

Transformation-Ready: The strategic application of information and communication technologies in Africa

Education Sector Study

EXECUTIVE SUMMARY

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Executive Summary

1 Background

This report is part of a cross-sector study (eTransformAfrica) conducted by the World Bank Group and the African Development Bank, with the support of the African Union, intended to identify how information and communication technologies (ICT) have the potential to transform the education and other sectors in Africa. The overall framework for this programme recognises that the future development of Africa will be heavily influenced by how Africa manages to deliver quality education to its citizens.

The following five thematic areas, which were specified in the study terms of reference, form the core focus of this examination:

- 1) **Teacher professional development:** with an emphasis on the contextualisation and implementation of a teacher competency framework that also addresses ICT in education.
- 2) **Digital learning resources:** with an emphasis on the experience and challenges for development of open educational resources that are responsive to development needs.
- 3) **Affordable technologies:** with an emphasis on the opportunities and challenges for use of mobile devices and smart phones for access to learning materials and collaboration platforms.
- 4) **Education Management Information Systems (EMIS):** with an emphasis on the opportunities and challenges for mobile data collection and dissemination.
- 5) **National Research and Education Networks (NRENs):** with an emphasis on the global and African experience in development of NRENs. Particular attention will be paid to costs and shared applications.

This document provides a full executive summary of the report of the education sector study, and incorporates the recommendations that conclude that study. Much more information and analysis is included in the main report and in eleven annexes which include assessments of each of the five thematic areas above and three country case studies. A shorter summary of the education study findings will be included in the eTransformAfrica overview report.

2 Overview of education in Africa

The African continent is very diverse in terms of governance, development, and culture: the generalisations below about education in Africa cannot therefore be applied to every country without further examination.¹

In general, Africa has a young population. In 2010, 43% of Africa's population of about 815 million people was aged 15 or under, resulting in a very large school-going population.

¹ References to information and commentary in the Executive Summary can be found in the main report.

From 1970 to 2008, actual enrolment in primary and secondary schools increased from 23 million to 129 million, and 4 million to 36 million respectively. Tertiary enrolment increased from 200,000 to 4.5 million during the same period. This rapid increase in enrolment has led to challenges of massification (sustained high growth rates of enrolment). Over the period cited, the number of teachers in primary and secondary schools increased, respectively, from 620,000 to 2.8 million, and 180,000 to 1.8 million, but there was still an estimated teacher deficit of one million in 2008.

Investment in education is high, but not sufficient. A study by the World Bank based on data up to 2007 states that countries in sub-Saharan Africa were spending, on average, 18.2%, of government budgets on education, 'a share that approaches the upper limits of what is generally considered to be feasible.' Despite this, teachers' salaries in Africa have, in real terms, remained stagnant for the last thirty years.

Quality of education is a challenge. The Education for All drive has been effective in getting more children to school, but most countries have completion rates below 90%, with some as low as 40%. Several countries in Africa also participate in frameworks for assessing the quality of education, such as the Programme on the Analysis of Education Systems (PASEC), as well as international testing programmes such as the Progress in Reading Literacy Survey (PIRLS) and the Trends in Mathematics and Science Survey (TIMSS) of the International Association for Educational Assessment (IEA). Scores from African countries in these international tests are well below average.

Access to computers and connectivity remains very limited. In 2006, the number of schools with computers based on a model of one computer laboratory with up to 40 PCs per school ranged from 100% (Egypt) and 22.6% (South Africa) to 1.1% (Mozambique). There is a need for more recent data in this area.

Despite considerable investment in the establishment of Education Management Information Systems (EMIS), data on educational resources, institutions, students and teachers to support planning, research, monitoring and evaluation is in short supply in Africa at national and regional levels. Existing approaches to EMIS have focused on systems and tools, neglecting capacity development and the organisational culture that supports data sharing, dissemination and utilisation.

Major changes in educational systems require the engagement of a wide range of stakeholders: students at all levels of education; parents; teachers; regulators; policy makers; and the private sector offering services, support, facilities, or learning materials to schools. In addition, Parent Teachers Associations (PTAs) have become influential stakeholders, because of the amount of money that parents contribute directly to school costs.

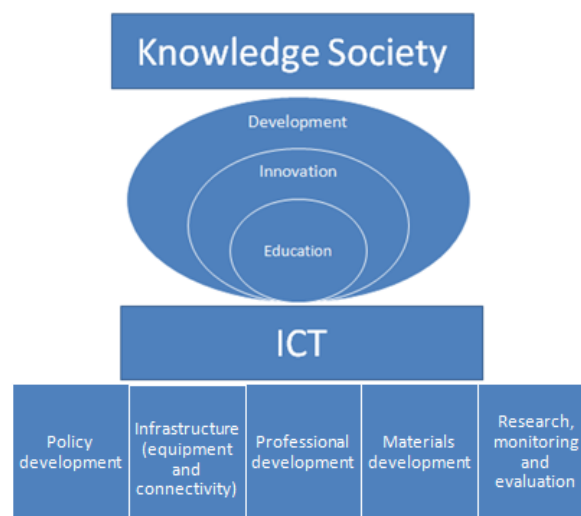
3 ICT in education in Africa: setting the scene

The NEPAD e-Schools Initiative provides a good starting point for a conceptual framework for ICT in Education in Africa. The vision of the NEPAD e-Schools Initiative was to ensure

that young Africans participate actively in the global information society and knowledge economy. Significantly, this vision makes no explicit reference to ICT. The focus of business planning in African schooling should be squarely on ensuring that schools are better equipped to prepare learners socially and economically to become proactive, engaged citizens.

