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# INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN EDUCATION IN SUB-SAHARAN AFRICA

## A comparative analysis of basic e-readiness in schools

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## Introduction

Information and communication technology (ICT) plays an ever important role in increasing economic productivity through digital economies, enhancing the delivery of public and private services and achieving broad socio-economic goals in education, health care, employment and social development. As a result, countries are advancing ICT policies to underpin growth in a variety of socio-economic sectors and help steer development and competition. Yet given the rapidly evolving ICT landscape due to a variety of newly emerging technologies, systematic examination and evaluation of these policies are essential.

In the education sector, policymakers widely accept that access to ICT can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility. They emphasise that ICT in education has a multiplier effect throughout the education system, by:

- enhancing learning and providing students with new sets of skills;
- reaching students with poor or no access (especially those in rural and remote regions);
- facilitating and improving the training of teachers; and
- minimising costs associated with the delivery of traditional instruction.

Beyond the rhetoric and of great importance to policymakers are basic questions related to the usage of ICT in education and student outcomes, including retention and learning achievement. There are those who contend that computers and other ICTs have properties or affordances that directly change the nature of teaching and learning (Kozma, 1991; 1994; Dede, 1996), while others argue that ICTs are merely a delivery mechanism for teaching and learning and it is the foundational pedagogy that matters (Clark, 1983; 1994). Regardless, a better understanding of ICT in education and how it is integrated across national education systems must be a priority for all countries.

## 1. Why do we measure ICT in education?

The UNESCO Institute for Statistics (UIS) is mandated to administer international data collections on the availability, use and impact of ICT in education. Through the establishment of internationally comparable and policy-relevant indicators, the UIS contributes towards benchmarking and monitoring of the integration of and access to ICT in education, which are fundamental for policymakers to select priorities and adopt and develop policies. For example, policymakers may use UIS data to inform decisions related to: i) national capacity and/or infrastructure levels (e.g. electricity, Internet, broadband) for integrating ICT tools in more schools; ii) the types of ICT currently being neglected and/or emphasised in relation to concerns of usability and affordability (e.g. radio- versus computer-assisted instruction); iii) whether ICT-assisted strategies are evenly distributed nationwide; iv) whether girls and boys have equal access; v) the types of support mechanisms currently in place or the lack thereof; and vi) the relative level of teacher training provided in relation to the demands placed on them to teach and/or use ICT in the classroom.

Neither the Millennium Development Goals (MDGs) nor *Education for All* (EFA) provided concrete objectives or goals related to the role of ICT in education. However, more than a decade later, the World Summit on the Information Society (WSIS), which convened in 2003 and 2005, resulted in a clear commitment by governments to foster the achievement of an inclusive information society. To this end, the WSIS Plan of Action identified ten targets to be achieved by 2015 – two of which are related to education *(see **Box 1**).*

**Box 1. WSIS targets on education and related indicators**

**Target 2. Connect all secondary schools and primary schools with ICT**

1. Proportion of schools with a radio used for educational purposes
2. Proportion of schools with a television used for educational purposes
3. Learner-to-computer ratio
4. Proportion of schools with Internet access, by type of access

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

1. Proportion of ICT-qualified teachers in schools
2. Proportion of teachers trained to teach subjects using ICT
3. Proportion of schools with computer-assisted instruction (CAI)
4. Proportion of schools with Internet-assisted instruction (IAI)

*Source: Partnership on Measuring ICT for Development, 2011*

Yet, despite the growing demand for data on ICT in education, the best-known international sources of education statistics lack basic information about ICT policy in education. For developed countries, neither the Organisation for Economic Co-operation and Development (OECD) nor the European Commission have a comprehensive set of indicators that include all three components of inputs, processes and outcomes related to ICT – although they are both increasingly improving the dataset to include, for instance, assessments of student performance in digital skills. In fact, the OECD's Programme for International Student Assessment (PISA) dataset remains one of the most reliable sources of information on access, use and outcomes in this domain, despite its limitations in terms of geographical coverage, reliability and inadequacy regarding current classroom practices (OECD, 2010; 2011; Scheuermann, Pedró and European Commission, 2009).

The situation is even more challenging for developing countries *(see **Box 2**)*, however the UIS has conducted regional data collections in Latin America and the Caribbean (UNESCO-UIS, 2012), Arab States (UNESCO-UIS, 2013), and Asia (UNESCO-UIS, 2014) to provide a comparative perspective of the integration of and access to ICT in education. Unfortunately, a comprehensive global assessment in developing countries remains sorely lacking.

## 2. Methodology: E-readiness as a framework for quantifying ICT in education

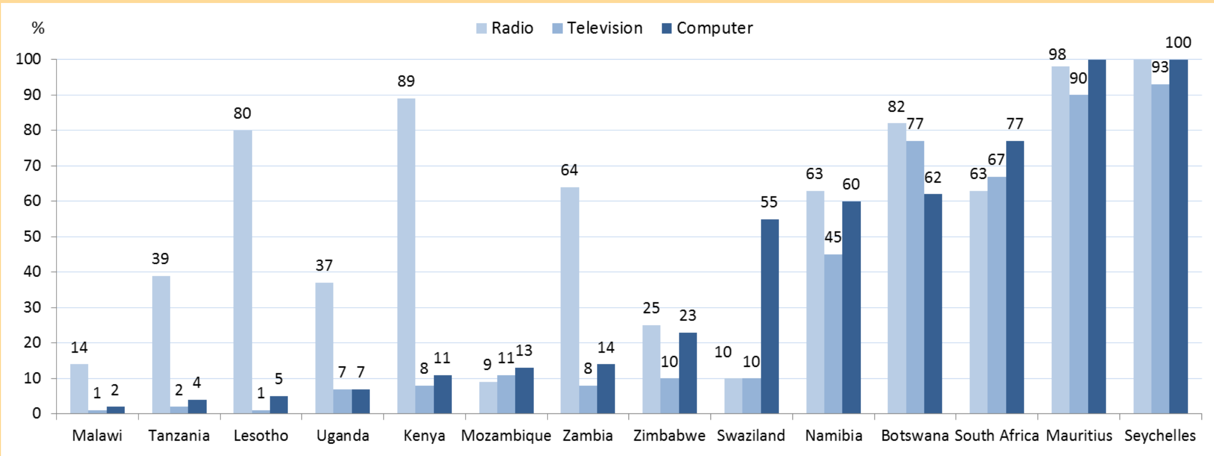
E-readiness is a measure of the degree to which a country is prepared to partake in "e-activities" and thus use ICT in education (Dada, 2006). E-readiness may be measured by a number of indicators presented in the UIS *Guide to Measuring Information and Communication Technologies (ICT) in Education (DOI: http://dx.doi.org/10.15220/978-92-9189-078-1-en).*

With the support of the Korean Education and Research Information Service (KERIS) and Brazil's Center of Studies on Information and Communication Technologies (CETIC.br), the UIS co-organised statistical capacity building workshops for sub-Saharan African countries in 2013 and 2014 to train national statisticians in ministries of education and other relevant ministries or national statistical organizations to collect and report data on ICT in education using a newly designed UIS data collection instrument. After the workshop, surveys covering primary and secondary education *(see http://www.uis.unesco.org/UISQuestionnaires/Pages/Communication.aspx)* were mailed to all countries in the region. Using these administrative data, this report presents the level of ICT integration and e-readiness in the 18 responding countries out of 45 across sub-Saharan Africa. Additional data on the availability of electricity in schools is obtained from the UIS Regional Module for Africa (http://www.uis.unesco.org/UISQuestionnaires/Pages/default.aspx). Although Djibouti is typically included within the Arab States region, the country was part of the data collection exercise and has been included in this report.

**Box 2. Various ICTs in primary schools in sub-Saharan African: Evidence from the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ), 2007**

Within its mandate to improve the overall quality of education in the region, SACMEQ has assessed the educational achievement among girls and boys at the end of primary school in 14 sub-Saharan African countries since 1995. To evaluate school resources and their impact on achievement, SACMEQ III collected data on radio, television and computers in primary schools. The target population was defined as all pupils at Grade 6 level in 2007 (at the first week of the eighth month of the school year) who were attending registered mainstream primary schools. A sample of schools covering all regions was used.

**Figure 1. Proportion of Grade 6 pupils in primary schools with radio, television and computers, by country, 2007**




**Notes:** Countries are in ascending order according to the proportion with computers.
*Source: Hungi et al., 2011*

**Figure 1** shows wide variations of ICTs within primary schools across sub-Saharan Africa. In 2007, ICTs were least common in Malawi, Mozambique and Zimbabwe, where 25% or fewer schools had neither radio, television nor computers. For example, in Malawi just 14%, 1% and 2% of schools had radio, television and computers, respectively. SACMEQ defines radio as an essential class resource in primary schools, given the scarcity of television and computers and the electricity to operate them. However, many countries were not able to provide radios in the majority of schools, including Malawi, Mozambique, Tanzania, Uganda and Zimbabwe, resulting in the majority of children in primary schools in these countries having had no access to any form of ICT. In contrast Lesotho, Kenya and Zambia could partially bridge the ICT gap having established radio in 80%, 89% and 64% of primary schools, respectively. Finally, ICTs were relatively well integrated in countries in Southern Africa. More than 60% of primary schools in Botswana, Namibia and South Africa have radio, television and/or computers, while this figure increased to more than 90% of schools in Mauritius and Seychelles.

