Target 2: Connect universities, colleges, secondary schools and primary schools with ICTs[1]

Introduction

Governments are increasingly recognizing the multiple benefits of providing access to information and communication technology (ICT) infrastructure within education systems. Connectivity provides a platform for students to obtain information technology and communication skills, and can reduce costs associated with printing and the distribution of books. Outside school hours, connected schools can also be used to provide connectivity for the community, including marginalized groups, such as the elderly, minorities, the unemployed and people with disabilities.[2]

The benefits of integrating ICTs in education can have a multiplier effect throughout the education system by:

- improving teaching and learning processes and allowing students to acquire new sets of skills required for the information society (Box 2.1);
- providing learners with access to Internet resources and computers as pedagogical tools;
- supporting teacher training through ICT-enabled distance-education programmes;
- improving the administration of educational institutions in order to enhance the quality and efficiency of service delivery.

Target 2 is closely related to WSIS Action Line C2 (Information and communication infrastructure):

"*In the context of national e-strategies, provide and improve ICT connectivity for all schools, universities, health institutions, libraries, post offices, community centres, museums and other institutions accessible to the public, in line with the indicative targets*."[3]

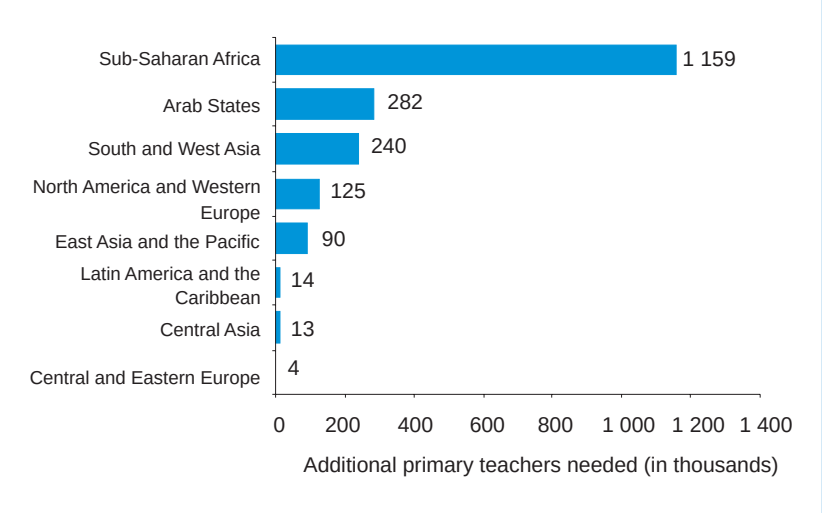
It is also significant in the context of Action Line C7, in respect of e-learning, and Action Line C4 (Capacity building), which enumerates a number of policies such as integrating ICTs in education and promoting e-literacy skills for all:

Box 2.1: The benefits of connecting educational institutions for learners and teachers

In order to prepare students for the changing needs of labour markets and knowledge-based societies, education systems must adapt their curricula to include ICT-assisted instruction. An ICT skill that is essential for participating in knowledge-based societies is information literacy, which can be used in conjunction with other problem-solving and communication skills.[5] In using the wealth of electronic resources available for pedagogical purposes via the latest Internet-based tools and digital technologies, learners can quickly expand their information literacy skills set. In essence, achieving full connectivity as sought by WSIS Target 2 is a precondition for attaining Target 7: "*To adapt all primary and secondary school curricula to meet the challenges of the information society, taking into account national circumstances*" .

At the same time, ICTs can act as a catalyst for alleviating bottlenecks in education systems, particularly teacher shortages. According to forecasts, a global total of 10.3 million teachers have to be recruited between 2007 and 2015 to meet the goal of universal primary education [UNESCO-UIS, 2009a], but the lack of trained teachers is a key challenge in achieving this goal. Sub-Saharan Africa has by far the greatest need for additional teachers, as shown by Chart 1 Box 2.1. Three quarters of countries (27 out of 45) in the region face a significant teacher gap, estimated at 1.2 million teachers.

Chart 1 Box 2.1: Increases in teacher stocks needed by 2015



Source: UIS.

Since for many countries the conventional method of course delivery is not a viable option, ICT-enabled distance-education programmes can be used to reach a greater number of primary-school age pupil populations, by complementing and enhancing existing teaching practices as well as providing additional content and delivery options, particularly in remote or rural areas where teachers are scarce. They may also be used for teacher training. Setting up relevant curricula at a distance based on an ICT-enabled environment has the advantage of flexibility, while achieving economies of scale in the dissemination of teacher-training content. Pedagogical content can thus be disseminated to potential populations at a declining unit cost, while also achieving a potential multiplier effect across the target populations.

Teacher training can take place through ICT-enabled distance-education programmes, which exploit ICTs to deliver all or a significant proportion of the teaching to learners who are removed in space and time. Distance education can take various forms, such as Internet-based distance learning, whereby content can be transmitted either synchronously or asynchronously. National circumstances will dictate the most effective technological solutions for the purpose of pedagogical training and course delivery. Self-learning using CD or DVD-ROM, in which the learner interacts with content on a computer or other integrated device, is another practical tool for delivering training. Broadcast-based education, in which content is delivered via radio or television, is very effective in delivering content to a mass of potential teachers.

To reap the full benefits and potential that Internet-based distance-education programmes have to offer, greater investment is required in infrastructure that can support broadband Internet services. As more web-based curriculum materials are developed using high-bandwidth applications, consumers of distance-education programmes in these new formats require access to the supporting infrastructure. Since many of the web-based applications make use of interactive media and streaming content in the delivery of distance-education programmes, users with broadband Internet access can take full advantage of these applications. One of the dilemmas that persist is that investment in such technologies can only occur when there is a minimum customer base that will consume the broadband Internet services. Given the high fixed costs associated with supporting such services, a sustainable customer base is essential for guaranteeing the viability of a market in the long run. The systematic deployment of any web-based distance education programmes or government policy to support such initiatives must therefore take this into consideration in delivering the curriculum.

Source: UIS.

"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."[4]

Measuring Target 2 — Proposed indicators

In order to monitor ICT in education from an international perspective, it is necessary to establish a consensus on the conceptual framework. Moreover, the approach must emphasize that educational institutions (or schools) are the main units of data collection, with aggregation at the country level. This method of data collection guarantees international comparability for the effective monitoring of ICT infrastructure in education systems.

The UNESCO Institute for Statistics (UIS) is leading a process for the development and pilot testing of cross-nationally comparable core indicators of ICT for education (ICT4E), under the auspices of the *Partnership on Measuring ICT for Development.* The *Partnership* is mandated to establish international standards, indicators and benchmarks for statistical monitoring of the WSIS global policy goals.

A set of core ICT in education indicators that measure aspects of e-readiness and access to ICT in education systems were 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 has established the international Working Group for ICT Statistics in Education (WISE). The purpose of the working group is 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 suggested to monitor Target 2 in the following sections are the result of this initiative [UNESCO-UIS, 2009b].

Apart from the efforts of UIS and the *Partnership* to monitor ICT in education at an international level, there have been no other global initiatives to identify indicators or to provide data on school connectivity.[6] Periodic surveys on school connectivity have been carried out in Europe, usually under a project of the European Commission,[7] and a number of studies exist for other regions, including Latin America and the Caribbean. Mostly, however, data on ICT in education are not comparable across countries and are based on different sets of indicators and definitions. Some countries have collected ICT in education data through statistical reports or one-time studies, especially to address policy needs. Often these data are available only for one country, for one year, and/or are limited to a specific school level. While the results of the UIS survey presented in this chapter provide important insights into the status of school connectivity, the survey is limited to 25 countries, including several developed countries. Not all data sets are available for all 25 countries. The UIS survey results were complemented through data received from ITU's *Survey on the WSIS Targets*, as well as some official data from regional or national sources. Despite the fact that a number of countries and regions, including Africa, have set specific targets on ICT in education (Box 2.2), relatively few countries seem to be actually able to track them.