Figure 1 (adapted from a GeSci report, 2010), highlights relevant dimensions to consider in ICT interventions.

Figure 1 ***Framework for reflecting on ICT, Education, Innovation and Development to support a Knowledge Society***



For a knowledge society to be realised, supported and developed, education and innovation should be viewed as interrelated drivers for socio-economic development, in a context where ICT is the enabler for both innovation and education. This has several related dimensions:

- policy development;
- ICT infrastructure;
- professional development (including leadership capacity);
- materials development (including content services); and
- research, monitoring and evaluation.

Policy for ICT integration in schools needs to consider individual social, political and economic environments, recognising that change will not occur in the same manner in each country or within different locations in any one country. Thus, integration of ICT into education needs to be sensitive to contextual differences.

A critical element in the use of ICT in education concerns the devices through which educators and learners access learning materials and collaboration platforms. Connectivity is also an important aspect of accessing learning resources. This calls for continued focus on the competitive supply of access to broadband networks using suitable technologies (wired and wireless).

Fully integrating technology into teaching and learning requires well-qualified educators, with a clear focus on both a) equipping teachers with ICT literacy skills and b) showing teachers how to use these skills to plan lessons and use technology for teaching and learning. This goes hand in hand with the actual content used in learning. Two important developments globally on the Internet have been the emergence of Open Education Resources and Web 2.0 platforms, which increasingly allow the average user to become a *source* of new information (the architecture of participation).

Finally, evaluation is recognised as especially important in the field of ICT, where there are many unknowns about how best to apply technology and where the technology itself is evolving very rapidly. There is widespread agreement that insufficient attention is often paid to monitoring and evaluation issues in the design process of educational ICT initiatives.

4 Trends in implementation

In Africa, many countries have focused on developing national ICT policies and National Information and Communication Infrastructure Plans to support their socio-economic development efforts and ICT in education policies. Several African countries are prioritising the use of ICT in education to achieve critical strategic developmental objectives, all at different stages of progress.

The World Bank notes that developing countries have faced challenges in adapting policies and regulations to rapid changes in technology and market structure. In some instances, policies concerned with ICT and education are not complemented by other relevant policies, for example a telecommunications policy that supports such development, or by necessary budgetary allocations. Some countries have national ICT policies, but do not have policies that make specific reference to ICT and education. Furthermore, ICT policies may not be accompanied by detailed implementation plans or commitment from government to implement them.

Increasingly, investment in ICT is being seen by education institutions as a necessary part of establishing their competitive advantage, because it is attractive to students and because it is deemed essential by governments, parents, employers and funders of higher education. Despite this, there is no direct correlation between increased spending on ICT and improved education performance. Benefit and impact, to the extent that they can be reliably measured, are more functions of how ICT is deployed than of what technologies are used.

The growth of knowledge societies has placed increasing emphasis on the need to ensure that people are information-literate. Information literacy should not be considered a given, even amongst learners with ubiquitous access to ICT (although many institutions are mistakenly assuming greater information literacy amongst 'tech-savvy' learners). Education systems are faced with a need to provide formal instruction in information, visual and technological literacy as well as in how to create meaningful content with today's tools. However, it is important to consider expanded definitions of these literacies that are based on mastering underlying concepts rather than on specialised skill sets. Education systems

need to develop and establish methods for teaching and evaluating these critical literacies at all levels of education.

The role of the teacher in the classroom is being transformed into that of an instructional manager who helps to guide students through individualised learning pathways, identifying relevant learning resources, creating collaborative learning opportunities, and providing insight and support both during formal classes and outside them. Unfortunately, however, most professional development programmes tend to focus on teaching teachers to use the technology. There is a need for professional development to focus on how to mentor and guide learners in this environment.

Another significant trend is the emergence of the concept of Open Education Resources (OER). There has been tremendous growth in collective sharing and generation of knowledge as more people become connected and because of the proliferation of Web 2.0 technologies. The digitisation of information in all media has introduced significant challenges concerning intellectual property, especially copyright.

ICT is reducing barriers to entry for potential competitors to traditional education institutions, by reducing the importance of geographical distance as a barrier, by reducing the overhead and logistical requirements of running education programmes and research agencies, and by expanding cheap access to information resources. Another trend is growth in the number of distance education programmes in which the teacher and students are physically separated, and teaching and learning takes place by means of single technologies or combinations of ICT.

Mobile and personal technologies are increasingly seen as delivery platforms for services of all kinds. In Africa, mobile cellular subscriptions reached 45 per 100 people in 2010, and the number continues to grow because of high demand and falling costs. The growth in the capabilities of these devices seems to be related to the increasing availability of digital materials and applications.

5 Opportunities

Changes in the ICT access and connectivity environment and the existence of examples and frameworks from which they can learn are important opportunities which African countries can exploit in integrating ICT in education. The opportunities highlighted below address policy, access and connectivity, educational management information systems, digital learning resources, and human capacity. In all instances, however, planning of new interventions aimed at harnessing ICT in education must begin with contextualised needs analysis and careful planning that takes account of the realities within which implementation will take place.

