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# ICT and Economic Development in Africa: The Role of Higher Education Institutions

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# Contents

Abstract .....	3
Introduction .....	3
Background.....	4
Review of Africa’s ICT challenges.....	4
Socio-economic disparities .....	4
Rural communities without basics .....	5
Disjointed ICT initiatives from local goals .....	6
Chasing the development tail syndrome.....	6
Acceptance of colonial developmentalism .....	6
Marginalisation of indigenous knowledge.....	7
Perception of ICT as a development panacea.....	8
Africa’s reality check – dealing with constraints .....	8
ICT infrastructure readiness.....	9
Collective African Development Vision .....	9
Internet Access and Use .....	10
Towards broadband connectivity .....	11
Policy Framework.....	11
Human capacity in ICT readiness .....	12
Human Development Index .....	12
Impact of skills shortage.....	12
Addressing skills shortage .....	13
Ensuring quality of ICT training.....	13
Ineffectiveness of traditional teaching models .....	14
Teaching with ICTs .....	14
Higher Institutions of Learning in Africa .....	15
Overview .....	15
Quality of education .....	16
Free “Open access” to resources .....	16
African Virtual University .....	17
Inter-Institutional Collaboration .....	17
University-Initiated Innovations/Projects .....	18
Donor-Funded ICT projects .....	18
Industry-University ICT projects.....	19
Emerging technologies and social practices .....	19
Changing Social practices .....	19
Changing teaching and learning .....	20
Supporting distant learners.....	21
Mobile and Wireless Technologies.....	21
New learning approaches meet with new technologies.....	21
Mobile phones .....	22
Personal Digital Assistants (PDAs) .....	23
Emerging Free Open Source Initiatives.....	24
Demand for Open Source.....	24
Web 2.0 – Should Africa “fasten seat belts”? .....	25
Is Africa ready for vortals? .....	26
Conclusion.....	27
Acknowledgements .....	28
References .....	28

## Abstract

This paper seeks to highlight how Information and Communication Technologies (ICTs) are used for economic development in Africa and the role of higher education institutions (HEIs) in this regard. The paper summarises secondary data on eight countries, namely Ghana, Nigeria, Uganda, Kenya, Tanzania, Mozambique, Madagascar and South Africa. There are three main arguments presented: i) any meaningful development requires alignment with a country's development goals, buy-in and the involvement of local expertise. ii) a collective ICT development vision for Africa exists and many governments are developing national ICT policies. iii) the emerging technologies and consequent changes in social practices (e.g. mobile phones) ought to be exploited for economic development. All the above arguments engage HEIs at various levels of teaching, research and social responsibility. The paper argues that infrastructure readiness without human capacity is futile. It then analyses specific ICT skills and delves into the role that HEIs in general and university-initiated projects in particular play in economic development. The paper concludes with a discussion on emerging technologies. For the sake of brevity, two technologies are reviewed: mobile technologies and the new Web 2.0.

## Introduction

In Africa, there is insufficient evidence to suggest a direct link between ICTs and development. Ngwenyama et al, (2006) argue that "recent studies have found a positive correlation between investment in ICTs and economic growth in developed countries, but evidence for developing countries is not as extensive" (p.3). However, the potential for ICTs to transform the productive capacities of developing nations has been noted (Crafts, 2003; Chen and Zhu, 2004). It must be stated that meaningful productive capacities are aligned with a nation's development goals. To the extent that ICTs are used in many businesses in Africa, especially in the urban areas, this does not suggest that ICTs have brought development to these areas. It can also be argued that the correlation between investment in ICTs and economic growth does not help in understanding whether ICTs cause economic growth or vice versa.

In their study involving five Francophone countries within the West African group, namely Benin, Cameroon, Ivory Coast, Niger, and Senegal, Ngwenyama et al, (2006) conclude, "it is clear from our analysis that the central focus on ICT as a solution to stagnated development will not bring the results that the promoters of 'ICT as an engine of development' are expecting". Ngwenyama's conclusion is profound and it provides a way of looking at ICTs not as technology but as mediums of social change or as vehicles to accomplish tasks.