Although Target 2 does not specifically say how many educational institutions should be connected, it could be interpreted as meaning "all" universities, colleges, secondary schools and primary schools. Nor does it specifically state precisely which ICTs it refers to. Clearly, however, ICT-assisted instruction must encompass technologies that are consistent with national circumstances and realities. In this sense, technologies and supporting infrastructure may include older or more conventional ICT tools such as radio and television broadcasts (live and off-air) as well as the latest digital technologies such as broadband Internet and computer software.

The type of indicators selected to measure Target 2 will depend to some extent on a country's development status and ICT-readiness. Countries that are in the early stages of introducing ICTs have different information needs from countries that have longer experience with the technology. For instance, when introducing computers or Internet-assisted instruction in education, it is important that teachers and learners have access to hardware and software to acquire basic computer skills. Countries whose education systems have reached this level of ICT integration can be characterized as being at the e-readiness stage (see Figure 2.1). As Target 2 aims to measure the overall presence of ICT infrastructure and connectivity, key e-readiness indicators must be identified for this purpose.

Countries in the more advanced stages of ICT use in education have other priorities — such as the management of pedagogical innovation, adaptive and inclusive curricula, organizational change, sustainable technical support, and

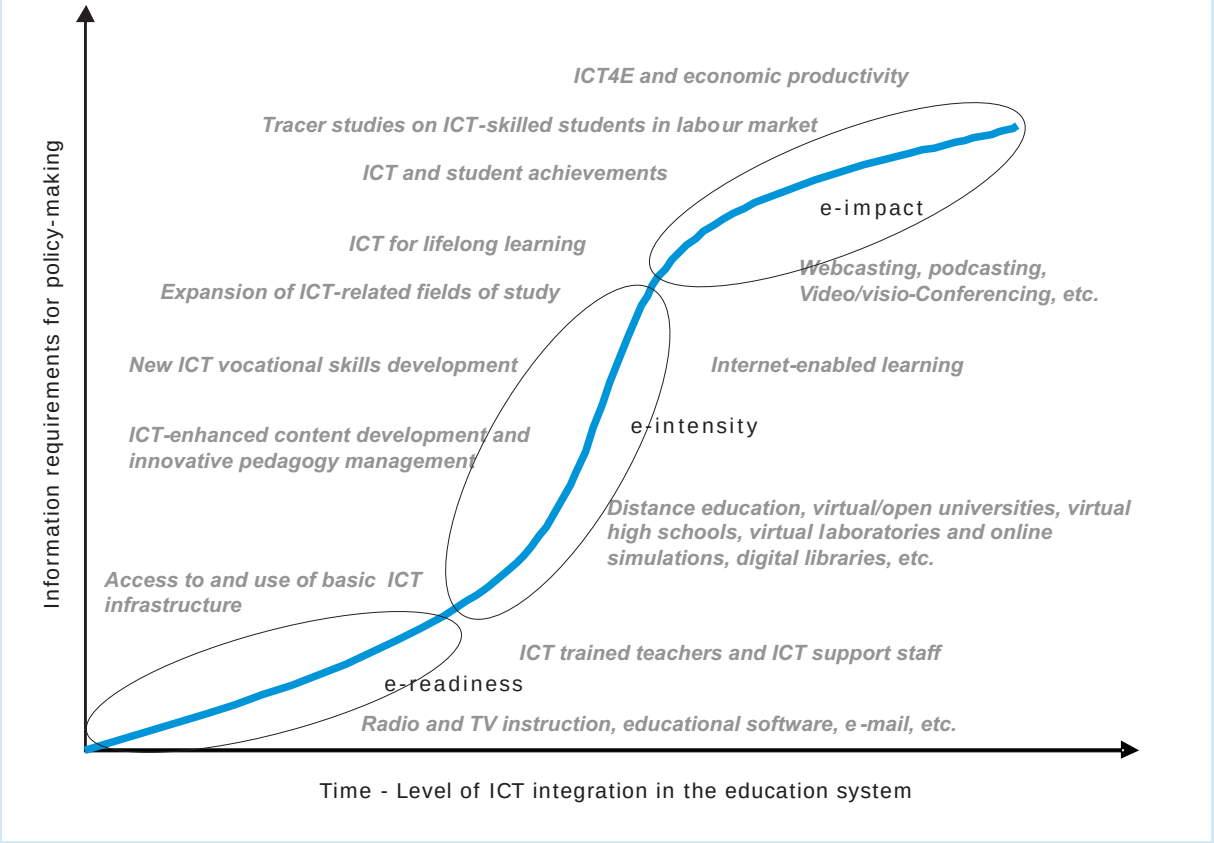
Box 2.2: Setting targets: Examples from the Americas, Africa and Australia

While Target 2 does not specify the percentage of schools that should be connected to ICTs, some regions and countries have set their own targets, usually in terms of Internet connectivity:

- In Latin America and the Caribbean, *eLAC 2010* established a target to connect 70 per cent of public educational institutions by 2010, preferably via broadband, otherwise tripling the current number of public schools connected to the Internet.[8]
- The New Partnership for Africa's Development (NEPAD) *e-Schools Initiative* was announced in 2003 at the Africa Summit of the World Economic Forum, for implementation until 2013. One of its goals was to equip "*all African primary and secondary schools with ICT apparatus such as computers, radios and television sets, phones and fax machines, communication equipment, scanners, digital cameras, copiers, etc., and to connect them to the Internet.*"[9]
- In 2009, Australia committed funding to provide 90 per cent of all schools with optical fibre progressively over the next eight years and to achieve a 1:1 learner-to-computer ratio for secondary schools by 2011.[10] Schools connected will have access to broadband speeds of up to 100 Mbit/s. These initiatives are among the many that recognize the positive impact that ICTs have on education.

Source: ECLAC; E-Africa Commission; Australian DBCDE.

Figure 2.1: Information needs at different levels of ICT penetration in educational systems



Source: UIS, adapted from [UNCTAD, 2007].

continued staff development. Thus, the concerns of policy-makers and their information needs shift over time. For some, measuring the impact of the implementation of ICT in education means gathering information on access, use and learner outcomes. For others, in the early days of implementation, attention centres more on creating an ICT infrastructure in order to provide schools with access to newer technologies, before moving on to focus on appropriate ways to use ICT in order to achieve intended educational outcomes.

The notion of e-readiness in an educational setting depends largely on the availability of ICT infrastructure. At higher levels of education, particularly in the contexts of colleges and universities, tracking Internet connectivity is less relevant from the international monitoring perspective. In an advanced pedagogical setting, measuring the degree of ICT intensity and use provides more meaningful information. For the purpose of international comparability and for monitoring the availability of ICT infrastructure, the indicators discussed in this chapter will focus on connecting primary and secondary schools with ICTs. Connecting learners early on will create the foundations required for the progression into more advanced levels of education.

The four indicators identified to monitor connectivity in primary and secondary schools are the following:[11]

1. Proportion of schools with a radio used for educational purposes (for ISCED levels 1-3)

2. Proportion of schools with a television used for educational purposes (for ISCED levels 1-3)

3. Learners-to-computer ratio (for ISCED levels 1-3)

4. Proportion of schools with Internet access (for ISCED levels 1-3), by type of access (narrowband, broadband)

These indicators cover both “older” and “newer” ICTs. All of these indicators are part of the *Partnership on Measuring ICT for Development’s* core list of indicators and, at the international level, are under the responsibility of UIS. A detailed discussion of each indicator and an overview of available data will be presented in the following section.

Status of Target 2

Radios and TV

Radio- and television-assisted instruction represents an effective solution for delivering educational content, particularly in remote areas where investing in infrastructure to support telephony and Internet services may be costly. While there are numerous benefits to be gained from spreading Internet connectivity throughout education systems, many developing countries may see broadcast technologies as a viable alternative to these newer technologies. Live radio broadcasts and off-air radio cassettes as well as television broadcasts and offline video-assisted technologies are still considered valid and cost-effective modes of education delivery. In terms of delivering educational content, they could be just as effective as the more interactive computer/Internet-based virtual education or online distance learning.