Establishing an enabling policy environment

South Africa and Egypt are examples of countries in Africa that have achieved significant progress in the integration of ICT in education. While their telecommunications

infrastructures may be significantly better than most of those in Africa, the fact that these countries have an enabling policy environment, as well as regulatory and supportive institutions and structures, provides a good lesson for ICT integration in education on the continent. The two countries illustrate that, where there has been significant scaling up of ICT integration into teaching and learning, implementation has been carried out through cross-sectoral collaboration between Ministries of Education and other sectors. This has led to the development, publishing, and systematic advocacy of a clear and detailed set of policies, laws and regulations that effectively support the integration of ICT into education systems. In broad terms, an enabling policy environment includes policies and initiatives that help to drive the national ICT agenda, and specifically policy on ICTs in education, bandwidth and connectivity.

Existing education policies in most African countries need thorough review and updating to ensure that the ICT in education policy supports and is supported by complementary policies for education as a whole. Additionally, all education legislation should be reviewed and updated to safeguard against legal and conceptual contradictions created by ICT in education policies.

The policy should contain a strategy, clear policy goals, and an implementation plan that covers all important aspects, including:

- criteria for school readiness;
- acquisition of basic infrastructure;
- models of affordable and appropriate ICT for schools;
- standards for procurement and installation of ICT professional development in a wide range of uses of ICT;
- provision for regional, district, and school policy planning;
- access to and local development of educational content;
- strategies to guide and protect learners from the negative consequences and dangers associated with increased use of ICT and Internet access;
- technical support and maintenance;
- strategies for managing the changes created through systematic introduction of ICT; and
- an environmentally sound policy governing purchasing, use, and disposal of ICT.

Widening access to ICT infrastructure and connectivity

Harnessing devices that teachers and learners already own

The proliferation of mobile phones has meant that more learners have access to ICT devices than ever before. There are also several platforms such as Mxit which reduce the cost of access and, as a result, have become popular with users. Some countries including South Africa have moved to exploit this high level of access in learning on an increasingly large scale. Some of the major uses of mobile phones include educational quizzes, multi-media content to solve puzzles (for example, for mathematics), interactive literacy programmes, simple question-and-answer activities, text- and/or audio-based short lessons, alerts by schools/teachers to students or parents and provision of support to teachers and learners.

They can also play a major role in informal education, for example to provide health education information.

The fact that users already have access to mobile phones offers opportunities in terms of sustainability and scalability. However, mobile phones may not be the most relevant device for helping to address a particular educational need and present challenges in terms of access and price of service, usability due to constraints such as small screen size, costs of developing applications and content, ensuring compatibility on all phone types, and the fact that many schools and teachers do not allow mobile phones in classrooms. Currently, mobile phones are predominantly being used to support learning outside of school and informal education, with the exception of projects such as Bridge IT.

In addition, as technology costs reduce further, there will be increased affordability and choice of devices used by and accessible to teachers and learners

Access models:

Models of shared access to mobile devices, as well as those focused on teacher access, can be more realistic from a cost and support perspective than one-to-one computer access. The falling cost of mobile computing devices means that there are increasing opportunities for devices such as laptops and netbooks to be used in schools. These devices can be moved around within schools, and therefore have the potential to be integrated into classroom teaching rather than being isolated in computer laboratories.

While one-to-one computing strategies for students remain a challenge, there may be opportunities for providing such access to teachers. If teachers have laptops, they can use these to engage in informal learning at their own pace, source and develop materials and use them for projecting lessons. This is being explored in countries such as South Africa (Teacher Laptop Initiative launched in 2009) and Kenya (Laptops for Teachers Programme announced in 2010).

Both of these access models move away from what has been the more traditional model of deploying computers into dedicated computer laboratories, and can potentially help to enable improved integration of ICT in teaching and learning. It is, however, critical that these access approaches are effectively evaluated to understand their impact and learn lessons from experience.

NRENs: providing increased connectivity to support education and learning

The increasing roll-out of competitive fibre to Africa and within African countries and the increased penetration of wireless and mobile platforms have expanded opportunities for connectivity and broadband access. Increased investment and deployment of fibre have resulted from a combination of the liberalisation of telecommunications markets in Africa, which has brought hitherto dormant fibre online and enabled the private sector to roll out new fibre, and direct government investment in national backbones as critical development infrastructure (for example in Uganda, Kenya, Rwanda, Tanzania and Ethiopia). In these countries, access for the education and research sector has been made a priority.

The liberalisation of telecommunications markets and the emergence of regional operators have increased competition in the mobile sector, leading to rapid roll-out, increasingly competitive price offerings and rapid improvements in capability, with more providers offering 3G services that enable faster Internet access than before. In addition to mobile platforms, WiFi and WIMAX penetration is growing rapidly, creating the opportunity for wide scale deployment of wireless access devices.

The emergence of National Research and Education Networks (NRENs) in Africa over the last ten years has created a major opportunity for extending affordable non-commercial broadband to education institutions. South Africa and Kenya stand out as examples where a combination of sector liberalisation and government investment in education connectivity, working with NRENs, has led to prices falling to less than 10% of what they were three years ago. The initial focus in both countries has been on university and research institutions. The NRENs in Kenya and South Africa are now, however, starting to reach out to lower level institutions.