The above argument is fundamental to shifting investment decisions linking tools to processes. Anecdotal evidence suggests that ICT evangelists have championed projects that have left hopefuls disappointed. This view is consistent with the findings of Banard and Vonk (2003) who examined the status of ICTs in Mozambique, Namibia, South Africa, Uganda and Zambia and reported that, "...many, if not most countries in Africa lag behind in basic requirements for ICTs to play a meaningful and sustained role in people's lives". Hence, realisation of development objectives requires leadership, as Ifinedo (2005) rightly puts it: "Sound leadership and commitment may be needed to help steer developing nations towards occupying a befitting place in the changing world, in which reliance on knowledge and information is paramount" (p.65). The focus on knowledge and information is significant and

helps to explain the precise title of this paper: *Knowledge and information for economic development in Africa: the role of HEIs*. Thus, the premise of the paper is that knowledge and information needed for economic development must be relevant and aligned with the country's development goals. Alignment alone is insufficient if knowledge and information does not reach people who need it. The role of HEIs is to produce and disseminate knowledge and information. Thus, the role of ICTs as a medium of knowledge and information is catalytic.

In the next section the realities of local contexts and how these affect HEIs in Africa are outlined.

## **Background**

The role of tertiary education in economic development is unquestionable. However, to suggest that Africa can learn from developed countries who have invested heavily in tertiary education and been economically successful could be naïve. The reality is that many African governments have to spread thinly meagre resources to other equally important needs.

The challenge in Africa is that investments in HEIs without corresponding improvement in the economies of the countries have led to massive and faster brain drain of HEI graduates. This is another reason for HEI to be involved in economic development. The shortage of skilled people in science and technology suggests that HEI have to consider ways of improving graduate throughput without compromising on the quality of education. It is here that the role of ICTs may become evident.

The 61st session of the United Nations (UN) General Assembly (October 13, 2006) identified Africa's challenge as lying in "institutional weaknesses which showed up both in the form of technical capacity to formulate and manage progress and in insufficiently developed rules to govern collective action".

While the UN General Assembly identified one of the challenges, in the next section other challenges are outlined.

## **Review of Africa's ICT challenges**

### **Socio-economic disparities**

Fleming (2002) attempts to examine the general struggling characteristic of African states burdened with high levels of poverty and large disparities in socio-economic levels and expresses the same sentiments echoed by Barnard and Vonk (2003). Both explain that the poverty and socio-economic disparities are symptomatic of Africa in general. They evidence this by the examination of certain states being marginally ahead in the race to equip themselves with effective ICT infrastructures, that include telephone lines, access to electricity, low Internet access costs, policy and legislative platforms. They conclude that some African states lag far behind in the basic requirements for ICTs to play a meaningful and sustained role in people's lives.

There are gaps in development in Africa. A greater presence of advancement in terms of the use of ICTs has been noted (Barnard and Vonk 2003) in the peripherals of the Southern and North African States, followed by the Eastern and West African States. Most of the Central African states have been lagging behind.

According to Vukanikids-DTI (2005), the developmental gaps are compounded by the problem of the digital divide, which is exacerbated not only by lack of access to ICTs but also the challenges of inadequate pools of skilled persons, and the use, maintenance and rapid obsolescence of the ICTs due to continuous technological innovations and development.

As a result of past history, in South Africa access to ICT has impacted differentially depending on diverse generic categories of users, namely age, wealth, vocation, education etc (Gillwald et al 2005). Despite these disparities, South Africa has no integrated ICT policy framework to ensure that ICT services are not just utilised by the privileged few (Gillwald et al 2005). Although many people do not have access to the Internet in South Africa, they generally regard their access to mobile phones as an adequate replacement for the Internet (Gillwald et al 2005).

