Thematic Paper

ICT, Education, Development, and the Knowledge Society

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1 Introduction

The Global e-Schools and Communities Initiative (GeSCI) is developing a conceptual framework for an African Leaders in ICT (ALICT) capacity building programme, which will be implemented in collaboration with the African Union Commission (AUC) and other African partners. ALICT, which is one of the AUC's flagship projects, focuses on building leaders' ICT and ICT management skills. The ALICT programme is based on the AUC's African Regional Action Plan for Knowledge Economy (ARAPKE) and is designed to intensify its activities. It is also well aligned with the framework of the EU-Africa eighth Strategic Partnership on Science, Information Society and Space (Africa-EU P8).[1] The GeSCI programme aims to model a methodology and multi-stakeholder approach to building capacity and raising awareness of African leaders on issues of the Knowledge Society, ICT, Education, Science and Technology and Innovation.

This paper is one of a series prepared for the AUC capacity building programme, with a focus on *ICT, Education, Development and the Knowledge Society*. It focuses on understanding what a knowledge society is and exploring its relationship to ICT, Education, and Development. It thereafter considers trends in ICT integration in Education and Development and highlights some of the challenges in implementing ICT in education initiatives in Africa. Finally, some tentative recommendations on key issues are presented.

2 Understanding the Knowledge Society

It is commonly thought that knowledge has replaced industrial organization and production as the major source of productivity.[2] The term 'Knowledge Society' generally refers to a society where knowledge is the primary production resource instead of capital and labour. It may also refer to the use a certain

[1] African Leaders in ICT - Terms of Reference for Expert Consultancies on the Development of Thematic Papers - Building Leadership Capacities for ICT and Knowledge Societies in Africa

[2] Evers, H. (2003). Transition towards a Knowledge Society: Malaysia and Indonesia in Comparative Perspective. *Comparative Sociology*, Vol2, Issue 1, pp.355-373.

society gives to information: a knowledge society 'creates, shares and uses knowledge for the prosperity and well-being of its people'.[3]

Globalization and the changing world economy are driving a transition to knowledge-based economies. In particular, developing countries need knowledge-based economies not only to build more efficient domestic economies, but to take advantage of economic opportunities outside their own borders. In the social sphere, the knowledge society brings greater access to information and new forms of social interaction and cultural expression. Individuals therefore have more opportunities to participate in and influence the development of their societies.[4]

According to Evers (2000), characteristics of a knowledge society are:

- Its members have attained a higher average standard of education in comparison to other societies and a growing proportion of its labour force are employed as knowledge workers i.e. researchers, scientists, information specialists, knowledge managers and related workers;
- Its industry produces products with integrated artificial intelligence;
- Its organizations – private, government and civil society – are transformed into intelligent, learning organizations;
- There is increased organized knowledge in the form of digitized expertise, stored in data banks, expert systems, organizational plans, and other media;
- There are multiple centres of expertise and poly-centric production of knowledge; and
- There is a distinct epistemic culture of knowledge production and knowledge utilization.[5]

A knowledge society is one where growth, development, and innovation are driven by optimal use of information and information products. In knowledge societies:

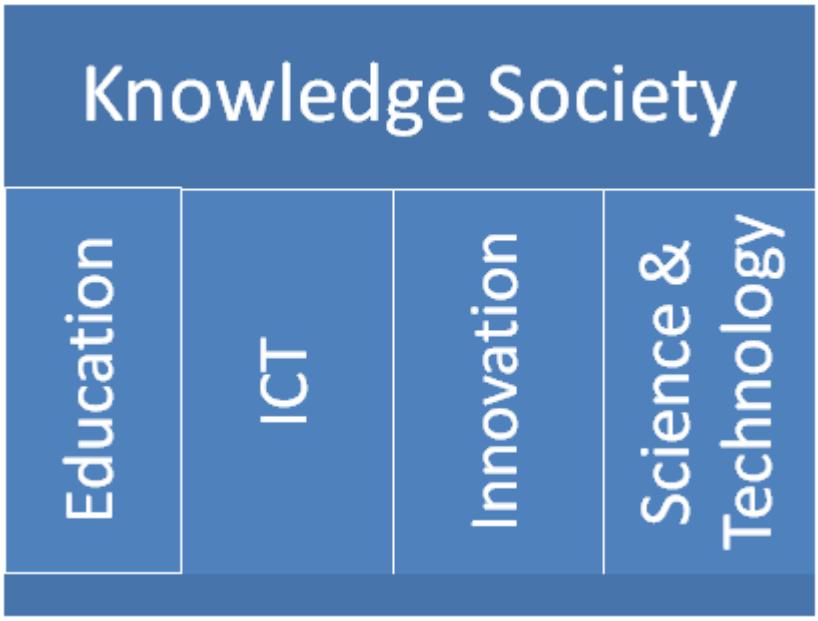
- The agricultural and manufacturing sectors become less significant, in favour of service and knowledge-based industries;
- Individual opportunity is greatly increased, with mobility being significantly determined by education;

[3] Knowledge Society. From Wikipedia: http://en.wikipedia.org/wiki/Knowledge_society
[4] UNESCO Asia and Pacific Regional Bureau for Education (2004) Guidebook 1 - ICTs in Education and Schoolnets. Retrieved from: http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/SchoolNetKit/guidebook1.pdf
[5] Evers, H. (2003). Transition towards a Knowledge Society: Malaysia and Indonesia in Comparative Perspective. *Comparative Sociology*, Vol2, Issue 1, pp.355-373.

- Competition is greater, with enterprises being exposed to global competition and global markets; and
- Cooperation is an important strategy for organizations and enterprises, in markets and societies with high levels of integration and interdependence.[6]

ALICT outlines four main pillars of a knowledge society: Education, ICT, Science and Technology, and Innovation.[7]

Figure 1: ALICT's pillars of the knowledge society



At the 2007 continent-wide African Knowledge Economy Forum on *Utilizing Knowledge for Development,* the pillars of Innovation and Science & technology were considered to present a single pillar, which was referred to as Innovation (incorporating Science & Technology).[8] With regard to education, lifelong learning is regarded as a requirement to keep pace with constantly changing global job markets and technologies. Preparation for lifelong learning involves an emphasis, in primary and

[6] UNESCO Asia and Pacific Regional Bureau for Education (2004) Guidebook 1 - ICTs in Education and Schoolnets. Retrieved from: http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/SchoolNetKit/guidebook1.pdf
[7] Hooker, M (2010) Concept Note: Building Leadership capacity for ICT Knowledge Societies in Africa, GESCI
[8] Hooker, M (2010) Concept Note: Building Leadership capacity for ICT Knowledge Societies in Africa, GESCI, p. 8.

secondary schools, on learning general skills and competencies, such as communication, mathematics and science skills, new literacy skills, problem-solving and interpersonal skills, as well as skills needed to learn other subjects. At tertiary level, the requirement is to build capacity in science and technology, discipline-specific skills, research, and development. Education is seen as contributing to all other sectors by providing the required skills and know-how for economic development. As such, education is not limited to formal education in traditional structures, but also encompasses the broader societal learning necessary for development.

As a second pillar, ICT is considered a critical tool in preparing and educating students with the required skills for the global workplace. It educates students so that they can continually adapt to a work world of continuous technological innovations, and makes it easier for students to access knowledge. ICT is regarded as an engine for growth and tool for empowerment, with profound implications for education change and socio-economic development.

Innovation, the third pillar, is seen as the means of support for development and economic functioning. It is described as a process of creation, exchange, evolution, and application of knowledge to produce new goods. It involves adapting, adopting, or using knowledge to produce new goods and services in local contexts or to advance society in general.[9]

The concept of a 'Knowledge Society' is often confused with that of an 'Information Society'. The latter is, however, considered more limited, as the application of knowledge to data creates information, and information has to be activated or generated by knowledge.

> Information is the codified result of observation, but knowledge entails the capacity to act (Stehr, 2001: 115).[10]

The concept of 'knowledge societies' includes a dimension of social, cultural, economical, political, and institutional transformation, and a more pluralistic and developmental perspective. It is regarded as a human process.[11] UNESCO argues that progression from Information Societies to Knowledge Societies

[9] Hooker, M. (2010). Concept note: Building Leadership Capacity for ICT and Knowledge Societies in Africa. Global e-schools and Communities Initiative

[10] Evers, H. (2003). Transition towards a Knowledge Society: Malaysia and Indonesia in Comparative Perspective. *Comparative Sociology*, Vol2, Issue 1, pp.355-373.

[11] Burch, S. (2006). The Information Society – the Knowledge Society. Retrieved from http://vecam.org/article517.html

requires that 'use of ICT must be linked to the recognition that knowledge is the principal force of the social, political, cultural and institutional dimensions of development, founded on human rights.[12]

As the status of information and knowledge are different in a knowledge-based society, the vision of what knowledge people need to acquire, and how they can acquire it, also needs to change. Knowing where knowledge is located and who has access to what kind of knowledge and why are becoming increasingly important. Social skills and 'relationship capital' become key skills for employment in the knowledge economy. Such skills are increasingly exercised using ICT. There is thus a need to skill both the workforce and the unemployed to increase their ICT literacy. These efforts need to be an ongoing part of lifelong learning, since a dynamic and fast-changing knowledge-based society requires continuous skills updating.[13]

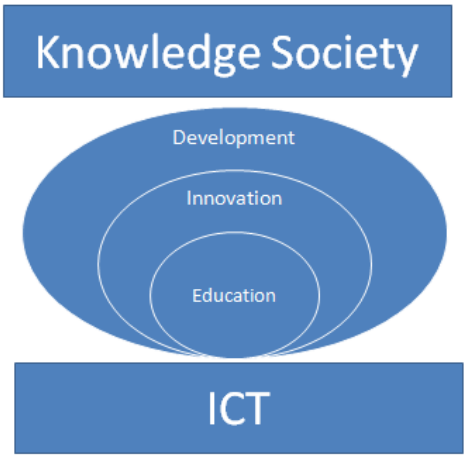
3 What Does This Mean for ICT, Education, and Development?

Increasingly, countries across the globe are embracing a vision for development of Knowledge Societies and adopting policies and strategies to encourage this development. Education is of vital importance in the knowledge society, as a source of basic skills, as a foundation for development of new knowledge and innovation, and as an engine for socio-economic development. Education is, therefore, a critical requirement in creating knowledge societies that can stimulate development, economic growth, and prosperity. It is not only the means by which individuals become skilled participants in society and the economy, but is also a key driver expanding ICT usage.[14]

Thus, rather than considering ICT, education, and development as separate pillars required to support the knowledge society, one may view education and development as interrelated drivers for socio-economic development. In this view, ICT is the enabler for both innovation and education – without which a knowledge society cannot be realized, supported or further developed. This is visually captured in the following figure:

[12] UNESCO (2005). Towards Knowledge Societies. Paris: UNESCO, p.2
[13] Punie, Y., and Cabrera, M. (2005). The Future of ICT and Learning in the Knowledge Society - Report on a Joint DG JRC-DG EAC Workshop held in Seville, 20-21 October 2005. Seville: European Commission Directorate-General Joint Research Centre
[14] UNESCO Asia and Pacific Regional Bureau for Education (2004) Guidebook 1 - ICTs in Education and Schoolnets. Retrieved from: http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/SchoolNetKit/guidebook1.pdf

Figure 2: ICT as an enabler of the innovation and education required for development and sustenance of a knowledge society



As noted earlier, learning in the knowledge-based society is considered to be holistic, as it is a lifelong activity and cuts across different learning generations and life spheres (private, public, and work). The focus should not be confined to traditional formal learning institutions such as schools and universities; and existing training organizations and training practices, but also embraces adult education, informal learning, and workplace-based learning. The potential impact of ICT on learning is the vision that it enables learning 'anywhere, anytime, and anyhow'. With ICT, knowledge is not constrained by geographic proximity, and offers more possibilities for sharing, archiving, and retrieving knowledge.[15] In addition, the knowledge society and widespread use of ICT generates a need for new digital skills and competences for employment, education and training, self-development, and participation in society.[16] ICT has potential to widen access to educational resources, improve the quality of learning, and improve management efficiencies of the education system.[17]

It is important to note that ICT use in education and development to build a knowledge society is not simply about teaching 'ICT literacy' – i.e. learning to operate the technology – but also about building

[15] Wikipedia, From Wikipedia: http://en.wikipedia.org/wiki/Knowledge_society
[16] Punie, Y., and Cabrera, M. (2005). The Future of ICT and Learning in the Knowledge Society - Report on a Joint DG JRC-DG EAC Workshop held in Seville, 20-21 October 2005. Seville: European Commission Directorate-General Joint Research Centre
[17] Gesci (2009) Building a Knowledge Society for All

higher-order skills, such as knowing and understanding what it means to live in a digitized and networked society and use digital technology in everyday life. This includes understanding how ICT applications and services function, as well as knowing where to search for certain information, how to process and evaluate information, and how to assess the reliability and trustworthiness of multiple sources of information (online and offline). It is especially important, when dealing with educational content, to be able to assess the quality and reliability of knowledge and to contextualize it effectively. In addition, there is a need for networking skills related to building, maintaining, and developing social interaction using ICT. Thus, effective education in a knowledge society must also deal with sharing information, knowledge, and other resources.[18] Critically, ICT is valuable only as a *means* to achieve genuine knowledge societies. The growth of ICT networks alone will not build a knowledge society.[19] Thus, ICT is a *facilitator* for major education and development reforms, but not a sufficient condition.

If societies are to harness ICT effectively to build knowledge societies, the implications are that there will be changing skills requirements for students and employees, as well as changing roles for educators and employers. For example, the growing importance of ICT has placed increasing emphasis on the need to ensure that learners and workers are information literate (including having higher order skills). Likewise, universities and employers 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. This requires education institutions to develop and establish methods for teaching and evaluating these critical literacies at all levels of education. It also requires employers to continue to engage in training, mentoring, and professional development practices that achieve similar aims, but within the workplace.

As learners learn the skills of using ICT in education, the professional role of academics as mentors – able to impart the wisdom that only experience can provide – will grow in importance. Similarly, requirements in the workplace will shift, creating additional expectations on new entrants to the job market about what are regarded as critical ICT-related skills. As such, ICT enables the development of the knowledge society, through the interrelated and mutually supportive pillars of education and innovation for development.