Harnessing ICT to improve management and administration

African countries still need knowledge on formulating cost-effective and sustainable strategies for educational data collection and use, and on developing indicators that enable the monitoring of national and regional education performance. There is a need to upgrade current Educational Management Information Systems (EMIS) through the adoption of Web-enabled education management information system tools, and the sharing of knowledge on requirements, challenges, and opportunities. The National Education Statistical Information System (NESIS) programme that was promoted by the Association for Education Development in Africa (ADEA) provides a platform to promote policy and other capacity support for EMIS development in Africa.

The other challenge faced in education management systems is inadequacy in the use of the actual data that is collected at all levels. The decentralisation of educational management information systems at schools and district levels could provide an alternative way of increasing the use of data at local levels. District Education Management Information Systems have become increasingly popular in meeting the need for decentralisation of educational planning and data gathering at local levels. An example is the Indian District Information System for Education (DISE) which was developed jointly by the National University for Education Planning and Administration (NUEPA), the Government of India and the United Nations Children's Fund (UNICEF). DISE has drastically reduced the time-lag in availability of educational statistics in elementary and secondary education. It has made data available at different levels, from school to cluster, block, district, state, and nationwide.

Open source platforms provide another opportunity for African countries, though they require expert human capacity. One example is OpenEMIS, which was sponsored by UNESCO. OpenEMIS is composed of two modules: (1) EMIS Builder, which allows database administrators to adapt the generic tool to the specific characteristics of the national education system, to customise the components of the information system, and to create

data entry forms; and (2) EMIS User, which enables data entry and queries, as well as production of reports, charts and indicators. OpenEMIS is seen as a useful tool in multilingual environments. The major benefits of using OpenEMIS include the ability to write interfaces that integrate mobile and PDA-based data collection. OpenEMIS also provides an interface to Geographic Information Systems (GIS).

Educational management information systems were initially focused largely on the primary and secondary levels. Recent progress with Higher Education Information Management Systems (HEMIS) provides another opportunity for building a full profile of education systems from K-12 to tertiary levels. One example of a HEMIS is the Sri Lankan National Higher Education Management Information System (NHEMIS), which consolidates data from tertiary institutions using a Web-based management information tool known as eduStore. The software provides access to a large set of data and statistics about higher education in the country.

Harnessing digital learning resources

The growth of Open Education Resources (OER) and the community around them is a significant opportunity that African countries can exploit to build up stocks of digital learning resources (DLR). This growth includes African OER initiatives, such as OER Africa, which is involved in promoting the use of OER in Africa and supporting individuals and organisations in creating OER.

The transformative educational potential of OER revolves around increased availability of high quality relevant learning materials that contribute to more productive students and educators. The principle of allowing adaptation of materials provides one mechanism amongst many for constructing roles for students as active participants in educational processes. Likewise, OER has the potential to build capacity by providing institutions and educators, at low or no cost, with access to the means to develop their competence in producing educational materials and carrying out the necessary instructional design to integrate such materials into high quality programmes of learning.

NGOs and the private sector are active in the generation of DLR and also provide opportunities for collaboration with governments and educational institutions. Examples include the Teacher Education in Sub-Saharan Africa (TESSA) initiative, a research and development initiative creating OER and course design guidance for teachers and teacher educators working in Sub-Saharan African countries; the AVU's ICT-integrated Teacher Education programme for Mathematics and Sciences; and Mindset Learn, a division of the Mindset Network, which addresses the needs of high school learners and educators.

Important challenges to OER development include the need to ensure that the resulting products are educationally effective and of a high standard; adequacy of infrastructure and connectivity; buy-in from those academics who are not yet aware of the benefits and possibilities; heavy staff workload; capacity to develop and adapt OER resources; and hidden costs associated with searching and adaptation. There is also the need to address enabling policies that include intellectual property rights, human resource benefits and quality assurance.

Building human capacity

Countries that have developed a national strategy for professional development generally seem to achieve scale in the training of their teachers, and in resourcing this professional development. For example, the Digital Strategy for Teachers in Australia has led to the government's commitment of AU\$40 million over two years for teacher training on ICT integration. Namibia's TECH/NA! strategy maps out training of the entire education workforce from ministry to school level, with training of teachers focused on pre-service and in-service training by teacher training colleges.

Available parameters for good practice that inform the strategy for professional development for ICT integration can be taken on board by African countries. The parameters developed under the NEPAD e-Schools Initiative advocate an holistic multistakeholder, multi-modal delivery approach to professional development, requiring all educational actors to 'possess the skills and competence required to use ICT effectively in their daily lives. In addition, ongoing educational opportunities – formal, non-formal, and informal – are made available to, and are used by, all of these groups of people to further develop their educational ICT competence.'

Opportunities for teacher competence development include worldwide and regional programmes such as iEARN, which works in 29 countries on the African continent; World Links, which provides capacity on ICT integration and is actively operating in 13 African countries; and Intel Teach and Microsoft Partners in Learning (PiL) courses, mostly used by SchoolNets.

Because of their reliance on teachers themselves to contribute and sustain them, communities of practice (CoP) offer a cost-effective model of professional development. Teachers who engage in communities of practice are confident of their work, and are not afraid to display it for scrutiny and critique by others. Examples include the Partners in Learning Network (PiLN), Siyavula and the Teacher Education in Sub-Saharan Africa (TESSA) Forum.