A high value (or percentage) for indicators (1) and (2) implies that radio- and television-based technologies are a widespread mode of instruction within schools in the country concerned, while a low value indicates the contrary. It should be noted that these indicators only reflect the degree of radio and television availability in schools, and not the actual intensity of use. By comparing them to the proportion of schools providing other ICT facilities as a delivery mode, one can assess the relative predominance of the different technologies used for pedagogical purposes within a country or across countries. Besides their use for international comparison, these indicators can also be calculated and analysed by geographical region, urban/rural area and public/private institution in order to detect patterns and potential discrepancies.

For the purpose of measuring radio-assisted instruction, a radio is defined as being a stand-alone device (in working condition) capable of receiving broadcast radio signals, using popular frequencies (such as FM, AM, LW and SW).

Radio-assisted instruction includes both radio broadcast education and interactive radio instruction. Radio broadcast education may be an audio lecture or lesson, with printed material for learners to follow it. Any teacher, not nec-

essarily qualified in the subject matter, can use the radio programme as a primary instructional source. Broadcast programmes follow the traditional model of education and can cover every subject in many different languages, depending on the target audience.

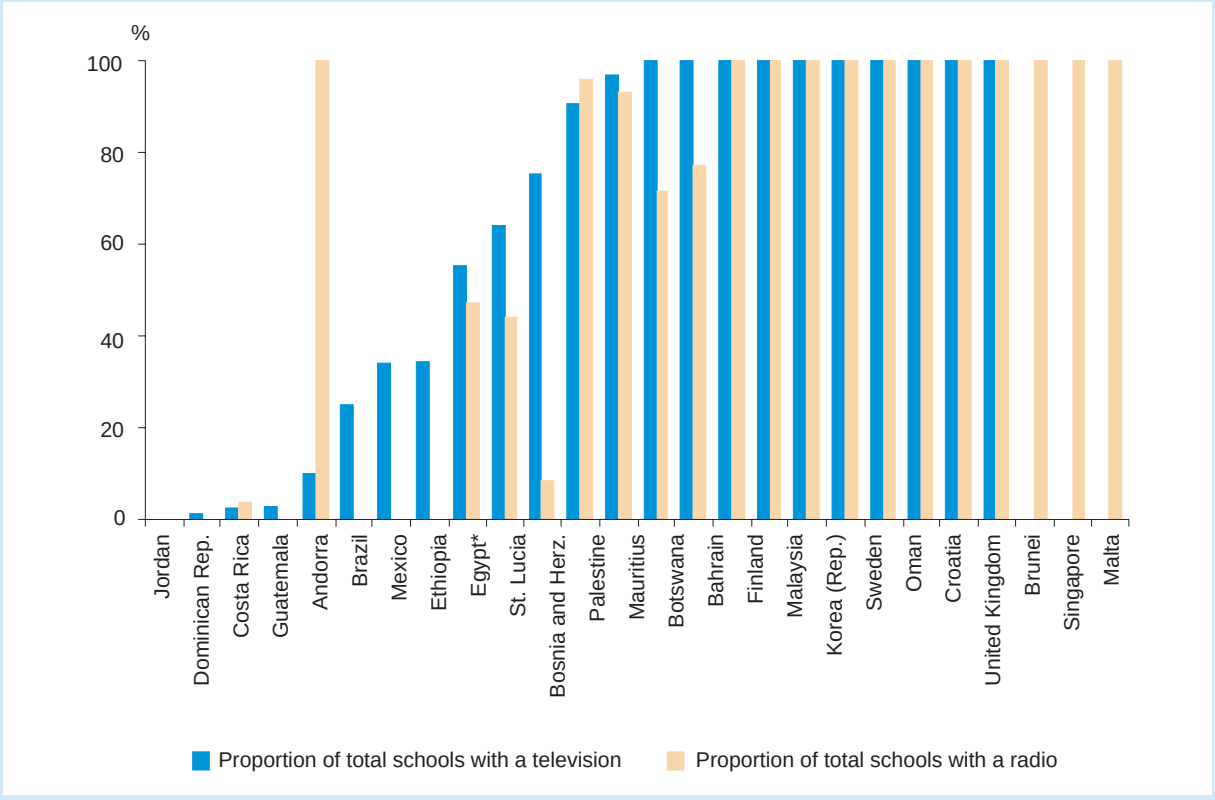
Interactive radio instruction turns a typically one-way technology into a tool for active learning inside and outside the classroom. It requires that learners react to questions and exercises through verbal responses to radio-programme contributors, group work and physical and intellectual activities while the programme is on air. For both teacher and learner, the lesson becomes an immediate hands-on practical guide [UNESCO, 2009c].

For the purpose of measuring television-assisted instruction, a television is defined as a stand-alone device (in working condition) capable of receiving broadcast television signals using popular access means (such as over-the-air, cable and satellite).

Television-assisted instruction is similar to radio broadcast education, with the additional benefit of video. It helps to bring abstract concepts to life through clips, animations, simulations, visual effects and dramatization. It can also connect a classroom to the world, but shares the same rigid scheduling and lack of interactivity as radio broadcast education.

Chart 2.1 shows that, in many countries (including Bahrain, Finland, Malaysia, Republic of Korea, Sweden and Oman), television- and radio-assisted instruction is present throughout the entire education system, with 100 per cent of primary and secondary schools having this type of instruction. In other countries, such as Jordan, there has been a deliberate policy shift away from radio- and television-assisted instruction to focus on other types of ICT-assisted

Chart 2.1: Proportion of schools with a television or radio used for educational purposes (for ISCED levels 1-3), 2008-09**



Note: * Refers to public schools only. **Or latest available year.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education; ITU Survey on the WSIS Targets; national sources.

instruction [UNESCO, 2009b]. This suggests that in some countries connecting schools to older ICTs is an alternative when newer ICTs are not available.

Computers

Depending on the measurement objective, indicator (3) — *the learners-to-computer ratio* — may be calculated in several ways. The most basic method involves the ratio of total learners to total available computers in particular schools, irrespective of the intended use of the computers. A high value for this ratio depicts a situation where, on average, there are many learners for each available computer in the schools. In a country which, in theory, enjoys full-scale deployment of computer-assisted instruction (CAI), this may signal either a low overall level of computer availability in the schools in question, or the existence of digital gaps, which can be identified when calculating and analysing this indicator by geographical region and individual school. Alternatively, the learner-to-computer ratio can be calculated for schools where CAI is deployed. A high value in this case signals that a greater number of learners must share a fixed number of computers. Pedagogically speaking, this may imply that the available computers are inadequate to serve the learning and practice needs of the learners.

In both circumstances a computer refers to a programmable electronic device that can store, retrieve and process data, as well as share information in a highly structured manner. It performs high-speed mathematical or logical operations according to a set of instructions. In collecting international data on the number of computers, a computer will include personal computers (PCs), laptops, notebooks, terminals connected to mainframes and minicomputers that are intended for shared use and are in working condition. Other additional criteria may be applied, such as the age of the computer, its configuration and capacity, the kinds of software available, etc. From a statistical perspective, the criteria for "working condition" of computers are left to the countries' discretion, taking into consideration their own pedagogical requirements for schools, their technological environment and their financial capacities [UNESCO, 2009c].