Analysis by Hungi (2011) of the pupil and school-level factors contributing most to variations in reading and mathematics achievement across most of the 15 school systems demonstrated that socio-economic background, grade repetition, age and school resources had the greatest impact. Unfortunately it is not known what specific contribution computers at home or at school had on achievement, if any. Moreover the literature on ICT and impact on outcomes is replete with inconsistencies and contradictions making simple cause-effect statements problematic.

## 3. Challenges measuring ICT in education in sub-Saharan Africa

The most significant obstacle in measuring ICT in education in sub-Saharan Africa is the lack of systematic data collections. Several countries do not currently carry out data collections, while others are in their infancy. In fact, in response to the recent UIS data survey amongst sub-Saharan African countries, Angola, Benin, the Central African Republic, Congo, the Democratic Republic of Congo, Djibouti and Somalia all reported that at the current time (i.e. 2013/2014) no systematic data collection on ICT in education existed at the national level.

The existence of a systematic data collection typically reflects national priorities, and in many countries in sub-Saharan Africa, the integration of ICT is a low priority when compared to other objectives, including increasing enrolment rates, decreasing the proportion of out-of-school children and ensuring an adequate number of trained teachers. Furthermore, the integration of ICT in education is occurring relatively slowly in many countries due to a number of factors, including a lack of formal policy, financial resources, basic infrastructure and teachers with appropriate skills.

## 4. Integrating ICT in education through policy, formal commitments and curricula

### *ICT in education policy and plans*

Policymakers are in a unique position to bring about change. This is illustrated in a study of 174 ICT-supported innovative classrooms in 28 countries (Kozma, 2003). In 127 cases, there was an explicit connection between ICT innovation and national policies that promoted the use of ICT (Jones, 2003). But while the introduction of ICT policy is necessary for change, it is not sufficient to result in its implementation or impact (Tyack and Cuban, 1995). Policies can, of course, fail to succeed and this happens when: i) they are viewed as mere symbolic gestures; ii) teachers actively resist policy-based change that they view as imposed from the outside without their input or participation (Tyack and Cuban, 1995); iii) they do not have explicit connections to instructional practice (e.g. focus on hardware rather than their relationship to pedagogy); iv) they do not provide teachers with an opportunity to learn the policies and their instructional implications; and v) there is a lack of programme and resource alignment to the policies' intentions (Cohen and Hill, 2001).

As previously demonstrated in a UIS report on ICT in education in Asia (UNESCO-UIS, 2014), policies vary between countries by level of specificity. For example, ICT in education policy may be expressed within:

- References to ICT in education sector strategy policy documents and plans;
- References to the education sector in national cross-sector ICT policy documents and plans; or
- Specific ICT in education policy documents.

Specific ICT in education policy documents typically develop the scope of the national policy most effectively. Eritrea's "National Policy for ICT in Education in Eritrea" (Eritrea, 2005) (http://www.eritreaembassy-japan.org/data/National%20Policy%20for%20ICT%20in%20Education.pdf) is one such example. Regardless of the type of policy, UIS survey data in **Table 1** show that in sub-Saharan Africa a number of countries have a policy addressing ICT in education. In some countries, for instance Djibouti and Togo, ICT in education policy uniquely covers certain education levels, most commonly upper secondary education.

While policies are defined as government-issued documents which set out the principles, guidelines and strategy for ICT in education, a plan is another important instrument. It documents how these principles are to be achieved within a specified timeframe and details each activity to be undertaken, the method employed for implementation, the timeframe, the resources required and the actors responsible for implementing each activity. Kenya's "National Information and Communication Technology (ICT) Strategy for Education and Training" (Kenya, 2006) is an example (http://nepadkenya.org/documents/MOE-ICT%20in%20Education.pdf). A number of countries across the region report having a plan to implement ICT into the education system.

In contrast, an active policy or plan does not exist in Cameroon, Comoros, Congo, Guinea, Lesotho and Madagascar *(see Statistical Table 1)*.

**Table 1. Countries in sub-Saharan Africa and policy on ICT in education, 2013-2014**

<table>
<tr><th>Country has a policy on ICT in education</th><th>Only for upper secondary education</th><th>No policy or plan</th><th>No information</th></tr>
<tr><td>Angola, Botswana, Côte d'Ivoire, Eritrea, Gambia, Mauritius, Rwanda, Sao Tome and Principe, South Africa, Uganda and Zambia</td><td>Ethiopia, Djibouti and Togo</td><td rowspan="3">Cameroon, Comoros, Congo, Guinea, Lesotho and Madagascar</td><td rowspan="3">Benin, Burundi, Cabo Verde, Central African Republic, Chad, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Guinea-Bissau, Malawi, Mali, Namibia, Nigeria, Senegal, Sierra Leone, Somalia, Swaziland, United Republic of Tanzania and Zimbabwe</td></tr>
<tr><th colspan="2">Country has a national plan on ICT in education</th></tr>
<tr><td colspan="2">Botswana, Burkina Faso, Côte d'Ivoire, Gambia, Kenya, Liberia, Mozambique, Niger, Sao Tome and Principe, South Africa, Uganda and Zambia</td></tr>
</table>

**Notes:** Data for South Africa reflect 2011; data for Angola, Botswana, Togo and Zambia reflect 2012; and data for Ethiopia, Gambia, Kenya, Liberia, Mauritius and Mozambique reflect 2014.

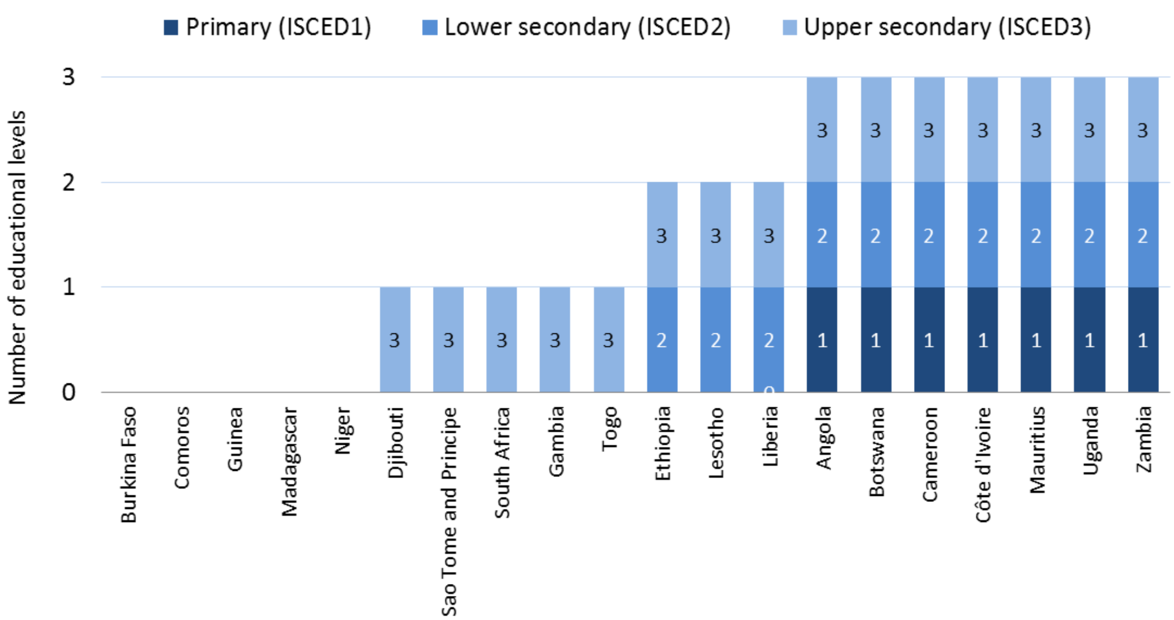
*Source: UIS statistical database, 2015 (Statistical Table 1); World Bank, 2013.*

### *ICT in education in national curricula*

Curriculum that includes courses on basic computer skills and that which uses ICT for the instruction of other subject areas is typically a reflection of policies advocating ICT in education. The early integration of ICT into primary and secondary curricula through formal recommendations is an important lever to ensure children and adults will develop digital literacy, not only for general life and work skills but also to empower youth in their ongoing education throughout secondary, post-secondary and tertiary education levels. While it is evident that curriculum cannot be implemented prior to the integration of the vital infrastructure, recommendations for ICT in curriculum can play an important role in promoting its use at the school level.

Especially where ICTs are absent in households, learning basic computer skills or computing in schools is important for developing skills and lifelong learning. **Figure 2** presents countries that have specific curricular objectives or a course on basic computer skills (or computing) in primary and secondary education. Several countries across the region do not have objectives or offer courses on basic computer skills or computing in primary or secondary curricula, including Burkina Faso, Comoros, Guinea, Madagascar and Niger. In other countries, regardless of whether or not it is achievable in all schools, courses are first recommended in upper secondary education in Djibouti, Gambia, Sao Tome and Principe, South Africa and Togo, and in lower secondary education in Ethiopia, Lesotho and Liberia. . Finally, while such objectives or courses are rare at the primary level in sub-Saharan Africa, Angola, Botswana, Cameroun, Côte d'Ivoire, Mauritius, Uganda and Zambia have recommendations in their national curriculum to do so.

**Figure 2. Education levels with an objective or course in basic computer skills or computing, 2013**




**Notes:** Educational levels are represented according to the International Standard Classification of Education 2011 (ISCED 2011). In ISCED 2011, the following education levels are labelled as follows: primary education = ISCED 1; lower secondary education = ISCED 2; and upper secondary education = ISCED 3.
Data for South Africa reflect 2011; data for Angola, Botswana, Togo and Zambia reflect 2012; data for Ethiopia, Gambia, Liberia and Mauritius reflect 2014.