6 Challenges

The opportunities of ICTs in education must be understood within a context of challenges and difficulties. The following are among the critical challenges which need to be considered when looking at the use of ICT in education:

- The absence of comprehensive policies which enable and support interventions and which are supported by clearly defined and resourced strategies for implementation at national level as well as at the level of educational institutions.
- Lack of financing and prioritisation of ICT investments. Little is known about the true costs of ICT in education, and, given budgetary and resource constraints, widespread investment in ICT in education may not be possible in many African countries. It is

essential to improve understanding of the costs and benefits associated with ICT types and uses in various educational situations in order to use scarce resources effectively.

- Limited infrastructure required to support the use of ICT in education – in particular limited access to power and the lack of affordable and reliable internet access – impacts on the roll-out of ICT in education and development initiatives. The wide gap in ICT access between urban and rural areas has meant that initiatives have tended to be concentrated in the former.
- A lack of capacity at all levels to integrate and support the use of ICT in education effectively. This includes a shortage of human capacity across all major stakeholders groups (including policy makers, teachers, administrators, technical staff and education managers).
- Many teachers do not have the necessary ICT skills or the specific training needed to be able to use ICT in the classroom. Professional development of teachers is vital as they are at the heart of the educational process and experience has shown that a variety of support and enabling mechanisms is required to optimise teacher use of ICT.
- Lack of appropriate content. While ICT – and the Internet in particular – provides access to a wide range of resources, there is a limited supply of appropriate and improvised content ranging from learning materials to learning support tools. In particular, there is little digital education content that is locally contextually-relevant or based on local curriculum frameworks.
- Lack of accurate, comprehensive, up-to-date data on education. In Africa, donors rather than governments have been the most important players in EMIS development and therefore organic growth towards data-driven planning is largely absent.
- The tendency of ICT to accentuate social, cultural and economic disparities. For instance, ICT projects tend to benefit schools and learners in urban areas and in areas where existing infrastructure is of a good standard more than they do those in other areas.
- It is generally believed that ICT can empower teachers and learners, promote change and foster the development of 21st century skills, but data to support these perceived benefits from ICT are limited and evidence of effective impact is elusive. Globally, insufficient attention is paid to monitoring and evaluation during the design of most ICT initiatives, and Africa is no exception.

7 Guidelines for integration of ICT into education

To prioritise investments in ICT in education, it is first necessary to define generic underlying needs of education systems in Africa. These needs are not about ICT *per se*, but rather define important systemic priorities where investments in ICT can contribute to meeting a given country's educational requirements. They include providing all learners with access to

quality education; building educators' capacity to teach effectively; and enhancing logistics and operations. Using the *NEPAD Guidelines for Good Practice* as a guide, it is possible to identify eight key areas for investment, as follows:

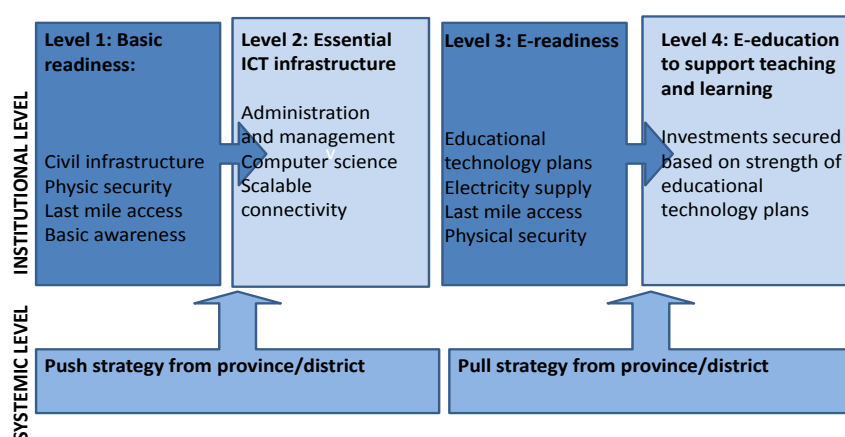
- Legal, regulatory, and policy framework;
- Bandwidth and connectivity;
- Infrastructure and technology;
- ICT applications and e-learning content;
- Professional development;
- Governance and operations;
- Monitoring evaluation and research;
- Change management and advocacy.

Taken together, these strategic objectives represent a comprehensive future vision for ICT in African education. In recognition of the variation across institutions, the following basic e-maturity levels can be used to guide planning for ICT in education initiatives:

- **Level 1 – Basic readiness:** institutions are prepared for rollout of ICT to enhance logistics and operations.
- **Level 2 – Essential ICT infrastructure:** ICT hardware and applications, connectivity, and associated professional development, maintenance, and support are provided to educational institutions predominantly to enhance management and administration processes at institutional level.
- **Level 3 – E-readiness:** institutions are prepared for roll-out of ICT to support teaching and learning.
- **Level 4 – Basic E-maturity:** ICT hardware and applications, connectivity, content, and associated professional development, maintenance, and support are provided to educational institutions predominantly to support teaching and learning.

Figure 2 shows that there are two potential dimensions to this approach: the institutional level; and the systemic level which establishes system-wide prerequisites needed to support institution-level implementation.

