ADAPT ALL PRIMARY AND SECONDARY SCHOOL CURRICULA TO MEET THE CHALLENGES OF THE INFORMATION SOCIETY, TAKING INTO ACCOUNT NATIONAL CIRCUMSTANCES

Target 7: Adapt all primary and secondary school curricula to meet the challenges of the information society, taking into account national circumstances

Executive summary

Moving beyond connecting schools with ICT, Target 7 reflects the need for countries to invest in human resources and provide adequate training to ensure that teachers have an appropriate skill set to adapt national curricula to ICT-assisted instruction. It also reflects the general shift amongst both developed and developing countries from using older forms of ICT-assisted instruction (for example, radio and television broadcasts) to newer more interactive forms of ICT-assisted instruction that rely on computers and the Internet. As the second target (besides Target2) to focus on schools, Target 7 highlights the importance of teachers and educational institutions to ensure educational quality as well as broadening equal opportunities for all, including traditionally underserved or marginalized groups.

The first two indicators – 'proportion of ICT-qualified teachers in schools' and 'proportion of teachers trained to teach subjects using ICT' – show varying levels of achievement amongst countries. Although developed countries typically have greater proportions of trained teachers than developing countries, most countries, regardless of economic position, have trained 10 per cent or fewer teachers to be ICT-qualified for delivering basic computer skills or computing courses. However, considering the overall proportion of time spent in specific computer skills classes, this may be sufficient in a number of countries. Rather, given the emphasis in many countries to integrate ICT skills learning into other subjects, measuring the proportions of teachers trained to teach other subjects using ICT in the classroom is equally if not more important. The proportion of teachers trained to teach using ICT varies much more widely. In developed countries, which have a relatively strong policy environment regarding ICT in education and the essential school infrastructure, there are relatively high proportions of teachers trained to teach subjects using ICT. In comparison, many low income countries, particularly least developed countries (LDCs),[1] are particularly challenged in guaranteeing an adequate supply of trained teachers. In both developed and developing countries, a lack of trained teachers presents significant challenges in terms of adapting national curricula to meet the challenges of the information society.

Given many countries' shift towards more advanced forms of ICT-assisted instruction in the classroom, the third indicator, 'proportion of schools with computer-assisted instruction (CAI)' is important to demonstrate the general availability of computers for teaching and learning in schools. Results show substantial disparity amongst developed and developing countries. For example, while several high income and OECD countries in Europe, Eastern Asia and the Caribbean have integrated CAI adapted curricula in all schools, fewer schools have done so in developing countries in Latin America and Asia. Data are largely unavailable for most countries in Africa and Oceania.

Typically, countries that have strong policies and plans that set targets for ICT in education have also shown the most rapid change amongst developing countries. This is true for a number of countries including Chile, Colombia and Uruguay in Latin America, as well as Oman, Jordan, Thailand and Georgia in Asia.

The fourth indicator, 'proportion of schools with Internet-assisted instruction (IAI)', shows that in general the level of IAI is somewhat lower than the level of CAI, suggesting that access to the Internet, which requires the availability of at least basic telecommunications/ICT infrastructure, may be a barrier. Moreover, the data show that in some countries the Internet is not fully exploited by all schools – in many it may be reserved for administrative purposes. In terms of disparities, OECD and other high income countries are more likely to have IAI than developing countries, particularly for a number of countries in Asia and Africa.

Countries that have adopted full scale implementation of CAI and IAI in their schools also typically have a relatively high proportion of trained teachers, compared to those that are still in the early stages of implementation. Looking at the gap observed, albeit across the limited number of countries with available data, countries that are in the earlier stages of e-readiness can propel their progress by seizing opportunities to determine what activities or conditions are necessary. It is hoped that they can learn from more advanced countries that have employed effective models and policies for integrating ICTs into their curricula.

While progress has been achieved adapting primary and secondary school curricula to meet the challenges of the information society in the last ten years, the level of progress has varied across countries. Since adapting all curricula for primary and secondary schools to meet the challenges of the information society has not been achieved in many countries, particularly middle and low income economies, a post-2015 ICT monitoring framework should continue to track Target 7. Based on current analysis, and considering the rapidly evolving policy-driven data needs, some additional indicators for effectively monitoring the adaptation of curriculum during the post-2015 agenda may be needed. For example, calculating new indicators on proportions of schools with computers in laboratories versus classrooms and other locations sheds light on ICT usage and reflect evolving information requirements as countries move from a phase of building infrastructure for ICT in education (e-readiness) to more focused usage of different ICTs (e-intensity). Another possible inclusion may be enrolment rates (by sex) in programmes offering CAI and/or IAI in order to get more insight into the participation of pupils in such programmes. In addition to illuminating the digital divide between the sexes, this indicator, which is currently collected by the UIS, would also provide information on usage in schools.

In order to improve international comparability of teacher training indicators, the UIS should consider an alternative measure, given the wide variety in the nature of how teachers are prepared. For example, insight into the educational level of the training and/or the length would shed additional light on the quality of training that teachers acquire.

Finally, this report offers some policy recommendations for adapting curricula to meet the challenges of the information society:

- To adapt school curricula to meet the challenges of the information society, policies must go beyond mere capital investments in ICT-related infrastructure. It is imperative that initiatives also develop ICT-skills amongst the teaching force, so that the knowledge and skills can be effectively transferred to students.

  - As courses in basic computer skills and more advanced courses in computing require teachers with specific ICT qualifications, countries need to ensure they train an adequate number of teachers to effectively deliver these courses in all schools.
  - Because ICT plays a role in the instruction of various curricular subjects, an adequate number of teachers should be trained to teach subjects using ICT in order to effectively adapt curriculum to ICT-assisted instruction.

- Where resources permit, countries should increase the number of devices per school and connect them to the Internet to ensure a critical mass of ICT is available to provide sufficient access to computer-assisted and Internet-assisted instruction.
- Where resources permit, countries should allocate desktops, laptops tablets and other computer devices to classrooms, computer laboratories, libraries and other locations around the school to provide pupils multiple access points.
- Increase access to online free and open-source software (FOSS) as well as other open educational resources (OER), to improve the quality of CAI and IAI, at relatively low cost.
- Recognise the role of community media centres, to play a role in extending the reach of computer-assisted and Internet-assisted instruction to pupils when ICT is not available in schools.

Introduction

The direction in which information societies are evolving reveals a picture of education moving rapidly away from traditional practices. Information and communication technology (ICT) has had a significant impact on education in recent years – in terms both of the pressure on decision-makers to acquire new technologies, and for effective content development, management and delivery. In order to make informed decisions, a critical examination of national policies, past and present, as well as of national circumstances is critical to successfully integrate ICT in education. In the simplest terms, a review of what education is aiming to achieve is required prior to articulating how ICT may best be utilized.

School connectivity[2] is a crucial precursor to the uptake of ICT in education; however, it is insufficient to ensure that ICTs are used effectively in schools, classrooms, or in education in general. Policy-makers in many countries previously believed that simply equipping schools with PCs would prepare pupils for the demands of the 21st century. However, they are increasingly aware that simply providing access to ICT will not necessarily result in improvements to the education system. Instead, thoughtful planning and effective execution are required to reap the benefits of ICT in education. More specifically, policies are needed that will enable pupils, through the acquisition of appropriate skills, to effectively participate in a globally competitive workplace.

The action lines in the WSIS Geneva *Plan of Action* (ITU, 2005) express a clear need for capacity building and skills development in order to reap the full benefits of the information society. Teachers who are formally trained in the fields of ICT literacy and computing are best positioned to deliver ICT-adapted curricula that build on the development of basic computer skills in preparation for advanced studies and the labour market. As illustrated in Figure 7.1, WSIS Target 7 is closely related to three specific WSIS action lines. As stated in WSIS Action Line C4, capacity building through e-learning initiatives (that is, WSIS Action Line C7) will be an important precondition for the development of skills in the information society:

> "Everyone should have the necessary skills to benefit fully from the information society. Therefore capacity building and ICT literacy are essential. ICTs can contribute to achieving universal education worldwide, through delivery of education and training of teachers, and offering improved conditions for lifelong learning, encompassing people that are outside the formal education process, and improving professional skills." (ITU, 2005)

The key points within Action Line C4 pertaining to teacher training and ICT-adapted curricula are as follows:

- "Develop domestic policies to ensure that ICTs are fully integrated in education and training at all levels, including in curriculum development, teacher training, institutional administration and management, and in support of the concept of lifelong learning."
- "Work on removing the gender barriers to ICT education and training and promoting equal training opportunities in ICT-related fields for women and girls. Early intervention programmes in science and technology should target young girls with the aim of increasing the number of women in ICT careers. Promote the exchange of best practices on the integration of gender perspectives in ICT education."

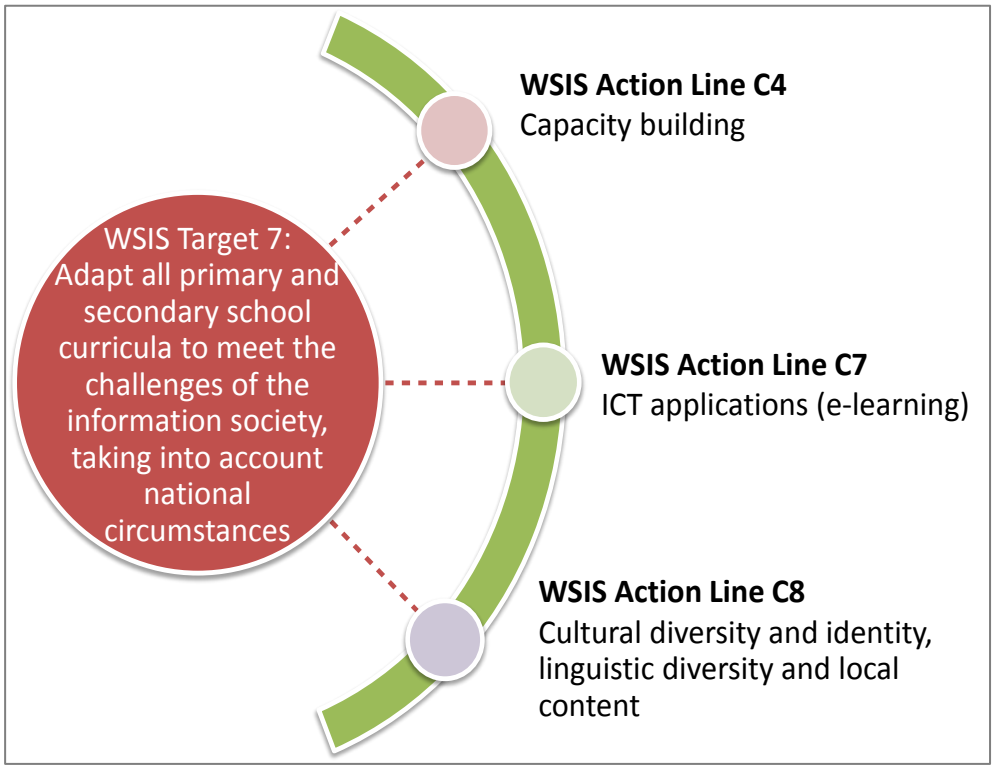
- "Design specific training programmes in the use of ICTs in order to meet the educational needs of information professionals, such as archivists, librarians, museum professionals, scientists, teachers, journalists, postal workers and other relevant professional groups. Training of information professionals should focus not only on new methods and techniques for the development and provision of information and communication services, but also on relevant management skills to ensure the best use of technologies. Training of teachers should focus on the technical aspects of ICTs, on development of content, and on the potential possibilities and challenges of ICTs." (ITU, 2005)

Action line 7 (ICT applications: benefits in all aspects of life), particularly the subcomponent e-learning, also has direct relevance for Target 7. Content for the e-learning subcomponent is elucidated above within Action Line C4 (Capacity building).

More indirectly, Action Line C8 (Cultural diversity and identity, linguistic diversity and local content) also has relevance to Target 7, particularly to build girls' and women's ICT capacity.

> "Strengthen programmes focused on gender-sensitive curricula in formal and non-formal education for all and enhancing communication and media literacy for women with a view to building the capacity of girls and women to understand and to develop ICT content." (ITU, 2005)

Figure 7.1: Relevance of Target 7 to WSIS action lines



Relating WSIS action lines to other international frameworks

Apart from the WSIS Geneva *Plan of Action*, two other global movements calling for equal educational opportunities are the Millennium Development Goals (MDGs) and the Education for All (EFA) goals. The eight MDGs, which were agreed upon in 2000, form a developmental blueprint for all the world's countries and leading development institutions. In particular, the MDGs have

galvanized efforts to meet the education, health, gender equality, environmental, economic and other developmental needs of the world's poorest. Meanwhile, the Education for All (EFA) goals, which were also agreed to in 2000, include six education-specific targets to increase participation in education by broadening access and eliminating exclusion; to improve equity and quality in schooling and lifelong learning for all; and to diversify youth's skill set to match the demands of the information society (see Box 7.1).

While it is important that all MDGs and EFA goals be achieved, the emphasis on the universalisation of education stated in WSIS action lines 4, 7 and 8 also have relevance for MDG Target 2.A and Target 3A, respectively:

> "Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling", and
>
> "Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015". (United Nations, 2012)

The substance of MDG targets 2.A and 3.A are reflected in EFA goals 2 and 5, respectively (see Box 7.1), nonetheless, WSIS action lines 4 and 7 also are also related to EFA Goal 3, which aims to enhance skills, and to EFA Goal 6, which aims to enhance the quality of education, particularly through teacher training on ICTs and the incorporation of ICT-assisted instruction (UNESCO, 2000).

