design and online provision of support modules to enable students to better prepare for examinations, particularly those required to earn the Certificate of Secondary Education. In addition to the e-learning modules, teachers are accessible online to answer students' questions. The e-learning component is available free of charge to enable as many students as possible, including those from low-income families, to participate. The courses aim to provide an alternative to purchasing large numbers of textbooks, and better monitoring of exam-year students.

Mobile applications and entrepreneurship: The goal of this component is to identify and support at least 100 Gabonese youth who wish to set up businesses based on the structural use of new technologies, and to make a living from those business. This component will involve:

- Providing encouragement for young Gabonese with the aspiration, drive and technical skills needed to design digital applications or adapt existing ones;
- Facilitating the success and mentorship of young Gabonese entrepreneurs; and
- Directly promoting the creation and growth of start-up companies founded by young people.

Support for specific professions: To meet market needs for ICT talent and support the development of tomorrow's workers, this component aims to set up a system of grants for work placements, further training and master's degrees. The professions primarily targeted will involve the use of broadband technologies.

Part III: Progress to date

To date, 10 out of 13 training centres have been established, and 1,538 students have received training. As part of the initiative's e-learning component, 28 training modules lasting 20 hours each have been produced and are now online in a virtual library. Two online teacher training centres are now operational, and 74 teachers have been trained in e-learning for high school science subjects and how to use online courses. More than 300 exam-year students are registered for the online tutoring platform.

A feasibility study has been drawn up for the initiative's last two components — mobile applications and entrepreneurship, and support for specific professions — and implementation is underway.

Part IV: Lessons learned and best practices

Through Train My Generation – Gabon 5000, UNESCO hopes to transfer tools for handling ICT training to relevant national institutions so that Gabon can sustain the programme. To accomplish this, UNESCO has executed partnership agreements with the following institutions:

- The African Informatics Institute (IAI), a well-known scientific institution with strong educational experience in Gabon.
- The Ministry of National Education, which supervises pre-university general and technical education.
- The Ministry of Digital Economy, which regulates ICT activities in Gabon and supervises the relevant national digital institution, the Institut National de la Poste des Technologies de l'Information et de la Communication (INPTIC)

Several difficulties led to significant delays in establishing the programme, including:

- Lack of appropriate and secure facilities for training sessions.
- Recurring network performance problems and incorrect equipment installations in training centres.
- Problems in complying with electricity consumption standards at the centres.
- Lack of a location to store several tonnes of computer equipment when it arrived in Gabon.
- Lack of basic ICT skills among the teachers available for the project.
- Irregular availability and commitment from members of the National Education Ministry.
- Drop-out of youth during training sessions or just prior to final exams.
- Abandonment of the project by some teachers to pursue their educational commitments.
- A post-electoral crisis in 2016, which impacted school functioning and teacher availability.
- Difficulties in organizing youth award ceremonies.

To address these difficulties, the following measures have been taken:

- A management committee has been established to regularly monitor ongoing activities. Committee members are from the National Education Ministry, Digital Economy Ministry, African Informatics Institute, Airtel, and the offices of the Prime Ministry and Gabon Presidency.
- A recovery plan was developed with the National Education Ministry to work through the backlog in youth training at the basic and intermediate levels that resulted from the post-electoral crisis. As part of the recovery plan, the African Informatics Institute is training 1,200 youth at the intermediate level and 150 at the expert level.
- To facilitate communication between the centres and the operational team, the Ministry of Education designated one teacher (Team Leader) to represent all of the teachers at each centre. In addition, a monitoring system was established to follow up issues each week. The Team Leader of each training centre is required to report technical and educational issues via this system. Unannounced visits to centres enable partners to verify the quality of training sessions.
- To address power supply and equipment storage issues, collaborations were arranged with additional partners, including Gabon Water and Electricity Company (SEEG) and Bolloré Logistics.

Finally, implementation of a project like this requires clear identification of who is responsible for supplying and maintaining all computing equipment, telecommunications networks, and internet access services. Written records of the transmission and receipt of equipment must also be kept. Clearly defining the role of each partner helps ensure commitment to the success of the project.

Conclusion

While plans call for 5,000 youth aged 17-35 to receive basic ICT training through initial implementation of Train My Generation – Gabon, because the initiative's educational support platform is easily accessible, the programme is expected to reach a far greater number of students.

Implementation plans call for 100 secondary education science teachers to receive training in online teaching. UNESCO and partners hope that the teachers will use their skills to provide online educational support to 15,000 secondary school students preparing for their end-of-school exams.[7]

Gabon has asked UNESCO to extend the project beyond its initial three-year plan. In addition, Equatorial Guinea has formally asked UNESCO to replicate this project for its youth. In the end, initiative developers hope that Train My Generation – Gabon 5000 will become an ICT training model for all of Central Africa.