Figure 2 : Service Delivery Approach for ICT in Education



ICT rollout will typically not be uniform across every province, district, and educational institution in a country, given that different institutions will already be at different levels of e-maturity. However, so far as possible it is preferable that national, provincial and district plans to invest in ICT in education focus on systematically moving all educational institutions sequentially through these levels towards a basic level of maturity. A detailed national baseline study is likely to be required, to determine which institutions are at which levels of maturity. Following this, a monitoring system will be needed to keep track of progress made with implementation at each institution. In this way, ICT integration can be phased across provinces and districts as they become ready.

8 Recommendations for policy makers and regulators

The final chapter of the report presents general and specific recommendations for policy makers/regulators in African countries. These recommendations, which should be considered along with the opportunities identified in Chapter 3 of the report, are reiterated below.

In implementing the following recommendations, it is almost certain that most sub-Saharan countries will need expertise that is not currently available within their governments. Generic guidelines, which are detailed in Chapter 5, provide a starting point in moving towards implementation, but governments should be prepared to engage the necessary expertise to help them in developing the detail of policy and implementation that is specific and appropriate to their national contexts.

1) Establishing an enabling policy environment

Ensure that all investments in ICT in education (including those made by governments, development partners, individual educational institutions and NGOs) are – to the greatest extent possible – directed by a single, integrated ICT-in-education strategy so that they are working towards common national strategic objectives. The importance of having an enabling policy and strategy environment is especially clear from the discussion in Section 2.1 of Chapter 3 where the success of South Africa and Egypt illustrate this need. This is reinforced by the comparative discussion of case study countries in Chapter 4.

An integrated strategy for ICT in education should be underpinned by a clearly defined systemic approach to the use of ICT (drawing on the suggested guidelines presented in Chapter 5) so that investments are focused on improving efficiencies within the system and on raising productivity levels. Such a strategy should, as a minimum, include:

- a) A focus on all critical aspects of ICT integration – the legal, regulatory and policy framework; bandwidth and connectivity; infrastructure and technology; ICT applications and e-learning content; professional development; governance and operations; management information systems; monitoring, evaluation, and research; and change management and advocacy.

- b) Mechanisms to prioritise connectivity for the education sector (for example, use of universal access funds, e-rates, national broadband strategies, or private-public partnerships).
- c) Strategies for ensuring sustainable availability and security of connectivity for schools and universities (for example support to NRENs and Schoolnets; ensuring that curricula, training, and internships are in place to produce a technically competent human resource base within the telecommunication and computer science disciplines).
- d) Strategies to remove unnecessary barriers to access to ICT (for example, taxation on equipment) and to support competition in the telecommunications sector.
- e) Analysis of the total cost of ownership of ICT investments, combined with assessment of options for reducing cost (for example, reviewing power consumption of all components, different power supply options, etc.).
- f) Emphasis on the importance of ongoing planning and strong leadership at the institutional level as a basis for rolling out ICT in education.
- g) A review of the scope for partnerships with the private sector (for example, network operators, technology manufacturers, publishers, application developments and social entrepreneurs).
- h) Support for experimentation, as well as research and ongoing evaluation, to understand the effects of particular technologies or approaches – rather than embedding use of a single, specific technology or ICT access model into roll-out plans.

To be effective, strategies should be developed through appropriate processes of consultation within countries, in order to ensure that there is strong consensus on the proposed approaches by all major stakeholders, combined with buy-in to the strategic objectives defined. Strategies should also be based on a clear assessment of the current status of all of the critical aspects of ICT in education identified in Chapter 5.

2) Widening Access to ICT Infrastructure and Connectivity

Implement programmes that enable students, teachers, and administrators to gain access to, or own suitable computing devices, and that support the development of NRENs as a means to enable resource-sharing and collaboration. As discussed in Section 2.2 of Chapter 3, connectivity and access provide the physical route that enables the integration of ICT in education. The opportunities provided by mobile platforms for connectivity anywhere have also been discussed. The “Push” strategy illustrated in Figure 5.1 of the main report is aimed at ensuring the minimum connectivity and access that are essential for progress. In addition to supporting an enabling policy and regulatory environment, important strategies include:

- a) Working with the private sector, through public-private partnerships (PPPs), to provide computing devices based on mass-market and concessionary pricing so that access, where there is connectivity, is not constrained.
- b) Supporting the development of NRENs, including PPP collaboration, to create an environment in which the connectivity needs of schools at all levels can be met, including the intensive short term demands common in higher institutions of learning.
- c) Engaging mobile service providers so that students and teachers can access online resources away from school campuses at educational rates.

3) Harnessing ICT to improve Management and Administration

Promote data-driven decision-making at all levels. With the decentralisation that is taking place in many countries, information is required away from the centre to support sector management at all levels. The focus on data usage at all levels implies that investment in the future of EMIS development should focus on schools (public and private, formal and non-formal), colleges and universities that provide the data. Strategies to drive this will include:

- a) The development of national EMIS policies and standards.
- b) Support for standardised school-based management information systems and higher education management information systems that are developed using open standards and capable of interfacing with GIS, social networks, and mobile and low-cost computing.
- c) Promotion of integrated educational management information systems at the level of tertiary education.
- d) Building the capacity of data providers, in particular school leaders and university registrars as well as other data providers and users.
- e) Support for the development of district-level EMIS data integration systems, as these provide an ideal platform for integration of school and college data and serve as a starting point for verification and application of EMIS.
- f) Building the capacities of the EMIS unit and the Ministry of Education, which require the capability to integrate data from multiple sources, multiple years and multiple levels in order for decision-makers to see the whole picture and to make effective decisions at national level.