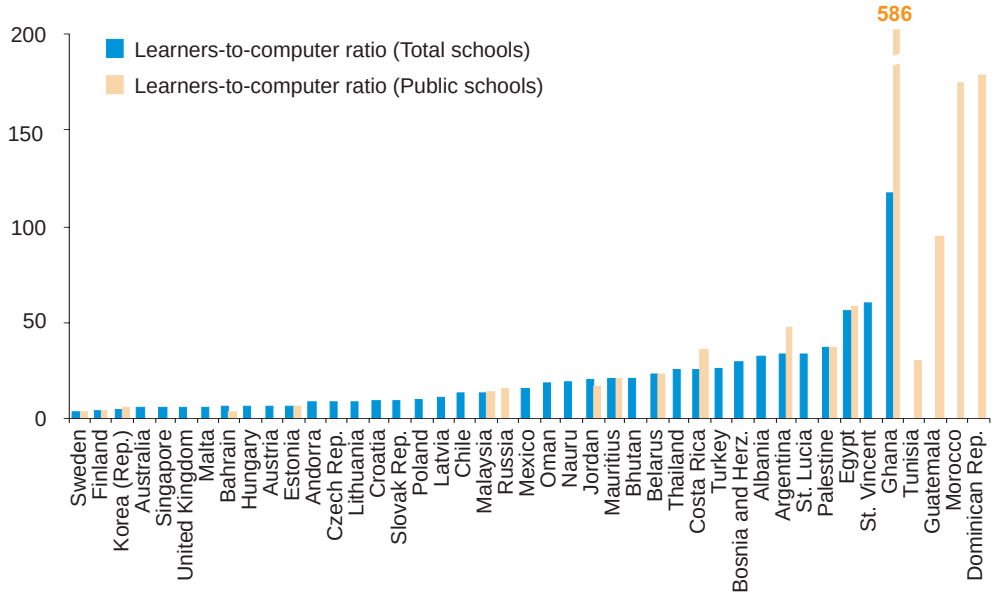
In the absence of national norms defined by pedagogues, a ratio of one learner to one computer suggests a perfect adequacy in the provision of a computer to all learners officially entitled to benefit from a computer in schools that offer CAI. However, except in cases where everyone has a privately owned computer, a perfect 1:1 match does not necessarily constitute an ideal target, since sharing a school-owned computer might equally reflect cost-efficient management of the resource. Not all subjects in curricula require the support of computers during the totality of class time scheduled in a week, a month or a year. This indicator also needs to be analysed in the context of parallel use of other, non-computer ICTs in schools.

Where national standards exist, a learner-to-computer ratio higher than the official norms implies that more efforts are required from policy-makers to equip schools with computers in order to ensure equitable opportunity for all entitled learners across the country. By frequently updating this indicator, one can monitor and ensure that all schools meet the required standard. Further methodological work will be required to test more robust measures than simple averages (e.g. median, percentiles) in order to improve cross-country comparisons. The ratios are a measure neither of actual use of computers in schools nor of the time learners actually spend using computers [UNESCO, 2009c].

The basic learner-to-computer ratio is an aggregate measure of the digital divide, irrespective of the type of school or intended use of computers. Chart 2.2 shows that the variation in the learner-to-computer ratio is very high across countries. Countries such as Sweden have a computer for every three learners in public primary and secondary schools, while some developing countries have very high ratios, namely Morocco (174:1), Dominican Republic (179:1) and Ghana (586:1). Belarus is an example of a developing country which has decreased its learner-to-computer ratio from 41:1 in 2000 to 24:1 in 2008 (Box 2.3). Based on the available data for 20 countries, the median leaner-to-computer ratio for public schools is 27:1.

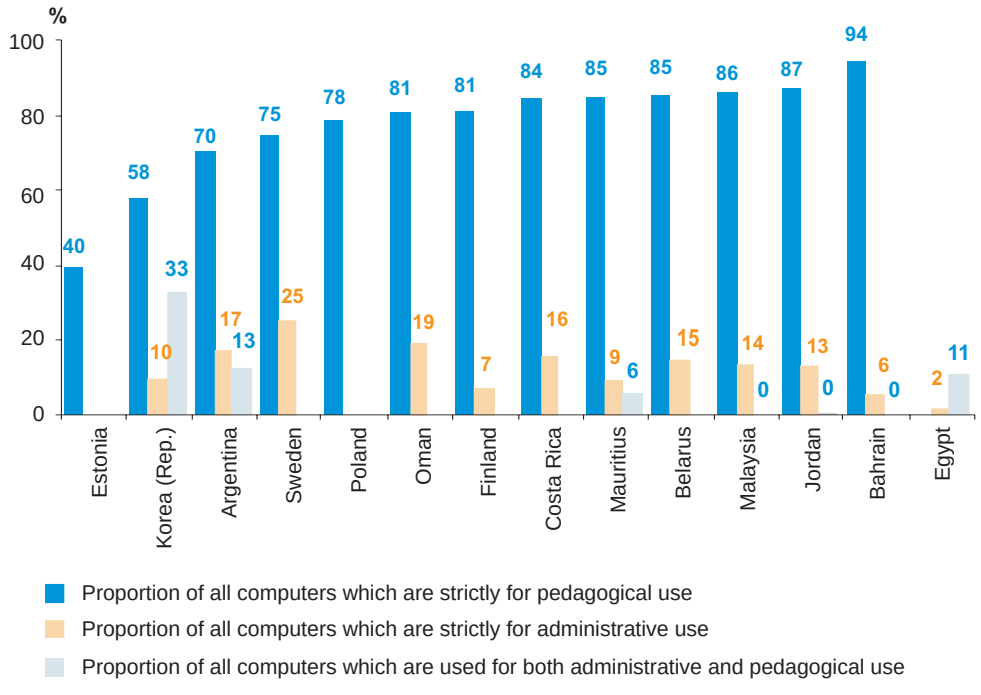
Whereas Chart 2.2 shows aggregate access to computers, there is a caveat in the sense that not all learners and teachers may have access to all of the available computers. Chart 2.3, on the other hand, shows the intended use of the computers in all primary and secondary schools. A high proportion of Sweden's computers are used for administrative purposes (25 per cent), whereas a relatively high proportion of the Republic of Korea's computers are put to both administrative and pedagogical use (33 per cent). Bahrain has the highest proportion of computers assigned for pedagogical use (94 per cent) while the proportion of computers for administrative use is relatively low, at six per cent.

Chart 2.2: Learner-to-computers ratio (for ISCED levels 1-3), 2008-09*



Note: * Or latest available year. Includes estimates.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education; ITU Survey on the WSIS Targets; national sources.

Chart 2.3: Proportion of computers available by intended use (for ISCED levels 1-3), 2008-09*

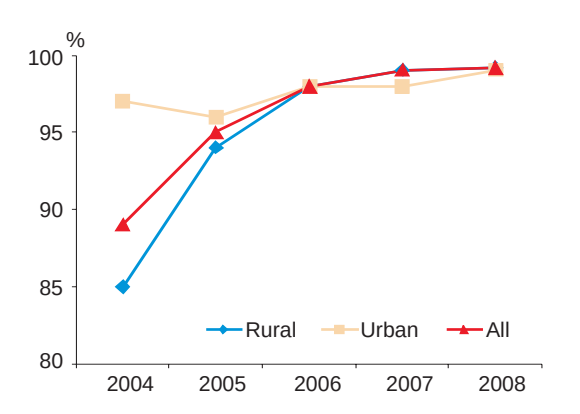


Note: *Or latest available year.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education.

Box 2.3: Measuring progress — Case of Belarus[12]

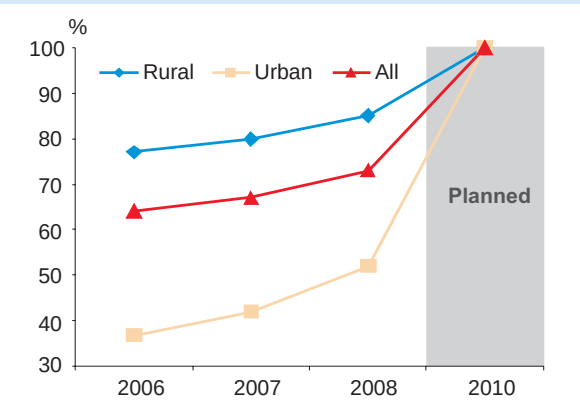
Since 1998, the integration of ICTs in education in Belarus has been carried out under special state programmes. Indicators monitoring ICTs in schools are calculated annually, and targets are tracked closely. To achieve universal connectivity, the objective has been to set up computer labs that provide Internet access across educational institutions. By 2008, practically all schools (99.2 per cent) were equipped with at least one computer lab (Chart 1 Box 2.3). Since in larger schools (those with 650 or more learners) one computer lab was considered insufficient to meet curricula needs, the Ministry of Education set a new target: less than 31 learners to one computer for all schools by 2010. The target is being closely tracked, and differences in urban and rural schools are getting smaller (Chart 2 Box 2.3).