Box 7.1: The six *Education for All* (EFA) goals

Goal 1: Expanding and improving comprehensive early childhood care and education, especially for the most vulnerable and disadvantaged children.

Goal 2: Ensuring that by 2015 all children, particularly girls, children in difficult circumstances and those belonging to ethnic minorities, have access to, and complete, free and compulsory primary education of good quality.

Goal 3: Ensuring that the learning needs of all young people and adults are met through equitable access to appropriate learning and life-skills programmes.

Goal 4: Achieving a 50 per cent improvement in levels of adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults.

Goal 5: Eliminating gender disparities in primary and secondary education by 2005, and achieving gender equality in education by 2015, with a focus in ensuring girls' full and equal access to and achievement in basic education of good quality.

Goal 6: Improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills.

Source: The Dakar Framework for Action (UNESCO, 2000).

The notion that adapting school curricula can help expand educational opportunities as well as enhance quality towards meeting the challenges of the information society, is an important stepping stone towards achieving Target 7 of the WSIS *Plan of Action* as well as the education-related MDGs and EFA goals. However, in view of the challenges faced, the sole reliance on conventional delivery mechanisms will be inadequate to provide affordable and sustainable education opportunities for all by 2015. For example, one of the greatest challenges for many education systems is to be able to offer learning, training and general educational opportunities to traditionally underserved or marginalized groups. This includes girls and women who face barriers to schooling; rural populations that are too dispersed to populate schools with reasonable class sizes; children from families in

extreme poverty; and special needs groups or persons with disabilities who have no access to learning centres. While the lack of ICT infrastructure remains a major constraint for many developing countries, some have made significant progress beyond connecting schools, particularly when countries set specific targets and have high government and sector-wide level support (see Chapter 2). Developed countries also face challenges integrating ICT in education; however, unlike developing countries, policy development focuses less on connectivity and more on how to enhance educational quality through the use of ICT, thus ensuring that sound pedagogy is central to the adaptation of school curriculum. Given ever-evolving technologies and pedagogies, exemplary policy initiatives are being taken by governments that address the multi-faceted challenges of adapting curricula in primary and secondary schools to meet the challenges of the information society (see Box 7.2).

Box 7.2: Singapore's Third Masterplan for ICT in Education (MP3)

In 2008, Singapore's *Third Masterplan for ICT in Education* (MP3) was launched to work towards the vision of "Harnessing ICT for Future Learning." MP3 follows two previous masterplans, the first (MP1) running from 1997 to 2002, focusing on equipping schools with basic ICT infrastructure and in training teachers, while the second (MP2), which ran from 2003 to 2008, focused on effective and pervasive use of ICT in education by sowing innovation in schools. MP3 continues the vision of MP1 and MP2 to enrich and transform the learning environments of students and equip them with the critical competencies to succeed in the information society.

The four MP3 goals are:

(1) Students possess competencies for self-directed and collaborative learning through the effective use of ICT.

(2) Teachers have the capacity to tailor and deliver ICT-enabled learning experiences for students to develop these competencies.

(3) School leaders provide the direction and create the conditions to harness ICT for teaching and learning.

(4) ICT infrastructure supports teaching and learning anywhere, anytime.

The key focus of MP3 is on self-directed learning (SDL) and collaborative learning (CoL) with ICT. It is believed that engaging students in SDL and CoL with ICT could better prepare Singaporean students to meet the challenges of the 21st century. The Ministry of Education (MoE) considers students to be engaged in SDL if there is some demonstration of ownership of learning, management and monitoring of one's own learning, and/or extension of this learning. Collaborative learning is where students work in pairs or groups to solve a problem or to achieve a common learning objective. Students engaged in collaborative learning are expected to develop effective group processes, and individual and group accountability of learning.

MoE supports schools to be innovative in the use of ICT and facilitates the sharing of good practices among schools through several programmes, including the FutureSchools@Singapore and LEAD ICT@Schools. Working closely with the MoE and the Infocomm Development Authority (IDA), the FutureSchools@Singapore initiative was launched in 2007 to support a small number of schools to become technology-enabled by focusing on innovative teaching approaches that fully leverage ICT and innovative infrastructure designs to bring about more engaged learning for students.

Source: Ministry of Education, 2014, http://ictconnection.moe.edu.sg/masterplan-3/mp3-vision-and-goals.

Data availability and scope

Monitoring the adaptation of curricula at the international level in relation to Target 7 can be understood from two distinct perspectives. On the one hand, monitoring Target 7 could include tracking outputs of ICT-adapted curricula. Currently, the greatest source of existing internationally comparable data on outputs derives from sample-based international assessments that rely on direct measurement of ICT use and curricula. The most commonly known examples include the International Association for the Evaluation of Educational Achievement (IEA) assessments, which

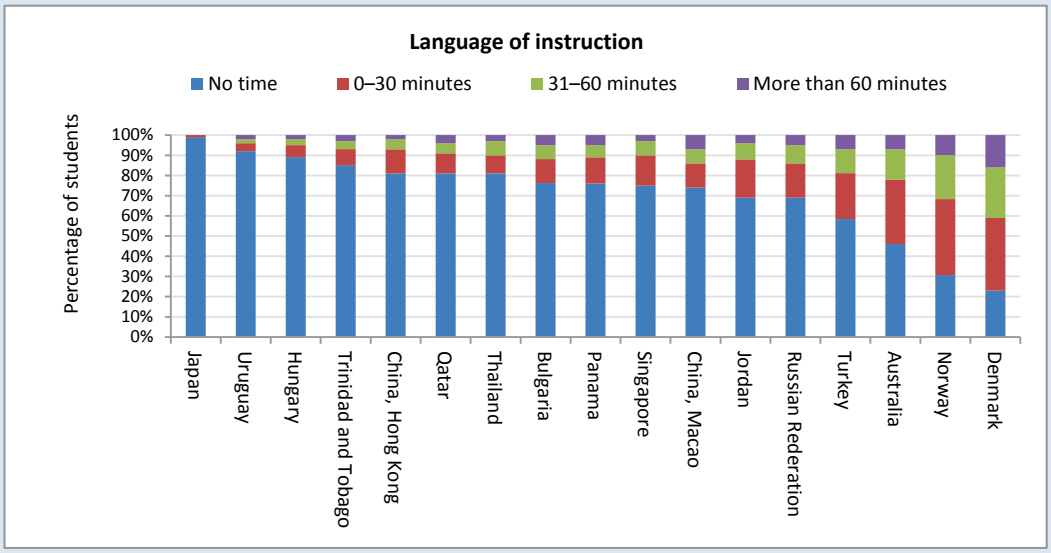
focus on measuring student achievement in mathematics, science and reading. Respectively known as *Progress in International Reading Literacy* (PIRLS) and *Trends in International Mathematics and Science Study* (TIMSS), both studies include modules on ICT use by students and teachers as part of the curriculum. Another well-known assessment is the Organisation for Economic Co-operation and Development (OECD) *Programme for International Student Assessment* (PISA), which is a standardized international study targeting the performance of 15-year old pupils (see Box 7.3).

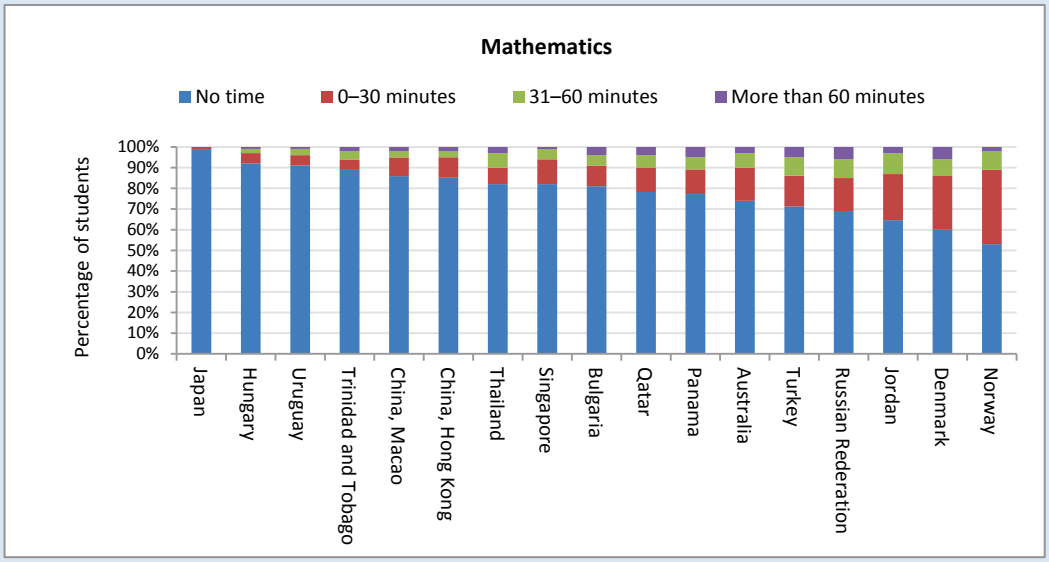
Box 7.3: The disconnection between ICT policy, infrastructure and use – evidence from PISA, 2009[3]

International survey data from the Programme for International Student Assessment (PISA) shed light on the use of ICT by 15-year old pupils in both OECD and participating non-OECD countries. Box Chart 7.3 shows the proportion of pupils using computers during school lessons by level of duration: high (>60 min per week), moderate (31–60 min per week), low (<30 min per week) or no time using computers, in 19 selected developed and developing countries.[4] Separate data are available for three subjects: language of instruction,[5] mathematics and science. Based on available data, there is evidence of an ongoing disconnection between national policy, existing infrastructure available to support ICT-assisted instruction, and use, by pupils. Box Chart 7.3 shows that in all countries represented, more than half of all 15-year old pupils do not use a computer during a typical week in mathematics lessons, while this is also true of the vast majority of countries in language of instruction lessons (16 of 19) and science lessons (18 of 19).

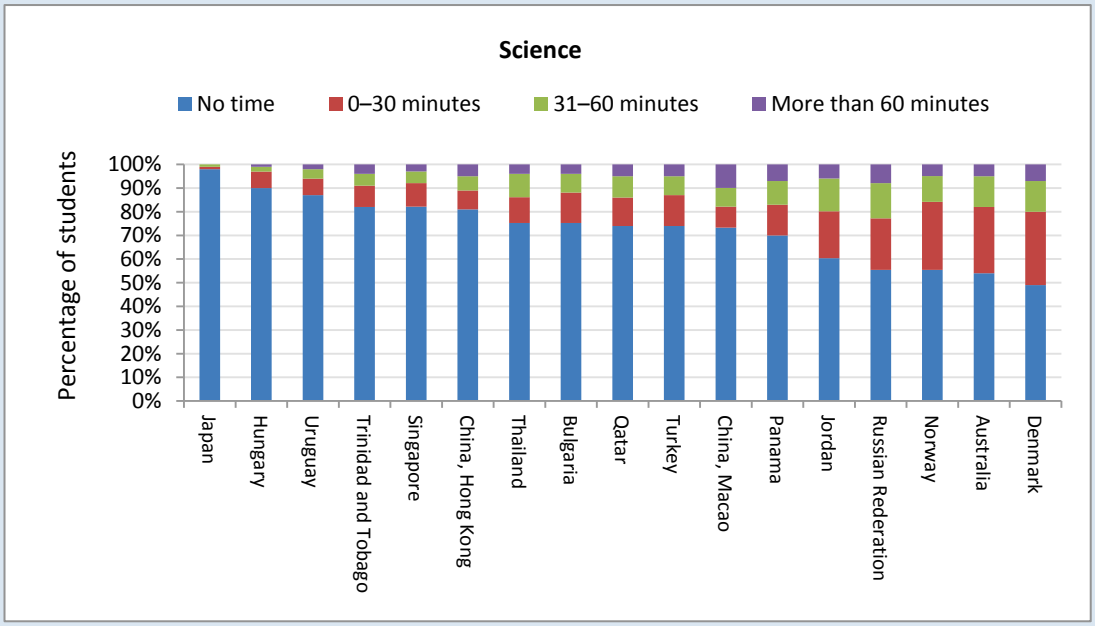
Weekly computer usage is lowest in Japan (below 5 per cent) for all three subjects even though the country has an ICT in education policy and supporting infrastructure providing access (that is, learner-to-computer ratio is 9:1) (see Chapter 2). Also in Asia, usage is higher and approximating the OECD average in Singapore, which implemented its third consecutive ICT in education policy in 2008 to progressively strengthen and reaffirm the use of technology in teaching and learning and where there is also a relatively low learner-computer ratio of 4:1.

Box Chart 7.3: Computer usage in language of instruction, mathematics and science, by frequency, 2009





Box 7.3: The disconnection between ICT policy, infrastructure and use – evidence from PISA, 2009 (cont.)



Computer use is highest in the Scandinavian countries Denmark and Sweden in all three subjects: around 70 per cent of 15-year old pupils or more use a computer during a typical week in language of instruction classes, compared to 40 to 50 per cent in mathematics and science classes. Somewhat less frequently, but higher than the OECD average, slightly more than half of pupils (54 per cent) also use a computer in language of instruction in Australia, compared to 26 per cent and 46 per cent in mathematics and science lessons.

While computer use is low to absent in some developed countries that have ICT in education policy and strong infrastructure, use is found to be higher than the OECD average in others, including Turkey and Jordan, which both actively promote educational reform that makes significant use of ICT in education. In Jordan, for instance, 31 per cent, 36 per cent and 40 per cent of pupils use a computer in language of instruction, mathematics and science classes, respectively, on a weekly basis. As per mathematics education, not only is Jordan becoming a pioneer in the region in the use of e-content under the Jordan Education Initiative, but compared to OECD countries, only Denmark and Norway surpass it for computer use.