*Source: UIS statistical database, 2015 (Statistical Table 2)*

In addition to the instruction of basic computer skills or computing, ICT is used to support teaching other subjects to enhance or expand student learning opportunities and may include i) mathematics; ii) natural sciences; iii) social sciences; iv) reading/writing and literature; v) second languages, among others. National curriculum may be explicit about which subjects are to be supported by ICT; however, curricula may also be explicit about the level of education, number of hours per week, or about the types of ICT used, while other countries may have a more generalised set of recommendations that are not specific to education level, subject, duration or type of ICT.

Despite variable capacity to provide ICT in education in all schools and for all children, UIS survey data in **Table 2** show that, whereas most countries (responding to the survey) have established formal recommendations to integrate ICT in at least some subject areas, the level and grades recommended for integrating ICT in curricula vary. For example, in South Africa recommendations for integrating ICT begin in primary education and cover all subjects and grades, whereas in Côte d'Ivoire and Zambia formal recommendations exist for some grades in primary education and then all grades in secondary education. In contrast, formal recommendations for integrating ICT in curricula are least common in Gambia, Madagascar and Sao Tome and Principe where they begin only at the upper secondary level and in just some grades. There are no formal recommendations at all for integrating ICT across subjects or education levels in Burkina Faso, Comoros, Guinea, Niger and Togo.

Moreover, formal recommendations are not always made for all subject areas. For example, Sao Tome and Principe has formal curricular recommendations for Social Sciences, whereas in Botswana formal recommendations exist to support Mathematics, Natural Sciences, Social Sciences and Foreign Language learning *(see Statistical Table 2)*.

**Table 2. Formal recommendations to integrate ICT in education in curricular subjects, 2013-2014**

| | **Formal recommendations to integrate ICT in education in curricular subjects:** | | |
|---|---|---|---|
| | **Primary education** | **Lower secondary education** | **Upper secondary education** |
| **All grades** | South Africa | Côte d'Ivoire, Ethiopia, South Africa and Zambia | Côte d'Ivoire, Djibouti, Ethiopia, South Africa and Zambia |
| **Some grades** | Angola, Botswana, Cameroon, Côte d'Ivoire, Mauritius and Zambia | Angola, Botswana, Cameroon and Mauritius | Angola, Botswana, Cameroon, Gambia, Madagascar, Mauritius and Sao Tome and Principe |
| **No grades** | Burkina Faso, Comoros, Guinea, Niger and Togo | | |

**Notes:** Data for South Africa reflect 2011; data for Angola, Botswana, Togo and Zambia reflect 2012; data for Ethiopia, Gambia and Mauritius reflect 2014.

*Source: UIS statistical database, 2015 (Statistical Table 2)*

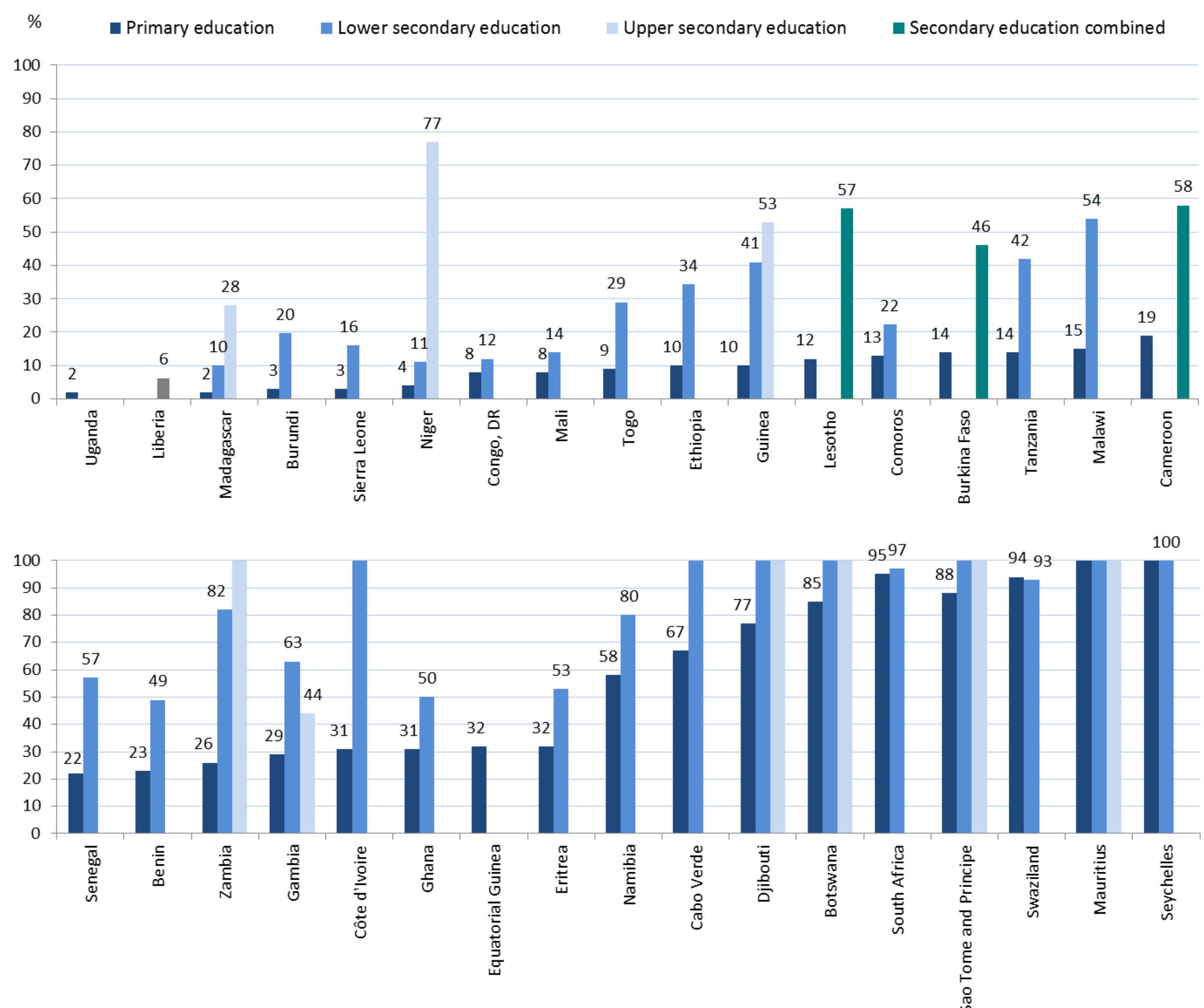
## 5. Electricity in schools

While battery-operated mobile devices that can be recharged off-site (e.g. mobile telephones including smart phones) have the potential for supporting instruction, most devices such as television, desktop/laptop/tablet computers and the Internet continue to require a more stable energy source. In other words, the integration of ICT in schools requires electricity that is regularly and readily available. In many developing countries, however, rural, remote and nomadic regions are frequently neglected when developing national infrastructure, yet they would be well served by innovative ICT solutions such as radio broadcasts, especially ones which are interactive in nature (UNESCO-UIL, 2014) *(see **Box 3**).* Moreover, even when schools are connected to an electrical grid, power surges and brownouts are common in both rural and urban areas further impeding the reliable usage of ICT (Mudenda, et al., 2014; Practical Action, 2013).

According to **Figure 3**, electricity is rare in primary schools in Burundi, Madagascar, Sierra Leone, Niger and Uganda where fewer than 5% are connected. It is also infrequently available in primary schools in Burkina Faso, Cameroun, Comoros, the Democratic Republic of the

Congo, Ethiopia, Guinea, Lesotho, Malawi, Mali, Togo and the United Republic of Tanzania where fewer than 20% have an electrical supply. In contrast, more than three-quarters of primary schools have an electrical supply in Botswana, Djibouti, Sao Tome and Principle, South Africa and Swaziland. In Mauritius and Seychelles, all primary institutions have electricity. Figure 3 also shows that secondary schools typically have relatively higher rates of electricity. This is most evident in Niger, where 77% of upper secondary schools have electricity compared to 4% in primary schools. In Liberia, where data cannot be disaggregated by school level, only 6% of primary and secondary schools combined have electricity. In the Central African Republic, the number of schools in primary and lower secondary level with electricity is negligible (near 0%).

**Figure 3. Electricity in public educational institutions, in primary and secondary education, 2013**




**Notes:** Data for Botswana, Eritrea, Mali, Namibia, Senegal, Seychelles, Sierra Leone, Swaziland, the United Republic of Tanzania and Zambia reflect 2012; data for Gambia, Liberia, Mauritius and Togo reflect 2014. Data for Burkina Faso, Cameroon, Djibouti, Gambia, Guinea, Lesotho, Madagascar, Mauritius, Niger and Sao Tome and Principe reflect public and private schools. Data for Liberia reflect primary and secondary education combined.

*Source: UIS Statistical database, 2015; Regional Module for Africa; Statistical Table 3*

**Box 3. Supporting learning in schools and communities through broadcast community radio: Two examples of radio-assisted instruction in Uganda and Liberia**

Broadcast community radio is a medium that gives voice to the voiceless, serves as a mouthpiece of the marginalised and is at the heart of communication and democratic processes within society (UNESCO, 2001). It can be locally owned and therefore remains popular in both developed and developing countries – particularly in rural and remote areas where awareness and sensitisation remain key tasks for improving social indicators. Compared with television, it offers cheaper, faster and therefore localised content and community interaction over a specified geography (Twining et al., 2015). In addition, where electrical infrastructure is lacking, radio offers an advantage over television since it can be powered through the use of batteries.