[18] Punie, Y., and Cabrera, M. (2005). The Future of ICT and Learning in the Knowledge Society - Report on a Joint DG JRC-DG EAC Workshop held in Seville, 20-21 October 2005. Seville: European Commission Directorate-General Joint Research Centre

[19] UNESCO. (2005). Towards Knowledge Societies. Paris: UNESCO

Seen within this context of social transitions towards a knowledge society, UNESCO outlines the following as broad reasons for growth in use of ICT within education systems:

- Development of knowledge-society attributes in students, including higher order thinking skills, lifelong learning habits, and the ability to think critically, communicate, and collaborate, as well as to access, evaluate, and synthesize information.
- Development of ICT skills and competencies in students, as preparation for operating in an ICT-rich workplace and society.
- Resolution of structural problems and deficits in education systems. This can include using ICT to enhance administrative and teaching efficiency, alleviate under-resourcing in specific areas (for example, a lack of textbooks or learning support materials), address equity issues through enabling equality of access to knowledge, resources and expertise, or support teachers who may be under-equipped to deal with new teaching challenges.[20]

Identical reasons can posited to justify use of ICT in development and increased efficiency in the private and public sectors of society:

- Development of knowledge-society attributes in employers, employees, citizens and the public service, including higher order thinking skills, lifelong learning habits, and the ability to think critically, communicate, and collaborate, as well as to access, evaluate, and synthesize information.
- Development of ICT skills and competencies in the public and private sector, as a requirement for operating in an ICT-rich workplace and society.
- Resolution of structural problems and deficits in social and commercial systems. This can include using ICT to enhance administrative and knowledge transfer.

The potential of ICT to tackle some of the challenges facing education, and thereby impact on development, has led many countries to invest heavily in ICT, placing it at the centre of their development strategies. ICT integration programmes benefit from a strong association with system-wide changes such as improved service delivery, curriculum changes, or new quality assurance and production processes in business. In the formal education context, this may include moves towards

[20] UNESCO Asia and Pacific Regional Bureau for Education (2004) Guidebook 1 - ICTs in Education and Schoolnets. Retrieved from: http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/SchoolNetKit/guidebook1.pdf

decentralization, school-based management, and learner-centred philosophies.[21] However, developing countries generally face challenges in terms of capacity, capability, and resources (human and financial) to harness the potential of ICT successfully and effectively. They thus require sustained investments in education, innovation systems, infrastructure (including ICT itself), and implementation of policies that support such knowledge-based economic transformation in order to transform their economies.[22]

If done well, increased deployment of ICT can lead to greater digital opportunities, including economic and human development. Thus, ICT is regarded as a potent tool in reducing poverty, extending health services, expanding educational opportunities and generally improving the quality of life:

> The leveraging of ICT to facilitate broader public goods including improved health care, literacy, civic responsiveness and equitable access to economic opportunity creates social capital essential for the full leveraging of economic development potential that can be achieved through the use of digital tools and telecommunications However, what is critical, is that ICT deployment be accompanied by simultaneous policies supporting equitable access to social institutions such as health care and education.[23]

Policymakers face the challenge of creating conditions that support these developments in their countries, whilst also creating policies and programmes that harness their effects to support economic growth and the public good. The improvement of educational systems and increased educational attainment are seen as primary ways that countries can prepare for these global, technology-based changes. As highlighted earlier, ICT is seen as a way to promote educational change, improve the skills of learners, and prepare them for the global economy and the information society. Similarly ICT is seen as a way to improve government service delivery, while increasing the productivity and efficacy of the private sector. Consequently, the desire to be globally competitive, grow national economies, and improve social conditions is often used to justify public sector investments in educational and developmental improvement through the application of ICT.[24]

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[21] UNESCO Asia and Pacific Regional Bureau for Education (2004) Guidebook 1 - ICTs in Education and Schoolnets. Retrieved from: http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/SchoolNetKit/guidebook1.pdf

[22] GeSCI (2009) Building a Knowledge Society for All.

[23] Mitchell, M and Gillis, B. (no date). Making Sense of the Relationship between Information Communication Technologies and Economic Development. Retrieved from: http://dgss.wsu.edu/di/docs/MakingSenseoftheRelationshipbetweenICTandEconomicDevelopment.pdf

[24] Kozma, R.B. (2005). National Policies That Connect ICT-Based Education Reform To Economic And Social Development. *Human Technology - An Interdisciplinary Journal on Humans in ICT Environments*. Volume 1 (2), October 2005, pp.117-156

In this context, the link between ICT, education and development appears obvious. In Africa, there is growing recognition by national, regional, and continental bodies of the role of ICT for socio-economic development. Evidence of this includes the many countries that have focused attention on developing national ICT policies and National Information and Communication Infrastructure Plans to support their socio-economic development efforts and ICT in education policies. There has also been significant growth of continental and regional strategies to create knowledge societies, examples of which include:

- The African Union, in its *Second Decade of Education for Africa (2006-2015): Draft Plan of Action*, recognizes that education is a critical sector, the performance of which directly affects and even determines the quality and magnitude of Africa's development. It notes that 'education forms the basis for developing innovation, science and technology in order to harness our resources, industrialise, and participate in the global knowledge economy and for Africa to take its rightful place in the global community. It is also the means by which Africa will entrench a culture of peace, gender equality and positive African values'.[25]
- The Africa EU-P8 partnership has the following priority area with regard to ICT: 'support the development of an inclusive information society in Africa, with the goal of bridging the digital divide and to enhance the use of ICT as key enablers for poverty reduction, growth, and socioeconomic development'.[26]
- The African Information Society Initiative (AISI), which has as its main objective, to support and accelerate socio-economic development across the region.[27]
- The New Partnership for Africa's Development (NEPAD) aims to provide an overarching vision and policy framework for accelerating economic cooperation and integration among African countries.[28]
- Southern African development Community (SADC) Member States have acknowledged the importance of ICT in meeting the challenges posed by globalization, facilitating the regional integration agenda, and enhancing the socioeconomic development prospects of the Region. Members have agreed on the need to develop an all-inclusive, balanced, and socially equitable

[25] African Union. (2006). Second Decade of Education for Africa (2006-2015) Draft Plan for Action

[26] Africa and Europe in Partnership. (no date). Science, Information Society and Space, http://www.africa-eu-partnership.org/partnerships/science-information-society-and-space

[27] African Union and Economic Commission for Africa. (no date). African Regional Action Plan for the Knowledge Economy Framework

[28] United Nations and Economic Commission for Africa. (2004). Report to the Tenth SRO-SA Meeting of ICE Lusaka, 3-5 May 2004 - National Information and Communication Infrastructure (NICI) Plans In Southern Africa AISI NICI Plan-Southern-Africa

information and knowledge-based society, which is founded on coordinated national strategies to integrate ICT into regional development policies effectively.[29]

- The Regional ICT Support Programme (RICTSP) is a development framework between: Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC), the Inter-Governmental Authority for Development (IGAD), and the Indian Ocean Commission (IOC). The primary objective of RICTSP is to 'contribute to the regional integration agenda through an effective and efficient ICT environment which will reduce the costs of trade and investment and thereby stimulate economic growth and reduce poverty. The purpose is to achieve a reduction in the digital divide by removing some of the constraints to the efficient use of ICT'.[30]

So, what are the implications of the above for education, development, and ICT?

For a knowledge society to be realized, supported, and/or further developed, education and innovation should be viewed as interrelated drivers for socio-economic development, in a context where ICT is an enabler for both innovation and education This shift in the conceptualization of education, development and ICT, from being distinct pillars to being interrelated and enabling drivers of socio economic development has several implications for policy makers:

1. Education is a lifelong activity and cuts across different learning generations and life spheres (private, public, and work) that can no longer be confined to investments in schools and universities. Likewise, education can no longer be dichotomized as face-to-face or distance education.
2. Teaching 'ICT literacy' is no longer sufficient, as higher order skills of how to participate in a knowledge society as citizen, worker and scholar are required.
3. Skills requirements for students and employees as well as for educators and employers change – and keep changing - in a knowledge society.
4. ICT can be used to tackle some of the challenges facing education and be a key driver of development strategies, but requires sustained investment and strong alignment with systemic changes (in education, service delivery, and/or economic productivity).
5. ICT can be regarded as a potent tool in reducing poverty, extending health services, expanding educational opportunities, and generally improving the quality of life.

[29] Southern African Development Community Regional Indicative Strategic Development Plan (no date). Retrieved from: http://www.sadc.int/attachment/download/file/74
[30] COMESA Regional ICT Support Programme. Retrieved from http://comesa.assure.danishictmanagement.dk/

6. A national policy framework to codify how ICT can, and will, be used for socio-economic development across the various spheres in government may be required.
7. Participation in regional and continental initiatives to harness ICT for education and development can streamline and support national efforts.

4 A Few Key Trends and Challenges

If the creation and sustenance of a knowledge society is a policy goal, then there are several trends and challenges introduced by ICT which cut across all sectors in society. A society that wishes to create, share, and use knowledge for socio-economic development must be aware of these trends and their related challenges, paying particular attention to how these challenges impact on the education sector, which feeds and supports all other sectors.

The past 20 years has seen rapid development in ICT in all economic sectors. Lagging behind this rapid development, there has been an accompanying explosion of ICT-related activity in the education sector in the last decade. Education institutions and national systems can no longer ignore ICT, and now grapple with the challenge of how best to deploy ICT to the benefit of students, academics, and countries. The long-term impact of ICT on education is still largely a matter of conjecture (often driven by ideological determinism or commercial marketing), and will only really start to become fully clear over the next ten to 15 years. Nevertheless, certain trends in ICT use that are evident across sectors, but are particularly relevant to education, are emerging:

1) ICT is expanding the range of options available to education planners in terms of the teaching and learning strategies they choose to use, providing an often bewildering array of choices in terms of systems design options, teaching and learning combinations, and strategies for administering and managing education.

2) ICT is allowing for exponential increases in the transfer of data through increasingly globalized communication systems, and connecting growing numbers of people through those networks.

3) ICT networks have significantly expanded the potential for organizations to expand their sphere of operations and influence beyond their traditional geographical boundaries.

4) ICT is reducing barriers to entry of 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.

5) There has been an explosion in collective sharing and generation of knowledge as a consequence of growing numbers of connected people, and the proliferation of so-called Web 2.0 technologies.[31] Consequently, collective intelligence and mass amateurization are pushing the boundaries of scholarship, while dynamic knowledge creation and social computing tools and processes are becoming more widespread and accepted.

6) Digitization of information in all media has introduced significant challenges regarding how to deal with issues of intellectual property and copyright. Copyright regimes, and their associated business models, that worked effectively prior to the development of ICT are increasingly under threat, and in some cases rapidly becoming redundant.

7) Systemically, ICT is tending to accentuate social disparities between rich and poor.

Increasingly, investment in ICT is being seen by education policy makers and planners as a necessary part of establishing national competitive advantage, because it is attractive to students (particularly in those parts of the world where young people have increasingly ubiquitous access to ICT) and because it is deemed essential by governments, parents, employers, and other key funders of education. Despite this, it is becoming clear that there is no direct correlation between increased spending on ICT and improved performance of education systems. Benefit and impact, to the extent that it can be reliably measured at all, is more a function of how ICT is deployed than what technologies are used. Hopefully, as this knowledge becomes more widespread, it will help education systems around the world – whatever their current resourcing constraints – to harness ICT over the coming years to improve education delivery and reduce its cost, rather than creating additional expenses, exacerbating operational complexities, and generating new problems.

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[31] Wikipedia notes that 'Web 2.0…refers to a supposed second generation of Internet-based services—such as social networking sites, wikis, communication tools, and folksonomies—that emphasize online collaboration and sharing among users… In the opening talk of the first Web 2.0 conference, Tim O'Reilly and John Battelle summarized key principles they believed characterized Web 2.0 applications:

- The Web as a platform
- Data as the driving force
- Network effects created by an architecture of participation
- Innovation in assembly of systems and sites composed by pulling together features from distributed, independent developers (a kind of "open source" development)
- Lightweight business models enabled by content and service syndication
- The end of the software adoption cycle ("the perpetual beta")
- Software above the level of a single device, leveraging the power of The Long Tail.'

Reference: http://en.wikipedia.org/wiki/Web_2. (Accessed on 18th November, 2006).

E-learning continues to grow in importance in different parts of the world. Indeed, some educational planners see it as one of the few relatively unrestricted avenues for innovation in teaching and learning. The European eLearning Action Plan defines e-learning as

> The use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchange and collaboration.[32]

A tendency has, however, grown to use 'distance education' and 'e-learning' interchangeably. The use of distance education and e-learning as interchangeable or composite phrases introduces a blurring conflation of the terms, which has sometimes led to poor quality strategic planning. It is true that introduction of ICT introduces a new range of educational strategies, but it remains a relatively simple matter to establish whether specific uses of ICT incorporate temporal and/or spatial separation. Thus, for example, learners working independently through a CD-ROM or online course materials are clearly engaged in a distance education practice, while use of satellite-conferencing, although it allows a degree of spatial separation, has more in common with face-to-face education because it requires learners to be in a specific place at a specific time. Many people harnessing ICT seem to think they are harnessing the benefits of good quality distance education, when, in most cases, they are simply finding technologically clever ways of replicating traditional, face-to-face education models.

The only complexity within this is that ICT has created one specific new form of contact, which is not easily classified as either face-to-face or distance. Online communication allows students and academics to remain separated by space and time (although some forms of communication assume people congregating at a common time), but to sustain an ongoing dialogue. Online discussion forums, for example, reflect an instance where the spatial separation between educator and learners is removed by the 'virtual' space of the Internet, but where there remains temporal separation. As a discussion forum allows sustained, ongoing communication between academics and students, it is clearly a form of contact not a form of independent study. Thus, there may be cause to introduce a new descriptor for educational methods of direct educator-student contact that are not face-to-face, but are mediated through new communications technologies.

[32] COM(2001)172 final. Communication from the European Commission to the Council and the European Parliament: 'The elearning action plan. Designing tomorrow's education'. Brussels, 28.3.2001. It is part of the comprehensive 'eEurope Action Plan'.

The most important lesson that has emerged from the past ten years is to ensure that each education intervention using ICT is planned and implemented on its own merits, rather than forced into simplistic, dichotomous categories (such as 'distance education' or 'face-to-face education'), which set arbitrary and unhelpful constraints. Technologies can be applied in a range of ways, to support an almost limitless combination of teaching and learning strategies, and it is essential to keep options as open as possible. Particularly, as Goodyear notes:

> We should try to design technology which is appropriate to their actual work rather than technology which embodies our teacher/managers' beliefs about what students should be doing.[33]

However, it should also be noted that the typical approach currently of experimentally deploying new technologies does not include processes to quickly scale them up to broad usage when they work and this often creates its own obstacles to full deployment. Thus, careful management, with a view to cost effective scalability, is an important requirement.

4.1 Explosion of Technologies

The past ten years has seen an unprecedented explosion of innovation in ICT, leading to a sometimes bewildering array of new technological options that can be harnessed to support education, in its managerial and administrative operations, in teaching and learning, and in research. It is beyond the scope of this paper to describe them all, but a few key recent technological developments are outlined in Appendix E. A significant proportion of these developments has emerged as a consequence of the growing availability of high quality, stable broadband Internet connections. Indeed, perhaps the defining feature of the development of the Internet in recent time has been the rapid growth of Web 2.0 platforms. This growth is predominantly driven by assumptions that participants (not users) are able to be online, in a broadband environment, 24 hours a day. The problems associated with this for people living in countries or areas where such Internet access does not exist or is not affordable are significant.