Source: OECD, 2011.

On the other hand, and of prime importance for Target 7, monitoring must also focus on measuring the inputs required in order to gear curricula to the needs of the information society. An evaluation over time of the requisite human and physical capital resources, as well as effectively linking ICT usage to sound pedagogy, are essential since these constitute the foundation for curricula that meet the changing needs of the information society.

The Partnership on Measuring ICT for Development is mandated to establish international standards, indicators and benchmarks for statistical monitoring of the WSIS global policy goals. Under the auspices of the *Partnership*, the UNESCO Institute for Statistics (UIS), in 2009, led a process for the development and pilot testing of internationally comparable core indicators on ICT in education leading to an international framework.

A set of core ICT in education indicators that measure inputs of e-readiness and access to ICT in education systems was submitted by the *Partnership* to the United Nations Statistical Commission (UNSC) at its 40th session in February 2009 (*Partnership*, 2010). As a response to the need to expand the initial core list, UIS established the international Working Group for ICT Statistics in Education (WISE). The purpose of the working group was to bring together statisticians (national focal points) from ministries of education (or national statistical offices) from 25 countries around the world to

pilot the international Questionnaire on Statistics of ICT in Education. The four indicators identified to monitor Target 7 in the following sections are the result of this initiative (UNESCO-UIS, 2009a).

While the results of the UIS survey presented in this chapter provide important insights into the status of ICT in education in both developed and developing countries, the survey has not yet been disseminated globally and this chapter is therefore limited to 80 countries from various data collections. Initially, data were collected from 25 countries using the pilot questionnaire; these were analysed and included in the *World Telecommunication/ICT Development Report 2010: Monitoring the WSIS Targets, A mid-term review* (WTDR) (ITU, 2010). Since then, UIS has conducted regional data collections and released reports for Latin America and the Caribbean (UNESCO-UIS, 2012), Arab States (UNESCO-UIS, 2013) and Asia (UNESCO-UIS, 2014). UIS began collecting ICT in education statistics in sub-Saharan Africa in late 2013. As several countries have yet to complete the UIS survey, data in this chapter are complemented with information collected using the 2013 WSIS targets questionnaire (*Partnership*, 2013) as well as from other regional or national sources.

Indicators to track WSIS Target 7

While Target 7 promotes adapting all primary and secondary school curricula to meet the challenges of the information society, it does not specifically provide information on how this will be accomplished (*Partnership*, 2011). Adapting curricula effectively to meet the challenges of the information society requires two key elements. Firstly, teachers need to be trained not only how to teach students to use ICT, but teachers themselves need to be trained in effective use of ICT in the classroom. Secondly, integrating ICT-assisted instructional environments using the latest technologies (for example, computers, tablets, broadband Internet) provides schools with the optimal context for adapting curriculum to meet the challenges of the information society and thus help pupils to acquire the knowledge and skills to successfully compete in an ever more globalized economy.

The following four indicators were defined in the 2011 WSIS statistical framework (*Partnership*, 2011) to track Target 7:[6]

Indicator 7.1: Proportion of ICT-qualified teachers[7] in schools

Indicator 7.2: Proportion of teachers trained to teach subjects using ICT

Indicator 7.3: Proportion of schools with computer-assisted instruction

Indicator 7:4: Proportion of schools with Internet-assisted instruction

Indicator 7.1 refers to the percentage of primary and secondary teachers trained to teach basic computer skills (or computing) in schools. It the only one of the four indicators that is in the *Partnership*'s core list of ICT indicators (Indicator ED8). The indicator measures the magnitude of the teaching workforce qualified to deliver curriculum related to basic computer training and computing. It does not measure the proportion of teachers actually teaching computing, nor does it measure quality – as training modalities vary substantially between countries.

Indicator 7.2 refers to the percentage of primary and secondary teachers trained to effectively use ICT to enhance their teaching of different subjects within the official curriculum. The indicator does not measure the proportion of teachers actually using ICT in their teaching, nor does it measure quality – as training modalities vary substantially between countries.

Indicator 7.3 refers to the percentage of primary and secondary schools offering computer-assisted instruction (CAI). In other words, it measures the availability of computers allocated for pedagogical purposes amongst educational institutions. The indicator does not measure the intensity or quality of use.

Indicator 7.4 refers to the percentage of primary and secondary schools offering Internet-assisted instruction (IAI). In other words, it measures the availability of the Internet allocated for pedagogical purposes amongst educational institutions. The indicator does not measure the intensity or quality of use.

All four indicators are collected and published at the international level by UIS. While relatively few have done so, a number of countries have set specific targets on adapting school curricula to meet the challenges of the information society (see Box 7.4), which can be monitored by these four indicators.

Box 7.4: Monitoring targets for adapting school curricula to the information society – Asia

While target 7 does not specify the percentage of teachers that should be trained in relation to ICTs, nor the percentage of schools that should offer advanced forms of ICT-assisted instruction including CAI and IAI, countries can monitor progress against a backdrop of significant ICT in education initiatives.

- In Thailand, where education authorities are systematically implementing a one learner to one tablet computer model annually for all Grade 1 and Grade 7 pupils, training teachers in advance to use these devices effectively will play a vital role not only to ensure better educational outcomes (Viriyapong and Harfield, 2013), but more fundamentally to ensure that teachers feel confident in their use.
- Consistent with its considerable reliance on the use of e-materials, Kazakhstan intends to supply 48 per cent of schools (4 120) with interactive whiteboards by 2014. To meet the challenges of adapting existing curricula, Kazakhstan has a cross-curricular ICT policy, which states that all teachers will require some level of ICT competence (ADB, 2012).
- Azerbaijan, where computer-assisted instruction (CAI) was available in 84 per cent of schools in 2012, aims to provide a computer classroom to every school (that is, CAI in 100 per cent of schools). In addition, each class is to be supplied with uninterruptible power supply, networking equipment (switch, cables and connectors) and a laser printer (ADB, 2012).
- In Turkey, the *Movement of Enhancing Opportunities and Improving Technology*, known as Fatih, is among Turkey's most significant educational investments and advocates the establishment of a *Smart Class* in all schools. Turkey aims to equip 42 000 schools and 570 000 classes with the latest ICTs (that is, computers, tablets and LCD interactive boards) (Fatih, 2013). Between 2003 and 2010, over 844 000 computers had been allocated to schools and by 2013, more than 97 per cent of schools were connected to the Internet (World Bank, 2013).

These indicators measure the inputs or determinants required for the effective delivery of ICT-adapted curricula. Inputs in this instance refer specifically to trained teachers as well as the required conditions for the delivery of enhanced forms of ICT-assisted instruction; they serve as the foundation for the integration of ICT in education systems. The indicators that monitor these inputs are statistically comparable internationally, and aim to track progress towards Target 7 and the corresponding WSIS action lines identified above.

Achievements against Target 7

Training teachers for ICT in education

The stock of available human resources for teaching is seen as the hallmark for the effective delivery of any curriculum, including those that use ICT-assisted instruction. The latter may include any

combination of the following: radio, television, computer and Internet-assisted instruction. Teachers are frequently considered the most important influence on classroom learning and therefore play an invaluable role in ensuring that pupils use ICT effectively, both inside and outside of school. However, to date, consensus is limited on how much teacher training is required to build a teaching workforce that is motivated to use ICT in the classroom in the context of new pedagogical frameworks and curricula. Other considerations for teacher training are: how often it should take place, what kind of training is most effective and what the training content should be.

Complicating matters, the integration of ICT into education is frequently resisted by teachers and their unions, particularly in countries with an ageing, underpaid teaching workforce, and where there has been inadequate training and preparation. In such circumstances, a lack of motivation to learn new skills, and teaching and learning methodologies, can occur and can even be compounded if teachers feel threatened by newer forms of ICT that students might understand better than them. For example, because of the high proportion of older teachers in the last quartile of their teaching career in Kazakhstan, concerns about a general lack of efficiency in the use of e-curriculum – an important focus of their education system – has been officially recognised by the Ministry of Education (ADB, 2012).

Proportion of ICT-qualified teachers

One useful measure in monitoring the stock of human capital for Target 7 is Indicator 7.1, 'Proportion of ICT-qualified teachers in schools' (that is, teachers trained to teach basic computer skills or computing). The qualification is based on a nationally defined qualification in the core disciplines of ICT or a qualification to teach basic computer skills or computing (in secondary education). Where a country has a high percentage of ICT-qualified teachers among the overall teaching staff in primary and secondary schools, this suggests that the country is aiming to provide learners with basic ICT skills and to meet emerging and evolving skills requirements in the information society. This does not necessarily mean that those basic ICT skills are taught by teaching staff who have received the requisite formal training.

Besides its use for international comparison, Indicator 7.1 can also be calculated and analysed at national and subnational levels (by education level and grade, geographical region, urban/rural area and public/private school) in order to design tailored policies and help implement training initiatives and deploy adequate numbers of ICT-qualified teachers in schools.

Proportion of teachers trained to teach subjects using ICT

A second approach to measuring the available human capital stock is via Indicator 7.2, 'Proportion of teachers trained to teach subjects using ICT'. The indicator refers to teachers who have received a nationally defined minimum formal training to teach one or more subjects at the relevant level(s) using ICT to support instruction. Where a country has a high percentage of teachers that are trained to teach subject(s) using ICT, this can be interpreted as an appropriate measure of e-readiness. When calculated by education level, geographical region, urban/rural area and individual educational institution, and analysed in conjunction with other indicators (for example 'proportion of schools with computer-assisted instruction'), this indicator can highlight discrepancies. Appropriate policy decisions can then be taken to reassign trained teachers more effectively and to provide additional training.

Training required to become ICT-qualified or to teach subjects using ICT may be completed either in a preservice teacher training programme, or during in-service professional development courses. Furthermore, it is possible that recurring training in a variety of formats may be required to match evolving technologies and related skills. At secondary education levels, teachers trained to teach computer skills or computing would typically have an accredited academic qualification in an ICT-related field such as computer science.

Chart 7.1 shows the proportion of ICT-qualified teachers (teachers trained to teach basic computer skills or computing) versus the proportion of teachers trained to teach subject(s) using ICT in combined primary and secondary education amongst the 33 countries for which data are available. The most apparent trend is that for the majority of countries, there appears to be more emphasis on training teachers to teach using ICT than on training teachers to teach basic computer skills or computing (that is, ICT-qualified). This finding is consistent with contemporary situated learning theory, which, at its simplest, stresses that learning that takes place in the same context in which it is applied. Lave and Wenger (1991), for example, have argued that learning should not be viewed as simply the transmission of abstract and decontextualized knowledge from one individual to another, but a social process whereby knowledge is co-constructed in a specific context and embedded within a particular social and physical environment. Extending this theoretical model to teacher training leads to the conclusion that teachers who have been trained how to integrate ICT into various learning contexts are more pertinent for overall learning than those specifically trained to pass along decontextualized computer skills.[8]

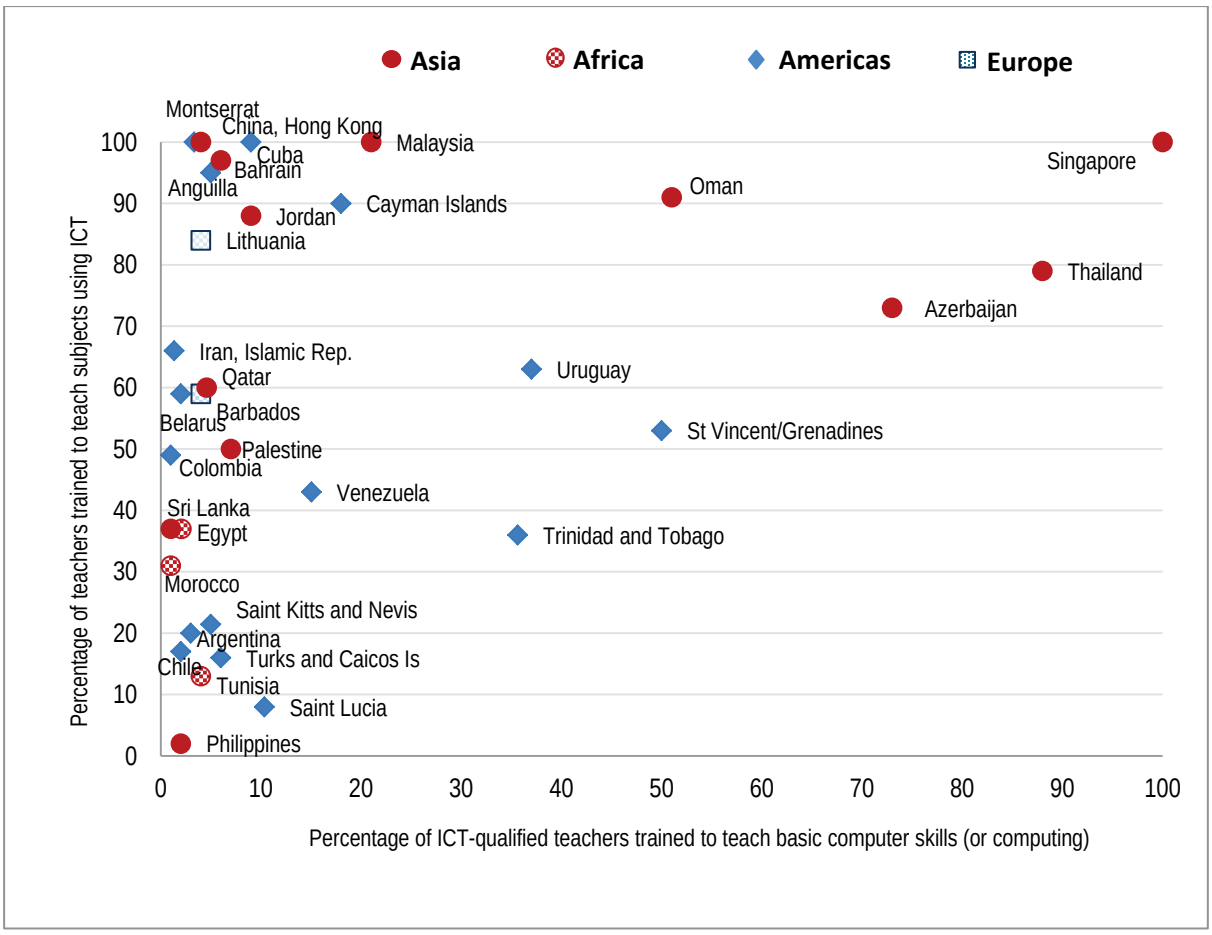
Representing different regions and national income levels, less than 10 per cent of the national teaching workforce was trained to teach basic computer skills or computing (ICT-qualified) in 2011/2012 in the vast majority of countries represented in Chart 7.1. In contrast, approximately 50 per cent of teachers or more were ICT-qualified in Oman (51 per cent), Azerbaijan (73 per cent), Thailand (88 per cent) and Singapore (100 per cent). This wide range can partly be explained by the fact that nationally defined standards to be ICT-qualified vary. In Jordan, for example, where 9 per cent of teachers are considered ICT-qualified, the training standard in the public education system is a tertiary level qualification in computer science (Ministry of Education, 2010). Meanwhile, the standard in many countries is likely to be lower, requiring only a single course during an entire teaching course or covered during short intensive in-service programmes. In Singapore, where 100 per cent of teachers are ICT-qualified, the same course requirements as teachers trained to teach subjects using ICT apply. Additional metadata on teacher training programmes would be required to make firmer statements about the quality of training between countries.