Chart 1 Box 2.3: Proportion of schools with a computer lab, Belarus



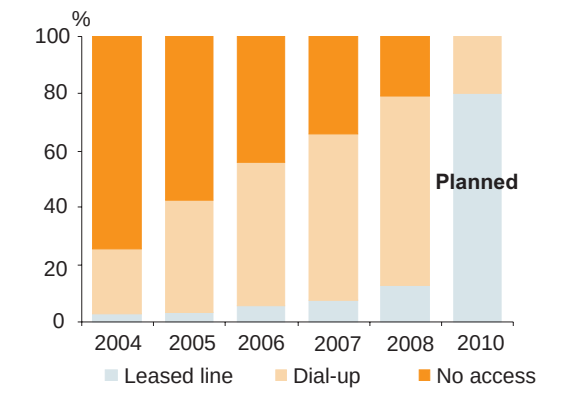
Source: Ministry of Education, Belarus.

Chart 2 Box 2.3: Proportion of schools with a ratio of less than 31 learners for one computer, Belarus



Source: Ministry of Education, Belarus.

Chart 3 Box 2.3: Proportion of schools with Internet access, Belarus



Source: Ministry of Education, Belarus.

By 2008, the learner-to-computer ratio in the country was 24, and all outdated computers had been replaced by modern computers.[13] Approximately 80 per cent of schools had Internet access and 67 per cent had dial-up Internet access, used mainly for administrative purposes. The objective for 2010 is to connect all schools with Internet access, and 80 per cent of schools with broadband access via cable or DSL to allow the use of the Internet for pedagogical purposes (Chart 3 Box 2.3).

In order to evaluate the implementation of national policies for ICT in education, the Ministry of Education developed an *ICT-Readiness Index for Schools* (ICT-R). The index ranks schools' ICT-readiness by region, and is composed of three indices which describe, respectively: readiness to use ICT for the development of ICT-literacy (*Computing*); quality, availability and improvement of educational services (*Other subjects*); and efficient educational management and planning (*Administrative work*). Each of the three component indices is in turn composed of subsidiary technical, programme and staff-related readiness indices. For the current 2007-2010 programme, 16 indicators have been selected to calculate the index. The weightings used in the aggregation reflect the relative importance of appropriate goals and objectives determined in the state's national ICT in education programme. Indicators and weightings are reviewed periodically when new programmes are under consideration. The ICT-R, which showed, for example, that in the capital region of Belarus, Minsk, schools' ICT-readiness is 24 per cent higher than the average for the rest of the regions, is used for policy purposes. The values for the index and its component indices and subsidiary indices help authorities to make informed decisions regarding investment in ICTs and the allocation of human resources in order to improve the efficiency of educational service delivery in schools.

Internet

Indicator (4), the *proportion of schools with Internet access*, is central to understanding connectivity at the primary and secondary level and hence to assessing Target 2. It measures the overall level of access to the Internet in schools, and the opportunities or limitations in terms of the use of computers in primary and secondary schools. Access may be through multiple wired or wireless devices (PCs, laptops, PDAs, smartphones, etc.). Given the paramount importance of broadband access, connectivity is also tracked by the type of Internet access. The *proportion of schools with fixed broadband Internet access* provides a good indicator of the quality of Internet connections and the potential to use ICTs for pedagogical purposes.[14] Broadband (as opposed to narrowband) Internet access is particularly important to exploit the Internet's full potential, for example in providing students access to Internet resources or in supporting online teacher training.

A high value or percentage for the proportion of schools with Internet access implies a high degree of access to the Internet among the schools in a given country, while a low value indicates the contrary. The percentages by type of Internet access can inform policies and decisions to expand and/or upgrade Internet connections in schools. The indicator measures only the availability of Internet access in schools, and not intensity of use or the actual amount of time that learners spend on the Internet for educational purposes. The type of Internet connection and access in schools may also depend on existing national and subnational telecommunication infrastructures, which can be constrained by electric power (Box 2.4) and other technological limitations in a developing context.

Data to monitor Internet and broadband access in schools exist for many developed countries and a number of developing countries (see Charts 2.4 and 2.5). They suggest that, by 2010, practically all schools in developed countries will be connected to the Internet. Many developed countries have in fact stopped tracking ICT infrastructure in schools, since connectivity was approaching 100 per cent, and in most developed countries broadband penetration in schools is either approaching or has already reached 100 per cent. For example, according to a report released by the European Union in 2006, the majority of schools in Europe had Internet access and in many countries, including Croatia, Sweden and the United Kingdom, 100 per cent of schools were already connected with broadband.[15] In the United States, all public schools were connected to the Internet as of 2006, and 97 per cent had a broadband connection. In Canada, 97 per cent of schools were connected to the Internet as early as 2004.

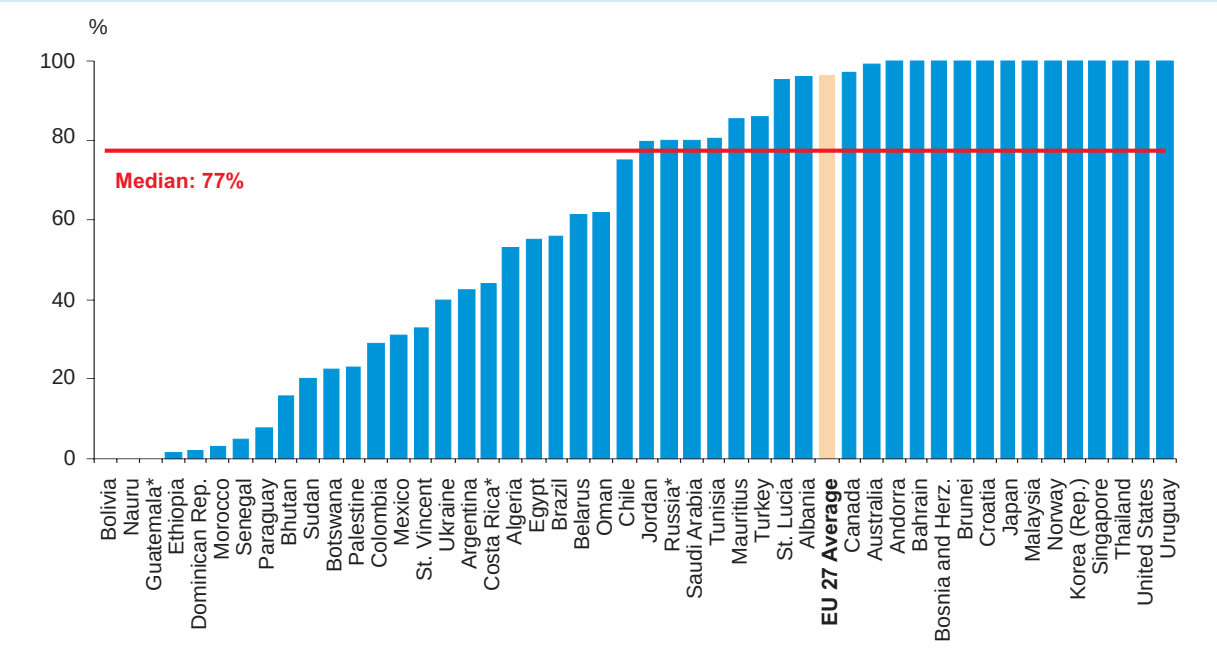
By comparison, the level of school connectivity is lower for middle-income and developing countries in the Americas. Between 2007 and 2009, Argentina, Costa Rica, Mexico and St Vincent and the Grenadines have come close to equipping half of their schools with Internet access, whereas Brazil and Chile have surpassed the 50 per cent mark. By 2009, Chile had connected three quarters of its schools to the Internet, of which 67 per cent had broadband (Box 2.5). Uruguay has successfully provided all of its schools with broadband Internet access in a relatively short time, mainly through a government-driven project (Box 2.6).