Radio can be used effectively to spread information and awareness in areas of governance, health, politics and education. Radio-assisted instruction plays an important role for extending educational opportunity to children in remote and rural areas where access to schooling is a challenge. In addition, with increasing mass access to mobile phones, radio has become interactive and accessible to individuals at home and as a Bring Your Own Device (BYOD) in schools. For example, many radio programmes have adopted an interactive radio style that uses mobile phones (audio and/or texting) to enable two-way interactions during the radio broadcast programme. In addition, most mobile phones have radio as a plug-in, so that radios are used increasingly as an individual device both at home and in groups at school with the addition of speakers (Twining et al., 2015).

Since its establishment in 2003, Uganda's Nakaseke community radio has served as a forum and knowledge portal for poor rural communities in Nakaseke, an impoverished district 75 km from Kampala. Nakaseke has been part of a piloted series of Multipurpose Community Telecentres (MTCs) (Ssenabulya, 2012). Education is one of the station's main programmes and recently Nakaseke radio – along with primary teachers from both government and private schools – started a programme called The Radio Quiz Competition in order to motivate students to improve their performance and raise literacy levels and academic achievement. The programme targets all schools in the district, which has a total of 95 primary schools and 13,400 pupils and where the primary pupil-teacher ratio is 75:1 (Ssenabulya, 2012). According to an evaluation carried out by the district education authorities and the District Teachers' Association (DTA), the competition has helped in:

- Promoting confidence among learners;
- Raising the academic standards in Nakaseke district and Uganda at large;
- Enabling teachers from different schools to share views and ideas on teaching;
- Enabling teachers to evaluate their teaching;
- Promoting competition amongst the students, providing them motivation to succeed;
- Exposing the pupils to an educational environment beyond the classroom; and
- Providing free computer trainings every year for pupils at the telecentre (Ssenabulya, 2012).

With the Ebola crisis resulting in school closures across Liberia, a USAID-funded initiative called "Advancing Youth Project in Liberia" has brought learning to homes in infected areas via ten broadcast community radio stations. Under this programme students tune in regularly as if for regular classes; they take notes and stay connected with schooling and literacy skills. They are also supported to improve their own as well as their families' knowledge of health including information related to Ebola. The project also set up a telephone hotline for students to call in and offer feedback (EDC, 2015; Twining et al., 2015).

## 6. Computer density

In order to ensure that instruction using computers and online tools meet the needs of all pupils, a sufficient number of computers, i.e. computer density, must be established keeping pace with demand based on enrolment. However, computer availability across sub-Saharan Africa remains poor. For example, the New Partnership for Africa's Development (NEPAD) found that 55% of secondary students participating in the first phase of the NEPAD e-schools initiative[1] reported no experience whatsoever with computers and most schools did not provide learning opportunities or teacher training (Adomi and Kpangban, 2010).

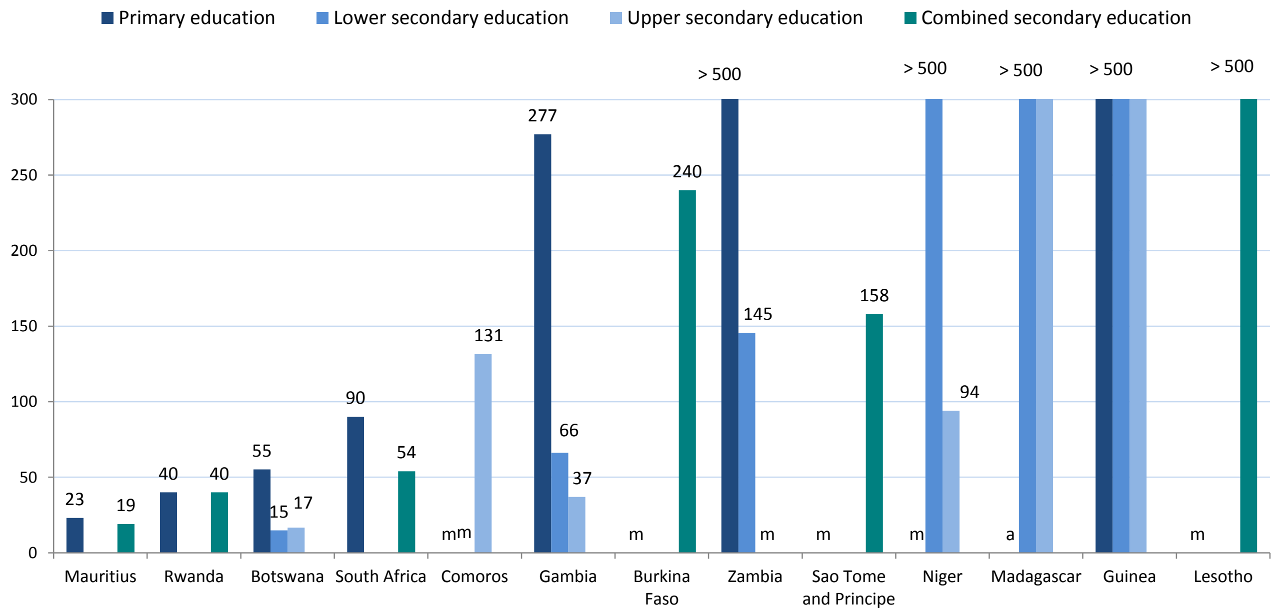
Computer density can be measured using the learner-to-computer ratio (LCR), which refers to the mean number of pupils sharing a single computer available for pedagogical use in national, aggregate education systems. While, the LCR sheds light on current infrastructure to support e-learning, national-level LCRs mask sub-national differences within a single country (i.e. digital divide). For instance computers are very unevenly spread within African countries, typically being concentrated in relatively few schools that already have the basic infrastructure to support them. Furthermore, in many developing countries such as Zimbabwe, computers may not be used to their potential or might even be stored away due to a number of factors, including weak school infrastructure, a lack of teacher training for ICT or general anxiety related to their use (Konyana and Konyana, 2013).

**Figure 4** shows that computer resources are greatly overstretched in primary education in a number of countries including Gambia, where 277 pupils on average share a single computer. Computers are especially overstretched in Zambia and Sao Tome and Principe, where there are more than 500 primary school pupils per computer. While the LCR is an average, computer resources may be so strained in many schools that time on task is too limited per pupil to allow a meaningful learning experience. While no country reporting data provides evidence of high computer density among pupils, some countries have made progress to lower their LCR. The primary level LCR in South Africa, Botswana, Rwanda and Mauritius is 90:1, 55:1, 40:1 and 23:1, respectively. In Rwanda, computer density is partly due to its involvement with the *One Laptop Per Child (OLPC)* programme, which included the distribution of more than 150,000 low-cost laptop computers to approximately 11% of Rwanda's primary schools (Rwanda, 2012).

According to Figure 4, computers are more frequently available for secondary education (i.e. based on enrolment), which might reflect the tendency to prioritise ICT in secondary education curricula compared to primary education. In Gambia, the LCR decreases from 277:1 in primary education to 66:1 and 37:1 in lower and upper secondary education, respectively, while in South Africa, the LCR decreases from 90:1 in primary education to 54:1 for combined secondary. In other countries, evidence shows that LCRs remain very high in secondary education. For example, there are more than 500 learners on average sharing a computer in lower secondary education in Guinea, Madagascar and Niger, while at the upper secondary level the LCR in Niger decreases to 94:1 but remains at over 500:1 in Guinea and Madagascar. Rwanda remains an exception to other countries in the region in that the ratio for both primary and secondary levels is the same at 40:1.

[1] Countries participating in the first phase of NEPAD's e-school initiative included: Algeria, Burkina Faso, Cameroon, Congo, Egypt, Gabon, Lesotho, Mali, Mauritius, Mozambique, Nigeria, Rwanda, Senegal, South Africa and Uganda.

**Figure 4. Learner-to-computer ratio, primary and secondary education, 2013**




**Notes:** m = missing data; a = not applicable. Data from Botswana reflect public sector schools only. Data from South Africa reflect 2011; data from Botswana, Rwanda and Zambia reflect 2012; data from Gambia and Mauritius reflect 2014.

*Source: UIS Statistical database, 2015; Statistical Table 3.*

## 7. Computer-assisted instruction and deployment

Computer-assisted instruction (CAI) is defined as an interactive learning method in which a computer is used by teachers or pupils to present instructional material, perform tasks for learning, and help in selecting and accessing additional pedagogical material (UNESCO-UIS, 2009). To provide all pupils with sufficient exposure to CAI, an adequate number of computers is important. However, to be delivered effectively, CAI also requires more than a haphazard distribution of computers across schools; computer laboratories and ICT support services may also play important roles in how CAI is delivered.

Establishing computer laboratories in schools is typically perceived to be a significant upgrade from classrooms with one desktop computer “at the back of the room”. Computer laboratories offer the promise of a learning environment with one device per child, structured and controlled by a well-trained and knowledgeable teacher. More recently, however, educational technologists argue that computer laboratories have become obsolete and provide a disservice to education. For example, given the multitude of both school- and personally-owned devices (including laptops, tablets and mobile devices), detractors of laboratories argue they imply a separation between computing as a subject and the general curriculum. Others meanwhile argue that the inclusion of a smaller number of computers and other devices in classrooms helps to build stronger links between ICT and curriculum, facilitating the development of ‘higher-order’ skills (Pedro, 2012; Trucano, 2005; UNESCO, 2011).