Compared with ICT-qualified teachers, the range of the proportion of teachers trained to teach using ICT was much wider. For example, 20 per cent or fewer teachers were trained to teach using ICT in Argentina (20 per cent) and Tunisia (13 per cent) in 2009, Saint Lucia (8 per cent) and Turks and Caicos Islands (16 per cent) in 2010, Philippines (2 per cent) in 2012 and Chile (17 per cent) in 2013. In contrast, between 80 and 100 per cent of teachers were trained to teach using ICT in Bahrain (97 per cent) in 2008, Anguilla (95 per cent) and Cayman Islands (90 per cent) in 2010, Jordan (88 per cent) in 2011 and Lithuania (84 per cent) in 2012. Extending training even further, 100 per cent of teachers were trained to teach other subjects using ICT in Singapore by 2009, Cuba and Montserrat by 2010, and China, Hong Kong by 2012.

Teacher capacity to effectively deliver ICT-assisted instruction is expected to be most effective in countries where high proportions of teachers are both ICT-qualified and trained to teach subjects using ICT. In Singapore, where all preservice teachers have had to undertake a module on the instructional uses of technology since the 1990s – complemented by additional professional development for in-service teachers – 100 per cent of teachers are both ICT-qualified and trained to teach using ICT. Relatively high proportions of teachers are also ICT-qualified and trained to teach using ICT in Azerbaijan, Thailand and Oman (see Box 7.5).

Concurrent to the implementation of Thailand's *One Tablet per Child*, the proportion of teachers trained to teach using ICT increased from 66 per cent in 2008 to 79 per cent in 2012. Uruguay has also successfully increased the proportion teachers that are ICT-qualified and trained to teach using ICT to 37 per cent and 63 per cent, respectively by 2009.

Chart 7.1: ICT-qualified teachers versus those trained to teach using ICT, 2012 or LYA[9]



Source: UIS database, Partnership on Measuring ICT for Development WSIS Targets Questionnaire, 2013 (*Partnership*, 2013).

Notes:

1. Reference years range from2008 to 2013 (2008 to 2010 for Africa; 2008 to 2013 for the Americas; 2008 to 2013 for Asia; and 2008 to 2013 for Europe). Full details can be found on the UIS website, http://www.uis.unesco.org/Communication/Documents/wsis-tables-2014.pdf.
2. All data for Montserrat and Saint Lucia refer to secondary only. Data for Philippines refer to primary and lower secondary only. Data for teachers trained to teach using ICT for Venezuela refer to primary only. All data for Anguilla, Azerbaijan, Barbados, Jordan, Singapore, Trinidad and Tobago, Uruguay, Philippines and Sri Lanka refer to public schools only. For Egypt, data on teachers trained to teach subjects using ICT refer to public schools. Data for Palestine refer to West Bank schools only.

Box 7.5: Increasing ICT skills among teachers in Oman to match evolving curricula

The development of Oman's education system mirrors its rapid emergence, both economically and socially. From only one all boys' school in 1970, Oman today has about 1 043 schools catering to both girls and boys. Responding to the global knowledge revolution and emerging information society, the education system of Oman is evolving rapidly to ensure that young Omanis are prepared to compete in a global economy by creating a skilled work force.

Information Technology (IT) is now taught in all schools as a separate subject from Grade 1 to Grade 10, while in Grade 11, the ICDL (International Computer Driving License) is a required course. Additionally, there are units in several other subjects that require the application of IT throughout. In 2007, the Ministry of Education (MoE) launched the Education Portal, which is an umbrella initiative to collate all IT initiatives and services within the MoE IT Master Plan. This web-based application is tied to a centralized database, which enables a single entry point for users within the MoE. The Education Portal provides users with the following applications:

- **Learning Management System (LMS)**, which handles all educational aspects publishing e-learning content like digital text, e-books, audio and video materials to present the subject in an appealing way for teachers and students;
- **Documents Management System (DMS)**, which tracks and archives electronic documents sent by users; and
- **School Management System (SMS)**, which transforms all administrative work in schools into electronic form.

As of late 2013, usage of the portal had increased to include 43 000 teachers, 27 000 administrators and 550 000 students in 1 040 schools. Close to 400 000 parents connect to the system to carry out daily transactions.

With the rapid evolution of ICT in education in Oman, the MoE recognized the importance of training to enhance teacher capacity through the acquisition of new skills and reduce internal resistance. Supported by influential private sector partners, and a training budget that was tripled from the 2010 level, the MoE embarked upon several initiatives to train teachers in the effective use of ICT in the classroom. In particular, in-service training was identified as an effective solution to bridge the skills gap occurring from rapid development of curriculum and the introduction of ICTs. Moreover, there is effective coordination between educational colleges in Oman and the MoE to ensure preservice and in-service training are aligned so that teachers are prepared and trained when programmes are implemented. Based on available statistics, Oman has been particularly successful in delivering training to its teacher workforce. Between 2010 and 2013, Oman increased the proportion of ICT-qualified teachers and those trained to teach subjects using ICT from 15 per cent and 37 per cent, respectively, to 51 per cent and 91 per cent.

Source: Information Technology Authority & Ministry of Education, 2014.

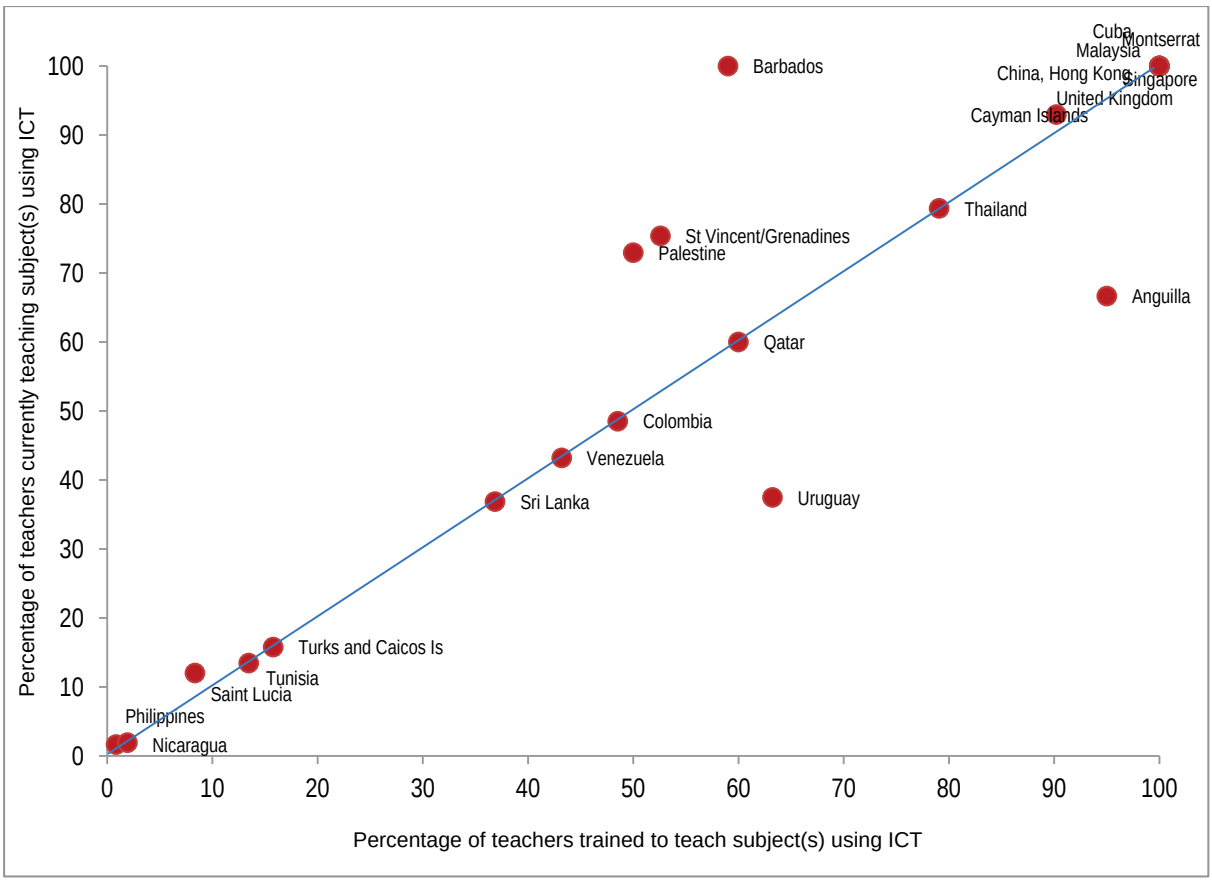
It is difficult to identify an ideal proportion of teachers who should be ICT-qualified or trained to teach subjects using ICT. Much will depend on the level of integration of ICT into the curriculum as well as how many children are enrolled in programmes that use various ICTs. Having ascertained the stock of teachers that are ICT-qualified or are trained to teach subjects using ICT according to national standards, it would also be useful to determine the proportion of teachers who actually use the relevant training in their teaching. One hypothesis is that there would be a one-to-one relationship between the two groups.

In terms of teachers trained to teach subject(s) using ICTs, Chart 7.2 shows that there is evidence of a perfect match in many countries. Countries such as Tunisia in 2009, Sri Lanka, Colombia and Qatar in 2011 and Thailand in 2012 displayed perfect proportionality (that is, a one-to-one ratio) between those trained to teach using ICTs and those engaged in teaching using ICTs. Moreover, there was significant variation amongst countries ranging from 1 per cent in Nicaragua in 2010 and 2 per cent in Philippines in 2012 to 100 per cent in China, Hong Kong in 2012; Malaysia and Singapore in 2011;

Cuba and Montserrat in 2010; and the United Kingdom in 2008. The high levels in these countries reflect active policies to fully integrate ICT into curricula and training programmes (see Box 7.6).

In contrast, Uruguay had a relatively high proportion of teachers trained to teach subjects using ICT (63 per cent) as against a smaller proportion of teachers actually teaching using ICTs (37 per cent) in 2009. This high level of trained teachers can likely be attributed to the El Ceibal project that is implementing one-to-one computing for all children (particularly in primary schools) and which was responsible for the training of 17 000 teachers. More recently, data show that by 2012, 100 per cent of primary teachers were trained to teach using ICT. Palestine, on the other hand, displayed a different type of gap between teacher resources and current practice, where as many as 73 per cent of teachers were teaching subjects using ICTs in 2012 compared to just 50 per cent who were trained.

Chart 7.2: Teachers trained to teach using ICT versus those teaching using ICT, 2012 or LYA[9]



Source: UIS database, Partnership on Measuring ICT for Development WSIS Targets Questionnaire, 2013.

Notes:

1. Reference years range from2008 to 2013 (2008 to 2010 for Africa; 2008 to 2013 for the Americas; 2008 to 2013 for Asia; and 2008 to 2013 for Europe). Full details can be found on the UIS website, http://www.uis.unesco.org/Communication/Documents/wsis-tables-2014.pdf.
2. Data for Montserrat and Saint Lucia refer to secondary. Data for Philippines refer to primary and lower secondary only. Data for Nicaragua and Venezuela refer to primary. Data for Philippines, Sri Lanka, Palestine, Barbados, Uruguay, Anguilla, Singapore and the United Kingdom refer to public schools. Data for Palestine refer to West Bank schools only.