Endnotes

[1] The World Bank in Gabon. http://www.worldbank.org/en/country/gabon/overview.

[2] Gabon aims to cut yawning poverty gap by ending its dependency on oil. The Guardian. 16 August 2016. https://www.theguardian.com/global-development/2016/aug/16/gabon-yawning-poverty-gap-end-dependency-oil.

[3] Pethud, D. and Tsassa, C. 2017. African Economic Outlook. http://www.africaneconomicoutlook.org/en/country-notes/gabon.

[4] Ibid.

[5] Ministry of Education data.

[6] National Employment Office.

[7] 'Train My Generation' ICT youth project launched by UNESCO and Airtel Gabon. UNESCO. http://en.unesco.org/news/%E2%80%9Ctrain-my-generation%E2%80%9D-ict-youth-project-launched-unesco-and-airtel-gabon.

Case Study 9

IT Supporters: Bridging the information gap in Korea

KT

Introduction: Building skills to thrive in the Fourth Industrial Revolution

Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, believes society is on the brink of a Fourth Industrial Revolution characterized by technologies that are fusing the physical, digital and biological worlds. This revolution has the potential to disrupt disciplines, economies and industries, with major impacts on governments, businesses, civil society and individuals. Schwab calls for leaders and citizens to work together to 'shape a future that works for all by putting people first, empowering them and constantly reminding ourselves that all of these new technologies are first and foremost tools made by people for people'.[1]

Organizations, governments and individuals who are unable to adapt and grasp the benefits of rapidly changing technology are in danger of being left behind. KT (formerly Korea Telecom) is working to help ensure that people of all ages, abilities, locations and economic levels are empowered to fully participate and thrive in the Fourth Industrial Revolution.

Part I: Broadband in the Republic of Korea

Recent data from the Organisation for Economic Cooperation and Development (OECD) ranked South Korea's mobile broadband penetration rate as one of the highest among OECD countries, with mobile subscriptions per capita now topping 100%.[2]

The age of hyper-connectivity heralds unprecedented convergence across diverse sectors and segments of society. Data management based on the Internet of Things (IoT), cloud, big data, and mobile technologies are becoming mainstream, and carry a potential to solve challenging social problems.

Still, many segments of South Korea's population lack the knowledge and digital skills they need to take advantage of the benefits that information and communications technology (ICT) can offer today and tomorrow. Providing twenty-first century skills to everyone is essential for sustainable development for current and future generations.

Part II: KT IT Supporters

The telecommunications provider KT launched the IT Supporters programme in 2007, with the goal of helping young people and marginalized populations in South Korea — in particular, seniors, people with disabilities, low-income families and those in remote locations — acquire ICT knowledge and training. Most recently, KT has implemented ICT education to help prepare children to succeed in the Fourth Industrial Revolution. As technology has advanced over time, the focuses of the initiative's key education programmes have evolved, as captured in the table below:

	Key ICT technology	Curriculum focus of IT supporters education programmes
2007-2008	- 100M FTTH[3] internet - 3G mobile	- How to use the internet
2009-2010	- Smartphone	- How to use a smartphone, - ITQ[5]
2011-2012	- LTE mobile	- Social marketing
2013-2014	- GiGA internet[4]	- Job training - Global mentoring
2015-2017	- GiGA LTE mobile	- Future ICT education (including IoT and other new technologies)

IT Supporters has three key programmes, each with curriculum offerings targeted toward different populations. KT staff members with an IT education background and KT retirees serve as instructors for each of the programmes. Upon request by local partner communities, KT IT Supporters bring equipment and teach the appropriate curriculum for each population. Descriptions of the three programmes follow:

1. Future ICT capacity-building

- **Future ICT education:** Designed to provide education and training on the latest ICT technologies, such as virtual reality, augmented reality, drones and relevant software programmes for students living in remote areas.
- **Software career school:** Designed to provide career curriculum in the areas of software coding, finance and economics. Supported by KT staff with IT education backgrounds, to help students envision their careers in these areas.
- **IoT learning centre:** KT has built three IoT learning centres free of charge to enable both students and local residents to experience IoT technologies.
- **IT education for remote areas:** KT has built learning sites for students living near the Demilitarized Zone between North and South Korea and other hard-to-reach locations. These sites provide interactive learning via a digital classroom whiteboard and individual student tablets. Offerings include athletics classes using an IoT health bike and IoT golf putting exerciser.