Shifting focus away from laboratories, schools in developed countries are deploying computers, interactive whiteboards and light-emitting diode (LED) projectors in classrooms, school libraries and other convenient locations around the school for both pupils and teachers. While this approach to ICT-assisted instruction is evolving amongst high-income countries, inadequate budgets in most schools hinder ICT provision beyond a few computers, and as such, policies remain focused on establishing and maintaining computer laboratories. At the school level, this focus also seems to be bolstered by the following perceptions that: i) schools need to provide security for expensive computer hardware; ii) ICT has specialised uses similar to science laboratories; and iii) computers are for use by specialists and not by ordinary subject teachers and pupils (ADB, 2012). In some developing countries, innovative solutions, including mobile laboratories, cyber cafes and community telecentres, offer schools the opportunity to engage with ICT *(see **Box 4**)*.

While computer density remains very low in a number of developing countries (i.e. reflected by high learner-to-computer ratios, laboratories may play an important role in managing and organizing how and when children can access computers and digital devices for learning. For this reason, laboratories – in addition to classroom-based learning – may be viewed in combination to effectively support ICT-assisted instruction, especially using computers and the Internet. Previous data from the *Programme d'Analyse des Systèmes Éducatifs de la CONFEMEN (PASEC),* covering West and Central African countries, demonstrated that 5% or fewer children in Grades 2 and 5 attended a school that housed a computer laboratory in Mali in 2012 (PASEC, 2014), the Democratic Republic of the Congo (PASEC, 2011), and Togo (PASEC, 2012a) in 2010, and Côte d'Ivoire in 2009 (PACEC, 2012b).

**Box 4. Solar-powered mobile ICT computer laboratories: An innovative solution to connect rural sub-Saharan African schools**

As part of its Digital Villages community initiative, Samsung Electronics has partnered with Kenya, Nigeria, Senegal, South Africa and Sudan to provide comprehensive support to improve health, enhance educational opportunities and boost employability amongst primary school-age, secondary school-age and adult populations. Samsung has set a target of reaching 2.5 million learners across the continent by the end of 2015. The initiative is targeted to areas in which electricity supplies are unreliable or non-existent (Twining et al., 2015). According to Samsung, the typical village ICT infrastructure that they provide consists of a number of solar-powered elements: i) Internet school (laboratories); ii) tele-medical centre; iii) generator; iv) health centre; and v) lanterns (Samsung, 2013).

The overall programme is focused on the deployment and creation of ICT infrastructure. Internet schools are created from re-purposed shipping containers, making them relatively transportable. The 12 m long space allows for classes of between 20 and 25 students, and each container comes equipped with a large interactive whiteboard, solar-powered notebooks, tablets and cameras. All devices can connect to the Internet via wireless broadband. Photovoltaic solar panels affixed to the container roof provide up to nine hours of electricity per day and charge using both visible and ultraviolet light, meaning overcast weather does not impede their usefulness. Furthermore, the robust panels are made of rubber, rather than plastic, improving their durability during transport and in harsh conditions. As well as providing Internet access, a local central server stores educational resources that can be accessed by teachers and students alike. In some locales, localised teaching and learning resources have been provided by partner organizations and pre-loaded onto the computers and server (Twining et al., 2015).

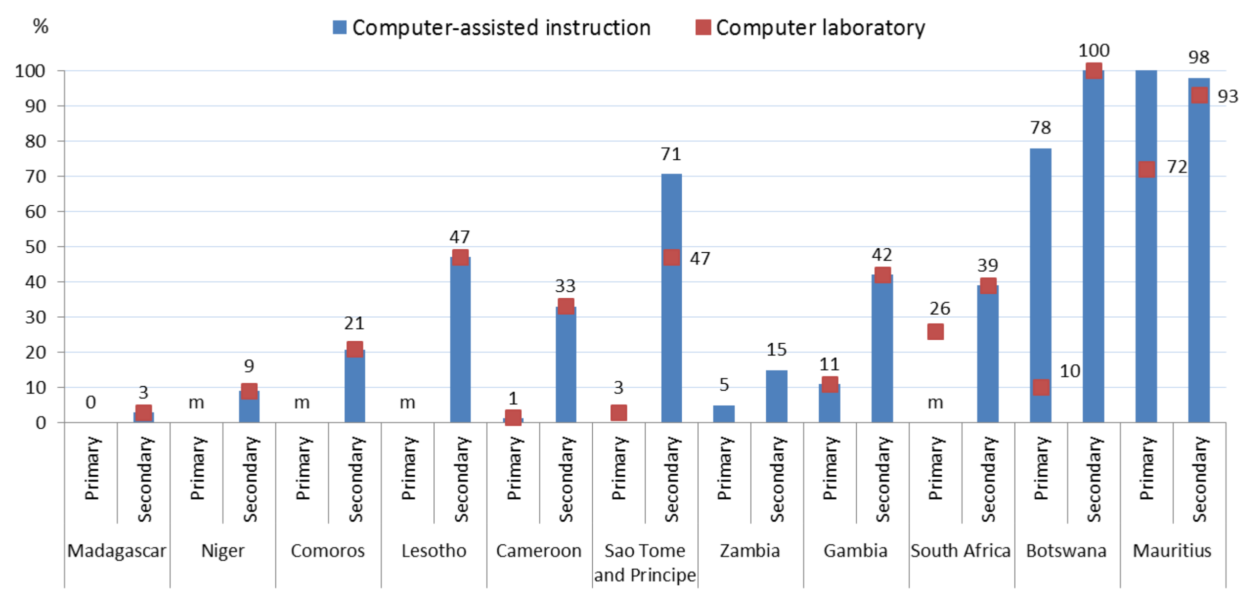
Training provided by partner organizations encourages collaboration between teachers and learning using videoconferencing capabilities. According to reports, teachers are further encouraged and supported to use technology with their standard curriculum. In Kenya, the Institute of Curriculum Developments has worked with Samsung in the development of ICT-enriched content aligned with the official school curriculum (Twining et al., 2015).

**Figure 5** shows the proportion of primary and secondary schools with CAI and computer laboratories for ten countries providing data. CAI is not offered in primary schools in Madagascar and is rare in Sao Tome and Principe and Zambia, where it is offered in 3% and 5% of primary schools, respectively. In contrast, it is offered in 78% of primary schools in Botswana. In Mauritius, CAI is universally offered in all primary schools.

Secondary schools are more likely to offer CAI, and this is particularly true in Sao Tome and Principe where 71% of secondary schools offer some form of CAI. Yet, despite the greater proportions of secondary schools offering CAI, still fewer than 10% offer it in Comoros and Madagascar.

According to Figure 5, in sub-Saharan Africa CAI is generally offered in computer laboratories. For instance, laboratories have been established in all schools with CAI in Cameroon, Gambia and Madagascar and all secondary schools in Comoros, Lesotho, Niger and South Africa. In contrast, Sao Tome and Principe and Mauritius do not deploy CAI only in computer laboratories but presumably also in classrooms and other locations in the school. For example, out of 71% of secondary schools with CAI in Sao Tome and Principe, there are laboratories in just 47%. Similarly in Mauritius, while CAI is almost universal in schools, laboratories are found in 72% and 93% of primary and secondary schools, respectively. An exception to this pattern is Botswana, where out of 78% of primary schools offering CAI, just 10% have a computer laboratory.

**Figure 5. Computer-assisted instruction and laboratories, primary and secondary education, 2013**




**Notes:** m = missing. Secondary education data for Comoros are for the upper secondary level only. Data for Botswana, Cameroon, Madagascar and South Africa reflect public sector schools only. Data for Botswana reflect 2012; and data for Gambia and Mauritius reflect 2014.

*Source: UIS Statistical database, 2015. Statistical Table 3*

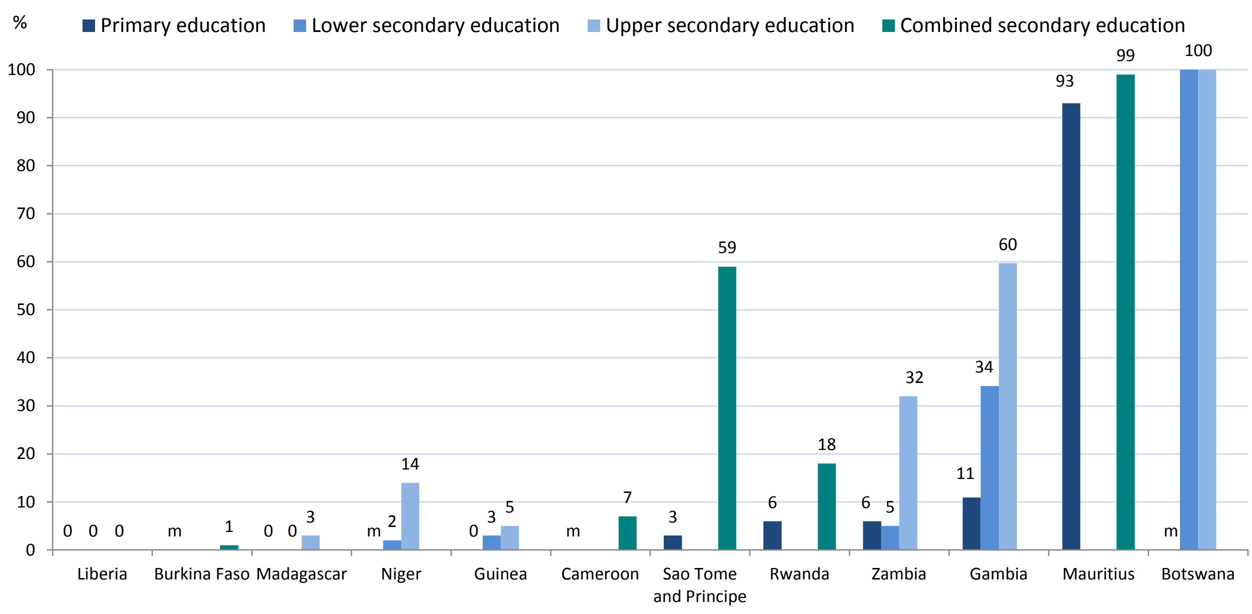
## 8. Internet to support online learning