[33] Goodyear, P. 1998. 'Integrating Information and Communication Technology in Higher Education (BITE)', Maastricht, March 25-7 1998.

In places, where the technology is readily accessible, 'digital natives' (i.e. people who have grown up with ubiquitous access to ICT) will continue to demand that more learning be delivered asynchronously, via whatever electronic telecommunications device they have handy, including – increasingly – low-cost laptop computers, mobile telephones, Personal Digital Assistants (PDAs), and MP3 players. Consequently, mobile and personal technology is increasingly seen as a delivery platform for services of all kinds, although it remains unproven what the educational benefits are.

Of course, harnessing technologies for education purposes to create blended learning – including gaming, virtual reality, text messaging, and social networking sites – requires continued investment in supporting academics and teachers to create and sustain these new learning environments. This will have significant financial implications for institutions, education systems, and governments. In addition, ongoing technological churn is bringing new kinds of support challenges. This introduces the importance of ensuring that technologies adhere to common open standards to facilitate integration and inter-operability. Inevitably, each new technology introduced brings its own requirements for support, while the support needs of established technologies remain. Introduction of new technologies can also create backlash from those expected to change how they work.

Critically, the emergence of these, and other related technological innovations has tremendous potential to accentuate the digital divide within education, conferring benefit on those with access to ICT and further marginalizing those without such access. However, while provision of hardware has been an essential focus of debates on the digital divide, it is now seen as only one of a range of factors that must be tackled to increase participation in the information economy. Particularly, speed and access to the Internet matter to productivity, not just to individuals' satisfaction with their technology interactions. The digital divide continues to widen, but increasingly the issue has become about access to broadband (high-speed) Internet connections, not just access to hardware. Thus, there is no binary digital divide, and no single overriding factor for determining such a divide. Consequently, the concept of digital inclusion has become increasingly important, as it seeks to examine the combination of factors that may limit participation in the information economy. Factors that require consideration include access to hardware and affordable/reliable Internet connections, information literacy, extent of integration of ICT into the social fabric of everyday life, provision of technical and training support, and access to compelling applications and content.

A final critical consideration arises from the above, given that recent technological developments are so much a function of the rapid expansion of the Internet. As more and more information is stored in shared, online spaces, security and privacy issues are likely to continue to be an area of contention throughout the world over the next few decades. If education does not actively participate in shaping appropriate security and privacy policies and strategies, criminal justice systems may drive the outcomes.

4.2 Shift from Content as a Product to Content as a Service

Another significant trend initiated by the explosion of ICT is the shift in the conception and value of content. Historically learning – in either education institutions, in the workplace, or in society at large – has relied on printed materials to deliver a content-rich product. With the advent of ICT and its rapid and cost-effective publishing opportunities, this is no longer the case. Content-rich materials are no longer static nor the exclusive domain of publishing companies. This frees all citizens – but particularly those in education – to author and publish learning materials in electronic formats. Content itself can be dynamically updated and need no longer be the preserve of single authoring team. Rather than the value being in the content itself, value is created in services that package and rapidly publish content that is both current and tailored for a myriad of audiences and purposes.

This trend is clearly seen in the emerging concept of Open Education Resources (OERs). In a nutshell, the concept of OERs describes educational resources that are freely available for use by educators and learners, without an accompanying need to pay royalties or licence fees. A broad spectrum of licensing frameworks is emerging to govern how OERs are licensed for use, some of which simply allow copying, others which make provision for users to adapt the resources that they use. These licensing frameworks have emerged partly in response to the reality that digitized content accessible on the Internet is impossible to govern under traditional copyright dispensations. However, the concept of OER has also gained momentum as some people see its potential transformative power for education.

The power of this concept revolves around three linked possibilities:

- Because OERs remove restrictions around copying resources, they hold potential for reducing the cost of accessing educational materials. In many systems, royalty payments for text books and other educational materials constitute a significant proportion of the overall cost, while processes of

procuring permission to use copyrighted material can also be very time-consuming and expensive (although some commentators have tended to overestimate the extent to which content is a cost driver in education by assuming that free content is almost synonymous with free education).

- The principle of allowing adaptation of materials provides one mechanism amongst many for constructing roles for learners as active participants in educational processes, who learn best by doing and creating, not by passively reading and absorbing. Content licences that encourage activity and creation by learners through re-use and adaptation of that content can make a significant contribution to creating more effective learning environments.
- OERs have potential to build capacity by providing educators access, at low or no cost, to the means of production to develop their competence in producing educational materials and completing the necessary instructional design to integrate such materials into high quality programmes of learning. Many educational systems are foundering because their employees have become so overwhelmed by administrative tasks that they have lost the time and space to exercise this critical creative capacity, and it will take time and investment to rebuild it. The concept of OERs has potential to facilitate this if the process of developing educational materials is seen as being just as important as – maybe more important than – the final product.

Problematically, though, many people in the 'OER movement' seem to assume that simply making content freely available for use and adaptation will improve higher education delivery. This simplistic position ignores the obvious reality that content is only one piece of the educational puzzle, and that effective use of educational content demands, amongst other requirements, good educators to facilitate the process. Importantly, OER provides a structured opportunity to engage higher education faculties and academics in structured processes that build capacity to design and deliver high quality higher education programmes without increasing cost. Without this growing institutional capacity, OER will not be able to fulfil its transformative potential.

4.3 ICT and Changing Skills Requirements

The growth of knowledge societies has placed increasing emphasis on the need to ensure that people are information literate. However, 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). Information literacy is defined as:

> The capacity to identify and issue and then to identify, locate and evaluate relevant information in order to engage with it or to solve a problem arising from it.[34]

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 specialized skill sets. Education systems need to develop and establish methods for teaching and evaluating these critical literacies at all levels of education.

In a fascinating review of *How Computerized Work and Globalization Shape Human Skill Demands*[35], American professors Frank Levy and Richard Murnane explore how growing use of ICT is changing the American workforce by automating certain tasks and facilitating the offshoring of others. In conducting this review, the paper concludes that education systems need to place increased emphasis on key basic and advanced skills if they are to produce skilled people to meet changing economic demands. As this neatly summarizes some of the key competences that will be required of future graduates, excerpts are quoted at some length below:

> **Basic Skills**
>
> The ability to read becomes particularly important in economic disequilibria when people must process new information to learn new routines. In these disequilibria, society relies on text to disseminate information rapidly. As computer technology and increased global competition accelerate the rate of economic change…the need for reading has increased correspondingly.
>
> The faster pace of change has also increased demands for writing. For example, a growing number of firms ask employees to document solutions to new problems so the solutions can be disseminated throughout the organization. The documentation can only be effective if it can be clearly understood. The reliance on email to exchange information rapidly similarly requires the ability to write clearly and persuasively.

[34] McCausland, H.,Wache, D. & Berk, M. (1999). *Computer literacy; its implications and outcomes. A case study from the Flexible Learning Centre*. University of South Australia. p. 2.
[35] Levy, F. & Murname, R. 2006. *How Computerized Work and Globalization Shape Human Skill Demands.* Unpublished paper.

Because of computerization, the use of abstract models now permeates many jobs and has turned many people into mathematics consumers…in most cases, a computerized tool does the actual calculation, but using the model without understanding the math leaves one vulnerable to potentially serious misjudgments.

Teaching Advanced Skills

Begin with Expert Thinking – the ability to solve problems that, unlike algebra, lack explicit rules-based solutions. These problems must be solved through some form of pattern recognition. Rules-based solutions must still be part of a curriculum – i.e. students still need to know subjects like algebra. But a curriculum must recognize that a rules-based solution is usually the second part of a two-part problem solving process. The first part of the process – the part that retains labor market value - is the ability to recognize which rules-based solution applies in a particular case…Understanding consists of seeing a pattern. Learning this kind of pattern recognition takes practice. In particular, it requires going beyond traditional assignments where a student knows that the problems at the end of a chapter on long division can all be solved using long division – no need to think about which rules apply. In subjects like history or literature, the equivalent of rules-based solutions is a focus on narrow facts – e.g. dates and names and little more. In this case, going beyond rules-based solutions means teaching the underlying relationships among narrow facts.

The skill of Complex Communication – making effective oral and written arguments, eliciting information from others – can similarly be taught using existing subject matter. But teaching this skill requires both a change in emphasis and additional time - the time needed to review and grade oral presentations and frequent student essays.

Perhaps the biggest potential obstacle to increasing students' mastery of Expert Thinking and Complex Communication are…tests (assessments) that emphasize recall of facts rather than these critical skills.[36]

[36] Excerpts extracted from: Levy, F. & Murname, R. 2006. *How Computerized Work and Globalization Shape Human Skill Demands*. Unpublished paper. pp. 18-23.

4.4 ICT and the Changing Role of Educators

Assuming that, notwithstanding the many challenges, it will become increasingly easy to create educational environments where the online world is seamlessly and ubiquitously integrated with the physical campus, students will face a new set of educational challenges. Increasingly, though, these challenges will not be teaching learners how to use the technology to learn. They are able to learn these skills themselves without much, if any, guidance. However, as they learn the skills of using ICT in education, the professional role of teachers as mentors – able to impart the wisdom that only experience can provide – will grow in importance. Thus, it is becoming essential for teachers to provide this mentoring. Unfortunately, though most professional development programmes tend to focus on trying to teach educators to use the technology.

Below is an overview of a few key ways in which educators will need to be able to mentor and guide learners in this environment. None of these is new nor are they directly related to ICT, but the growth of ICT as a social phenomenon heightens their importance at a time when most professional development for educators is paradoxically reducing focus on them:

1. *Fostering coherence and discipline in thinking*

   While access to multiple sources of information can enrich thinking, it can also debilitate it, and educators have a critical responsibility to ensure that they foster the ability of learners to be able to concentrate, to retain coherence in constructing arguments, and to be able to think with discipline (the latter being a key original purpose of undergraduate disciplinary studies). Further, the ability to integrate different disciplinary ways of thinking – which will grow in importance – should not be confused with pastiche. To be able to engage in inter-disciplinary modes of thought, learners must first have constructed basic disciplinary platforms on which to build. The distractions of ever-expanding exposure to information and media has potential to undermine construction of these platforms, so educators will need to be better prepared than ever to help learners to develop them.

2. *Navigating the ethics of a world with no apparent limits*

   A feature of the online world is that it places before people a plethora of ethical dilemmas, made more complex by the apparent anonymity of the online experience. For example: pornography comprises a significant proportion of the content accessible online; MP3 and other download sites

provide ready access to vast quantities of copyrighted material; the potential for disguising and stealing identities has grown significantly in the digital world; and unsubstantiated rumour and gossip can travel around the world in seconds, often with devastating consequences for individuals. People who lack an effective, structured framework for considering such ethical dilemmas and making appropriate decisions to guide their actions will find the Internet a place for potential self-destruction, very often with broader negative social consequences. Here, the key role of educators and education systems is not to deny access to these environments in the pretence that learners will therefore be 'saved' from them. Rather, it is to provide learners the competences and knowledge to be able to navigate their way through these ethical dilemmas effectively and positively, both for themselves and for the societies of which they are part.

3. *Coping with the challenges of 'unlimited' choice*

   Another reality that technological developments have made possible is to put before consumers access to an unprecedented range of choice in almost all material aspects of life. If knowledge societies are to open access for people to this world of ever-increasing choice, policy makers need also to ensure that future graduates are equipped with the skills to cope with it effectively and responsibly, to remain decisive and able to act, without succumbing to the potentially debilitating illusion that the choices they have not taken are the better ones.

4. *Encouraging learners to become creators in the educational environment*

   A flaw in much educational practice is the tendency to treat learners as recipients of knowledge, and education as a process of information transmission. In environments where learners have ubiquitous access to Web 2.0 platforms, a natural tension will arise, as learners will want increasingly to become active members of communities of practice, a notion well aligned with the educational theory of constructivism. A key barrier to fostering such approaches in education, however, is the strong emphasis that is still placed on protecting intellectual property. While there may be strong commercial incentives to protect certain kinds of intellectual property, the economic and educational arguments in favour of the concept in education are spurious to say the least. Releasing intellectual property as OERs for use and adaptation under emerging licensing frameworks such as the Creative Commons[37] is possibly the single most powerful way in which academics can

[37] For more information, see www.creativecommons.org.

encourage their learners to become creators in the educational environment, who derive benefit by sharing the results of their intellectual endeavours with their peers online.

5 How Countries are Responding

In response to the above trends, several approaches have been noted worldwide which seek to adopt a comprehensive approach to ICT integration, in order to promote and develop knowledge societies. These include addressing issues of policies, infrastructure, professional development, evaluation and research. A few examples are highlighted below.

5.1 Policy Development

Internationally, the need to provide quality education for all learners has motivated countries to develop plans focused on the use of ICT for teaching and learning. The drive to promote ICT in education has typically been aligned with broader social and economic goals. In particular, visions of how ICT in education can lead to participation in a global knowledge economy and how ICT will improve country economies are explicated in ICT policies.