The developed economies in Asia and the Pacific display high levels of school connectivity, with all schools having Internet access in Brunei, Japan, the Republic of Korea, Malaysia, Singapore and Thailand. Of these, Brunei, the Republic of Korea, Singapore and Thailand offer 100 per cent broadband connectivity across schools. Australia had almost achieved full Internet connectivity in all schools as far back as 2003, and one objective of its new super fast National Broadband Network project is to connect 90 per cent of schools to a fibre-optic connection with speeds up to 100 Mbit/s.[23] Unfortunately, data on ICTs in education are lacking for both India and China, the two most populated nations in the region.[24]

Available data from between 2007 to 2009 for the Arab States show that several Arab countries, including Jordan, Saudi Arabia and Tunisia, have connected over three quarters of their schools to the Internet. Bahrain has connected all of its schools with broadband Internet access as well as a radio and a television set for educational purposes. This can be attributed in part to policies pursued by the Ministry of Education aimed at enhancing and elevating the level of education in Bahrain by integrating ICTs. The King Hamad's School of the Future project, launched in 2004 to connect and link all schools in the kingdom to the Internet, is an example of such an initiative [UNESCWA, 2009]. Broadband penetration in schools is also relatively high in Jordan (73 per cent).

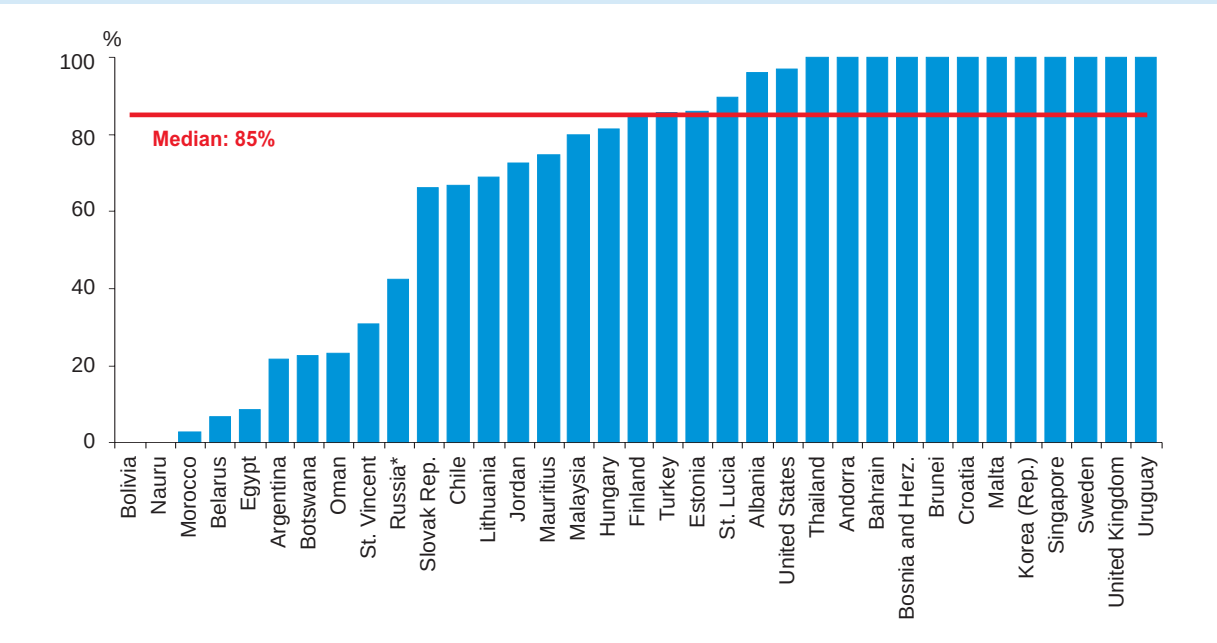
Data on ICTs in education are particularly scarce in Africa and what data do exist suggest that there is much room for improvement. In Ethiopia and Senegal, less than ten per cent of schools are connected to the Internet, and only

Chart 2.4: Proportion of schools with Internet access (for ISCED levels 1-3), 2008-09**



Note: **Or latest available year. Includes national estimates. *Refers to public schools only.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education; ITU Survey on the WSIS Targets (including data for Egypt, which was also part of the UIS Pilot Questionnaire); national sources.

Chart 2.5: Proportion of schools with broadband Internet access (for ISCED levels 1-3), 2008-09**

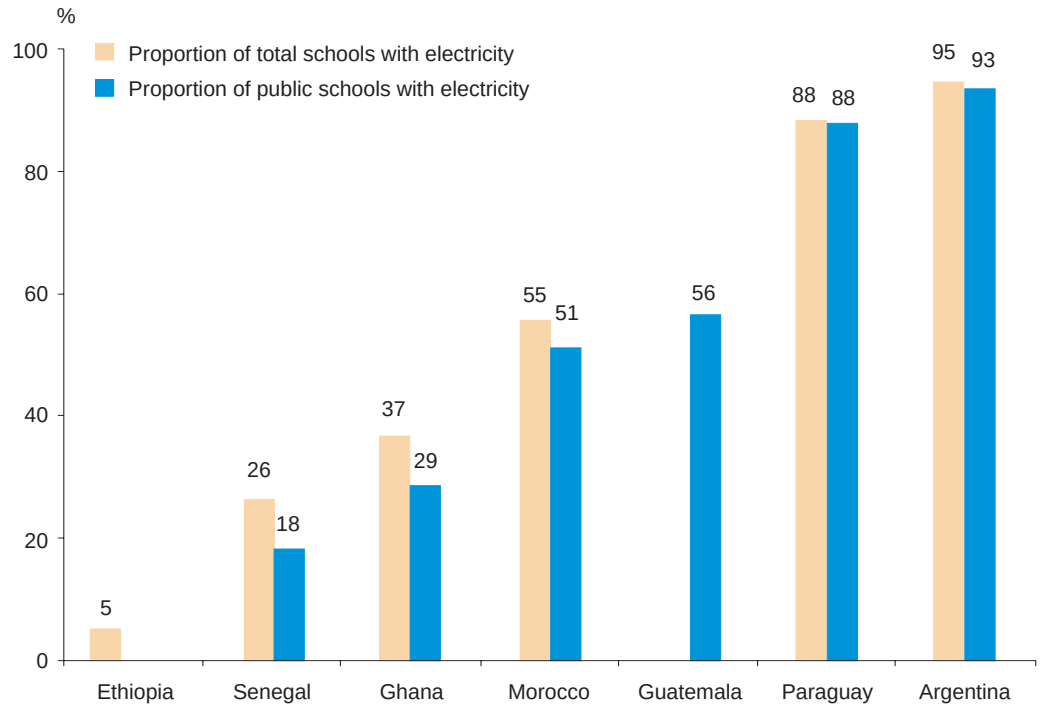


Note: **Or latest available year. Includes national estimates. *Refers to public schools only.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education; ITU Survey on the WSIS Targets (including data for Egypt, which was also part of the UIS Pilot Questionnaire); national sources.

Box 2.4: Electricity before broadband?

While the promise of broadband and wireless technologies heralds effective solutions for many education systems wishing to reap the benefits of ICT for their curricula, the relative scarcity of basic electric power in schools in many developing countries is an obstacle to accessing many of the technologies that support pedagogical objectives. Since high-income countries have full access to electric power in their educational institutions, monitoring this phenomenon is not seen as relevant. However, for the selection of countries for which data are available in Chart 1 Box 2.4, measuring progress in this area still has value. In some developing countries, such as Ghana (37 per cent, 29 per cent), Senegal (26 per cent, 18 per cent) and Ethiopia (5 per cent), only a minority of primary and secondary schools have electricity.