Category	Future ICT education	Software career school	IoT learning centre	IT education for remote areas
Photos				

2. Equity through ICT

KT Dream School Global Mentoring: Designed for students in remote schools, this online platform enables 70 university student volunteers from 36 countries to teach foreign languages and share cultural experiences online twice per week. The volunteers, selected by KT and the Seoul metropolitan government, provide individual mentoring and teach English, Chinese, French, and Japanese, among other languages.

3. Better life and economic independence through ICT

KT staff and retirees deliver the following courses, with the goal of improving quality of life and enabling economic independence for specific populations:

Themes	**Better life**		**Economic independence number of ITQ certificates**	
Beneficiaries	**Seniors**	**Farmers and fishermen/ small business owners**	**People with disabilities**	**BOP[6] multicultural families**
Goals	To understand smartphones and applications	To communicate online via PCs / mobile devices	To improve the ability to use Microsoft Office and online access	To improve the ability to handle electronic documents and online access
Courses	Smartphone application for Alzheimer's prevention	How to use Smartphone/PC applications/Social network service/ Social marketing	Internet access/ITQ certificate training	Smartphone/ internet access/ ITQ certificate training
Partners	Local community and social welfare centre	Local community	Service centre for the disabled	Local community and NGOs/ Multicultural family service centre




Part IV: Results and impact

Over the last decade, KT IT Supporters has delivered 310,701 training courses to 3.2 million people, 26% of whom were children. Over 2,300 participants — mostly from multicultural families — have obtained ITQ certificates, which are desirable in the ICT-related job market.

	Categories		Number of beneficiaries	%	Number of ITQ certificates
Beneficiaries	Four categories of marginalized, digitally deprived populations	Seniors	767,673	24%	345
		Disabled	238,626	7%	133
		Low-income urban	136,014	4%	-
		Farmers and fishermen	47,045	1%	-
	Children		853,618	26%	402
	Adults		786,822	24%	
	Multicultural families		338,500	11%	1,425
	Small-business owners		87,900	3%	-
	Total		**3,256,198**	**100%**	**2,305**

Beneficiaries of KT IT SUPPORTERS as of June 2017.

KT IT Supporters has also resulted in the creation of jobs, with 207 KT retirees extending their careers as instructors in the programme, and 2,178 IT Supporters trainees now working as home IT assistants who offer basic knowledge about using PCs and smartphones to people living in remote areas. The home IT assistants work as part of an IT employment programme funded by local government.

Part V: Lessons learned

KT IT Supporters has thrived for over a decade because the programme has continually evolved amid the fast-changing ICT environment. In the beginning, basic ICT training that covered topics such as how to use the internet was enough to meet public needs. As ICT trends that drove the initial courses became outdated, the programme has diversified, and now includes curricula related to topics such as social marketing and the IoT. Working to fully understand and address the changing needs of society has been critical to the programme's success.

Conclusion

To sustain IT Supporters, KT has developed a roadmap for the future, which includes improving curriculum and partnership management, and expanding the number of beneficiaries. The company plans to continue to integrate the latest technologies into the programme, and to strengthen the IT Supporters' ecosystem by delegating more ownership of programme operation to local partners.

To date, KT has played a key role in the in the programme's workstream — from recruiting of instructors and trainees, to providing IT training equipment. Now, to enable a long-term, more independent service, KT is working to engage partners to perform recruitment, logistics, and course development tasks. For example, partner school teachers in the Demilitarized Zone have created digital versions of regular school courses such as mathematics and sociology, after receiving KT Supporters' training on IT education solutions.

KT plans to increase the number of programme beneficiaries by extending training opportunities to the broader population. By doing so, and creating a more independent and collaborative ecosystem, the company hopes to further scale projects to enable broad social change.

Endnotes

1 World Economic Forum. The Fourth Industrial Revolution, by Klaus Schwab. https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab.

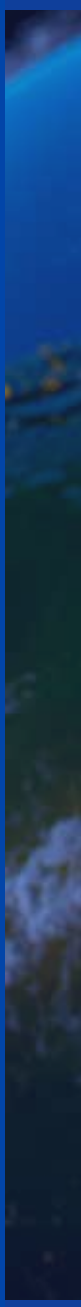
2 OECD. 2017. Broadband Statistics Update, July. http://www.oecd.org/sti/broadband/broadband-statistics-update.htm.

3 Fibre to the home

4 Internet speed of over 1Gbps

5 Information Technology Qualification for Microsoft Office, a training and evaluation system used to certify levels of IT management and practice skills

6 'Bottom of pyramid'



#Broadband
#ICT4SDG

BROADBAND COMMISSION
FOR SUSTAINABLE DEVELOPMENT