Several African countries are prioritizing the use of ICT in education to achieve critical strategic developmental objectives. For example, Kenya's *National Information and Communication Technology (ICT) Strategy for Education* recognizes that 'an ICT literate workforce is the foundation on which the nation will become a knowledge-based economy…education [is] a platform for equipping the nation with ICT skills in order to create dynamic and sustainable economic growth.' In addition, Kenya envisages that the use of ICT will help the country to meet the objectives of education for all and universal primary education.[38] Similarly, the *Egyptian Information Society Initiative* intends to exploit e-learning applications to spread knowledge and information using electronic means through the Internet. The Egypt Education Initiative's objective is to improve education in Egypt through effective the use of ICT.[39]

[38]Kenyan Ministry of Education (June 2006). National Information and Communication Technology (ICT) Strategy for Education and Training, p.3.
[39] Czerniewicz, L. (ed). 2007. Report on Higher Education ICTs and e-Learning in Egypt, p.4. Cape Town: CET

In South Africa, the government has expressed its commitment to the knowledge society through the establishment of a Presidential National Commission on Information Society and Development (PNC on ISAD), which focuses on policy and development of ICT in five priority areas of e-Government: e-Health, e-Education, Small, Micro and Medium Enterprises (SMMEs), and content development. Several projects are underway in these five priority areas. For example, in e-government, Government has launched Batho Pele gateway, a toll free call centre available at 1020 and South African Post Office Internet terminals, and the South African Revenue Service's (SARS) e-filing system.[40]

Further afield, there are also many examples of e-Education being identified as critical strategic imperatives for education systems. For example, New Zealand's *Enabling the 21st Century Learner: The e-Learning Action Plan for Schools 2006–2010* outlines the action plan to achieve ICT integration into the curriculum. This document specifies that ICT literacy is an essential skill in a 'time of rapid social, cultural, economic, technological, and global change. Without ICT Literacy, there is a risk that people will be cut off from job opportunities and unable to take part in the full life of the community'.[41] Malaysia's 2001 *ICT Master Plan* aims to position Malaysia in the global information society.[42] Korea's *Comprehensive Plan for Developing ICT use in Education* recognizes that ICT enables education reform, and it is a powerful and instructional tool.[43]

Investment in ICT in education has also been motivated by the promise of ICT capabilities to make education administration more efficient. In the United Kingdom (UK), the use of computerized systems for school administration has improved communication with parents, reduced paper work, and increased teamwork through networked systems.[44] Use of ICT by the UK government to collect, collate, use, and share management information has become an imperative.[45] Similarly, China's *Administration Informationalization Project* aims to establish a web-based support environment for educational administration to enhance efficiency of the education administration system.[46]

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[40] The PNC on ISAD, http://www.pnc.gov.za
[41] New Zealand Ministry of Education. Enabling the 21st Century Learner: An e-learning Action Plan for schools – 2006 – 2010. Retrieved from: http://www.minedu.govt.nz/index.cfm?layout=document&documentid=10475&indexid=6918&indexparentid=1024
[42] https://www.cia.gov/library/publications/the-world-factbook/print/my.html.
[43] Korea, ICT use in Education. Available on: http:www.unescobangkk.org
[44] http://download.microsoft.com/documents/customerevidence/23324_Harrow_Final.doc
[45] http://www.bromley.gov.uk/NR/rdonlyres/6C0AA8B4-AAF4-46F6-AB77-9974F6D9375A/0/ICTinEducationDevelopmentPlan.doc
[46] http://www.unescobkk.org/index.php?id=1374&type=98

Unsurprisingly, African countries are at very different stages in considering policies to harness ICT in support of education and development. So, for example:

- In some instances, ICT and development policies may not be complemented by other relevant policies, for example a telecommunications policy that supports such development, as well as associated budgetary allocations to policies.
- Some countries (for example Angola, Republic of Congo and Cameroon) may have national policies, but may not have policies that make specific reference to ICT and education. Stakeholders may therefore need further coordination and technical support to design and adopt a specific policy. The absence of specific ICT and education policies at the national and ministerial level may impede implementation of ICT.
- ICT policies may not always be accompanied by a detailed implementation plan or commitment from government to implement the policies.
- Policies may not take into consideration sustainability issues, and some countries may rely on donor funding and programmes that do not give sufficient thought to context.
- There may be a limited layer of skilled personnel and champions within ministries to drive national policy implementation.
- As leadership in countries changes, there is a constant need to capacitate relevant government officials. Ongoing changing socio-political changes in African countries may impact on how change management occurs.[47]

Whilst national policies provide a framework for implementation, trends are moving towards a more decentralized approach in terms of implementation, key examples of which include Australia, Thailand, and Indonesia. 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 and integration of ICT into education needs to be sensitive to cultural differences. For example, it has been recognized in Chile that no single formula can be applied uniformly to all schools – the uses to which computers and networks are put depends on each school's educational projects, needs and its social, cultural and geographical environment.

[47] Information drawn from various country reports in Farrell, G., Isaacs, S., and Trucano, M (2007). Survey of ICT and Education in Africa (Volume 2): 53 Country Reports. Washington, DC: infoDev / World Bank.

5.2 ICT Infrastructure

The role of technology infrastructure in enabling ICT in education has been recognized internationally. Britain established a specific agency, the British Educational Communications Technology Agency (BECTA), which was – until its closure in 2010 – responsible for school technology procurement. Australia and the United States of America (USA) have a ratio of five students to one computer and this ratio does not deteriorate according to geography.[48] In Chile's Enlaces programme, schools with fewer than 100 students receive three computers and one printer, schools with 100 to 300 students six computers and two printers, and schools with more than 300 students nine computers and two printers.[49] By 2003, in the Philippines, the Department of Education had deployed hardware, printers, office software and educational CD-ROMS and had conducted teacher training on basic computer literacy for 986 of the over 4,500 public secondary schools. In partnership with the Japanese government, hardware, software and basic computer literacy training had been deployed to 1,000 public secondary schools.[50]

ICT infrastructure encompasses access to equipment as well as to connectivity.

5.2.1 ICT equipment

Equipping schools and universities and keeping them up to date with ICT equipment is very expensive due to hardware and software purchases, as well as the recurrent costs associated with maintenance and support. A general observation is that, despite huge investments, ICT is hardly integrated in daily classroom practices, even in countries that were forerunners. Pelgrum and Law believe that ICT infrastructure may have been emphasized too strongly in educational policy making in the past, causing attention to be diverted away from the pedagogical mission of schools. They argue that ICT is not a goal in itself, but rather a potential tool that may help schools to improve their performance.[51]

Rapid advances in technology have continued to add potential to the use of ICT as an integral part of teaching and learning. However, changes and innovations in technology tend to be much faster than

[48] http://www.unescobkk.org/index.php?id=1374&type=98
[49] Enlaces: The Chilean ICT Experience in Education. Retrieved from: www.enlaces.cl.
[50] Tinio, V. 2003. ICT integration in education in the Philippines. Retrieved from: http://www2.unescobkk.org/education/ict/resources/JFIT/schoolnet/case_studies/Philippines_ICT.doc
[51] Pelgrum, W.J. and Law, N. (2003) *ICT in Education Around the World: Trends, Problems and Prospects*. UNESCO International Institute for Education Planning: Paris.

changes in the education system, and this is an area of concern, as reform may be dependent on technologies that are no longer available or supported. Trends indicate that wireless technology is becoming more pervasive and cost-effective, and telecommunications liberalization is occurring globally, although at a slow pace. Mobile Internet centres are also being deployed as a way to reach rural areas. Community telecentres (sometimes based in schools) are also regarded as important tools to provide access to learners (including teachers engaged in personal enrichment and professional development opportunities) to ICT outside of formal school settings.

5.2.2 Bandwidth and Connectivity

Connectivity is an important aspect of accessing learning resources, and thus many countries have addressed this issue. For example, New Zealand put connectivity for schools in place by rolling out the Schoolzone programme in 1,000 schools. In 2005, the Provincial Broadband Extension (PROBE), a joint initiative between the New Zealand Ministry of Education and the Ministry of Economic Development to roll out broadband Internet access to all schools, was completed. All schools in New Zealand at present have broadband Internet access.[52] In Britain BECTA established an online portal, the National Grid for Learning and a Virtual Teaching Environment to develop a National Educational Network (NEN).[53] In Turkey, Egypt and Jordan, the governments have fully funded connectivity at schools. The Ministries of Education take full responsibility for funding broadband Internet connectivity in all schools.[54]

5.3 Materials Development

The provision of materials for learning is considered critical for the successful integration of ICT in education. Britain holds an annual competition for digital content development. Criteria used to evaluate these materials are design, cost-effectiveness, support of higher order skills and effective learning and teaching styles, and technical robustness and resilience, as well as accessibility for groups with specific needs.[55] Australia has a robust environment in digital content. Examples of some of the educational portals are *EdNA Online*[56] and different state education department portals (for example,

[52] New Zealand Ministry of Education. ICTs in Schools 2005 Report. Retrieved from: http://www.minedu.govt.nz/index.cfm?layout=document&documentid=9486&indexid=6920&indexparentid=1024
[53] Becta, National Educational Network, http://www.becta.org.uk
[54] HEDCOM Sub-committee on ICT. 2008. Report on the Study Tour of the Hedcom Sub-committee on ICT.
[55] Becta (2006). Quality principles for digital learning resources.
[56] http://www.edna.edu.au

the Queensland government's education portal).[57] The Enlaces Programme in Chile created a website which offers educational content and services for teachers and students. The website is seen as an educational portal where teachers can access curriculum-oriented content, fora and up-to-date educational information.[58] The Chinese government has partnered with the USA to use advanced multimedia and simulation to develop web-based courseware for English and Chinese instruction.[59] The Thai Ministry of Education has worked with the National Electronics and Computer Technology Centre (NECTEC) to develop an extensive range of materials, web sites, and other resources.

As highlighted earlier, one of the most important developments globally on the Internet has been the emergence of Web 2.0 platforms, which allows the average user to increasingly become the *source* of new information (the architecture of participation). Furthermore, in the examples of technologies such as blogs and wikis, users are actively encouraged to add to and shape all of the content within the community, rather than 'owning' their own content and simply reading other people's content.

5.4 Professional Development

Teacher training is essential for educators to use ICT effectively for teaching and learning. Fully integrating technology into teaching and learning requires well-qualified educators. There are as many schools of thought on how best to equip educators with skills and knowledge to use ICT for teaching as there are tried-and-tested models for professional development. The dominant schools of thought regarding ICT integration are whether teachers need ICT literacy skills, without looking at how those skills will be applied pedagogically, or whether ICT skills should be deployed in a manner that equips teachers with ICT literacy skills and at the same time shows teachers how to use these skills to plan lessons and use technology for teaching and learning.

In Thailand, in 2006, 20,350 teachers were enrolled in online professional development courses and could access 200 e-books through e-libraries. BECTA holds an incentive-based annual ICT Excellence Award, which recognizes innovative implementation and use of technology across a whole school system both in and out of school. Australian states have different professional development approaches in relation to ICT, but all of them are aimed at helping teachers integrate ICT into teaching and learning.

[57] http://education.qld.gov.au/
[58] Enlaces: The Chilean ICT Experience in Education. Retrieved from www.enlaces.cl
[59] http://www.unescobkk.org/index.php?id=1374&type=98

In Mauritius, the task group on e-education and e-training has, through its Computer Proficiency Programme (CPP) identified and trained up to 6,000 teachers in basic ICT proficiencies. There was also an initial cadre of some 300 teachers who were specially trained to offer computer-related subjects to students in their schools in the initial rollout of computers to schools in 2003.[60] Training has been an important element of Indian efforts in deploying technologies for education and exposure to computers and training in the use of computers form part of professional education.[61] Implementation of training is focused on trainers, producers of content, field level facilitators, and other key personnel.[62]

There is a great interest in participatory approaches to professional development where educators are involved in initiating and designing their own professional development and would share materials and ideas and discuss challenges and solutions. This approach will also help teachers to become model lifelong learners. Case studies have indicated that a model of learning by doing may be a good starting point for initiating forms of future staff development linked to school-based curriculum.

5.5 Research, Monitoring, and Evaluation

Evaluation is recognized as especially important in the field of ICT, where there are many unknowns about how best to apply technology and the technology itself is evolving very rapidly. However, monitoring and evaluation is not receiving the attention it deserves. There is consensus that insufficient attention is paid to monitoring and evaluation issues in the design process of most educational ICT initiatives. In general, many of the issues and challenges associated with educational ICT initiatives are widely known by experts and advanced practitioners in the field. However, data on the nature and extent of these issues remain limited in most places because of the lack of monitoring and evaluation tools and methodologies dealing with use of ICT in schools and its impact on teaching and learning.

There have been very few international evaluations of impact of ICT use in education. Those that exist rely largely on self-reported data. There is also an absence of widely accepted standard methodologies

[60] WITFOR Education Commission, (2005). Enhancing ICT competence of Teachers in the SADC Region through Innovative Learning $ Knowledge Communitees. Retrieved 30th August 2006 from the WITFOR Web site: http://www.witfor.org.bw/themes/edu_report.htm p.2

[61] ICT in Education – India. Retrieved from: http://www.unescobkk.org/index.php?id=1675

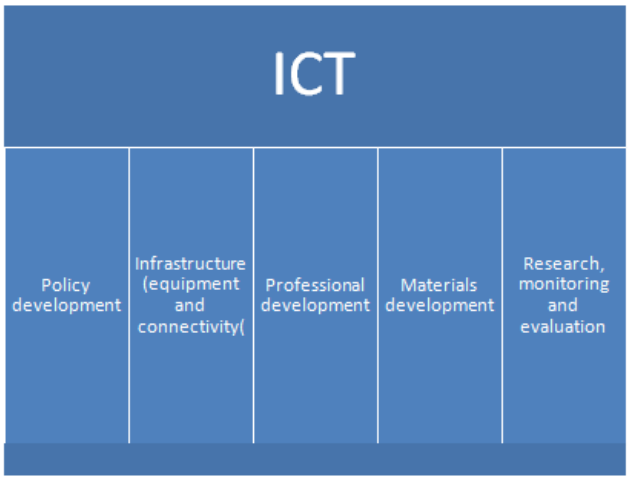
[62] Reddi, U.V. and Sinha, V. (no date) India – ICT Use in Education. UNESCO Meta-survey on the Use of Technologies in Education. Retrieved from: http://www.unescobkk.org/fileadmin/user_upload/ict/Metasurvey/NEPAL.PDF#search=%22India%20ICT%20use%20in%20education%20Ms%20Usha%20Vyasulu%20Reddi%2C%20Ph.D%22

and indicators to assess the impact of ICT in education. Where evaluation data is available and monitoring and evaluation projects have occurred, much of such work is seen to suffer from biases. Data collection methods are also quite varied. The use of the Internet to collect data, and for self-assessment, especially in developing countries, has not been very successful and is seen as problematic.

5.6 Framework for Country Responses

We have argued that ICT is an enabling requirement to support the interrelated pillars of education, and innovation for socio-economic development in a knowledge society. The above trends, challenges, and country responses reveal that ICT interventions are not uni-dimensional. Rather ICT itself as a concept comprises several interrelated ideas, each of which requires consideration in by policy makers.

Figure 3: Dimensions of ICT investment and policy



ICT for education and development encompasses several dimensions, which have been elaborated upon above. In summary, these are:

- Policy development;
- ICT infrastructure including ICT equipment and connectivity;
- Professional development (for leaders, educators, public servants, and employers);
- Materials development; and
- Research monitoring and evaluation.

In African contexts where the socio-economic conditions are vastly different from developed economies societies, there are several enabling requirements for the above which require consideration. These include for example access to reliable electricity, access to safe and efficient transport networks, access to functional institutions – in their physical form in terms of suitable and secure buildings to house ICT equipment, and their human resourcing which should able to manage ongoing technology maintenance and reinvestment plans. Recognising these basic pre-conditions is not intended to imply that no investment in ICT can made until the basics are ubiquitous in all parts of a country. It would however be remiss to neglect these basics which in African context continue to require attention, particularly in rural areas, and without which ICT use is simply not possible. The next section focuses on ICT for education and development in Africa, highlighting the key challenges faces in this context.