Chart 1 Box 2.4: Proportion of primary and secondary schools with electricity (for ISCED levels 1-3), 2009*



Note: *Or latest available year. Includes national estimates.
Source: UIS Pilot Questionnaire on Statistics of ICT in Education

Botswana and Mauritius have data on both the percentage of schools connected to the Internet (23 and 85 per cent, respectively) and the percentage of schools with broadband (23 per cent and 75 per cent).

Conclusions and recommendations

Setting targets and measuring progress in the area of ICTs in education involves a balancing act between identifying quantifiable information to monitor international goals, on the one hand, and taking into account the heterogeneity of national circumstances, on the other. The four suggested indicators to track Target 2 serve to reconcile these two conflicting aspects by monitoring the digital gap and the overall convergence between developing countries and

Box 2.5: The Chilean model — Partnering to connect schools

In Chile, close collaboration between the Ministry of Education and *Enlaces*[16] has long been considered a model of good practice by many policy-makers. What initially started as a pilot project to connect schools has evolved over time into a national initiative to systematically integrate ICTs in subsidized state schools.[17] With the help of *Enlaces*, the Chilean Centre for Education and Technology has provided Internet access to approximately 75 per cent of schools. No fewer than 67 per cent of schools have a broadband connection.[18]

From the point of view of many middle-income and developing countries, implementing a national connectivity initiative of this magnitude can be quite cost-intensive. *Enlaces* has used a variety of financing sources and mechanisms to fulfil its mandate. In 1998, the Ministry of Education reached an agreement with the *Compania de Telecomunicaciones de Chile* through which the operator agreed to provide free unlimited Internet service to all schools in the country for a period of ten years. As part of its efforts to promote broadband access, *Enlaces* has been negotiating agreements with telecommunication operators since 2004 in order to obtain preferential rates for educational facilities, and subsequently established a fund through which schools could apply for subsidies totaling 50 to 100 per cent of their broadband connection fee.[19]

Chile's innovative thinking made it look beyond just connectivity towards teacher development and digital content long before other middle-income countries recognized the value added from educational technologies. At present, *Enlaces* is working with the *Fondo de Desarrollo de Telecomunicaciones*, the country's universal service fund, to develop a project that will roll out fibre-optic cable to Chile's largest schools.[20]

Box 2.6: Uruguay closes the digital gap

Uruguay's government, through its *El Ceibal* project, has made a strong commitment to making ICTs available in its schools, and to teachers and students, including the youngest ones.[21] By 2008, Uruguay had connected all of its primary and secondary schools to the Internet, via a broadband connection. It further fulfilled its commitment to provide all primary school children and all teachers with a free laptop computer by the end of 2009.

Closely linked to the *One Laptop Per Child*[22] project, which manufactures the low-cost XO computer specifically designed for children in developing countries, *El Ceibal* seeks to link education with social networking. Beyond introducing ICTs for teaching and learning, the programme also aims at providing free broadband Internet access for schools and communities at large through servers located in schools and other access points, using students' XO computers. Since the XOs are laptop computers capable of interconnecting with each other, they act as servers and form a wireless network.

The project is founded on three pillars: to provide equal access, to enhance teaching and learning, and to integrate ICTs in schools in tandem with the environment outside school. For policy-makers, the priority is to provide equal opportunities for all primary school children and for various segments of society, a strategy designed to accelerate Uruguay's integration in the information society.

The findings of a preliminary study on monitoring and evaluation of *El Ceibal* [Salamano et al, 2009] detected some positive outcomes associated with the use of computers and Internet connectivity for teaching and learning. In particular, it showed an increase in computer literacy among children (grades 1 to 6) and among their parents, and a closing of the intergenerational ICT gap.

countries at advanced stages of ICT integration in education. Furthermore, the selected indicators aim to do justice to an array of technologies with applications in an educational context. By monitoring both "old" and "new" technologies, there is a recognition that technological infrastructures and circumstances at the national level vary at any given time across countries, as well as over time.

To make the target as concrete and measurable as possible, it is suggested that the word "all" be added in order to seek to connect 100 per cent of educational institutions to either "old" or to "new" ICTs (or both) depending on national circumstances, at least in the short term. At the same time, governments need to recognize the potential

of broadband access, and aim to equip educational institutions with high-speed Internet access, which opens up full access to educational material and firmly grounds schools in the information society.

It is further suggested that Target 2 be amended to reflect that it is designed to track the availability of ICTs in primary and secondary schools only. Monitoring ICT infrastructure is less relevant for higher-education institutions, since they are expected to have basic access.

Target 2 would then read: "Connect all secondary schools and primary schools with ICTs"

Given today's data limitations, it is not possible to provide a comprehensive review of progress towards achieving the target. Based on available data, it is nevertheless possible to draw some conclusions for the most developed countries and regions, especially in terms of Internet access in schools, the indicator which is currently tracked by the greatest number of countries. The data presented in this chapter highlight that while schools in developed countries are largely connected, and indeed to high-speed broadband networks, penetration levels in developing countries vary considerably. Internet and especially broadband penetration in schools remains a major challenge in many developing countries across the world. A number of developing countries which have initiated projects to bring ICTs to schools and have set clear targets have attained high levels of Internet and even broadband penetration. This highlights the importance of strong government policies and clear commitments and targets in the area of ICTs in education.

Existing data on the learner-to-computer ratio show that there are sizeable variations between countries, with relatively many computers for few students in most developed and high-income economies and less favourable ratios in the developing world. While in general it must be seen as advantageous to have more computers for fewer students, it is not clear what an ideal ratio might be. The "ideal" ratio will depend a lot on national circumstances and on how computers are used, and it has been suggested that more research should be conducted in respect of this indicator.

Only relatively few countries collect and publish data on the proportion of schools with "older" ICTs, namely TVs and radios. Penetration levels vary between developed and developing countries, but also among countries within each category, suggesting that national policies and objectives vary. While some countries may try to achieve full penetration for both older and newer ICTs, others may see broadcasting technologies as a relevant alternative only if newer technologies are not available or affordable. Bringing radios and TVs into schools could therefore be understood as a short- to medium-term target that should be complemented by Internet access in the long term.

Notes

1 Substantial inputs to this chapter have been provided by Mr Patrick Lucas from the UNESCO Institue for Statistics (UIS), Mr Claude Akpabie (UIS), M. Beatriz Valdez-Melgar (UIS) and Dr Katsiaryna Miniukovich (Ministry of Education of Belarus). These inputs are greatly acknowledged.

2 There are a number of examples of schools, which provide access to the Internet for the community at large after school hours. ITU's *Connect a School, Connect a Community* initiative (http://www.itu.int/ITU-D/connect/flagship_initiatives/connecting_children/index.html) is an example of an effort to benefit both students and the communities in which they live by promoting broadband access in schools.

3 See WSIS Geneva Plan of Action, 2003, at: http://www.itu.int/wsis/docs/geneva/official/poa.html#c2.

4 See WSIS Geneva Plan of Action, 2003, at: http://www.itu.int/wsis/docs/geneva/official/poa.html#c4.

5 Information literacy is defined as the capacity of people to recognize their information needs, locate and evaluate the quality of information, store and retrieve information, make effective and ethical use of information and apply information to create and communicate knowledge. See [UNESCO, 2008].

6 The World Bank measured the percentage of schools connected to the Internet in its 2006 *Information and Communications for Development Report*, but the data presented were only available for selected countries, and for the year 2004.

7 The latest is: European Commission, Information Society and Media Directorate. August 2006. *General Benchmarking Access and Use of ICT in European Schools 2006: Final Report from Head Teacher and Classroom Teacher Surveys in 27 European Countries*. Available at: http://ec.europa.eu/information_society/eeurope/i2010/benchmarking/index_en.htm.

8 "San Salvador Commitment," in Second Ministerial Conference on the Information society in Latin America and the Caribbean, LC/R.2144, (San Salvador, 2008).
http://www.eclac.org/socinfo/elac/default.asp?idioma=IN.

9 http://www.eafricacommission.org/projects/127/nepad-e-schools-initiative.