4) Harnessing Digital Learning Resources

Consider judicious investments in content creation and aggregation to ensure compliance with African curricula and/or local language demands, motivating usage by educators and students. In the first instance, priority content could be derived from open content sources. If suitable content is not available, it will be useful to identify and invest in priority content development focus areas that might not be covered by the open market. The latter may include:

- a) Reviewing and adjusting existing national/institutional policies and staff incentive schemes to ensure that they encourage educators to invest time in ongoing curriculum design, the creation of effective teaching and learning environments within courses and programmes, and the development of high-quality teaching and learning materials.
- b) Translating existing digital educational material into priority indigenous languages in priority content areas.
- c) Procuring the copyright to high-quality existing materials so that resources can then be freely distributed without generating additional cost.
- d) Building structured long-term partnerships with commercial organisations, corporate social investment (CSI) initiatives and NGOs that currently produce free materials, and supporting their efforts to raise funds to sustain their business models.

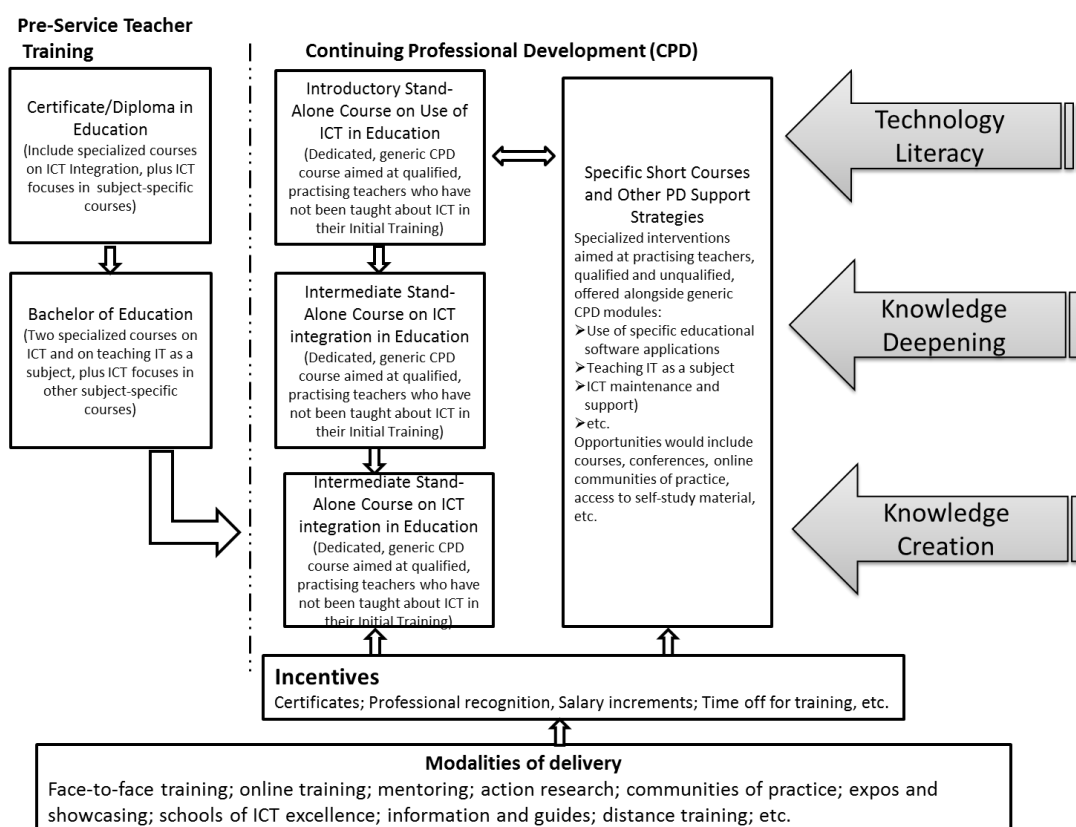
- e) Investing in knowledge management systems and strategies to store, curate and share educational content, ideally in partnership with emerging global OER networks and repositories.

It may be worth investing in a centralised national content development process (selected through competitive tender) which will lead to the generation of content. Additionally, incentive mechanisms could be devised to encourage educators to contribute materials. Any new materials commissioned for development should be licensed under a suitable Creative Commons licence so that they can be freely copied and adapted by the public, while also acknowledging the work of those responsible for developing them.

5) Building Human Capacity

Adopt a suitable global professional development framework to guide national implementation of ICT in education professional development. The absence of the necessary capacity among those responsible for education has been identified in this report as one of the major barriers to the integration of ICT in education, making it a priority point of action. Based on discussion in Section 2.5 of Chapter 3, this report recommends use of the UNESCO ICT Competence Standards for Teachers and Teacher Training as a starting point for planning professional development strategies at national level. Adoption of this would lead to a generic national strategy along the lines in the figure below, which is taken from Chapter 3 of the report.