## **Rural communities without basics**

In Ghana, most users access the Internet through Internet Cafes (Frempong and Stork 2005). Over 90 percent of the Internet Cafes are in Accra, suggesting that access to the Internet in other parts of Ghana is impossible. Since the majority of Ghana's population that generate the greater part of the country's income live in rural areas, the lack of Internet access may have huge ramifications for the economic development of the country. Thus the challenge is how to use ICTs to improve delivery of services and the well-being of rural people (Frempong and Stork 2005). It must be pointed out that most rural communities, especially villages along major highways, can receive a mobile phone signal. Needless to say, the other challenge is how communication infrastructure can be exploited in communities without electricity.

Few people in Uganda use email due to either lack of computer skills or lack of access to ICTs (Tusubira et al 2005). Access to email is through Internet Cafes which are only available in large towns. Fleming (2002) alludes to the idea of basic Internet access being closely associated with economic privileges, thus keeping popular access to the Internet in the hands of a few well-educated and relatively affluent Africans. The reverse side of this coin as highlighted by Barnard and Vonk (2003) is that around 70% of the continent's population live in rural areas, with many Africans lacking the basics of life, including even basic telephone services.

In Kenya, there is generally no incentive to develop the ICT sector. The problem is compounded by inadequate ICT skills, and lack of research and development capacities in ICT (Waema 2005). The poor infrastructure and poor economic climate<sup>1</sup> are some of the reasons why ICTs may not be prioritised. The role of ICT in the social and economic development of the nation's development is however recognised by the Kenyan government<sup>2</sup>.

One of the challenges in Tanzania is that key sectors of the national economy do not perceive ICTs as a critical business imperative. However, the government of Tanzania recognises that ICTs are indispensable for development and is creating a conducive ICT environment starting with a National ICT Policy<sup>3</sup> framework.

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<sup>1</sup> <http://www.american.edu/initeb/en6343a/Analysis.html>

<sup>2</sup> <http://www.american.edu/initeb/en6343a/ICT-policy.htm>

<sup>3</sup> <http://www.tanzania.go.tz/pdf/ictpolicy.pdf>

## **Disjointed ICT initiatives from local goals**

Development needs are goals a community sets for itself to achieve and these may involve “enhancing equity, quality and sharing instructional technology resources” (Mutula, 2003). It is important to distinguish development goals from development activities aimed at achieving these goals. ICTs can change how development activities are performed, and also accelerate the realisation of development goals. In a study conducted in Nigeria, Elijah and Ogunlade (2006) report “although little empirical evidence of the benefits of ICTs in Nigeria are found in literature, there are great potentials of ICTs as tools for enhancing people’s daily lives whether by increasing access to information relevant to their economic livelihood, better access to other information sources; healthcare, transport, distance learning or in the strengthening of kinship”.

However, the alignment of development activities with development goals, and both integration and use of ICTs for development requires human skills. Thus, HEIs through research and teaching are involved at all levels of development: research produces knowledge to conceptualise and develop frameworks in which development happens; teaching prepares skilled manpower that can link and implement development goals through appropriate activities.

In Madagascar, the Japanese Policy and Human Resource Development (PHRD) funded an educational reform which included modernization of curricula and increasing its relevance to developmental needs (Viens and Lynch 2000).

## **Chasing the development tail syndrome**

ICT and development are linked both in terms of “information and communication technologies as an engine of development” (Fleming 2002), and by the “multicausal duality of technological effect” (Ng’ambi and Brown 2004) on development. Ng’ambi and Brown explain that the relationship between ICTs and the effects it causes is always a two-way process. This means that poor nations cannot afford to invest in ICTs, yet without such investment they are likely to continue being poor. In any case, investment in ICTs alone would not make a nation rich. Hawkins (2002) contends that although development is driven by information, technology, and knowledge, without corresponding investment in infrastructure and human capital, such development would not be realised. The paradox though is that the level of ICT use in any country is closely related to the country’s income (Hesselmark 2003). The implication of this is that there is a need for Africa to conceptualise the role of ICTs in realising the continent’s unique development goals. The needs in most African countries are too compounded to disaggregate. Ngwenyama et al (2006) warn that disaggregating issues of education and healthcare infrastructure from ICT infrastructure development is unwise.