6 ICT in Africa: A Few Key Challenges

As indicated earlier, developing countries generally face challenges in terms of capacity, capability and resources (human and financial) to successfully and effectively harness the potential of ICT. These are echoed in literature on challenges facing African ICT in education initiatives, a selection of which is presented below. Addressing each of the issues requires building of capacity at all levels, starting with African leaders so that systemic changes can be planned from the top, creating an enabling environment for bottom-up innovation and development.

6.1 Policy Environment

Strong government support is a key for advancing ICT availability and usage in education as a broad social and economic development enterprise, a challenge that many education institutions in Africa face. However, policy moves such as those in Senegal and South Africa, which introduced special education rates (e-rates), have facilitated ICT access to schools and colleges. Mauritius has gone even farther towards establishing a university of science and technology to capitalize on ICT development.[63] Unfortunately, use of ICT in education is seen internationally to advantage schools and learners in urban areas and in locations where existing infrastructure is the best in a country – thus impacting on issues of

[63] Adam, L. (2003). Information and Communication Technologies in Higher Education in Africa: Initiatives and Challenges. JHEA/RESA Vol 1, No. 1, pp. 195–221

equity. This issue requires specific focus in policies, particularly in developing countries (see Appendix B for some guidelines for policy considerations). It is worth noting that the creation of a strong enabling policy environment requires that African leaders are sufficiently capacitated and informed about the knowledge economy and familiar with how policy frameworks may hinder or support this objective. Leadership capacity – which impacts on the policy environment – is discussed in more detail in relation to professional development and capacity below.

6.2 Infrastructure

Many African countries face unreliable power supply, uncompleted networks for data and telecommunications, coupled with the high cost of energy and telecommunications (for example, the Economic Community of West African States (ECOWAS) notes that its countries face the serious challenge of affordable and accessible telecommunication backbone and stable electricity supply).[64] This lack of affordable and accessible telecommunication backbone and a stable electrical supply impacts on the rollout of ICT in Education and development initiatives. This has additional implications for the concentration of initiatives in cities due to the wide gap in ICT access between urban and rural areas. Adam (2003) notes that, at universities, differences in the status of infrastructure (and donor interventions and the level of economic development) has led to different levels of ICT adoption. At most African universities, the underlying infrastructure is inadequate to support high bandwidth intensive applications.[65]

Knowledge of available infrastructure and awareness of technical options, as well as their ongoing maintenance requirements and environmental impact, are important considerations for leaders when making choices about how best to use ICT for development. Any capacity building programme for African leaders should include consideration of infrastructure options and models assessing the long term financial and environmental implications of large-scale investments in particular options. More important than providing information on the latest infrastructure options would be ensuring that robust models for costing implementation and assessing environmental impact are considered. As technology infrastructure options continually change, flexible approaches to modelling costs and assessing the cost-

[64] Ibn Chambas, M. (2003). ECOWAS, NEPAD and ICT: Building West Africa's Future. Retrieved from Connect World.com: http://www.connect-world.com/index.php/component/k2/item/1754-ecowas-nepad-and-ict-building-west-africas-future

[65] Adam, L. (2003). Information and Communication Technologies in Higher Education in Africa: Initiatives and Challenges. JHEA/RESA Vol 1, No. 1, pp. 195–221

effectiveness of various options are likely to be a constant requirement for African leaders. Comparison of legislative frameworks, particularly those that have advocated – and succeeded in enforcing – e-rates for social services from telecommunications and technology companies, would be a useful addition in any capacity building programme for African leaders.

6.3 Funding/Budget allocations

Despite a mainstream claim that investing in ICT is cost-effective, as well as the continuous decline in ICT prices, the total cost of ownership of ICT including hardware, software, maintenance, upgrading, skills and development remains high. Investing in ICT for learning could be perceived as an additional cost, and sustaining meaningful ICT utilization is a problem faced by many institutions, particularly those that rely on donor funding. ICT may not feature high on the list of education institutions' investments or priorities when compared to important items like paying staff salaries or maintaining utilities. There is also a lack of government funding for ODL and e-learning, and these initiatives rely mostly on donor funding. For example, in Madagascar, there appears to be limited budget for ICT in education, while in Malawi the ICT for development strategy is strongly dependent on external donor funding. [66] Budgetary pressure on education and training could thus result in under-investment in the quality of education.[67] Therefore, education investments in ICT require long-term planning that should take into account sustainability and the developments that ICT-enhanced education may bring.

Lack of financing is one of the greatest challenges facing policy-makers, and part of the answer to this challenge is to share facilities and costs with the broader community. A ministry of education cannot take on the task of equipping schools alone. Common trends in advocating ICT integration include educational institutions entering into partnerships with the business sector, particularly the IT industry, in order to help maintain operation and financial viability of ICT-based education programmes.

This issue aligns with the focus for capacity-building programmes for African leaders suggested above, which places financial modelling and systems of evaluating and assessing options at its core. Rather than

[66] Information drawn from various country reports in Farrell, G., Isaacs, S., and Trucano, M (2007). Survey of ICT and Education in Africa (Volume 2): 53 Country Reports. Washington, DC: infoDev / World Bank.
[67] Punie, Y., and Cabrera, M. (2005). The Future of ICT and Learning in the Knowledge Society - Report on a Joint DG JRC-DG EAC Workshop held in Seville, 20-21 October 2005. Seville: European Commission Directorate-General Joint Research Centre

focusing on the detail of particular options, comparison of different approaches to funding and budgeting should be included. Topics of interest may include, for example:

- Risks associated with relying heavily on donor funding;
- Models to assess cost savings from systemic investment in ICT for development;
- Dynamic financial modelling tools, which including ongoing maintenance, insurance, and technical redundancy of technical equipment;
- Assessing the costs of lack of government investment in bandwidth and infrastructure;
- Corporate social investment and e-rates as key levers for research and development in small scale innovative ICT use.

6.4 Shortage of Trained Professionals and Skilled Leaders

Harnessing ICT for education and socio-economic development requires visionary and skilled management and visionary leadership. African leaders, civil servants, and administrators need to be knowledgeable about the potential that ICT presents in terms of socio-economic development. Where this knowledge is lacking, policy frameworks created by government and their related investment priorities frequently miss opportunities to realize systemic change through investments in ICT. ICT planning and investment tends to be treated as an additional 'nice-to-have' budget item, which is layered on top of traditional developmental priorities, rather than seen as a fundamental lever for changes in education, socio-economic transformation, and service delivery. This reflects a need to build capacity in African leaders and administrators to ensure that leveraging ICT for a knowledge society is both a top-down and bottom-up process.

Harnessing technologies for education purposes requires continued investment in supporting educators to create these new learning environments. Educators play a pivotal role in the adaptation and integration of ICT as they are a key element in curriculum implementation and innovation. However, many African countries face a challenge of shortage of IT professionals and lack of educators with ICT skills. For example, Lesotho faces the challenge of brain drain in the ICT sector, as trained professionals move to South Africa seeking better working conditions. In addition, the Ministry of Education and Training has limited skilled human resources to implement ICT-in-education projects.

African universities in particular face a critical shortage of skilled workers who understand basic and advanced programming to plan, design, and implement distributed information systems and manage large-scale e-learning projects. Another challenge is the high turnover of skilled technical personnel, as institutions are unable to pay salaries that are competitive with the private sector. Some higher education institutions have tried to work around this problem by launching extensive and ongoing professional development programs for their staff and exploiting their computer science and electrical/network/computer engineering departments.[68] Studies conducted in the United States, United Kingdom, and Australia have revealed that computer anxiety and lack of confidence are important factors that hinder teachers' willingness and effectiveness in using computers in the classroom. Thus, teachers need to be convinced of the value and utility of ICT-enabled learning programmes, otherwise they will not be motivated to use them. Literature also indicates that teacher training should not just focus on the competent use of ICT, but also on its pedagogical use. Moreover, teachers and trainers need to learn to teach differently as learning become more flexible, dynamic and personalised.[69] Other studies show that insufficient understanding of the scope of an ICT resource leads to inappropriate or superficial uses in the curriculum. However, designing and implementing successful teacher professional development programmes in the application of technology is neither easy nor inexpensive.

6.5 Materials Development

According to Adam, in Africa, appropriate and improvised content ranging from learning materials such as textbooks, journals, web pages, video, television, radio, audiotape, and multimedia packages to learning support tools such as study guides, exam sheets, worksheets, laboratory manuals, and field exercises are in short supply in education system on the continent. This dearth of learning materials is, for example, evident when one compares African higher education libraries to the developed world. Creating local e-learning content has proved difficult in Africa for the following reasons:

- Many African educators are not conversant with courseware tools and digital environment;
- Educators have excessive loads and limited time, skills, and incentives to develop e-learning materials suitable to their local needs;

[68] Adam, L. (2003). Information and Communication Technologies in Higher Education in Africa: Initiatives and Challenges. JHEA/RESA Vol 1, No. 1, pp. 195–221

[69] Punie, Y., and Cabrera, M. (2005). The Future of ICT and Learning in the Knowledge Society - Report on a Joint DG JRC-DG EAC Workshop held in Seville, 20-21 October 2005. Seville: European Commission Directorate-General Joint Research Centre

- The educational reward system was not designed to encourage faculty and students to own and get involved in e-learning content development and use;
- Maintaining an e-learning environment requires consistent improvisation and skills that are not readily available to most African educational institutions.
- It is a resource intensive enterprise.[70]

In addition, country reports on InfoDev's Survey of ICT and Education in Africa (2007) reveal that there is little digital education content that is locally contextually relevant or based on local curriculum frameworks. Nevertheless, there have been a number of initiatives that have been adopted to address the e-content challenge in Africa, particularly related to the development of OER, for example work done by the Partnership for Higher Education (PHEA) and OER Africa.

The ability to share information quickly and cost-effectively that is of relevance to African leaders making decisions relating to the knowledge society is a key benefit of ICT. In addition, networking opportunities created through collaborative online environments should be harnessed in any capacity building programme for African leaders. In this way, the strengths of the online environment and the information repository, knowledge production, and networking benefits of an online space can be experienced directly by leaders engaged in such programmes. Access to a dynamic repository of policy frameworks, case studies of African and international experience, legislative frameworks, and monitoring and evaluation outcomes relating to the use of ICT for education and development would be of great potential benefit to African leaders.

6.6 Bandwidth Constraints

The most obvious obstacle to use of ICT in Africa remains access to higher bandwidth. Even in countries like South Africa and Egypt, which have relatively high ICT capacities, internet bandwidth at education institutions is very congested. A survey by Jensen (2002) revealed that almost 60% of African countries have bandwidth that is less than that of a typical institution in the developed world. In Africa, insufficient private sector investments in the telecommunications infrastructure and the lack of competition has led to arbitrary pricing-setting that has set the cost of ICT beyond the reach of most

[70] Adam, L. (2003). Information and Communication Technologies in Higher Education in Africa: Initiatives and Challenges. JHEA/RESA Vol 1, No. 1, pp. 195–221

education providers. Providing universal access to higher education is costly and complex. The need to create a robust bandwidth capability throughout Africa exposes the various constraints that need to be addressed at the institutional, national, and regional levels.[71] In Africa, a particular emphasis needs to be placed on under-serviced areas, where telecommunications infrastructure is weak or non-existent. While an open and competitive market will ensure that infrastructure will generally develop in high density areas, policy interventions will be required to ensure that under-serviced areas receive infrastructure investment and remote schools also get connected to a telecommunications networks. See Appendix D for some guidelines for bandwidth considerations.

Bandwidth options, the legislative frameworks for telecommunication licences, and how to enforce e-rates and social service delivery while remaining attractive to private sector investors and companies, would be important topics for a capacity-building programme for African leaders.

6.7 Research, Monitoring, and Evaluation

Leaders and decision makers demand evidence of the efficacy of solutions and innovations, before they are willing to invest in them at a large scale. Thus, it is imperative that research funding for small-scale innovation requires that research is designed with a deliberate focus on the longer term need for scalability to have national impact. At the points at which innovations have been piloted and trialled, it is key to be able to invest in them at a meaningful scale. However, without adequate research on efficacy, new innovations tend to remain pilots, which are never invested in at any significant or meaningful scale.

Globally, insufficient attention is paid to monitoring and evaluation during the design of most ICT initiatives, and Africa is no exception. However, in Africa there is a wide range of programmes and projects on ICT in Education, several of which involve more than one African country. These range from high-level intergovernmental, multi-stakeholder programmes such as the NEPAD e-Schools initiative, to corporate social investment projects, to collaborative learning projects that directly involve learners and teachers from schools such as the Global Teenager Project (GTP) and the International Education Resources Network (iEARN). An illustrative (non-exhaustive) list of prominent organizations active in

[71] Adam, L. (2003). Information and Communication Technologies in Higher Education in Africa: Initiatives and Challenges. JHEA/RESA Vol 1, No. 1, pp. 195–221

supporting and promoting technology related activities in the education sector in Africa is provided in Appendix A. Some, but not all of these do include a monitoring and evaluation component.

The envisaged capacity-building programme for African leaders could include a component which requires leaders to produce and/or review research, monitoring and evaluation reports on the use of ICT for education and development. In so doing, this would contribute to the repository of Knowledge Society cases and information of relevance to African contexts. A topic of relevance in a capacity building programme for African leaders would be the design, implementation, and assessment of monitoring and evaluation processes.

7 Conclusion and Recommendations

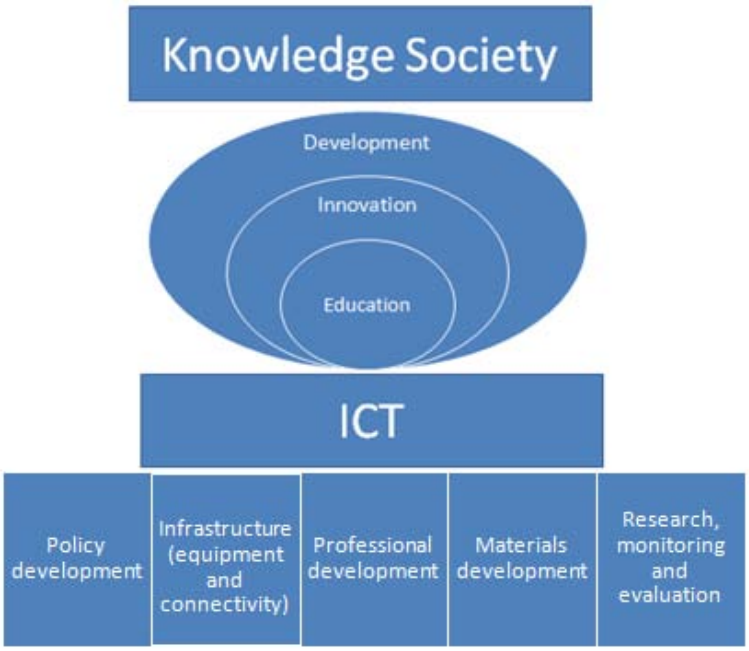
A knowledge society has knowledge as its primary production resource, and as such has shifted, or is shifting to, a knowledge-based economy. It is a society that creates, shares and uses knowledge for socio-economic development. As such the education and skill levels of the people in these societies are the key indicator of its wealth. High proportions of its populations are employed as knowledge workers. This sees shifts in the way knowledge is accessed, created and used in the society and traditional barriers between the workplace and the formal places of learning are eroded. This is not just about the availability of information, but its effective selection, evaluation and use to solve societal and economic problems. Everyone is a learner and reflective practitioner: employers, employees, students and academics or teachers. A necessary requirement – although not a sufficient condition – for such a society is ICT. ICT is used to ensure rapid, cost effective and reliable communication, networking and access to and publication of information which, in turn, is used to enhance productivity, education and development.