Box 7.6: Training teachers to be effective change agents – the VLE in Malaysian schools

Experienced in the implementation of computer- and Internet-assisted instruction educational solutions, Malaysia is currently implementing the *Frog Virtual Learning Environment* (VLE) as a platform for teaching and learning in all primary and secondary schools. Part of the broader 1BestariNet initiative under the Malaysia Education Blueprint, 2013 –2025, VLE is geared towards ensuring that students learn how to use ICT as well as how to leverage it to enhance other areas of knowledge. To achieve this, all 10 013 schools in Malaysia will be provided with broadband access through either a 4–10 Mbit/s bandwidth using wireless 4G technology, or 2–4 Mbit/s bandwidth in rural and remote schools, requiring the use of Very Small Aperture Terminals (VSAT).

Nevertheless, several challenges confront the nationwide implementation of VLE including: adequate supporting infrastructure, universal access among stakeholders, availability of quality VLE resources, and continuous monitoring and evaluation. However, the most significant challenge has been undertaking the training of principals, Malaysia's 450 000 teachers and pupils. To ensure that all teachers are trained, a cascading model, whereby at least one teacher per school receives formal training, which they in turn disseminate to other teachers in their respective schools, has been employed. Since its implementation in 2012, approximately 17 000 school principals and teachers have been trained on the use of VLE in teaching and learning, while a substantial number of students have also been trained.

To facilitate implementation, the Ministry of Education (MOE) also created 451 *Champion Schools* throughout Malaysia to serve as test schools; these schools offer three levels of teacher training to progressively develop basic to advanced skills in the use of VLE. Training is geared towards the development of *Communities of Practice*, whereby school teachers are encouraged to develop instructional materials in the form of learning sites for their own use and to be shared with other teachers and students. Currently, a total of 4 000 learning sites have been developed by teachers. To ensure consistency in the quality of these learning sites, a special committee comprising inter-divisional members was created.

To further support teacher training, 367 district level *Teacher Activity Centres* (TACs) across Malaysia are actively involved in providing training and support services to schools. These TACs are in turn monitored by the 15 State Education Technology Centres and the Educational Technology Division of the Ministry of Education. A recent evaluation of teachers' skills based on a sample revealed that about 70 per cent have moderate to high levels of skills in using the VLE, while 55 per cent were of the opinion that the VLE motivated teachers in teaching and learning. Similarly, about 77 per cent of the students were of the opinion that the VLE increased students' interest in learning.

Source: Ministry of Education, Educational Technology Division, 2014.

Adapting curricula to computer and Internet-assisted instructional environments

Developing an informed assessment of primary and secondary curricula to meet the changing needs of the information society entails multiple dimensions. While policies for the recommended use of ICT in curricula and for human capital formation (that is, of teachers) are vital to this assessment, other dimensions are required in order to monitor progress towards achieving WSIS Target 7. In tandem with teacher training, indicators that measure the actual proportion of primary and secondary schools that offer computer-assisted instruction (CAI) and/or Internet-assisted instruction (IAI) provide policy-makers with a sense of the magnitude of advanced forms of ICT use across schools. Indicators 7.3 and 7.4 are 'Proportion of schools with computer-assisted instruction' and 'Proportion of schools with Internet-assisted instruction' respectively. It should be noted that these indicators do not provide insight on quantitative or qualitative aspects of usage – that is, frequency and types of activities that pupils are engaged in.

The history of computer-assisted instruction (CAI) and Internet-assisted instruction (IAI) is much more recent than the use of radio and television for pedagogical purposes. However, their evolution and diversification have been exponential and they are increasingly merging with older ICTs to create

new platforms for teaching and learning. In the 1970s, the approach of CAI was based on programmed learning or 'drill and practice' software, whereas both the software and hardware have since evolved. Various devices are well suited to this form of instruction (for example, desktops, laptops and tablets) or even specifically designed for learning and teaching (for example, interactive whiteboards). IAI, in comparison, can be defined as an interactive learning method using content from the World Wide Web (WWW) for pedagogical purposes. While IAI may often be thought of as CAI with the addition of Internet access, new models of instruction using tablets and mobile phones, especially smart phones, have introduced new and diverging forms of IAI.

One of the hallmarks of both CAI and IAI is the increased opportunity for interactivity with teachers and other learners, compared with older forms of one-way broadcasts delivered by radio or television. On the other hand, because of the increased level of technical sophistication of CAI and IAI, their start-up and maintenance costs are substantially higher than for older technologies. More recently low cost laptops and tablets are helping to reduce these costs; moreover some countries have been successful in negotiating preferential Internet rates for schools to ensure that IAI is sustainable.

Proportion of schools with computer-assisted instruction

Computer-assisted instruction (CAI) is defined as an interactive learning model in which a computer is used by teachers or pupils to present instructional material, perform learning-oriented tasks and help in selecting and accessing pedagogical content (UNESCO-UIS, 2009b). However, for CAI to be delivered effectively in schools, a critical mass of computers is needed to provide sufficient access. The learner-to-computer ratio (LCR) is one indicator that can play an important role in assessing this critical mass (see Target 2). In a number of countries, one-to-one computing models, where students are given their own laptop or tablet computer, represent an ideal for educational planners. One-to-one computing has become policy in Uruguay (see Box 7.8) (Martínez, Díaz and Alonso, 2009), Thailand (Ministry of Education, 2013) and Turkey (World Bank, 2013). In contrast, the current inadequacy of school budgets in most developing countries hinders CAI provision beyond a limited number of devices.

To be delivered effectively, CAI requires more than a simple haphazard system for distributing computers across schools. CAI policies focus on a variety of options as the most effective way to deliver CAI, including the establishment and maintenance of computer laboratories, as well as promoting ICT in classrooms, libraries and other designated locations. While the installation of computer laboratories is considered an important upgrade compared to one desktop computer placed at the back of the classroom, labs have been the subject of increasing criticism. Educational technologists argue that computer laboratories are becoming obsolete for delivering CAI and may in fact provide a disservice. Given the multitude of both school- and personally-owned devices (including laptops, tablets and mobile devices), detractors argue that labs imply a separation between computing as a subject and the general curriculum. Instead, they argue that computers and other devices should be primarily located in classrooms, to help build stronger links between ICT and curriculum, thus facilitating the development of ‘higher order’ skills (Pedro, 2012; Trucano, 2005; UNESCO, 2011a).

Chart 7.3 shows the proportion of schools that offer computer-assisted instruction (CAI). While the available data demonstrate the availability of CAI, they do not shed light on the intensity or type of

usage by students or teachers. Given the increasing attention on where computers are located in schools in the support of curriculum, Chart 7.3 also shows data on the proportion of schools with computer laboratories. For countries where the proportion of schools offering CAI is greater than those with computer laboratories, CAI is thus also delivered in alternative locations including classrooms, libraries and other locations.

In several countries in Asia, CAI and computer labs were offered in 100 per cent of schools in Oman in 2013, China, Hong Kong and Georgia in 2012, and Singapore in 2011. In contrast, the provision of CAI was uncommon in some developing countries in Asia, including Nepal, Cambodia and Myanmar, representing 5 per cent or fewer of all primary and secondary institutions in 2012. The proportion of schools in Bangladesh with CAI is not known; however, due in part to newly emerging programmes such as multi-media classrooms, 14 per cent of schools had a computer lab in 2013 (see Box 7.7). Bangladesh struggles with basic infrastructure including electrification; therefore to further support the introduction of CAI, 17 mobile ICT labs containing laptop computers, wireless Internet modems, digital cameras, multimedia projectors, webcams and other e-learning facilities were introduced. Mobile labs move around and cover more than 1 000 schools in remote areas, with support from the non-governmental development organisation BRAC (World Bank, 2010). While data for CAI are unavailable for Bangladesh, computer labs are now present in 14 per cent of primary and secondary schools, where newly emerging programmes are under development (see Box 7.7).

In many developing countries, CAI frequently tends to be concentrated through the establishment of computer laboratories, due to limited computer resources (World Bank, 2010; ADB, 2012). In Armenia and Mongolia, where CAI is universally available, 91 and 92 per cent of schools respectively centralised CAI through computer laboratories in 2012. Similarly, CAI tended to be delivered through laboratories in Kyrgyzstan (86 per cent), Azerbaijan (84 per cent) and Maldives (40 per cent).

Countries where the proportion of schools with CAI is much greater than those with computer labs demonstrate greater capacity to provide a mixed model for delivering CAI in multiple locations. In Asia, a mixed model was present in Iran (Islamic Republic of) in 2012, where 74 per cent of schools offered CAI, compared to 38 per cent of schools with computer laboratories. Similarly, CAI was present in 100 per cent and 60 per cent of schools in Malaysia and Sri Lanka, respectively, in 2011, and computer laboratories were present in 72 per cent and 34 per cent of schools In Latin America and the Caribbean, considerable disparity in the availability of CAI is also present between countries. CAI was integrated in all primary and secondary education institutions in many Caribbean countries by 2010, as well as in Uruguay (see Box 7.8) by 2009 where national policies, with strong Presidential support, played a significant role in ensuring widespread availability of computers through the One Laptop per Child (OLPC) initiative under the aegis of *El Ceibal* (Martínez, Díaz and Alonso, 2009). Similarly, Chile under its *Enlaces* initiative, has increased the availability of CAI amongst schools during a relatively short time period, being available in approximately 58 per cent of schools in 2010 to 82 per cent by 2013. In contrast, CAI was present in less than one-quarter of schools in countries with relatively weaker electrical infrastructure including Guyana (15 per cent), Nicaragua (10 per cent) and Paraguay (16 per cent) in 2010, and Dominican Republic (18 per cent) in 2013.

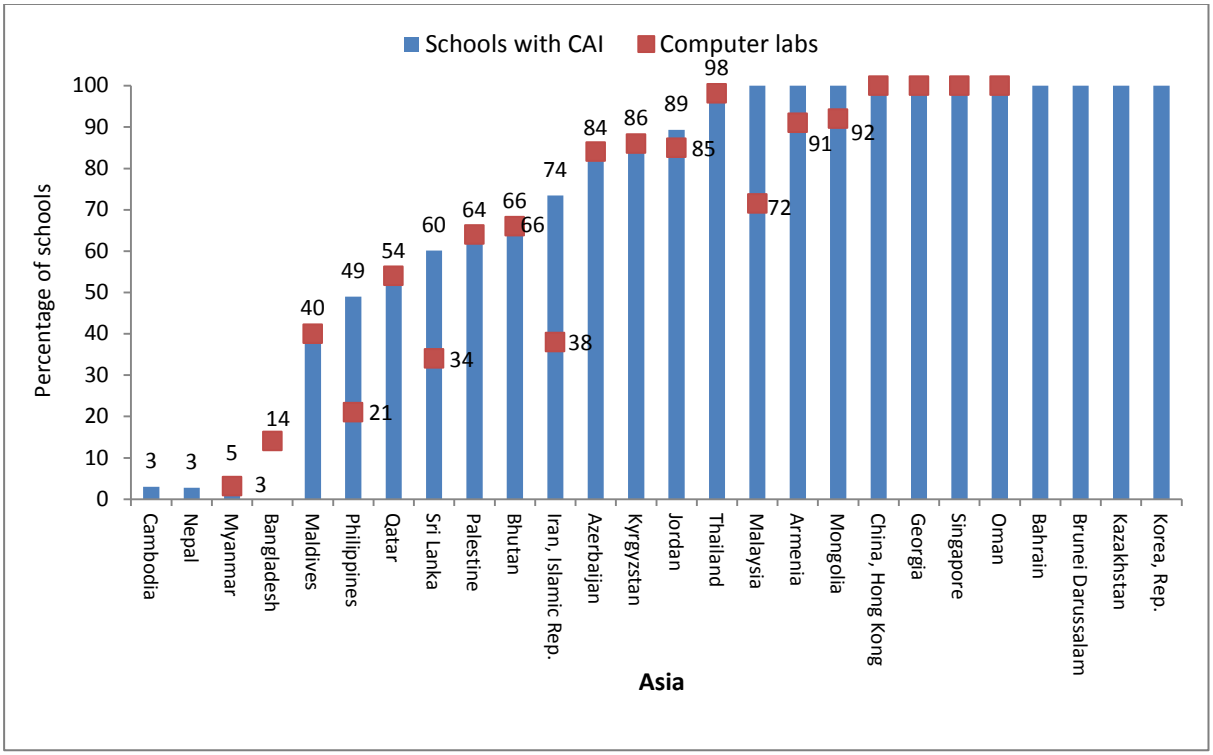
The proportion of schools offering CAI in Colombia increased substantially to 88 per cent by 2011, partly due to the consolidation of existing schools and the closure of schools where ICT infrastructure was scarce. Beginning in 2003, Colombia had decreased the total number of schools from over 56 000 to less than 23 000 by 2013 – a decrease of approximately 60 per cent of all schools over the

decade (Ministerio de Educación Nacional, 2014). In Colombia, computer labs are present in the vast majority of schools offering CAI (that is 85 per cent), suggesting they play an important role in the delivery of CAI. Labs are very common in the majority of countries in the region for which data are available. Irrespective of the proportion of schools offering CAI in countries in Latin America and the Caribbean, those demonstrating a mixed delivery model of CAI include El Salvador, Grenada, Turks and Caicos Islands, and Saint Vincent and the Grenadines.