10 See "Australia's Digital Economy: Future Directions," Department of Broadband, Communications and the Digital Economy (2009).
http://www.dbcde.gov.au/__data/assets/pdf_file/0006/117681/DIGITAL_ECONOMY_FUTURE_DIRECTIONS_FINAL_REPORT.pdf.

11 ISCED refers to the *International Standard Classification of Education* and is used to define the levels and fields of education. ISCED levels 1, 2, and 3 refer to primary, lower secondary and (upper) secondary education. For more information, see [UNESCO 1997].

12 The content of this box was contributed by by Dr Katsiaryna Miniukovich, Leading mathematician, Central Information and Analytical Centre at the Ministry of Education of Belarus. See [Ministry of Education of Belarus, 2009].

13 Modern computer is considered as IBM-compatible with 32-bit operating system supporting graphic interface.

14 Fixed broadband Internet refers to high-speed connectivity for public use of at least 256 kbit/s or more in one or both directions (download and upload). It includes cable modem Internet connections, DSL Internet connections of at least 256 kbit/s or higher, fibre and other fixed broadband technology connections (such as satellite broadband Internet, ethernet LANs, fixed-wireless access, wireless local area network, WiMAX, etc.). See [Partnership, 2010].

15 By 2006 already, 71% of schools in the EU 27 countries were connected to broadband Internet access.

16 *Centro de Educacion y Tecnologia (Enlaces), Ministerio de Educacion*, available at:
http://www.enlaces.cl/index.php?t=44&i=2&cc=1273&tm=2.

17 The education system in Chile is decentralized with municipal governments and private schools responsible for most administrative and financing aspects. Private institutions account for 43% of primary and secondary students. Some municipal schools are subsidized by the federal government. The Enlaces programme only applies to subsidized municipal schools. See http://www.chile-usa.org/education.html.

18 *Enlaces en Cifras*, available at: http://www.enlaces.cl/index.php?t=44&i=2&cc=230&tm=2.

19 *Enlaces: 15 Años Integrando Tecnologia a la Educacion Chilena*, page 64, available at:
http://www.enlaces.cl/tp_enlaces/portales/tpee371c23bs52/uploadImg/File/libro_enlaces.pdf.

20 *En Marzo Habra Banda Ancha Real para Escuelas, La Nacion*, October 2008, available at:
http://www.lanacion.cl/prontus_noticias_v2/site/artic/20081021/pags/20081021215239.html.

21 See: http://www.ceibal.edu.uy/.

22 For more information on this project, see: http://www.laptop.org.

23 See Joint Media Release by the Prime Minister, the Treasurer, and the Ministers for Finance and for Broadband, 7 April 2009, Canberra, at: http://www.minister.dbcde.gov.au/media/media_releases/2009/022.

24 InfoDev is coordinating a survey of the use of information and communication technology for education in India and South Asia, including data on the connectedness of schools, see:
http://www.infodev.org/en/Project.103.html.

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Annex 2.1: ICTs in schools (ISCED levels 1-3), 2009**

Country	% of schools with radio		% of schools with TV		% of schools with Internet		% of schools with broadband		Learners to one computer	
Africa										
Botswana	77	2009	100	2009	23	2009	23	2009	...	
Ethiopia	...		35	2008	2	2008	...		...	
Ghana	...		...		...		...		117	2009
Mauritius	93	2008	97	2008	85	2008	75	2008	20	2008
Senegal	...		...		5	2008	...		...	
Arab States										
Algeria	...		...		53	2008	...		...	
Bahrain	100	2008	100	2008	100	2008	100	2008	6	2008
Egypt	47*	2008	55	2009	55	2009	9	2009	56	2008
Jordan	0.1	2009	0.1	2009	80	2009	73	2009	20	2009
Morocco	...		...		3	2008	2	2008	174*	2008
Oman	100	2008	100	2008	62	2008	23	2008	19	2008
Saudi Arabia	...		...		80	2007	...		...	
Sudan	...		...		20	2005	...		...	
Tunisia					81	2008			30*	2008
Asia and the Pacific										
Australia	...		...		99	2003	...		5	2007
Bhutan	...		...		16	2008	...		21	2008
Brunei Darussalam	100	2009	...		100	2009	100	2009	...	
Japan	...		...		100	2005	...		...	
Korea (Rep.)	100	2008	100	2008	100	2008	100	2008	5	2008
Malaysia	100	2008	100	2008	100	2008	80	2008	13	2008
Nauru	...		...		0	2009	0	2009	19	2009
Singapore	100	2009	...		100	2009	100	2009	5	2009
Thailand	72	2008	100	2008	100	2008	100	2009	25	2008
CIS										
Belarus	...		...		61*	2008	7*	2008	23*	2008
Russia	...		...		80*	2008	43*	2008	15*	
Ukraine	...		...		40	2007	...		...	
Europe										
Albania	...		...		96	2009	96	2009	32	2009
Andorra	100	2009	10	2009	100	2009	100	2009	9	2009
Austria	...		...		100	2007	...		6	2008
Belgium	...		...		97	2006	...		...	
Bosnia and Herzegovina	9	2008	75	2008	100	2008	100	2008	30	2008
Croatia	100	2009	100	2009	100	2009	100	2009	9	2009
Cyprus	...		...		95	2006	...		...	
Czech Republic	...		...		99	2006	...		9	2008
Denmark	...		...		100	2009	...		...	
Estonia	...		...		97	2008	86	2008	6	2008
Finland	100	2008	100	2008	100	2008	85	2008	4	2008
France	...		...		90	2006	...		...	
Germany	...		...		98	2006	...		...	
Hungary	...		...		99	2009	...		6	2009
Ireland	...		...		98	2006	...		...	
Italy	...		...		98	2006	...		...	
Latvia	...		...		100	2009	...		11	2009
Lithuania	...		...		69	2009	69	2009	9	2009
Luxembourg	...		...		96	2006	...		...	
Malta	100	2009	...		100	2009	100	2009	6	2009
Norway	...		...		100	2009	...		...	
Poland	...		...		93	2006	...		10	2008
Portugal	...		...		92	2006	...		...	
Slovak Republic	...		...		100	2008	66	2008	9	2008
Slovenia	...		...		100	2006	...		...	
Spain	...		...		95	2006	...		...	
Sweden	100	2008	100	2008	100	2008	100	2008	3	2008
The Netherlands	...		...		100	2006	...		...	
Turkey	...		...		86	2009	86	no yr.	26	2009
United Kingdom	100	no yr.	100	2009	100	2009	100	2009	5	2009

Annex 2.1: ICTs in schools (ISCED levels 1-3), 2009** (continued)

Country	% of schools with radio		% of schools with TV		% of schools with Internet		% of schools with broadband		Learners to one computer	
The Americas										
Argentina	...		...		42	2007	22	2007	34	2007
Bolivia	...		...		0	2008	0	2008	...	
Brazil	...		25	2009	56	2009	...		...	
Canada	...		...		100	1999	...		...	
Chile	...		...		75	2009	67	2009	13	2009
Colombia	...		...		29	2008	...		...	
Costa Rica	3	2008	2	2008	44*	2008	...		25	2008
Dominican Republic	...		1	2008	2	2008	...		179*	2008
Guatemala	0.2	2009	3	2009	0*	2009	...		95*	2009
Mexico	...		34	2008	31	2008	...		16	2008
Paraguay	...		...		8	2008	...		...	
St. Lucia	44	2009	64	2009	95	2009	90	2009	34	2009
St. Vincent and the Grenadines	...		...		33	2009	31	2009	60	2009
Uguguay	...		...		100	2008	100	2008	...	
United States	...		...		100	2005	97	2005	...	
Other economies										
Palestinian Authority	96	2009	91	2009	23	2009	...		37	2009

Note **Or latest available year. Includes estimates. Existing data are presented for total schools (public and private), unless marked by an * which indicates only public schools. "...": data not available.

Source: UIS Pilot Questionnaire on Statistics of ICT in Education; ITU Survey on the WSIS Targets; national sources.