## **Acceptance of colonial developmentalism**

The conditions attached to some development funding received in Africa have been heavily criticised for being ineffective, and for the tendency “to find local problems to suit pre-packaged assumptions and solutions” rather than empirically ascertain the local perceptions of what the problems and priorities are, and incorporate local knowledge and expertise in the process of solving the problems (Nwaka 2005).

Accepting Nwaka's argument, it follows that the impact of well-intended initiatives and investments in Africa are bound to be negligible if conceptualised outside the needs of local communities. Hofstede (2001) observed that "nobody can develop a country but its own population" (p. 437). Understood in context, Hofstede suggests that while a country needs assistance to develop, unless such development initiatives have a buy-in and are owned by local communities, there is a danger of "colonial developmentalism" (Zeleza, 1997). Zeleza (1997) cautions that "colonial developmentalism threatens to throw out the babies of development conceived in the struggles of social groups in Africa, Asia, Latin America, and indeed, in the industrialised countries themselves, with the bathwater of western developmentalism" (p. 128).

Hofstede (2001) also argues that "as all countries are gradually exposed to products of the same scientific discoveries in the form of modern technology, and as these play an important role in culture change, some authors have concluded that all societies will become more and more similar" (p. 34). To accept Hofstede's argument is to take a narrow view of Africa's development challenges. It would be naïve to believe that scientific discoveries such as technology alone can have a uniform effect on all societies. This perception could explain some frustrations in developing countries where there has been very little technology-induced development.

## **Marginalisation of indigenous knowledge**

To remain relevant, universities all over the world and Africa in particular are under pressure to redefine their mission and review their curricula to produce African graduates with "global" skills (Yieke 2005). The University of Nairobi's mission statement is:

To be a leading centre of excellence in the pursuit of development, dissemination and preservation of knowledge, inspired by African values, and committed to virtues of quality and relevance; and to contribute to the dynamic socio-economic and cultural development of Kenya, Eastern Africa and the world at large. The mission of the university is to maintain a leadership role in the pursuit of development of knowledge through quality and relevant teaching, research, consultancy and community service.

In a desire to incorporate indigenous knowledge into the corpus of university knowledge, the Centre for Complementary Medicine and Biotechnology at Kenyatta University aims to foster research in traditional healing methods (Foundation Partnership 2004).

Foundation Partnership (2004) observes that HEIs in Africa offer innovative curricula with greater subject choices, and have an emphasis "on African culture not only through the study of the humanities but also through incorporating important aspects of indigenous knowledge into courses in medicine, technology and architecture".

At the interface of ICT and indigenous knowledge is the challenge of culture and language. It is difficult for information and knowledge to be effectively disseminated to communities who need it if language issues are unresolved. In response to these challenges, an Open Source Software Translation Project<sup>4</sup>, a South African-based NGO project, has been working on translating computer applications to local

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<sup>4</sup> <http://translate.org.za/>

languages in order to overcome language barriers in the use of computers. Mutula (2003) reports that “the computer applications covering the full desktop, web browser, word processor, spreadsheet and email have been translated into some local languages such as Xhosa, Zulu and Venda”.

## **Perception of ICT as a development panacea**

The duality of technological effect demands holistic visions of ICT initiatives. For example, “to funnel large sums of investment into ICT initiatives without complementary investments in building adequate education infrastructures would be a recipe for the failure of development and could further frustrate millions of people in the developing world” (Ngwenyama et al 2006). In other examples Gillwald (2005) points out that “a certain threshold of national communications infrastructure rollout and skilled individuals have to be in place for the positive network effects of these technologies to reach a takeoff point and multiply through the national economies” (Gillwald 2005).