Online or web-based learning refers to an interactive learning method using content from the World Wide Web. Ministries of education, however, often have little or no control over school Internet connectivity as this depends to a great extent on the level of development of the national telecommunications infrastructure and access to a reliable power supply (UNESCO-UIS, 2014; World Bank, 2010). In countries where fixed broadband Internet is infrequently available in schools, mobile Internet can be employed to connect pupils both in school and at home *(see* ***Box 5****).*

**Figure 6** shows the proportion of schools with Internet. However, the data are not disaggregated by use, i.e. schools that use the Internet for pedagogical purposes or administrative use. Moreover, data do not provide information on bandwidth, and therefore, the data may reflect a combination of schools with both broadband and narrowband.

Internet availability ranges substantially within sub-Saharan Africa. For example, Internet availability is negligible in schools in Burkina Faso, Guinea, Liberia and Madagascar. Generally, Internet is more available in secondary schools than primary schools, although remains scarce in 1% of combined secondary schools in Burkina Faso, 3% of upper secondary schools in Madagascar, and in 3% and 5% of lower and upper secondary schools in Guinea, respectively. In Niger the proportion of lower and upper secondary schools with Internet is 2% and 14%, respectively. Despite the progress achieved in decreasing the learner-to-computer ratios in Rwanda, Internet connectivity remains low with 6% and 18% of primary and secondary schools, respectively, being connected. At the other end of the range, Mauritius has connected 93% and 99% of primary and secondary schools, respectively, while Botswana has connected all public secondary schools to the Internet. Data for private primary schools in Botswana are not available.

**Figure 6. Proportion of educational institutions with Internet, primary and secondary education, 2013**




**Notes:** m = missing data. Data for Botswana, Burkina Faso and Madagascar reflect public institutions only. Data for Botswana, Rwanda and Zambia reflect 2012; data for Gambia, Liberia and Mauritius reflect 2014.

*Source: UIS statistical database, 2015. Statistical Table 3*

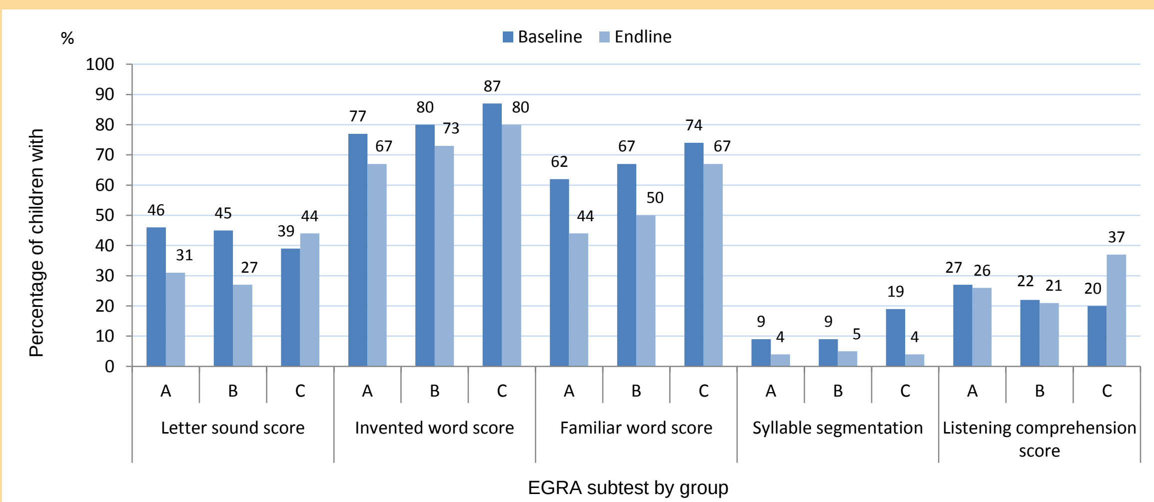
**Box 5. Using mobile phones to improve literacy skills in home-based programmes with primary children in disadvantaged districts of Uganda**

Given the proliferation of mobile phones in Uganda, MobiLiteracy Uganda (MLIT) was developed to see if text message prompting could bridge the gap between school and home to improve children's early literacy. Studies have documented how poor learning conditions in Ugandan schools result in children who cannot read after two to three years of schooling (Piper, 2010). Similarly, we know that school is not the only influence on learning; a child's home environment and having the opportunity to learn in and out of school can also make a difference. The Wakiso district of Kampala, which was chosen as the site for this study, includes both rural and urban schools. To participate in the programme, a child had to be in the first or second grade of primary education. The programme included three randomized groups where parents were provided: i) instructional prompts by mobile phone; ii) instructional prompts by paper; or iii) a one-time prompt delivered verbally. Student/parent pairs were recruited from eight schools selected purposefully based on similar demographic characteristics, which were confirmed by baseline data.

**Figure 7** presents the percentage of children who could not answer any question correctly (i.e. "zero score") before and after the programme. Final results indicate that actual gains were quite small across all groups, but children in both groups receiving the MLIT prompts (SMS and paper) showed greater improvement than the group receiving one verbal instruction only. Parent and student-reported measures of participation correlated positively with student scores (i.e. when parents and students said they used the programme regularly, the student's score was higher) while regression analysis suggests that changes were not due to factors such as home and school environment or family demographics.

Overall, parents expressed satisfaction with MLIT and support its expansion through mobile phone or by paper; however, many factors unrelated to the design of the materials prevent parents from engaging frequently with their children in literacy-promoting activities. The authors conclude that the opportunity to engage with a family member on a regular basis using specific content has a measurable effect on early literacy skills, especially for children with little or no previously-demonstrated reading ability. While the mobile programme is more likely to be implemented at larger scale, both formats would be improved by supplementary reading materials to reinforce the lesson content as well as follow up support.

**Figure 7. Zero scores by literacy subtest at baseline and endline for all groups**
Group A : Mobile phone group ; Group B : Paper ; and Group C: Verbal (control)




**Notes:** EGRA is an individual, oral assessment of reading. Children were asked to identify the sound of letters of the alphabet, say the syllables in words, read words (real and made up, or 'invented' words) in a list and answer questions about a story they heard. For more information about the assessment globally, see www.eddataglobal.org
*Source: S. Pouezevara and S. King (2014). MobiLiteracy-Uganda Program. Phase 1: Endline Report. Report. Research Triangle Park, NC: RTI International/ Urban Planet Media and Entertainment Corporation*

## 9. Looking forward: A call for action

ICT use in education is at a particularly embryonic stage in the majority of countries in sub-Saharan Africa. Nevertheless, there are new developments and announcements related to ICT in education on an almost daily basis somewhere on the continent. Yet, for many years Isaacs (2012) has noted that the focus of investment has been on making successive waves of new technologies work in resource-poor education environments – an emphasis that tended toward a techno-centric approach to ICT in education. Clearly, a strategy that prioritises sound pedagogy, training teachers to use ICT effectively to support instruction and building overall capacity is more appropriate.

While ICT is being introduced in education in most countries – albeit at different paces – expansion remains slow due to a lack of effective policies, basic infrastructure (e.g. electricity, devices, Internet), financial resources and teacher capacity. As such, the introduction of ICT in education in a minority of schools has the potential of widening the digital divide based on several factors, including sex, location and socio-economic status.

Although data on ICT integration in primary and secondary education in sub-Saharan Africa are scarce, this analysis provides a ‘snapshot’ of available resources to support ICT in education across a number of countries in the region. Collecting more and better quality statistics from sub-Saharan Africa will be a priority in the post-2015 development agenda as ICT is expected to play an increasing role in future education goals. The recent gathering of ministers of education at the UNESCO Conference on ICT in Education in Qingdao, China, which resulted in the *Qingdao Declaration*, commits countries to the timely reporting of accurate ICT in education data to the UIS to facilitate its work and advance its mission to build and maintain a global repository for ICT in education statistics (UNESCO, 2015).

To complement national efforts, the UIS is committed to support countries in establishing the appropriate national-level mechanisms and processes for reporting data. In particular, data on device type, deployment patterns and other key aspects will be important to help shape policymaking as ICT expands across African education systems. Given the advocacy work of the Broadband Commission and its role in development, data on bandwidth in schools will also be in high demand and important for policymakers (Broadband Commission, 2013).

Moreover, it is understood that ICT cannot replace teachers or poor teaching, thus additional data on teacher training, including quantity and quality aspects, will be important for future data collection efforts. Finally, understanding that ICT resource inputs alone are inadequate for understanding the impacts of ICT on student outcomes, additional data on usage are required – more specifically data on how, when, how much and where teachers and pupils use ICT.