For a knowledge society to be realized, supported and/or further 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. ICT as an enabler for education, and innovation to drive development comprises of several related dimensions:

- Policy development;
- ICT infrastructure;
- Professional development (including leadership capacity);

- Materials development (including content services); and
- Research, monitoring and evaluation.

Figure 4: Framework for reflecting on ICT, Education, Innovation and Development to support a Knowledge Society



ICT and education are critical for development and for securing employment in a knowledge society. However, the potential of ICT in education can only be realized when it is embedded in a social context that is open to innovation and supported by a favourable policy environment. Government policy has a real impact on strategic initiatives, and often determines the parameters of such initiatives through laws, regulations, and the allocation of funds. The potential educational power of Web 2.0 platforms is significant in contributing to education and the knowledge society, where content is important primarily as a tool to be used by learners to construct their own knowledge building on what they already know.

For this potential to be realized, however, two key criteria need to be met. First, to participate in such online learning communities and to tap into the massively expanding base of content that is increasingly accessible on the Internet, learners need to be able to participate fully. This cannot be done if they cannot be connected to those communities via broadband Internet connections. Second, it becomes critical to open access to content, so that it can legitimately be used and manipulated by learners to

support their learning. This will require a significant shift in thinking, as most educational content generated for use in education systems is protected by inflexible laws of copyright, which explicitly prevent this kind of use and manipulation.

ICT is an enabler and important foundation from which education and innovation can accelerate socio-economic development in a knowledge society. In this regard, key trends can be noted:

1) ICT is expanding the range of options available to education planners, in terms of both the teaching and learning strategies, and the managerial and administrative operations they choose to use.
2) ICT is allowing for exponential increases in the transfer of data through increasingly globalized communication systems and networks.
3) ICT networks have significantly increased the potential for organizations to expand their sphere of operations and influence beyond their traditional geographical boundaries.
4) ICT is reducing barriers to entry of potential competitors to traditional education institutions.
5) Collective intelligence and mass amateurization are pushing the boundaries of scholarship, while dynamic knowledge creation and social computing tools and processes are becoming more widespread and accepted.
6) Copyright regimes, and their associated business models, that worked effectively prior to the development of ICT are increasingly under threat, and in some cases rapidly becoming redundant.
7) Systemically, ICT is tending to accentuate social disparities between rich and poor. The emergence of technological innovations has tremendous potential to accentuate the digital divide within education, conferring benefit on those with access to ICT and further marginalizing those without such access.
8) Mobile and personal technology is increasingly seen as a delivery platform for services of all kinds.
9) Security and privacy issues are likely to continue to be an area of contention throughout the world over the next few decades.
10) Rather than the value being in the content itself, value is seen in the service provided in packaging and rapidly publishing content that is both current and tailored for a myriad of audiences and purposes.

In Knowledge Societies, these trends are being driven by access to technology with high quality, stable broadband Internet connections. However the digital divide – which includes consideration for access to broadband (high-speed) Internet connections, not just access to hardware – continues to widen.

Africa lags behind other parts of the globe in terms of ICT access and faces many challenges in relation to the capacity, capability and resources (human and financial) to successfully and effectively harness the potential of ICT. These can be organized against the framework for country responses to ICT. Although generalizing challenges across multiple countries is necessarily over-simplistic, there are some challenges applicable to several countries that are worth highlighting:

- Policy development challenges:
  - Lack of strong government support in advancing ICT availability and usage in education as a broad social and economic development enterprise.
  - Lack of financing and prioritization of ICT investments as a means for development is serious barrier to effective ICT use.

- Infrastructure challenges:
  - Lack of affordable and accessible telecommunication backbone and a stable electrical supply
  - Inadequate access to bandwidth.

- Challenges relating to professional development / human capital:
  - Lack of leadership capacity and vision of how ICT can be leveraged for education and socio-economic development.
  - Shortage of IT professionals and lack of educators with ICT skills.
  - High turnover of skilled technical personnel, as institutions are unable to pay salaries that are competitive with the private sector.
  - Educators need to be convinced of the value and utility of ICT-enabled learning programmes, otherwise they will not be motivated to use them.
  - Educator training should not just focus on the competent use of ICT, but also on its pedagogical use.
  - Educators and trainers need to learn to teach differently as learning become more flexible, dynamic and personalised.

- Materials development challenges in Africa

- Short supply of appropriate and improvised content ranging from learning materials to learning support tools

- Research monitoring and evaluation in Africa:
  - Lack of investment in systemic research, monitoring, and evaluation on ICT for education and development.

There are several relevant implications in these trends for policy makers. A few key ones are highlighted below as tentative recommendations for consideration:

- With regard to African leadership capacity for policy development and national strategies relating to ICT:
  - Ensure that African leaders have an understanding of the Knowledge Society and are capacitated to make informed policy and investment decisions to enable ICT to support socio-economic development effectively.
  - Develop a supportive policy environment, with a clearly articulated rationale for the use of ICT in education, linked to national economic and social development frameworks, noting that:
    * New technologies must serve rather than drive the implementation of education and development strategies and the vision of a knowledge society;
    * Attempts to integrate ICT applications into education and development will depend, for their success, on the vision of those responsible for planning and implementation;
    * A multilateral approach should be adopted, with a willingness by all role-players to create working partnerships where required;
    * A national policy framework ought to codify how ICT can, and will, be used for socio-economic development across the various spheres in government;
    * All sectors of the development and education system must be prepared to understand the investment in and value of technology.
  - Harness ICT as a potent tool in reducing poverty, extending health services, expanding educational opportunities and generally improving the quality of life.
  - Plan for sustained investment in ICT that aligns with systemic changes (in education, service delivery, and/or economic productivity), considering that:

    * There is a need to consider how technologies can be used to improve the efficiency of operations of the underlying systems of education.
    * Successful application of ICT in improving systemic efficiency and operations can lead to improvements in delivery of all education, regardless of what teaching and learning strategies are finally being used to communicate with students. In particular, investments should be made in developing applications that significantly improve the quality of management information systems (at national and institutional level) and the ability to use these systems to support strategic decision-making and policy implementation; and contribute to stimulating free flow of information throughout the education system.

- Ensure that processes integrating use of ICT into education seek to create learning environments wherein exploration of educational roles for the technologies available can function as a catalyst for effective educational transformation and for building high quality education. This involves matching the choice of technologies to learning outcomes and processes of courses and programmes, and mixing media and technologies to achieve learning objectives.
- Ensure that investments in ICT for education and development involve long-term planning that take into account sustainability and the developments that ICT-enhanced education may bring;
- Participate in regional and continental initiatives to harness ICT for education and development to streamline and support such national processes, noting that;
    * increased coordination and resource sharing between African institutions should be beneficial as institutions move to fully integrate ICT into their teaching and learning; and
    * Regional platforms for sharing information on ICT policies and courseware and exchanging experiences are useful to increasing the positive contribution of ICT to education.
- In seeking to narrow the digital divide, focus on digital inclusion which seeks to examine the combination of factors that may limit participation in the information economy:
    * access to hardware
    * access to affordable/reliable high speed Internet connections,
    * information literacy,
    * extent of integration of ICT into the social fabric of everyday life,
    * provision of technical and training support, and
    * access to compelling applications and content.

- Legislate that telecommunication companies target under-serviced areas, where telecommunications infrastructure is weak or non-existent;
- Share facilities and costs with the broader community by encouraging educational institutions can enter into partnerships with the business sector, particularly the IT industry, in order to help maintain operation and financial viability of ICT-based education programmes;
- Define education as a lifelong activity that cuts across different learning generations and life spheres (private, public, and work) and can no longer be confined to investments in schools and universities;
- Avoid dichotomising education as face-to-face or distance education;

- With regard to access and infrastructure issues:
  - Provide adequate infrastructure to education institutions: sufficient computers with good Internet connectivity (in turn depending on electricity and telecommunications services).
  - Legislate to ensure that the ongoing costs for connectivity, equipment maintenance and support are affordable for individual educational institutions over a sustained period, or ensure that there is provision to cover these costs centrally in the long term.
  - Focus on the how ICT is deployed, rather than on what technologies are used.
  - Ensure that each education intervention using ICT is planned and implemented on its own merits, rather than forced into simplistic, dichotomous categories (such as 'distance education' or 'face-to-face education'), which set arbitrary and unhelpful constraints.
  - Keep options as open as possible, as technologies can be applied in a range of ways, to support an almost limitless combination of teaching and learning strategies
  - Carefully manage experimental deployment of new technologies with a view to cost effective scalability.
  - Ensure that technologies adhere to common open standards to facilitate integration and inter-operability
  - Ensure that technical support services are accessible, affordable, responsive and effective. Education and service delivery institutions required technical support and their technical problems should be resolved within a reasonably short period of time.

- With regard to what should be taught to student and/or employees (curriculum and materials development):

- Ensure that there are appropriate forums, short courses, and leadership capacity programmes so that growing numbers of African leaders are capacitated to support and make decisions which seek to leverage ICT effectively for a Knowledge Society
- Recognise that teaching 'ICT literacy' is not sufficient, but higher order skills of how to participate as citizen, worker and scholar in a knowledge society are required;
- Recognise that the skills requirements for students and employees as well as for educators and employers change – and keep changing - in a knowledge society;
- Develop school and university curricular that require the following skills from learners are teachers:
    * Information, visual, and technological literacy;
    * How to create meaningful content with today's tools;
    * The ability to read and evaluate what is read;
    * Writing and communication;
    * The use of abstract models;
    * Expert Thinking – the ability to solve problems that lack explicit rules-based solutions;
    * The skill of Complex Communication – making effective oral and written arguments, eliciting information from others.
- Invest in online content to build a large enough existing or potential user base to build effective online communities, achieve economies of scale and justify further investment. An online repository of case studies, evaluation findings, trends in ICT, and models and tools for financial planning and evaluation would support capacity building for African leaders, while creating a managed online environment for them to publish and network with each other.

• With regard to the role of educators, mentors and/or employers,
    - Focus clearly on ensuring that both educators and learners are equipped to engage effectively in the teaching and learning that takes place.
    - Incorporate clear strategies to ensure that both teachers and learners are equipped with the necessary skills, knowledge, and competencies to engage effectively in any educational process using ICT.
    - Ensure that professional development for educators focuses on:
        * Developing and support mentoring (the ability to impart the wisdom that only experience can provide) in formal education and in employment structures;

    * Fostering coherence and discipline in thinking;
    * Navigating the ethics of a world with no apparent limits;
    * Coping with the challenges of 'unlimited' choice;
    * Encouraging learners and or employees to become creators in the educational and professional environments

- With regard to research, monitoring and evaluation:
  - Invest in a continuous process of evaluation of ICT related interventions in education and development. This should include:
    * Planning, implementation, reflection, refinement, effectiveness, and user acceptance.
    * Benchmarking the quality of ICT projects against international studies, standards, and best practices (in cases where there is limited experience in ICT use).
  - Ensure that international lessons and examples of good and innovative practice are communicated and fed back into capacity development programmes for African leadership.
  - Invest in knowledge-sharing events and innovative ways of publishing and distributing research findings, so that growing numbers of African professionals have access to research, monitoring, and evaluation findings, and are themselves producers of knowledge and lessons to share globally.

Appendix A: Examples of programmes and projects on ICT in Education in Africa that have activities that involve one or more African countries[72]

- African Academy of Languages - The African Academy of Languages is a pan-African organisation that was set up in 2001 by Mali's then president Alpha Konare. It was established under the auspices of the African Union to promote Africa's many indigenous languages. One of its major projects relates to the promotion of African languages in 'cyberspace' and particularly the use of local languages in education in Africa.
- African Development Bank - The African Development Bank (AfDB) is a membership-based, regional multilateral development finance institution that mobilises resources to support the economic and social development of its member countries. The AfDB has an education policy which promotes support for basic, vocational, and adult education and training. The AfDB also supports the use of ICT in education in Africa. To date the AfDB has assisted with open, distance, and e-learning capacity development centres and connectivity provision at Africa Virtual University (AVU) partner institutions to support teacher training and development programmes and to mainstream gender issues, as in the AVU Support Project.
- African Virtual University (AVU) - Initially a project of the World Bank and now an independent intergovernmental organisation, the AVU is an innovative education institution based in Nairobi, Kenya, that services 57 learning centres in 27 African countries. The AVU works with universities based in Africa and other countries such as the US and Australia to provide academic programmes and short courses through open and distance e-learning. The AVU also boasts a digital library that provides resources to African academics and students.
- AMD - AMD is a leading global provider of innovative processing solutions in the computing, graphics, and consumer electronics markets. AMD introduced the 50x15 Initiative, an attempt to promote affordable, accessible Internet connectivity and computing capabilities for 50% of the world's population by 2015. IN the first stage of this initiative, AMD introduced its personal Internet communicator (PIC) device which it deployed to African schools through its support for the NEPAD e-Schools programme. In Africa, AMD led a consortium of companies in the promotion of the NEPAD

[72] Ngombo, F. (2010). Quick guide: ICT in education initiatives in Africa. http://www.infodev.org/en/Publication.347.html

e-Schools Demonstration Project in five African countries (Cameroon, Gabon, Mali, Senegal, and Uganda) where they promoted their 50x15 devices.