Figure 3 - Illustrative Model of National Framework for ICT professional development



Professional development strategies should take into account all educational actors and target groups – including government officials, principals and management teams, administrators, teacher educators, educators at all levels (including those in pre-service teacher training programmes), learners, and community opinion-leaders, ICT coordinators (the staff members at a school or university who are responsible for implementing its ICT integration plan) and ICT maintenance and support personnel. Professional development strategies should:

- a) Make professional development in ICT integration a mandatory aspect of pre-service training so that all educators become aware of the value of ICT for teaching and learning, and how they might use ICT for teaching and learning when they become practicing teachers;
- b) Incorporate incentives for all target groups linked to enhancing their knowledge of ICT integration, which should be based not just on acquiring a qualification but also on demonstration of the successful application of skills and competencies acquired; and
- c) Ensure that the national professional development system gives people a choice of which professional development activities they can participate in (not limited to formal training courses), to enable them to select needs-based activities.

9. Recommendations for Development Partners

Development partners have various roles to play in relation to the use of ICT in education. They are potential sources of funding for initiatives which cannot be readily financed from national budgets, as well as potential sources of policy guidance and expertise. Development partners are especially well positioned to stimulate and support initiatives that are based on cross-border collaboration. In this light, it is recommended that development partners:

- 1) **Ensure that funded projects contribute to implementing the initiatives outlined in the recommendations for policymakers and regulators.** Often, ICT in education projects initiated by development partners have not been clearly aligned to broader national policies and objectives. Where this has been the case, such projects tend – at best – to be unsustainable and – at worst – to impede progress in effective roll-out of ICT in education by creating conflicts of interest and unnecessary fragmentation. Should it not be clear what the national strategy is, initial investments might most usefully focus on supporting policy and strategy development at the national level.
- 2) **Consider investment in the enabling environment.** In particular, they should consider support for governments that want to move towards establishing enabling policy environments as discussed in Section 2.1 above, including expert support, financing and capacity building at both national and regional levels.
- 3) **Consider investments at a regional or continental level that build common capacity across countries.** There are many ways in which regional or continental initiatives can contribute to building capacity that would support policy makers in implementing the kinds of initiatives outlined in the previous set of recommendations. These might include:

- a) The development of common, openly licensed course and programme materials aligned to the UNESCO ICT CFT that can be adapted and used in national professional development initiatives.
 - b) Support for the aggregation and release under open licences of digital learning resources produced in African countries in order to widen and deepen the pool of available educational content that is specifically designed with African educational contexts in mind. Where appropriate, this might usefully be done by supporting regional consortia of providers to produce materials in areas of common need, an important activity that often cannot be funded solely through government or other sources of national funding.
 - c) The establishment of platforms for capacity building and knowledge exchange on EMIS deployment, building on the experience of ADEA, using this to support the development of district-level EMIS data integration systems and to build the capacities of EMIS units and the Ministries responsible for education.
 - d) Support for the development of NRENs and deployment of associated data networks and applications (grid-computing, video-conferencing, e-learning, *etc.*).
 - e) Development of the capacity of policy makers and regulators to enable them to establish more effective ICT in education policies, strategies and regulatory frameworks.
- 4) **Continue to fund pilot projects that test the use of new and innovative technologies, ensuring that these experiments are well evaluated and the results widely shared.** As this report has illustrated, development of technology is still occurring rapidly and bringing with it new educational opportunities. As a result, it is important that there are controlled 'experiments' taking place on a regular basis in order to test the potential educational applicability of these new technologies and approaches, examine their total cost of ownership and establish their strengths and weaknesses. Often, it is difficult for governments to fund such experimentation, but it remains an essential part of building a knowledge base of best practice. Development partners have a critical role to play in supporting such activities.
- 5) **Ensure that the intellectual capital generated by funded projects is shared under a suitable open licence and made accessible via an appropriate web platform.** Over the years, development partners have invested large sums of money in many innovative initiatives which have produced important and high-quality products, either in the form of software applications, research outputs, educational resources, or other similar forms of intellectual capital. In a small minority of instances, there has been a good reason to allow the project grantee to retain full copyright of this intellectual capital in order to establish a viable long-term business model. More often than not, however, over time, this intellectual capital has simply been lost due to restrictions in its re-use and subsequent poor curation of the intellectual capital in a suitable repository. While some donors have started to impose requirements that funded projects release their intellectual capital under an open licence and have developed websites to store the products of such projects, the majority still do not do this, with the result that, in the long term, the full value of these investments is lost to education in Africa. Adopting policies that lead to release of intellectual capital under open licences (unless there are

valid reasons not to do so) and ensuring that this is stored in a sustainable online repository would help significantly to reduce wastage and duplication of investment.

- 6) **6) Undertake an evaluation and impact assessment of regional initiatives at different stages of development and implementation.** This report has highlighted regional initiatives in a number of thematic, ranging from those focused on digital learning resources and teacher education, such as the Teacher Education in Sub-Saharan Africa (TESSA) initiative and AVU's Teacher Education programme, to those focused on connectivity and access such as the UbuntuNet Alliance. Some of these have achieved gains which are discussed in this report, but the impact of many is uncertain. Investments by donors in this crucial field – and indeed those of national governments – will be much more productive if they are rooted in independent critical evaluation of these regional initiatives. This will provide a better understanding of which initiatives to support and how these can be best supported, reinforced or expanded where appropriate. Approaches resulting from independent evaluation could potentially include support for collaboration between regional initiatives so that they reinforce one another.