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# Reader's guide

The following symbols are used throughout the report and the statistical tables:

| Symbol | Interpretation |
|---|---|
| … | Data missing (or not available) |
| * | Country estimation |
| ** | UIS estimation |
| – | Magnitude nil or negligible |
| . | Not applicable |
| x[y] | Data included in column [y] of the table (or indicated with a comment) |
| p | Public institutions only |

# Annex. Statistical tables

# Table 1. Political commitments on ICT in education | ISCED 1, 2 and 3 | 2014 or latest year available

√ = Yes x = No

| REGION | | Strategies to promote integration of ICT in education | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | National Policy | | | National Plan | | | Regulatory Provision(s) | | | Regulatory Institution | | |
| Country or territory | Reference Year | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| **SUB-SAHARAN AFRICA** | | | | | | | | | | | | | |
| Angola | 2012 | √ | √ | √ | x | x | x | √ | √ | √ | √ | √ | √ |
| Benin | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Botswana | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Burkina Faso | 2013 | x | x | x | √ | √ | √ | x | x | x | x | x | x |
| Burundi | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Cabo Verde | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Cameroon | 2013 | x | x | x | x | x | x | x | x | x | √ | √ | √ |
| Central African Republic | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Chad | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Comoros | 2013 | x | x | x | x | x | x | x | x | x | x | x | x |
| Congo | 2013 | x | x | x | x | x | x | x | x | x | x | x | x |
| Côte d'Ivoire | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Democratic Republic of the Congo | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Djibouti* | 2013 | x | x | √ | x | x | x | x | x | x | x | x | x |
| Equatorial Guinea | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Eritrea | 2014 | √ | √ | √ | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Ethiopia | 2014 | ... | ... | √ | ... | ... | ... | ... | ... | ... | ... | ... | √ |
| Gabon | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Gambia | 2014 | √ | √ | √ | √ | √ | √ | x | x | x | √ | √ | √ |
| Ghana | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Guinea | 2013 | x | x | x | x | x | x | x | x | x | x | x | x |
| Guinea-Bissau | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Kenya | 2014 | x | x | x | √ | √ | √ | ... | ... | ... | ... | ... | ... |
| Lesotho | 2013 | x | x | x | x | x | x | x | x | x | x | x | x |
| Liberia | 2014 | x | x | x | √ | √ | √ | x | x | x | x | x | x |
| Madagascar | 2013 | x | x | x | x | x | x | x | x | x | x | √ | √ |
| Malawi | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Mali | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Mauritius | 2014 | √ | √ | √ | x | x | x | x | x | x | x | √ | √ |
| Mozambique | 2013 | √ | √ | √ | √ | √ | √ | ... | ... | ... | ... | ... | ... |
| Namibia | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Niger | 2013 | x | x | x | √ | √ | √ | x | x | x | x | x | x |
| Nigeria | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Rwanda | 2014 | √ | √ | √ | x | x | x | x | x | x | x | x | x |
| Sao Tome and Principe | 2013 | √ | √ | √ | √ | √ | √ | x | x | x | x | x | x |
| Senegal | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Sierra Leone | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Somalia | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| South Africa | 2012 | √ | √ | √ | √ | √ | √ | x | x | x | x | x | x |
| Swaziland | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Togo | 2013 | x | x | √ | x | x | x | x | x | x | x | x | x |
| Uganda | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| United Republic of Tanzania | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Zambia | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Zimbabwe | | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

* Although Djibouti is typically included within the Arab States region, the country was part of the data collection exercise and has been included in this Table

## Table 2. Curriculum and ICT in education | ISCED 1, 2 and 3 | 2014 or latest year available

√ = Yes x = No

| REGION | | Strategies to promote integration of ICT in education | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Curriculum includes specific objectives or a subject on basic computer skills (or computing) | | | Curriculum includes recommendations for ICT-assisted instruction to form part of subject delivery in the following subjects | | | | | |
| | | | | | Mathematics | | | Natural Sciences | | |
| Country or territory | Reference Year | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| **SUB-SAHARAN AFRICA** | | | | | | | | | | |
| Angola | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Benin | | … | … | … | … | … | … | … | … | … |
| Botswana | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Burkina Faso | 2013 | x | x | x | x | x | x | x | x | x |
| Burundi | | … | … | … | … | … | … | … | … | … |
| Cabo Verde | | … | … | … | … | … | … | … | … | … |
| Cameroon | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Comoros | 2013 | x | x | x | x | x | x | x | x | x |
| Congo | 2013 | x | x | x | x | x | x | x | x | x |
| Côte d'Ivoire | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Djibouti* | 2013 | x | x | √ | x | x | √ | x | x | √ |
| Eritrea | | … | … | … | … | … | … | … | … | … |
| Ethiopia | 2014 | x | √ | √ | x | √ | √ | x | √ | √ |
| Gambia | 2014 | x | x | √ | x | x | √ | x | x | √ |
| Ghana | | … | … | … | … | … | … | … | … | … |
| Guinea | 2013 | x | x | x | x | x | x | x | x | x |
| Kenya | | … | … | … | … | … | … | … | … | … |
| Lesotho | 2013 | . | √ | √ | . | … | … | . | … | … |
| Liberia | 2014 | x | √ | √ | √ | √ | √ | √ | √ | √ |
| Madagascar | 2013 | x | x | x | x | x | √ | x | x | √ |
| Mauritius | 2014 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Mozambique | | … | … | … | … | … | … | … | … | … |
| Niger | 2013 | x | x | x | x | x | x | x | x | x |
| Rwanda | | … | … | … | … | … | … | … | … | … |
| Sao Tome and Principe | 2013 | x | x | √ | x | x | x | x | x | x |
| Senegal | | … | … | … | … | … | … | … | … | … |
| South Africa | 2012 | x | x | √ | √ | √ | √ | √ | √ | √ |
| Togo | 2013 | x | x | √ | x | x | x | x | x | x |
| Uganda | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Zambia | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ |

* Although Djibouti is typically included within the Arab States region, the country was part of the data collection exercise and has been included in this Table

## Table 2. Curriculum and ICT in education | ISCED 1, 2 and 3 | 2014 or latest year available, cont.

√ = Yes x = No

| REGION | | Strategies to promote integration of ICT in education | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Curriculum includes recommendations for ICT-assisted instruction to form part of subject delivery in the following subjects | | | | | | | | |
| | | Social Sciences | | | Language | | | Second Language | | |
| Country or territory | Reference Year | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) | Primary (ISCED 1) | Lower Secondary (ISCED 2) | Upper secondary (ISCED 3) |
| | | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| **SUB-SAHARAN AFRICA** | | | | | | | | | | |
| Angola | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Benin | | … | … | … | … | … | … | … | … | … |
| Botswana | 2012 | √ | √ | √ | x | x | x | √ | √ | √ |
| Burkina Faso | 2013 | x | x | x | x | x | x | x | x | x |
| Burundi | | … | … | … | … | … | … | … | … | … |
| Cabo Verde | | … | … | … | … | … | … | … | … | … |
| Cameroon | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Comoros | 2013 | x | x | x | x | x | x | x | x | x |
| Congo | 2013 | x | x | x | x | x | x | x | x | x |
| Côte d'Ivoire | 2013 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Djibouti* | 2013 | x | x | √ | x | x | √ | x | x | √ |
| Eritrea | | … | … | … | … | … | … | … | … | … |
| Ethiopia | 2014 | x | √ | √ | x | √ | √ | x | √ | √ |
| Gambia | 2014 | x | x | √ | x | x | √ | x | x | √ |
| Ghana | | … | … | … | … | … | … | … | … | … |
| Guinea | 2013 | x | x | x | x | x | x | x | x | x |
| Kenya | | … | … | … | … | … | … | … | … | … |
| Lesotho | 2013 | . | … | … | . | … | … | . | … | … |
| Liberia | 2014 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Madagascar | 2013 | x | x | x | x | x | √ | x | x | x |
| Mauritius | 2014 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Mozambique | | … | … | … | … | … | … | … | … | … |
| Niger | 2013 | x | x | x | x | x | x | x | x | x |
| Rwanda | | … | … | … | … | … | … | … | … | … |
| Sao Tome and Principe | 2013 | x | x | √ | x | x | x | x | x | x |
| Senegal | | … | … | … | … | … | … | … | … | … |
| South Africa | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Togo | 2013 | x | x | x | x | x | x | x | x | x |
| Uganda | 2013 | x | x | x | x | x | x | x | x | x |
| Zambia | 2012 | √ | √ | √ | √ | √ | √ | √ | √ | √ |

* Although Djibouti is typically included within the Arab States region, the country was part of the data collection exercise and has been included in this Table