- Association for the Development of Education in Africa (ADEA) - ADEA is a network of partners promoting the development of effective education policies based on African leadership and ownership. ADEA has produced research and guidebooks on the use of ICT in education such as Towards and Information System for Non Formal Education: A Practical Guide.
- Computer Aid International - Headquartered in the UK with a dedicated African regional programme comprising officers in Southern, Eastern, Central, and West Africa, Computer Aid International specialises in sourcing and distributing professionally refurbished computers for re-use in education, health, and not-for-profit organisations in Africa and other developing countries. To date, Computer Aid International has distributed more than 80,000 PCs to developing countries.
- Computers for African Schools (CFAS) - CFAS is a registered charity in the UK that mobilises computer donations from firms and computer users and distributes them to schools in Southern Africa through partner organisations based in Malawi, Tanzania, Zambia, and Zimbabwe.
- Cisco Systems - Cisco Systems is a global company that promotes networking for the Internet. In Africa, Cisco is a leading partner in the New Partnership for Africa's Development (NEPAD) e-Schools programme to which it contributed human and financial resources. Cisco led a consortium of companies in this project in which it promoted the installation of networking equipment for Internet access and satellite connectivity in schools in Algeria, Ghana, Mauritius, Rwanda, Senegal, and South Africa. It also promoted the use of digital education content and teacher training in these countries. In addition, Cisco has established a Networking Academy programme that trains students to design, build, and maintain computer networks. A number of Networking Academies have been established in Africa in countries like, Ghana, Mauritius, and Nigeria.
- Commonwealth of Learning (COL) - The Commonwealth of Learning (COL) is an intergovernmental organisation created by Commonwealth heads of government to encourage the development and sharing of open learning/distance education knowledge, resources, and technologies. COL has historically assisted with the development and support of national ICT for education policies in some African countries that form part of the Commonwealth, and have promoted the growth of national schoolnet organisations through networking workshops, action research, and the publication of guidebooks such as the African SchoolNet Toolkit which it produced in partnership with SchoolNet Africa. COL is also spearheading the establishment of a Virtual University for Small States of the Commonwealth (VUSSC) which involves a number of small states in Africa and which serves as a

network committed to the collaborative development of free content resources for education. COL is also involved in a programme on ICT in support of technical vocational education and training in Africa in partnership with UNESCO.

- Department for International Development (DFID) - DFID is the official ministry within the British government that promotes the fight against world poverty. DFID supports numerous bilateral programmes in Africa in support of education, the Education For All objectives, and the Millennium Development Goals. With particular reference to ICT in education in Africa, DFID has in the past established organisations such as Imfundo, which has developed a knowledge bank of research on the experiences related to ICT in education in Africa; DFID has also supported research done by the TESSA programme.
- Digital Links - Digital Links is headquartered in the UK with offices in South Africa and Tanzania. They provide an IT disposal service to UK companies, and refurbish computers for re-use in schools, NGOs, and small enterprises in Africa and the developing world. To date, Digital Links has distributed more than 50,000 PCs to developing countries
- Edubuntu - Edubuntu involves a group of people who distribute a complete Linux-based operating system to schools for classroom use, with future versions being made available for university use. Edubuntu also provides community-based support. Edubuntu philosophy promotes free and open source software and espouses that software should be freely available, that software tools should be usable by people in their local language, that software should be used anyone including people with disabilities, and that people should have the freedom to customise and change their software in whatever way they see fit.
- eGranary Digital Library - Supported by partnership between the Hewlett Foundation, USAID, and the McArthur Foundation, among others, the eGranary Digital Library provides millions of digital educational resources to institutions that do not have adequate Internet access. They deliver digital education resources by gaining permissions, copying Web sites, and delivering them to intranet Web servers in their partner organisations in Africa and other developing countries. They recently initiated satellite data broadcasting to deliver digital resources to African education institutions.
- eLearning Africa - eLearning Africa is an international conference on e-learning which is hosted annually by the government of an African country. The main focus of these conferences is on the experiences of ICT in education in Africa relative to the rest of the world. The conference is organised by ICWE and Hoffmann & Reif Consultants. In 2006 the conference was held in Addis Ababa, Ethiopia; in 2007 it was held in Nairobi, Kenya; and in 2008 it will be held in Accra, Ghana.

- Free and Open Source Software Foundation for Africa (FOSSFA) - FOSSFA was launched in February 2003 as a network of practitioners, professionals, and organisations promoting the use of free and open source software for Africa's development. FOSSFA has an education subdivision focused on the promotion of open source solutions in education in Africa
- Geekcorps - IESC Geekcorps is an international non-profit organisation based in the US that promotes digital skills transfer and independence through various programmes that involve volunteers with technical expertise. Geekcorps has supported a few programmes in Africa, such its Last Mile Initiative in Mali, which promotes telecommunication-based business models for people without ICT access in rural areas, and the Digital Freedom Initiative in South Africa, which promotes the benefits of ICT to small businesses.
- Global Development Learning Network (GDLN) - The Global Development Learning Network (GDLN) is a global partnership of approximately 120 learning centres that provide tools and services in support of distance learning through ICT. Learning centres based in a number of African countries, including Benin, Ethiopia, Ghana, Senegal, Tanzania, and Uganda, form part of the GDLN network.
- Global e-Schools and Communities Initiative (GeSCI) - Promoted by Ireland, Switzerland, Sweden, and Canada, GeSCI was established in 2003 by the United Nations ICT Task Force in an attempt to raise global standards of education for communities in the developing world and to help make the UN Millennium Development Goals a reality. In Africa, GeSCI has focused its work in Namibia and Ghana by supporting policy development and implementation. It has expanded its work to Kenya and Rwanda as well. GeSCI has also developed knowledge products such as a toolkit on total cost of ownership.
- Global Teenager Project (GTP) - The Global Teenager Project is an initiative of the Dutch-based International Institute for Communication and Development (IICD). It was launched in 1999 to promote the use of ICT in the classroom. The project focuses on collaborative learning among secondary school students and teachers from around the world through a safe, structured virtual environment known as 'learning circles.' Thus far the project involves about 3,000 teachers and students from 200 classes in over 29 countries. The most participants are from Africa, involving learners, teachers, and schools from 12 countries.
- Hewlett Foundation- Based in San Francisco, the Hewlett Foundation provides resources in support of activities in education, environment, global development, performing arts, and population. In Africa, the Hewlett Foundation has promoted the development of open education resources, and it supported the AVU in the development of a comprehensive open educational resources architecture

to ensure the efficient application of the open content movement in African higher education and training institutions. It also supported the Meraka Institute in South Africa to promote the development of a collection of papers describing the use of open educational resources in tertiary education, in primary and secondary schools, and within communities in South Africa.

- Highway Africa - Highway Africa is an annual ICT conference hosted by Rhodes University in South Africa. Each year, more than 500 delegates from across the globe attend the conference to discuss issues relating to Internet governance, ICT policy, and media for democracy. Highway Africa also produces a weekly online bulletin, the HANA Weekly Digest, which documents progress in ICT for development, including ICT in education in Africa.
- International Development Research Centre (IDRC) Acacia - The IDRC is based in Canada and its Acacia programme, which was established in 1996, seeks to empower sub-Saharan communities with the ability to apply ICT to their own social and economic development. The IDRC has supported a number of pilot projects and action research in the area of ICT in education, particularly the initial establishment of schoolnet organisations in some African countries.
- International Education Resources Network (iEARN) - iEARN is one of the largest and oldest global networks of teachers and learners that use ICT in a diverse range of collaborative learning projects. All iEARN projects are designed, initiated, and run by teachers and learners. Its network in Africa involves learners and teachers from schools in 29 countries.
- International Institute for Communication and Development (IICD) - The IICD is a non-profit foundation based in the Netherlands that specialises in ICT for development. The IICD has supported a number of programmes such as its Global Teenager Project as well as projects supporting teacher development through ICT in Tanzania and ICT for education policy processes in Zambia.
- Intel - Intel is a global company focused on silicon innovation and development of technologies, products, and initiatives, to continually advance how people work and live. Intel's education efforts centre on improving teaching and learning through the use of ICT. The focus is on advancing math, science, and engineering education and research. Intel also works with education leaders worldwide on solutions that support the creation of 21st century skills. Their programme, Intel Teach, which is currently running in Ghana, Egypt, Nigeria, and South Africa, has reached four million teachers in 40 countries and is targeted to reach 10 million by 2011. Intel recently announced its new Intel World Ahead programme, a project to provide cheaper computers to schools and boost wireless Internet links. Target countries in Africa are Egypt, Ghana, Kenya, Nigeria, and South Africa.

- LinuxChix Africa - LinuxChix Africa was formed in 2004 by a group of African women to promote the development of free and open source software, particularly Linux skills.
- Microsoft - Working closely with worldwide education communities, Microsoft has developed technology, tools, programmes, and solutions to help address education challenges while improving teaching and learning opportunities. In countries like Ghana, Kenya, and South Africa, Microsoft has promoted low-cost access to software for schools. In addition, Microsoft established its Partners in Learning programme and its related Innovative Teachers Network which supports teacher development projects in a number of African countries.
- Mtandao Afrika - Formerly known as ThinkQuest Africa, Mtandao Afrika holds a n Internet challenge contest for African youth. The contest focuses on the collaborative development of educational Web sites by youth who work in multinational teams and who are awarded prizes by a panel of international judges.
- One Laptop per Child (OLPC) - OLPC is a non-profit organisation set up to promote a low-cost laptop, known as the '$100 laptop,' in an attempt to promote access to the technology to the world's children to support their learning. To date interest has been expressed by governments in Libya, Nigeria, and Rwanda.
- Panafrican Research Agenda on the Pedagogical Integration of Information and Communications Technologies (ICT) - A knowledge network, initiated by the International Development Research Centre (IDRC), bringing together partners in eleven African countries to help researchers, practitioners, and institutions to collect and share data.
- Peace Corps - Peace Corps is an organisation based in the US that encourages US citizens to volunteer their time to work in developing countries in areas such as HIV/AIDS, information technology, and business development. In the ICT for education sector, Peace Corp volunteers have been stationed in a number of African countries to assist with the provision of technical training and support to groups and organisations that use ICT in education.
- Schoolnet Africa - SchoolNet Africa is an NGO-based in Senegal that promotes education through the use of ICT in African schools. SchoolNet Africa functions as a network of schoolnet organisations operating in 33 countries on the basis of regional programmes on ICT access, teacher training, and collaborative learning. To date SchoolNet Africa has produced a range of research reports on the experiences of African countries on the use of ICT in schools.
- Teacher Education for Sub-Saharan Africa (TESSA) - TESSA is a partnership led by the Open University and the African Virtual University that includes a range of African universities, the

Commonwealth of Learning, and the BBC Trust. It is a research and development programme that creates open multimedia resources for sub-Saharan African teachers and teacher-educators. To date TESSA has introduced a BBC radio programme that debates the role of teachers in improving quality primary education and produced a toolkit for educators and planners on designing open and distance learning for teacher education in sub-Saharan Africa.

- Teacher Training Initiative for Sub-Saharan Africa (TTISSA) - TTISSA is a 10-year programme co-ordinated by UNESCO aimed at improving national teacher policies and strengthening teacher education in 46 sub-Saharan African countries. It is designed to support the development of national teacher education systems in African countries to produce more and better - quality teachers.
- Ubuntu Alliance for Education and Research Networking - UbuntuNet Alliance has been established to capitalise on the emergence of optical fibre and other terrestrial infrastructure opportunities and thus become the Research and Education Network (REN) backbone of Africa. Tertiary education and research institutions throughout the rest of the world are connected to the Internet using fast, low-cost fibre.
- United Nations Economic Commission for Africa (UNECA) - The Economic Commission for Africa (ECA) was established by the United Nations to promote the economic and social development of its member states, foster intra-regional integration, and promote international co-operation for Africa's development. UNECA has historically led the African Information Society Initiative (AISI) since 1996 and has been instrumental in supporting the development of national information and communication infrastructure (NICI) policies and plans in a number of African countries. Since 1999 UNECA has also adopted the formation of an African Learning Network which incorporated the formation of SchoolNet Africa, Out of School Youth Network, and Varsity Network.
- United Nations Educational, Scientific and Cultural Organization (UNESCO) - UNESCO is the UN's specialised agency for education. UNESCO has had a range of programmes and projects to support the use of ICT for development, specifically in education. UNESCO promoted the establishment of telecentres and community learning centres in a number of African countries. More recently UNESCO has promoted the development of a regional programme on technical and vocational educational education and training through the use of ICT in Africa, in partnership with the Commonwealth of Learning. UNESCO also leads the TTISSA programme.
- United States Agency for International Development (USAID) - USAID was among the first donor agencies to support ICT in education. Through its Leland Initiative in 1996, USAID provided grant aid for pilot projects in a number of African countries. USAID later supported the establishment of the

Dot Com Alliance for e-learning and e-governance programmes in Africa such as the Network for Capacity Building and Knowledge Exchange project.

- The World Bank - Headquartered in Washington, DC, the World Bank is an international development institution that provides low-interest loans, interest-free credit, and grants to developing countries for education, health, infrastructure, communications, and many other purposes. The World Bank has historically supported a variety of programmes and projects for education through ICT. These include the African Virtual University, World Links for Development, and the Global Development Learning Network.
- World Computer Exchange - Headquartered in the US, the WCE sources secondhand computers and support services to partner organisations in developing countries. To date the WCE has established 289 partners in Africa from 25 countries and has sent 42 shipments of computers to these countries.
- World Links - World Links is an independent organisation headquartered in Washington, DC, spun off from the World Bank to promote ICT in education in schools in developing countries across the world. In Africa, World Links has historically been a pioneering organisation in the promotion of ICT access and teacher development in eight African countries through various programmes and partnerships.
- UNESCO International Institute for Capacity Building in Africa – IICBA's Teacher Development in ICT consists of the Electronic Library and short courses on ICT including on how to design a website and a CD ROM. The Edukiosk Pilot Project Worldspace Direct Media Services is a Worldspace program that allows downloading of web content directly from the Worldspace server through digital satellite receiver to a computer. UNESCO IICBA has conducted a pilot project on Worldspace Edukiosk, to let four Educational Institutes in Ethiopia use this technology for Information retrieval for their staff. The concept behind IICBA's Electronic Library Series is simple: many teacher education institutions and schools lack up-to-date reference materials for use in teaching. IICBA seeks to provide these materials through CD ROMS and videos.[73]

[73] UNESCO IICBA ICT Teacher Development in Africa

Appendix B - Policy Considerations[74]

The following general policy considerations can guide policy makers by applying it to analyze current situations and crafting development strategies for a knowledge-based society:

- Create a Vision - Policy leadership is the key to any successfully development strategy, particularly if these efforts are to contribute to economic and social transformation. Develop a clear vision of how new technologies could increase economic productivity, improve the quality of life, and enrich the culture. This vision should be founded on broad-based consensus among public and private stakeholders which will coordinate distributed efforts across sectors to accomplished shared goals.
- Develop a Plan – Create a detailed plan for developing the economy to guide long-term efforts. Many countries have national plans for implementing ICT in education, which describe how ICT can contribute to education reform and improvement and tie it into economic and social development. Typically the plan describes the hardware, software, and networking that will be implemented in schools, as well as the technical support and technical training for teachers. The national plan should specify measurable goals, authorize and fund specific programs, and projects to advance this vision and provide the resources needed to implement them. To reinforce broader education reform, the technology plan should also describe how technology will be coordinated with changes in curriculum, pedagogy, assessment, teacher professional development, and school restructuring.
- Align Policies - To realize the full impact of ICT-based education reform, ICT in education policies should share the same vision, complement and be coordinated with those in other ministries, such as economic development, human resource development, telecommunications, agriculture, and rural and urban development. A national, cross-ministerial ICT coordinating agency or council can facilitate this policy and programmatic harmonization as well as promote the sharing of knowledge and resources. The committee should include participants from outside the government, such as business people, unions, university faculty, members of scientific organizations, and so on.
- Monitor and Evaluate Outcomes - Significant public investments demand a significant return in terms of educational, social, and economic benefits. National development plans should specify a stepped trajectory of expected outcomes. Measures of both the implementation process and the outcome should be used to continuously monitor the progress of programs toward goals and

[74] Adapted from Kozma, R.B. (2005). National Policies That Connect ICT-Based Education Reform To Economic And Social Development. *Human Technology - An Interdisciplinary Journal on Humans in ICT Environments*. Volume 1 (2), October 2005, pp.117-156

provide information to policymakers that can be used to refine policies and programs and adjust trajectories. In this way, initial policies and programs can be shaped to assure on-going coordination and foster fundamental changes in education, society, and the economy.