Data on the proportion of schools with CAI are currently unavailable for most African countries.[10] Amongst those countries with data, CAI was offered in 98 per cent of schools in Egypt in 2010 and in 99 per cent of schools in Mauritius in 2008. It is noteworthy that this indicator sheds little light neither on the quality of CAI, nor on the intensity of its use. For example, the number of computers available in Egyptian schools was not keeping pace with enrolment since 48 pupils on average shared a single computer. In contrast, time using CAI in Mauritius is likely greater because there were approximately 20 students on average sharing a single computer.[11] CAI was available in less than a third of schools in South Africa (30 per cent) in 2012 and in just 11 per cent of schools in both Zambia in 2012 and Sao Tome and Principe in 2013.

CAI is relatively common in Europe and has been universally available in Andorra and Croatia since 2009, and Finland, Sweden, and the United Kingdom since 2008. However, the availability of CAI in schools has lagged in some Eastern Europe countries. For instance, while almost all schools in Lithuania (97 per cent) have had CAI from 2009, CAI was available in only 69 per cent of schools in Poland in 2008 and 86 per cent in Albania in 2009.

Chart 7.3: Schools with computer-assisted instruction (CAI) and computer labs, 2012 or LYA[9]



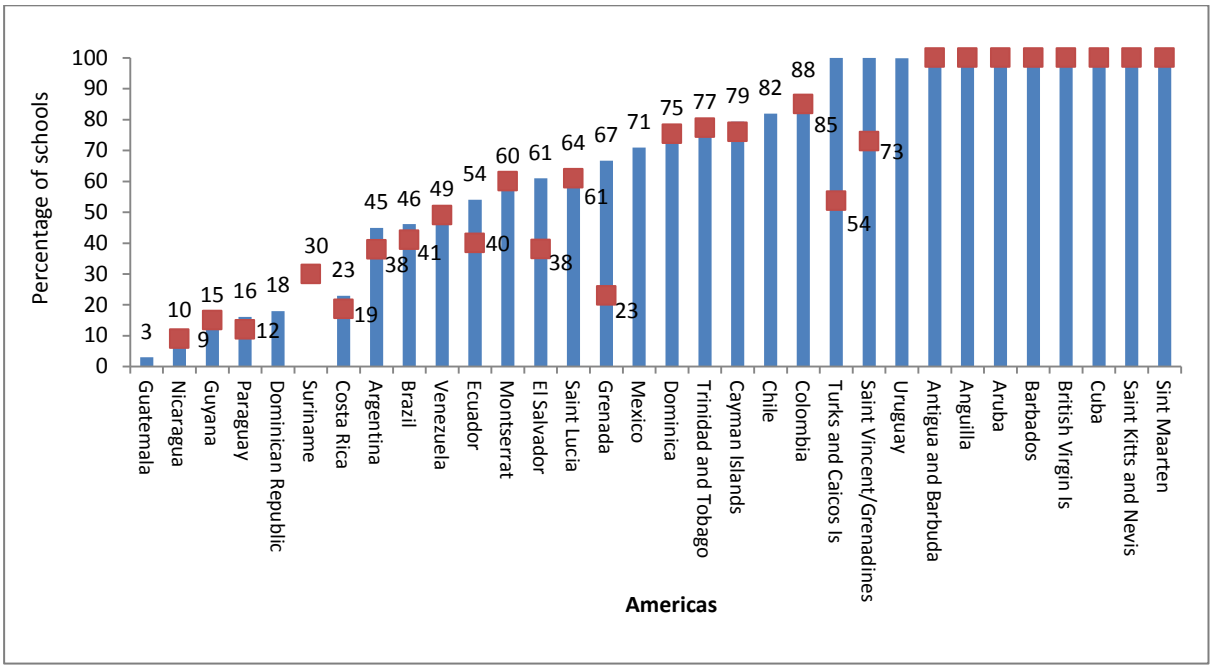
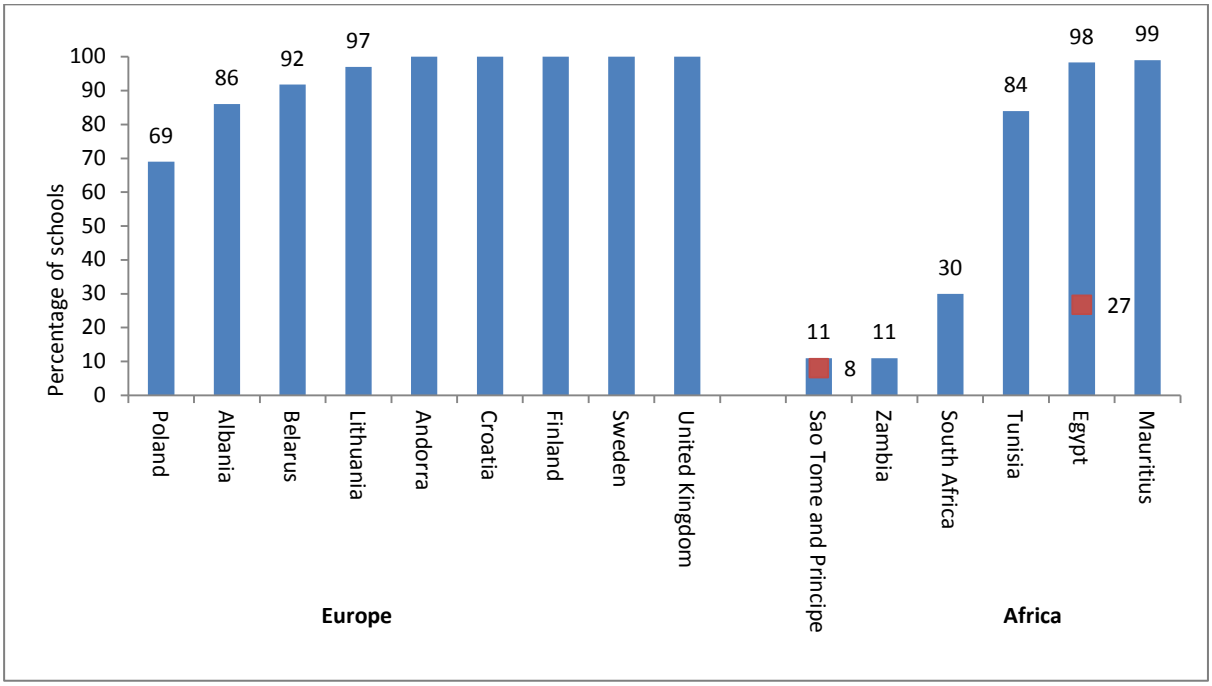


Chart 7.3: Schools with computer-assisted instruction (CAI) and computer labs, 2012 or LYA (cont.)



Source: UIS database, Partnership on Measuring ICT for Development WSIS Targets Questionnaire, 2013.

Notes:

1. The first chart shows countries in Asia, the second in the Americas and the third in Europe and Africa.
2. Reference years range from2008 to 2013 (2008 to 2013 for Africa; 2008 to 2013 for the Americas; 2008 to 2013 for Asia; and 2008 to 2012 for Europe). Full details can be found on the UIS website, http://www.uis.unesco.org/Communication/Documents/wsis-tables-2014.pdf.
3. CAI data for Colombia refer to 2011 and for Chile to 2013, while computer lab data refer to 2010 and 2009 respectively. Data for Bhutan and Saint Vincent and the Grenadines refer to secondary schools. Data for Philippines and Nicaragua do not include upper secondary. Data for Costa Rica refer to primary school. Data for Cambodia, Maldives, Philippines, Sri Lanka, Bhutan, Azerbaijan, Iran (Islamic Republic of), Kyrgyzstan, Malaysia, Singapore, Guyana, Dominican Republic, Costa Rica, Saint Lucia, Trinidad and Tobago, Chile, Colombia, Antigua and Barbuda, Anguilla, Barbados, Sint Maarten and Belarus refer to public schools. In Suriname, there are no private schools in upper secondary. Data for Palestine refer to West Bank schools only.

Box 7.7: Enhancing teaching and learning using computer-assisted instruction in Bangladesh

Considering ICT as a driving tool for socio-economic development, Bangladesh is undertaking a series of measures to promote expansion of ICT across society. BRAC, formerly known as the Bangladesh Rural Advancement Committee, is one of the largest non-governmental development organisations in the world and works in collaboration with the Directorate of Secondary and Higher Education of the Bangladesh Ministry of Education to improve quality in education and attain *Education for All*. Supporting 3 989 secondary schools in rural areas, BRAC is increasingly playing a significant role in broadening the reach of ICT in education including support to the 20 500 and 1 503 multimedia classrooms established in secondary schools and primary schools, respectively (Ministry of Education, 2014). For girls and children from lower socio-economic levels who are generally deprived of access to ICT due to social barriers, the provision of CAI in the school environment plays a significant role in reducing the digital divide.

While teaching and learning in rural schools in Bangladesh has been based on a traditional didactic paradigm where teachers are active and students are passive, BRAC advocates for the augmentation of ICT in the classroom to make teaching and learning more effective. As part of its efforts, BRAC introduced a CAI programme in 2005 with the objective to make classes more enjoyable for the students, as well as rewarding and motivating for teachers. The programme concentrated on the development of interactive educational software, based on national curriculum, using animated content and games for English, mathematics, and science that require practice, in pairs, groups and individually. The CAI contents are disseminated in the form of CDs and through a website[12] at no cost to users.

Anecdotal experience suggests that CAI has brought far-reaching changes to pilot schools. Teachers remark that students' attendance has increased and that they seem more motivated and engaged. Moreover, internal monitoring shows that not only have drop-out rates declined in pilot schools, but the *Secondary School Certificate* (SSC) examination results have also improved since the programme began. Some also suggest that CAI has been particularly useful as the content helps compensate for the shortage of expert teachers, while others note that CAI allows teachers to use their time more efficiently, particularly in the management of large class sizes.

While some challenges regarding teacher training and professional development in the use of unfamiliar technology were encountered, teachers increasingly accept the use of computers in classrooms. Moreover, the success of this CAI programme inspired BRAC to expand ICT to other components of its secondary intervention. BRAC has extended the reach of ICT services not only at school level but also at the community level through multipurpose community learning centres, which offer low cost computer training to people of different age groups. Students can also access the Internet in *Gonokendros*, of which 250 were newly established in 2014.

Source: BRAC, 2014.

Proportion of schools with Internet-assisted instruction (IAI)

Internet-assisted instruction (IAI) refers to an interactive learning method using content from the Internet and the WWW for pedagogical purposes. It can be argued that instruction employing the seemingly infinite resources of the Internet should have a profound impact on the nature of education by facilitating its transformation from a teacher-centred to student-centred process. Programmes that employ mobile forms of IAI (for example, assisted by laptops, tablets and mobile phones) increasingly facilitate student access to various learning platforms throughout, as well as outside, the physical school environment. In countries where Internet access has traditionally been limited, mobile learning forms of IAI may ultimately have a multiplier effect throughout the family and community (see Box 7.8).

In most countries, the pace of integration of IAI typically lags behind CAI, as some schools have computers, which are not connected to the Internet. While Internet connectivity is essential to provide IAI, its mere existence is insufficient. In order for IAI to be viable, the following are required:

- formal commitments for integrating ICT in education (for example, policy)

- curricula adapted to using the Internet
- supporting infrastructure (for example, an adequate number of devices, adequate connectivity)
- effective teacher training.

Chart 7.4 shows the proportion of primary and secondary schools that have IAI in 49 countries across Asia, Europe, Latin America and the Caribbean, and Africa. While the data provide insight on the availability of IAI amongst schools, they do not shed light on intensity of use or the ways that students engage with IAI. Chart 7.4 also provides data on proportions of schools with an Internet connection, to show the differences between the availability of Internet connectivity and the provision of IAI.

IAI was universally available in a number of Eastern Asian and South-Eastern Asian countries including China, Hong Kong and Republic of Korea in 2012, Singapore in 2011, Brunei Darussalam in 2009, and the majority of schools in Thailand (98 per cent) in 2012, and Malaysia (91 per cent) in 2011. In Western Asia, Georgia, Jordan (see Box 7.9) and Oman have made significant strides increasing the availability of IAI in schools. IAI was universal amongst schools in Georgia, whereas 73 per cent of primary and secondary schools combined offered IAI by 2011 in Jordan. Similarly, Oman has increased the proportion of schools with IAI from 62 per cent in 2008 to 77 per cent by 2011. Despite universal electrification of schools in Kyrgyzstan and Azerbaijan, in 2012, IAI was available in just 6 per cent and 27 per cent of schools, respectively, due to the lack of Internet service providers (ISPs), high connectivity costs and/or the under resourcing of school budgets (ADB, 2012). Lastly, IAI was also uncommon in the Philippines (8 per cent in 2012) and Sri Lanka (18 per cent in 2011).

In Latin America and the Caribbean, IAI was universally available in a number of Caribbean countries including Anguilla, British Virgin Islands and Saint Kitts and Nevis in 2010, and Barbados and Trinidad and Tobago in 2009. In Uruguay, under the El Ceibal/OLPC project, it was available in 96 per cent of schools by 2009. In contrast, IAI was uncommon in Dominican Republic (12 per cent) in 2013, Ecuador (18 per cent), Guyana (13 per cent) and Turks and Caicos Islands (7 per cent) in 2010, as well as Mexico (12 per cent) in 2009. Chile, under its *Enlaces* project, has made significant progress in terms of offering IAI in its schools. While 45 per cent of public schools offered some kind of IAI in 2009, the proportion of schools using the Internet for pedagogical purposes increased to 70 per cent by 2013.

In countries where IAI is frequently unavailable, other forms of ICT-assisted instruction may be alternatively used to fill in gaps. For example, due to a lack of budgetary funds and a reliance on community donations in Palestine (West Bank) (Pacetti, 2008), Internet and IAI, which was in 30 per cent and 21 per cent of schools, respectively (in 2012) was bolstered by the use of radio and television, which were present in 100 per cent and 77 per cent of schools respectively (see Chapter 2).