## Table 3. ICT infrastructure in educational institutions | ISCED 1, 2 and 3 | 2014 or latest year available

| REGION | Educational institutions with electricity | | | | | | Educational institutions with computer-assisted instruction (CAI) | | | | | | Educational institutions with computer laboratories | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (%) | | | | | | (%) | | | | | | (%) | | | | | |
| Country or Territory | ISC1 | ISC2 | ISC3 | ISC2-3 | ISC1-3 | RefY | ISC1 | ISC2 | ISC3 | ISC2-3 | ISC1-3 | RefY | ISC1 | ISC2 | ISC3 | ISC2-3 | ISC1-3 | RefY |
| | (1) | (2) | (3) | (4) | (5) | | (6) | (7) | (8) | (9) | (10) | | (11) | (12) | (13) | (14) | (15) | |
| **SUB-SAHARAN AFRICA** | | | | | | | | | | | | | | | | | | |
| Benin | 23 | 49 | … | … | … | 2013,p,** | … | … | … | … | … | | … | … | … | … | … | … |
| Botswana | 79 | 100 | 100 | 100 | 84 | 2012 | 78 | 100 | 100 | 100 | 83 | 2012,p | 10 | 100 | 100 | 100 | 32 | 2012,p |
| Burkina Faso | 14 | x[4] | x[4] | 46 | … | 2013 | … | … | … | … | … | | … | … | … | … | … | |
| Burundi | 3 | 20 | … | … | … | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Cabo Verde | 67 | 100 | … | … | … | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Cameroon | 19 | x[4] | x[4] | 58 | 24 | 2013 | 1 | x[9] | x[9] | 33 | 6 | 2013,p,** | 1 | x[14] | x[14] | 33 | 6 | 2013,p,** |
| Central African Republic | - | - | … | … | … | 2012, p | … | … | … | … | … | … | … | … | … | … | … | |
| Chad | 5 | … | … | … | … | 2011, **, p | … | … | … | … | … | … | … | … | … | … | … | |
| Comoros | 13 | 22 | … | … | … | 2013,p | … | … | 21 | … | … | 2013 | … | … | 21 | … | … | 2013 |
| Côte d'Ivoire | 31 | 100 | … | … | … | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Democratic Republic of the Congo | 8 | 12 | … | … | … | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Djibouti* | 77 | 100 | 100 | 100 | … | 2013 | … | … | … | … | … | | … | … | … | … | … | |
| Equatorial Guinea | 32 | … | … | … | … | 2011,p | … | … | … | … | … | | … | … | … | … | … | |
| Eritrea | 32 | 53 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Ethiopia | 10 | x[4] | x[4] | 34 | 12 | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Gambia | 29 | 44 | 63 | 50 | 36 | 2014 | 11 | 34 | 60 | 42 | 22 | 2014** | 11 | 34 | 60 | 42 | 22 | 2014 |
| Ghana | 31 | 50 | … | … | … | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Guinea | 10 | 41 | 53 | 45 | 14 | 2013 | … | … | … | … | … | | … | … | … | … | … | |
| Guinea-Bissau | 20 | … | … | … | … | 2010,p,* | … | … | … | … | … | | … | … | … | … | … | |
| Lesotho | 12 | x[4] | x[4] | 57 | 20 | 2013 | … | x[9] | x[9] | 47 | … | 2013 | … | x[14] | x[14] | 47 | … | 2013 |
| Liberia | x[5] | x[5] | x[5] | x[5] | 6 | 2014 | … | … | … | … | … | | … | … | … | … | … | |
| Madagascar | 2 | 10 | 28 | 12 | 3 | 2013,p | - | 1 | 18 | 3 | - | 2013,p,** | - | 1 | 18 | 3 | - | 2013,p |
| Malawi | 15 | 54 | … | … | … | 2013,p | … | … | … | … | … | | … | … | … | … | … | |
| Mali | 8 | 14 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Mauritius | 100 | 100 | 100 | 100 | 100 | 2014 | 100 | x[9] | x[9] | 98 | 99 | 2014 | 72 | x[14] | x[14] | 93 | 79 | 2014 |
| Namibia | 58 | 80 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Niger | 4 | 11 | 77 | 29 | 6 | 2013 | … | x[9] | x[9] | 9 | … | 2013** | … | x[14] | x[14] | 9 | … | 2013 |
| Rwanda | 35 | … | … | … | … | 2012,p | 39 | x[9] | x[9] | 64 | … | 2012* | … | … | … | … | … | |
| Sao Tome and Principe | 88 | 100 | 100 | 100 | 89 | 2013 | … | x[9] | x[9] | 71 | … | 2013,** | 3 | x[14] | x[14] | 47 | … | 2013 |
| Senegal | 22 | 57 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Seychelles | 100 | 100 | 100 | 100 | 100 | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Sierra Leone | 3 | 16 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| South Africa | 95 | 97 | … | … | … | 2011,p | … | x[9] | x[9] | 39 | … | 2011,p | 26 | x[14] | x[14] | 39 | 40 | 2011,p |
| Swaziland | 94 | 93 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Togo | 9 | 29 | … | … | … | 2014,p | … | … | … | … | … | | … | … | … | … | … | |
| Uganda | 2 | … | … | … | … | 2011**,p | … | … | … | … | … | | … | … | … | … | … | |
| United Republic of Tanzania | 14 | 42 | … | … | … | 2012,p | … | … | … | … | … | | … | … | … | … | … | |
| Zambia | 26 | 82 | … | … | … | 2012,p | 5 | 11 | 66 | 15 | 11 | 2012 | | … | … | … | … | |

* Although Djibouti is typically included within the Arab States region, the country was part of the data collection exercise and has been included in this Table

## Table 3. ICT infrastructure in educational institutions | ISCED 1, 2 and 3 | 2014 or latest year available, cont.

| REGION | Educational institutions with access to the Internet | | | | | | Learners-to-computer ratio (for pedagogical purposes) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (%) | | | | | | (%) | | | | | |
| Country or Territory | ISC1 | ISC2 | ISC3 | ISC2-3 | ISC1-3 | RefY | ISC1 | ISC2 | ISC3 | ISC2-3 | ISC1-3 | RefY |
| | (16) | (17) | (18) | (19) | (20) | | (21) | (22) | (23) | (24) | (25) | |
| **SUB-SAHARAN AFRICA** | | | | | | | | | | | | |
| Benin | … | … | … | … | … | | … | … | … | … | | |
| Botswana | … | 100 | 100 | 100 | … | 2012,p | 55 | 15 | 17 | 15 | 29 | 2012,p,** |
| Burkina Faso | … | x[19] | x[19] | 1 | … | 2013,p | … | x[24] | x[24] | 240 | … | 2013** |
| Burundi | … | … | … | … | … | | … | … | … | … | … | |
| Cabo Verde | … | … | … | … | … | | … | … | … | … | … | |
| Cameroon | … | x[19] | x[19] | 7 | … | 2013,p | … | … | … | … | … | |
| Central African Republic | … | … | … | … | … | | … | … | … | … | … | |
| Chad | … | … | … | … | … | | … | … | … | … | … | |
| Comoros | … | … | … | … | … | | … | … | 131 | … | … | 2013** |
| Côte d'Ivoire | … | … | … | … | … | | … | … | … | … | … | |
| Democratic Republic of the Congo | … | … | … | … | … | | … | … | … | … | … | |
| Djibouti* | … | … | … | … | … | | … | … | … | … | … | |
| Equatorial Guinea | … | … | … | … | … | | … | … | … | … | … | |
| Eritrea | … | … | … | … | … | | … | … | … | … | … | |
| Ethiopia | … | … | … | … | … | | … | … | … | … | … | |
| Gambia | 11 | 34 | 60 | 42 | 22 | 2014 | 277 | 66 | 37 | 51 | 110 | 2014 |
| Ghana | … | … | … | | … | | x[25] | x[25] | x[25] | x[25] | 117 | 2009 |
| Guinea | - | 3 | 5 | 4 | - | 2013 | >500 | >500 | >500 | >500 | >500 | 2013 |
| Guinea-Bissau | … | … | … | … | … | | … | … | … | … | … | |
| Lesotho | … | … | … | … | … | | … | x[24] | x[24] | >500 | … | 2013* |
| Liberia | x[20] | x[20] | x[20] | x[20] | - | 2014 | … | … | … | … | … | |
| Madagascar | - | - | 3 | - | - | 2013,p | … | >500 | >500 | >500 | … | 2013,p |
| Malawi | … | … | … | … | … | | … | … | … | … | … | |
| Mali | … | … | … | … | … | | … | … | … | … | … | |
| Mauritius | 93 | x[19] | x[19] | 99 | 95 | 2014 | 23 | x[34] | x[34] | 19 | 21 | 2014 |
| Namibia | … | … | … | … | … | | … | … | … | … | … | |
| Niger | … | 2 | 14 | 5 | … | 2013 | … | >500 | 94 | >500 | … | 2013** |
| Rwanda | 6 | x[19] | x[19] | 18 | … | 2012,p,* | 40 | x[24] | x[24] | 40 | … | 2012* |
| Sao Tome and Principe | 3 | x[19] | x[19] | 59 | … | 2013 | . | x[24] | x[24] | 158 | … | 2013** |
| Senegal | … | … | … | … | … | | … | … | … | … | … | |
| Seychelles | … | … | … | … | … | | … | … | … | … | … | |
| Sierra Leone | … | … | … | … | … | | … | … | … | … | … | |
| South Africa | … | … | … | … | … | | 90 | x[24] | x[24] | 54 | … | 2011,p |
| Swaziland | … | … | … | … | … | | … | … | … | … | … | |
| Togo | … | … | … | … | … | | … | … | … | … | … | |
| Uganda | … | … | … | … | … | | … | … | … | … | … | |
| United Republic of Tanzania | … | … | … | … | … | | … | … | … | … | … | |
| Zambia | 6 | 5 | 32 | 7 | 7 | 2012 | >500 | 145 | … | … | … | 2012** |

* * * Although Djibouti is typically included within the Arab States region, the country was part of the data collection exercise and has been included in this Table