- Policies need to be based on the specific situation and educational goals of a country in order for ICT to be used to its full potential within education systems.
- There should be a phased implementation of ICT in education policy ensuring that the implementation process is manageable and that the development of best practices and lessons learned is gradual. This provides opportunities for evaluations so that the policy can be revised. A holistic approach to ICT in education policy includes a technological dimension and adequate physical and technological infrastructures as necessary conditions for effective ICT integration.
- To improve sustainability of projects, it is necessary to elicit the active participation and involvement of administrators, teachers, experts, students, parents, and other stakeholders.

Appendix C: Professional Development Considerations

While educators who do not have technical backgrounds may consider it to be a daunting task to develop an understanding of technology, it is critical for the successful take-up of technologies that schools and educators drive selection and deployment of technology and are empowered through the process to take ownership of the technology. For effective ICT deployment in education, a holistic approach to professional development should be multi-pronged and should focus on:

- ICT skills for government officials and change management processes associated with ICT deployment;
- ICT for leadership in schools;
- ICT for administration in schools;
- ICT technical installation, security and maintenance; and
- ICT for enhancing teaching and learning.

A holistic framework for professional development targeting all agencies in the education value chain will lead to the design of an implementation strategy for ICT that looks at the value that different role players add to ICT implementation, as well as the value that ICT brings to different education departments.

Government officials are involved in ICT integration into education at several levels. First, they are the official policy drivers and have to motivate schools to accept ICT to enhance teaching and learning. As such, in order to fulfil this role, government officials have to know the possibilities offered by ICT for teaching and learning, as well as potential risks so that their advocacy with schools and teachers is based on an informed understanding of ICT integration.

Another important aspect of staff development is the development of ICT-related educational leadership, especially in the context of professional development for school principals, as they play a crucial role in organizational change and leadership. Principals play a critical role in whether ICT implementation in a school will be successful or not. If the principal supports ICT, any plans to integrate ICT into the curriculum will be endorsed by the principal who will become a change agent. This aspect of

professional development has not been as well documented or explored as teacher professional development.

Even if generic professional development is given to principals, implementation and acceptance of ICT will ultimately depend on the management style of the principal. Perhaps sharing experiences of how different principals are implementing ICT programmes in the school would be an important aspect of professional development for principals, as this will help expose the range of implementation styles which are based on different leadership styles. In the expositions, it will be important to emphasize that there is no wrong or right way of implementing ICT, as long as implementation considers issues of sustainability.

Ideally, school administrators are responsible for many functions, most of which are to do with ensuring day to day functionally of the school. One of the most important aspects of keeping a school functional is keeping communication open. Communication can flow efficiently if there are several ways in which information is disseminated. When there is a range of available ICT options for communication, it takes skills to know which mode to use at particular times, with the most minimum disruption to other activities taking place in the school. Administrators can be trained on the range of options they can use to communicate with the parents, teachers and the education department.

A new paradigm is emerging that replaces training with lifelong professional preparedness and development of teachers. This approach includes at least three dimensions:

- Pre-service – focusing on initial preparation on pedagogy that provides teachers with a solid foundation of knowledge; competency in teaching, classroom management, and organization skills; mastery of the subject matter they will teach; and proficiency in using a variety of educational resources, including technology;
- In-service – workshops, seminars, and short courses that offer structured opportunities for acquiring new teaching skills, subject matter knowledge, and skills development in the use of technology in the classroom; and
- Ongoing formal and informal pedagogical and technical support for teachers as they address their daily challenges and responsibilities. This can help to break the professional isolation that many teachers undergo, breaking down their classroom walls and connecting them to colleagues, mentors, curriculum experts, and the global teacher community.

The UNESCO Planning Guide for ICT in teacher education cites three key principles for effective ICT development in teacher education:

- Technology should be infused into the entire teacher education programme. ICT should not be restricted to a single course but should permeate all courses in the programme;
- Technology should be introduced in context. Particular ICT applications like word processing, databases, spreadsheets and telecommunications should not be taught as separate topics but rather dealt with as the need arises in all courses of the teacher education programme; and
- Students should experience innovative technology-supported learning environments in their teacher education programme. Students should see their lecturers engaging in technology to present their subjects, for example, using PowerPoint or simulations in lectures and demonstrations. They should also have the opportunity to use such applications in practical classes, seminars and assignments. The application of these three principles will go a good way towards effectively integrating ICT in teacher education.

A teacher development strategy that maps out implementation on a long-term plan has to be developed and this must be based on a detailed action plan. A catalogue of examples of different forms of professional development drawn from international experience is presented in Annexure 1. However, it is important to note that, while there may be resistance to acquiring ICT skills and knowledge and using these to change practice, many teachers require additional motivation and incentives to become ICT savvy. Teachers may be more willing to participate in professional development activities if they are given time off from school to train and if their training expenses are paid for, or if they are considered for promotion if they are ICT compliant.

Furthermore, communities of practice can provide sustained platforms where teachers share resources that enhance their curriculum, get peer reviews of lesson plans they have created, and exchange ideas and good practices with other teachers of their subject. Communities of practice can be formed through online networks or through dedicated exchange of information in any format between teachers who are dedicated to effective use of ICT for teaching and learning. These communities can be collocated (involving people within the same school, district or country), or distributed (involving people from other schools, districts and across countries). Communities of practice can exist around curriculum development projects, teaching projects or teacher research projects.

Appendix D: Bandwidth Considerations

A competitive range of broadband technology is required to ensure schools can make informed choices that are appropriate to their needs. National policies should attract a variety of vendors in the market place to offer different broadband solutions. The greater the number of broadband service providers in the market, the more affordable connectivity can be offered to the market in general, including schools. Due to the recurring nature of bandwidth and connectivity costs, a key concern is the funding of ongoing connectivity. Various options exist including:

- Self funded by the school - In this case, the school needs to make provision for payment of connectivity costs through a line item in their budget. Schools can potentially seek a sponsor to pay for the school's monthly connectivity costs.
- Funded by government through a national or other government budget - The national ministry of education or communication makes funding available for the payment of internet access costs for schools.
- National telecommunications sponsors - In Malaysia, SchoolNet has a 'smart' partnership with their network provider which ensures that they receive an 'educational price' for telecommunications support and maintenance. In the Philippines, the Pilipinas SchoolNet entered into partnerships with the IT sector and universities which has included one year free telephone and internet service and a 50% discount thereafter.
- Nationally negotiated packaged deals - The national ministry of education negotiates bulk discounted package deals with service providers to provide special packages to schools.

When considering bandwidth, they key question for an education institution is what size bandwidth is required. Broadband has been taken to mean different sizes in different countries. In general, broadband is larger bandwidth which enables quick delivery of online or real-time services. For purposes of full educational use, full broadband is recommended. School uses of connectivity might include:

- Administration of the school such as banking or submitting reports to education officials;
- E-mailing done by educators and learners;
- Browsing done by educators and learners;
- Research done by educators and learners;
- Content requirements (for example, video and multi-media); and

- Real time use (for example, voice and chat).

The choices that need to be made regarding bandwidth provision at schools need to be driven by:

- Educational approach of the school – if curriculum is to be delivered, what content will the school expect to house in the school itself and what content will it need to access over a link, how will e-mail, browsing and downloading as well as online services feature in the school curriculum;
- Preferences of educators in schools – in a situation where there is limited curriculum related content inside the computer laboratories, educators would want to access websites that relate to the curriculum, thereby placing load on the connection; and
- Budgetary constraints – if budgetary constraints are a major factor in selecting a connectivity solution, the choice of what functions will be undertaken would need to be made in line with the amount of bandwidth can be purchased. However, this also means that there should not be a policy in place which forces educators to attempt to undertake high usage activities on low or medium usage bandwidth as this will lead to frustration.

When considering access for schools, in addition to the speed of a connection, it must also be considered that such a connection will be shared by various users. While a school may start off with connectivity only for the administration, the aim of e-schooling would be to ensure ubiquitous access throughout the school. Therefore, the end goal should be full broadband capacity for all users in the school. This goal may not be achieved immediately and also requires adoption and maturing of technology use in the school. However, school management and educators should be aware that the full benefits of technology in learning and teaching can only be experienced with high-speed, full broadband access in proportion to the number of users.

Appendix E: Technology Applications

This Appendix provides a quick guide to some of the technology applications which are available to support education and development initiatives. [75]

- Social network sites – social network sites are web-based services that allow people to construct a public or semi-public profile within a bounded system, define a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system. Possibly the most well known of these sites are Facebook and MySpace, although many such sites exist. Some also focus on specific dimensions of social networking. For example, social bookmarking sites such as Del.icio.us allow people to save bookmarks to websites and tag them with keywords, generating community-driven, keyword-based classifications known as 'folksonomies'. Likewise, photo-sharing websites such as Flickr allow people to upload, tag, browse, and annotate digital photographs, as well as participate in self-organizing topical groups. While social networking sites have massive potential for influencing the way in which we organize and find information and how we interact with people, it is important to note that the for-profit sector is selling itself as the provider of choice for these Web 2.0 collaboration capabilities, predominantly in an effort to create new platforms for funding consumers and selling advertising.

- Blogging – blogging is remarkable for the speed with which it has grown as an online communication vehicle. Blog is an abbreviated version of 'weblog', which is a term used to describe web sites that maintain an ongoing chronicle of information. A blog is a frequently updated, personal website featuring diary-type commentary and links to articles or other Web sites (and, in the case, of video-blogging, video). Given the personal perspectives presented on blogs, they often generate ongoing discourse and a strong sense of community. Blogs provide diverse, alternative sources of information for higher education, as well as providing tools that can be used by academics and students for a wide range of educational purposes.

[75] The descriptions contained in this section have drawn heavily on documentation prepared by the Educause Leaning Initiative – www.educause.edu/eli - and especially its '7 Things You Should Know About...' series.

- Wikis – a wiki enables documents to be written collaboratively, in a simple mark-up language using a web browser. A defining characteristic of wiki technology is the ease with which pages can be created and updated. This ease of interaction and operation makes a wiki an effective tool for mass collaborative authoring, the most famous example of which is Wikipedia, an online phenomenon that has played a massive role in challenging notions of what constitutes 'expertise' and about reliability of information. Wikis are already extensively used in many higher education programmes for educational purposes, and are one of the authoring tools being used to generate 'open' content (see below).

- RSS – Real Simple Syndication (RSS) is a protocol that allows users to subscribe to online content by creating lists of preferred sources of information in a 'reader' or 'aggregator' that automatically retrieves content updates, saving users time and effort. RSS feeds can be very helpful in managing information and undertaking ongoing research.

- Podcasting – 'podcasting' refers to any combination of hardware, software, and connectivity that permits automatic download of (usually free) audio files to an MP3 player to be listened to at the user's convenience. This is typically done by subscribing to an RSS feed linked to the specific podcast, so that when new editions of a podcast are made available, they are automatically downloaded by podcasting software. Podcasting has made available a very broad spectrum of educationally useful audio material, including radio programmes from around the world, lectures, conference speeches, and custom-produced podcasts created by enthusiasts. Growing numbers of universities and academics are making lectures available as podcast series, usually making these freely available to anyone around the world with Internet access.

- Virtual Worlds – virtual worlds are immersive online environments whose 'residents' are avatars representing individuals who participate via the Internet. Some, such as the very popular World of Warcraft, are explicitly focused on gaming and entertainment. However, possibly the most well known of these from an educational perspective is Second Life, a fully three dimensional world where users with many varying interests interact, but within which many universities and businesses are now constructing virtual campuses for their students.

- Voice-Over Internet Protocol (VOIP) – VOIP is a protocol optimized for the transmission of voice through the Internet or other packet-switched networks. VoIP is often used abstractly to refer to the actual transmission of voice (rather than the protocol implementing it). VOIP facilitates applications such as Skype, which allow users to make free telephone calls between computers.

- Instant messaging (IM) – IM is a form of online communication that allows real-time interaction through computers or mobile devices. It is often bundled into applications such as Skype and social networking sites, so that it can be used seamlessly while within those applications. It has become such an integral part of students' lives that many universities are working to move IM beyond the social sphere into teaching and learning.

- Online applications – these are web-based programmes that run in web browsers and typically replicate the functionality currently available on desktop-based applications. A good example is Google Apps, which provides access to office productivity, communication, and file storage tools. Another more specialized example is Lulu, which offers online access to the tools one needs to design, publish, and print original material, facilitating inexpensive production of publications. The online nature of such tools is intended also to facilitate collaboration, peer review, and collective generation of knowledge.

- Wielding the applications – by drawing on the potential of the above technologies, several new possibilities are emerging that are worth documenting:
  a) Mashups, which are web applications that combine data from more than one source into a single integrated tool.The power of mashups for education lies in the way they help us reach new conclusions or discern new relationships by uniting large amounts of data in a manageable way. Web-based tools for manipulating data are easy to use, usually free, and widely available.
  b) Digital storytelling, which involves combining narrative with digital content to create a short movie or presentation.
  c) Data visualization, which is the graphical representation of information to find hidden trends and correlations that can lead to important discoveries.
  d) Open journaling, which manage the process of publishing peer-reviewed journals online, allowing authors to track submissions through the review process, which creates a sense of openness and transparency uncommon in traditional, peer-reviewed publications.

e) Google jockeying, which involves a participant in a class surfing the Internet during the class for terms, ideas, web sites, or resources mentioned by the presenter. These searches are then displayed simultaneously with the presentation.

f) Virtual meetings, which are real-time meetings taking place over the Internet using integrated audio and video, chat tools, and application sharing.

g) Grid computing, which uses middleware to coordinate disparate IT resources across a network, allowing them to function as a virtual whole, providing remote access to IT assets and aggregating processing power.