In a number of countries, Internet connections in schools are not exploited for the provision of IAI, and instead are used for administrative purposes. For example, in Iran (Islamic Republic of), just 32 per cent of educational institutions offered IAI out of 87 per cent that are connected to the Internet in 2012; the other schools use the Internet principally for administrative purposes (UIS, 2014). Also in Asia, just 40 per cent of schools in Maldives offered IAI in 2012 despite universal Internet connectivity. The Internet is also less than fully exploited for teaching and learning in some other Latin American and Caribbean countries. For example, while IAI was offered in just 7 per cent of

schools in Turks and Caicos Islands in 2010, Internet connectivity was available in 54 per cent of schools. While not as substantial, Internet was also less than fully used in Argentina and Brazil, where 23 per cent and 38 per cent of schools, respectively, offered IAI in 2009 and 2010, compared to 36 per cent and 46 per cent that had an Internet connection.

Few data are currently available for Africa; however, according to Chart 7.4, IAI was rare in Ethiopia in 2008, occurring in just 2 per cent of schools, while it was relatively common in Tunisia and in Mauritius, being offered by 81 per cent and 85 per cent of schools, respectively.

IAI has been universal in a number of European countries, including Andorra and Croatia, since 2009, and Finland, Sweden, and the United Kingdom since 2008. In contrast, just 45 per cent and 65 per cent of schools offered some form of IAI in Belarus and Poland in 2008, respectively, out of 61 per cent and 93 per cent of schools with Internet connections.

Chart 7.4: Schools with Internet-assisted instruction (IAI) versus Internet access, 2012 or LYA[9]

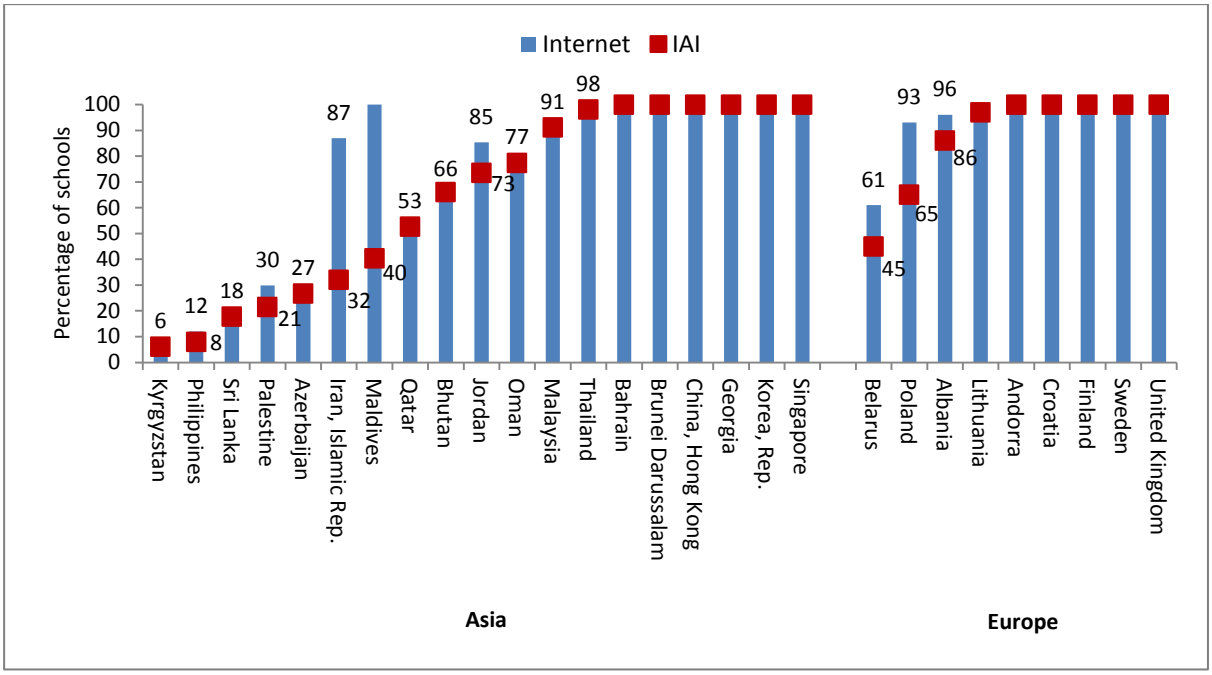
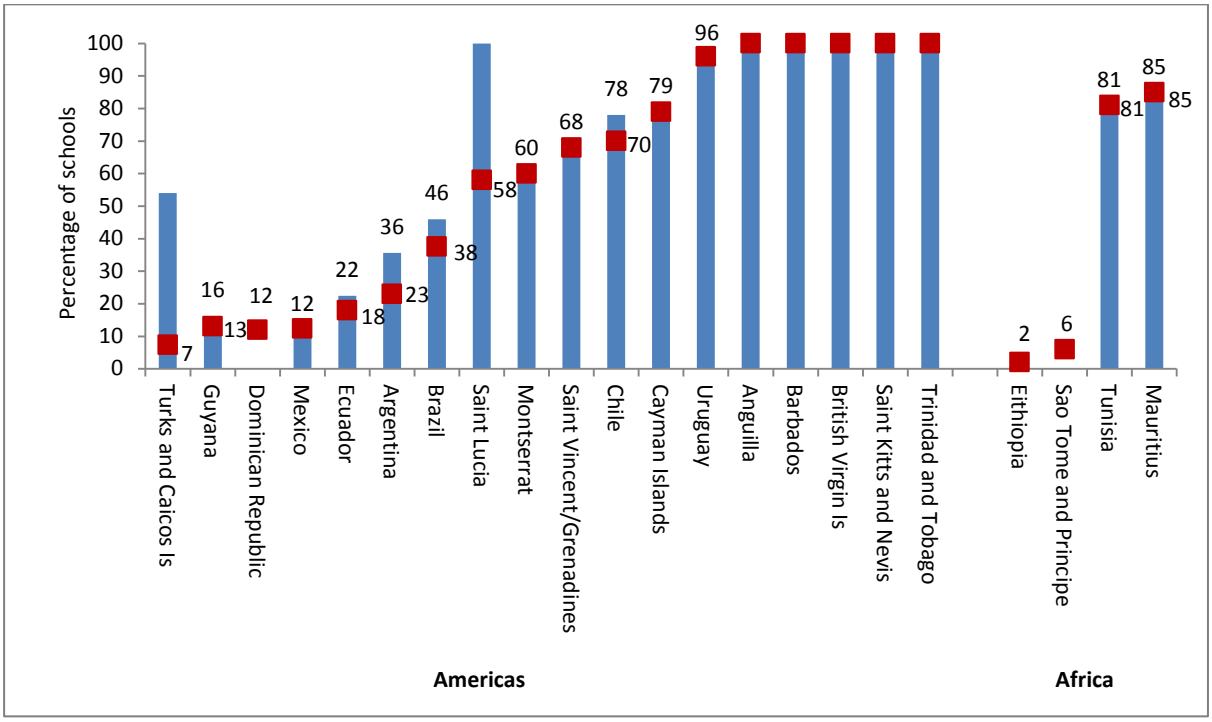


Chart 7.4: Schools with IAI versus Internet access, 2012 or LYA (cont.)



Source: UIS database, Partnership on Measuring ICT for Development WSIS Targets Questionnaire, 2013.

Notes:

1. The first chart shows countries in Asia and Europe, and the second in the Americas and Africa
2. Reference years range from2008 to 2013 (2008 to 2013 for Africa; 2009 to 2013 for the Americas; 2008 to 2012 for Asia; and 2008 to 2012 for Europe). Full details can be found on the UIS website, http://www.uis.unesco.org/Communication/Documents/wsis-tables-2014.pdf.
3. Data for Bhutan, and Trinidad and Tobago, refer to secondary schools. Data for Guyana and Mexico refer to lower secondary schools. Data for the Philippines refer to primary and lower secondary. Data for Philippines; Azerbaijan; Maldives; Bhutan; China, Hong Kong; Singapore; Belarus; Guyana; Mexico; Trinidad and Tobago; Chile; Barbados and Cayman Islands refer to public schools. Data for Palestine refer to West Bank schools only.

Box 7.8: Uruguay's El Ceibal Project – Internet-assisted instruction using mobile XO laptop computers

Education in Uruguay has long been regarded as the cornerstone to foster social integration and mobilization. *El Ceibal* is a socio-educational project focusing on social and technological inclusion established in 2007 by presidential decree. Its main pillars are: equipment distribution (laptops and tablets); connectivity in schools and public spaces; teacher training and support; user services; and training and support to families. El Ceibal positioned Uruguay as the first country in the world to implement the One Laptop Per Child (OLPC) model in public primary and lower secondary education (general and technical and vocational programmes), providing free Internet connections to educational institutions, as well as to a great diversity of public spaces. Laptops were also given universally to teachers.

Since 2007, El Ceibal has expanded sustainably, resulting in universal availability of Internet-assisted instruction in schools benefitting more than 630 000 users by the end of 2013. Moreover, a learner-to-computer ratio of 1:1 has been achieved in public primary and lower secondary education, in upper secondary technical and vocational (TVET) and professional programmes, as well as in semi-professional programmes taught at the Universidad del Trabajo. In terms of Internet connectivity, 96 per cent of schools have been connected. Concurrently, a total of 911 schools have been migrated to fibre optics and 312 rural schools are connected via 3G. In addition, the El Ceibal network is offered in more than 200 public spaces in prioritized neighbourhoods to ensure additional access.

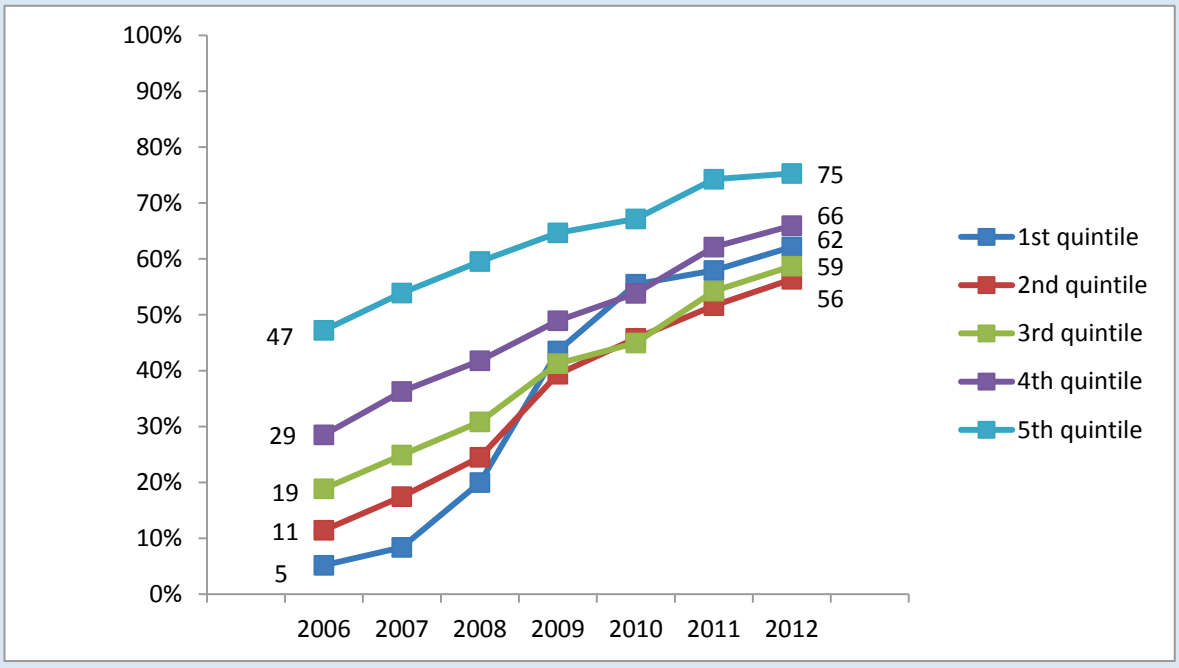
Box 7.8: Uruguay's El Ceibal Project (cont.)

El Ceibal has resulted in a number of additional measures including the development of:

- content management systems to facilitate and promote the use of digital resources in the classroom
- videoconferencing solutions in 61 per cent of urban schools
- expansion of the educational robotics programme to rural schools
- online courses
- the training of 17 000 teachers
- an online evaluation covering all students from grade 3 to 6
- advising and collaborating with various countries inside and outside the region to replicate the Uruguayan experience.

The ceibailitas (that is, XO laptop computers) have changed both the urban and rural landscape in Uruguay by providing its target population more possibilities for new practices and forms of social interaction. As a consequence, it is commonplace to see children in parks and malls with their computer equipment taking pictures, recording videos, searching information on the Internet and sharing their knowledge with the elderly. In terms of access to technologies, El Ceibal has significantly contributed to decreasing the digital divide across Uruguay. For example, in 2006, only 5 per cent of the poorest households had a computer compared to 47 per cent of the richest households; however, by 2012, the proportion of poorest and richest households with a computer had increased to 62 and 75 per cent, respectively, thus, decreasing the gap to 13 percentage points between poorest and richest quintiles (see Box Chart 7.8).

Box Chart 7.8: Households with computers, by income quintiles, 2006–2012



Source: Departamento de Monitoreo y Evaluacion Plan Ceibal, 2014.

Box 7.9: The Jordan Education Initiative (JEI) – Preparing learners for the information society

In response to Jordan's slow GDP growth, young population and concerns over rising rates of unemployment, Jordan, implemented the *Educational Reform for a Knowledge Economy* (ERfKE) in 2003 to create the knowledge, skills and attitudes needed for the global market and the information society. The programme's objectives included curriculum reform, teacher training, adoption of ICT as an enabler of learning, and upgrading existing school infrastructure.

Driven by the private sector's goal to create a high-quality education programme that would harness ICT to reduce the gap between developed and developing countries, Jordan was identified as an appropriate candidate at the World Economic Forum in 2003 due to its committed, clear and aggressive strategy for reform. The Jordan Education Initiative (JEI) thus was born as a public-private partnership involving the Government of Jordan, the international private sector (for example, Cisco, Microsoft, Intel, SMART Technologies, Hitachi and IBM), the local private sector, NGOs and donors, under the auspices of the World Economic Forum's Global Education Initiative.

Designed as a pilot project to leapfrog education reform, the JEI aims to:

- Improve the delivery of education through public-private partnerships.
- Unleash the innovation of teachers and students through the effective use of ICT.
- Build the capacity of the local information technology industry.
- Create a model of reform that can be used by other countries.

In order to review and evaluate Jordan's policy for educational change, JEI selected 100 *Discovery schools*, covering grades 1–12 amongst existing boys and girls schools from different socio-economic classes to inform future nationwide programmes. Discovery schools are equipped with computer labs, networks including LAN, WAN, 3G connectivity and cloud computing, to allow teachers and students alike to more freely access the educational platform in the school environment. Teachers were given laptops and projectors to practise new learning strategies that rely on a blended learning approach, where ICT tools may play a significant role in facilitating interaction between teachers. To facilitate the aims of the ERfKE and JEI, the government also installed the National Broadband Learning and Research Network to connect schools, colleges and universities, and community centres via fibre optics.

E-curricular development strategy is a main focus for JEI and is centred on improving the quality of education through interactive, media-rich content in several subjects including English, mathematics, ICT, Arabic, science and civics. The JEI pedagogical approach is based on collaborative learning models, while ICT is to be integrated throughout the teaching and learning process. Teacher-led learning in the classroom, supported by teacher laptops and data projectors, enable technology to support 80 per cent of student learning time.

Under the scope of *Discovery schools*, by 2013, the JEI had had an impact on more than 80 000 students and 3 000 teachers. In addition, the JEI has been successful in accelerating the deployment of computers and Internet connectivity in schools: the proportions of schools offering some type of computer-assisted instruction (CAI) and Internet-assisted instruction (IAI) by 2011 were 88 and 73 per cent, respectively. However, others note that the teaching model employed by the majority continues to be teacher-centred, which is considered to be inconsistent with the proposed model for ICT-assisted instruction being developed in discovery schools. Therefore, despite the fact that 88 per cent of teachers were considered trained to teach using ICT in 2011, according to some, the need to reinforce teaching capacity remains, in order to facilitate the evolution of more student-centred teaching and collaborative learning approaches.

Source: UIS research from Ministry of Information and Communication Technology, 2012; Light *et al*., 2008; McKinsey and Company, 2005.

Conclusions and recommendations

Under the right conditions, it is believed that ICTs can have a significant impact on the expansion of learning opportunities to greater and more diverse populations, beyond cultural barriers, and outside the confines of traditional educational institutions or geographical boundaries (Haddad and Draxler, 2002). Indeed, ICT can also play a role in improving the teaching and learning process by reforming

conventional delivery systems to meet the educational needs of primary and secondary pupils. However, ICTs by themselves cannot provide the education that learners need to become productive citizens in society and to contribute to the economic, social and political life of their countries. Rather, ICT enhances the quality of learning and facilitates state-of-the-art skills formation best when pedagogical principles are adequately adhered to and implemented in the reformulation of education delivery. Moreover, to ensure sustainability of education provision, national circumstances including current policy environment, infrastructure and economic factors need to be considered and taken into account.

For Target 7, indicators to measure the adaptation of curricula such as 'proportion of schools with CAI' and 'proportion of schools with IAI' are relatively difficult to collect (compared with those for Target 2). For the limited sample of countries for which data are available, the variation across countries is striking. While a number of developed and high income countries show evidence of an ICT-adapted curriculum in all or a majority of their primary and secondary schools, only a small proportion of schools in many developing countries have the requisite inputs to effectively adapt curriculum using ICT to meet the challenges of the information society. Typically, countries that have strong policies and plans that set targets for ICT in education with high-level government and sector-wide support have also shown the most rapid change amongst developing countries. This is true for a number of countries including Chile, Colombia and Uruguay in Latin America, as well as for Oman, Jordan, Thailand and Georgia in Asia.

Countries that have adopted full scale implementation of CAI and IAI in their schools also typically have a relatively high proportion of trained teachers, compared to those that are still in the early stages of implementation. Looking at the gap observed, albeit across the limited number of countries with available data, countries in the earlier stages of e-readiness can propel their progress by seizing opportunities to determine what activities or conditions are necessary, learning from more advanced countries that have employed effective models and policies for integrating ICTs in their curricula.

While evidence suggests that in a number of countries progress is being made towards the achievement of Target 7, it is still not possible to give a comprehensive review of achievements against Target 7. For example, while data have been collected for an increasing number of countries since the launch of the UIS international data collection on ICT in education (80 by the year 2013), data are still missing for many developing countries, particularly in Africa, Asia and Oceania. Moreover, demonstrating progress is further complicated by a lack of time series data for the majority of countries to permit reliable measurement. However, the situation should improve since UIS is currently conducting statistical capacity-building activities in Africa to be followed by data collections, and is moving towards conducting a biennial global data collection on ICT for education beginning in 2015.

Nevertheless, it is possible to draw some conclusions related to the training of teachers and the provision of advanced forms of ICT-assisted instruction for both developed and developing countries. While an adequate pool of trained teachers is arguably required to effectively adapt curricula to meet the needs of the information society, guaranteeing an adequate supply remains a challenge confronting many developed and developing countries. Although developed countries typically have greater proportions of trained teachers than developing countries, most countries, regardless of economic position, have trained 10 per cent or fewer teachers to be ICT-qualified for delivering basic computer skills or computing courses. In contrast, the proportions of teachers trained to teach other

subjects using ICT in the classroom varies widely. For instance, developed countries, which have a relatively strong policy environment regarding the integration of ICT in education as well as the essential school infrastructure, have relatively high proportions of trained teachers compared to many low income countries, particularly least developed countries (LDCs) where very few teachers are trained. Data for many countries in Asia, Africa and Oceania remain unavailable. In Europe where most teachers are trained at the tertiary level, data are also unavailable due to a lack of monitoring.

In a general sense, adapting curricula means modifying the ways that content is presented and delivered. It means adjusting curricula to ensure that all ICT-mediated content is accessible to all students. Adapting curricula to integrate ICTs requires emphasis on design, development and implementation of instructional approaches that provide multiple means of representation and multiple means of student engagement. The inclusion of computer-assisted instruction (CAI) and Internet-assisted instruction (IAI) in curriculum design means that more flexibility is required in order to be able to adjust to learners.

Building upon Target 2, which addresses school connectivity, the current target 7 reflects the importance of enabling schools to benefit from ICT. It focuses on teacher training as well as the use of advanced forms of ICT-assisted instruction. Increasingly reliant on ICT, schools are important for providing students with the essential skills needed to effectively succeed in the information society. Given the continued relevance of Target 7, it is recommended that it remain consistent during the post-2015 monitoring period. Nevertheless, some consideration to the indicators may be required.

The key limitation of the teacher training on ICT indicators is the variability existing in terms of how teachers are trained from country to country. Since each of these concepts will vary widely from a few days of in-service training to formal qualifications acquired in tertiary level preservice training programmes, these indicators may ultimately be more useful in terms of demonstrating a country's own progress to meet their own objectives to train teachers, than providing information on the relative capacity of teachers to instruct on the use of ICTs or to be able to use them in their general teaching of curricula. Despite this shortcoming, indicators 7.1, 'proportion of ICT-qualified teachers' and 7.2, 'proportion of teachers trained to teach subjects using ICT', should be retained in the post-2015 environment as they provide valuable information on the readiness of the teaching workforce to use ICT in the adaptation of curricula to meet the needs of the emerging information society. However, UIS should consider collecting additional metadata on teacher training, and/or using other available data to further contextualize the training of teachers relative to ICT in education.

Meanwhile, the key limitation of indicators 7.3, 'proportion of schools with CAI' and 7.4, 'proportion of schools with IAI', is the lack of information related to ICT usage, which is increasingly in strong demand from policy-makers. However, given the slow progress amongst many countries across Asia, the Americas, Africa and presumably Oceania[13] to implement CAI and IAI, and the relative availability of indicators 7.3 and 7.4, they should be retained in the post-2015 environment to measure achievement towards Target 7. Given the perceived disconnect between policy and practice in many countries, possible additional indicators to measure achievements against Target 7 could include disaggregated data for proportions of schools with CAI and IAI by school location. Collecting new indicators on proportions of schools with computers in classrooms versus schools with computers in laboratories and other locations provide some information on ICT usage and reflect the evolution of demand for information as countries move from a phase of building infrastructure for ICT in education (e-readiness) to more focused usage of different ICTs (e-intensity). Other possible

additions would be participation indicators, the 'proportion of pupils enrolled in programmes offering CAI and IAI, by sex' since these provide proxies for usage of ICT in education and meet the measurements needs of other international frameworks that include objectives for eliminating gender gaps in access, participation and educational quality.

Specific recommendations to countries are:

- To adapt school curricula to meet the challenges of the information society, policies must go beyond mere capital investment in ICT-related infrastructure. It is imperative that initiatives also develop ICT skills amongst the teaching workforce, so that their knowledge and skills can be effectively transferred to students. While it is difficult to determine the ideal proportions of teachers that require training, national circumstances should inform objectives. For example, countries with greater levels of ICT integration in national curricula would require greater proportions of trained teachers than those that do not.
- In most developed and developing countries, just 1 to 10 per cent of teachers are trained to teach basic computer skills and computing (that is, ICT-qualified). Since courses in basic computer skills and more advanced courses in computing require teachers with specific ICT qualifications, countries need to ensure that they train an adequate number of teachers to effectively deliver these courses in all schools or as per curriculum (for example, primary versus secondary schools).
- Beyond basic computer skills and computing courses, ICT may play a role in the instruction of various other curricular subjects. Therefore, an adequate number of teachers should also be trained to teach subjects using ICT in order to adapt curriculum effectively to ICT-assisted instruction. Where ICT is widely integrated across all, or many, curricular subjects, teachers trained to teach subjects using ICT in the classroom may be more essential than ICT-qualified teachers.
- Where resources permit, countries should increase the number of devices per school and connect them to the Internet to ensure that a critical mass of ICT is available to provide sufficient access to computer-assisted and Internet-assisted instruction.
- Where resources permit, countries should allocate desktops, laptops tablets and other computer devices to classrooms, computer laboratories, libraries and other school locations in order to provide pupils with multiple access points.
- In order to firmly ground schools in the information society, countries could consider increasing access to online free and open-source software (FOSS) as well as other open educational resources (OER), in order to improve the quality of CAI and IAI, at relatively low cost,.
- Countries should recognise the role of community media centres (or similar) to play a role in extending the reach of computer-assisted and Internet-assisted instruction to pupils where ICT is not available in schools. This may involve negotiation of schedules and formation of partnerships with public and private entities (for example, Internet cafés).

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Endnotes

[1] UN list of least developed countries (LDCs): http://unctad.org/en/pages/aldc/Least%20Developed%20Countries/UN-list-of-Least-Developed-Countries.aspx.

[2] See Chapter 2 in this report.

[3] Source: OECD. 2011. PISA 2009 Results: Students on line: Digital Technologies and performance (Volume VI). Paris: OECD, Table VI.5.19, page 321.

[4] Data are available for 45 countries, including 29 OECD countries and 16 partner countries. Countries were selected to represent a combination of both developed and developing countries from different regions.

[5] Language of instruction refers to reading, writing and literature in the main language of instruction in schools, which may or may not be pupils' mother tongue.

[6] The scope of all the indicators is ISCED levels 1–3, that is, public and private schools from primary to upper secondary education unless otherwise stated. The International Standard Classification of Education (ISCED) is a classification system for education statistics. The data collected for this report refer to ISCED97 whereby ISCED 1, ISCED 2 and ISCED 3 refer to primary, lower secondary and upper secondary education levels, respectively.

[7] UIS defines teachers as persons employed full-time or part-time in an official capacity to guide and direct the learning experience of pupils and students, irrespective of their qualifications or the delivery mechanism, that is, face-to-face and/or at a distance. This definition excludes educational personnel who have no active teaching duties (for example, headmasters, headmistresses or principals who do not teach) or who work occasionally or in a voluntary capacity in educational institutions. Teacher numbers reflect total teacher headcounts, which include both full-time and part-time teachers.

[8] While the Lave and Wenger (1991) theoretical model for situated learning may have relevance for the data presented in Chart 7.1, it is impossible to state whether this model has been systematically applied in countries in relation to an overall teacher training strategy.

[9] Latest year available. Notes on reference years are under the chart.

[10] UIS is conducting a data collection across Africa during 2014–2015.

[11] For a fuller discussion of learner-to-computer ratios, please see Chapter 2.

[12] See http://e-education.brac.net.

[13] There are no current data for Indicators 7.3 and 7.4 from countries in Oceania.