According to Ngwenyama et al (2006), the Economist Intelligence Unit warns that ICT investment may not bring the same returns in the developing world as in the developed world. Their analysis of 60 countries found that ICT begins to deliver per capita growth only after a certain threshold of ICT development has been reached. In spite of this, ICT initiatives are high on the agendas of many developing countries. Often ICTs are seen as the key solution that will allow countries to meet the needs of rural and under-served areas and hopefully bring services to widely distributed citizens rapidly and cost efficiently, be it in health, education or public services (Euro-Afri Pact 2006).

## **Africa’s reality check – dealing with constraints**

In a two-year study on the effects or changes experienced by ICT users in communities conducted in Kenya, Senegal, Uganda and South Africa Thioune reports that, “the process of appropriating and using ICTs on a large scale in poor communities was hindered by many institutional, technical, economic, and socio-cultural constraints” (Thioune, 2003). Some of the constraints facing ICTs in poverty alleviation, according to Elijah and Ogunlade’s (2006) Nigerian study are technological and socio-cultural constraints. The technological constraints are: lack of access to electricity or unstable supply of electricity and lack of adequate technical support. These constraints have huge ramifications as Ngwenyama et al (2006) caution: “in Africa, three quarters of the population is illiterate and lives in rural areas that lack basic facilities such as electricity and to expect effective utilisation of communication technologies like the Internet in all areas, by all people, would be unreasonable” (p.4). These constraints have not spared HEIs. For example, in Ghana most universities lack course web sites and cannot support online courses that rely on heavy bandwidth. Moreover, the costs require that students be charged a fee for Internet access at the ICT centre. This fee limits the time each student can spend accessing the Internet and therefore also the content they are able to access (Obuobi 2006).

An example of socio-cultural constraints is provided in Elijah and Ogunlade (2006) who report that “... women in Nigeria considered the word ‘technology’ to have male connotations, even though ‘information’ seemed more feminine. Some even believed that working with ICTs would drive women mad”.

While it is important to be mindful of constraints, Africa has strengths that can serve as springboards to development. In a study of e-readiness in nine countries from two regions of Africa, namely Nigeria, Ghana, Cote d'Ivoire, Kenya, South Africa, Mauritius, Botswana, Egypt and Tunisia, Ifinedo (2005) reports that "Africa performs fairly well on culture, understanding, effectiveness and these should be used as springboards towards improving the overall position of the networked economy" (p.65).

The above section reviewed Africa's challenges both in general and in specific countries. It was shown that despite constraints Africa has strengths that can serve as development springboards. In considering the role of ICTs it is important to be mindful of both challenges on the ground and available opportunities.

The next section examines the ICT infrastructure readiness. The section takes the view that Africa has a collective development vision which has a continent-wide buy-in and support. This holistic approach is critical in ensuring Africa realises the United Nations Millennium goals. The section also highlights the growth in Internet penetration.

## **ICT infrastructure readiness Collective African Development Vision**

One of the key attempts towards a collective African vision is the New Economic Partnership for African Development (NEPAD). Barnard and Vonk (2003) report that "53 countries have been urged to implement ICTs in three crucial development arenas: education, health and trade". While NEPAD and other initiatives have contributed to the provision of ICT infrastructure with positive results as seen in the growth of Internet uses, the disparities in development across Africa are enormous.

The challenge to HEIs in Africa, has been summarised by Colle (2005): "central to creating digital resources and academic infrastructure is the question of universities' relevance to the world around them, and especially to the challenge of being an active player – 'an anchor of a broad-based poverty alleviation strategy' in an increasingly knowledge-based economy". It can be inferred from Colle that the activities of HEIs in Africa ought to be geared towards contributing to the realisation of the Millennium development goals.

In 2003, the World Summit on the Information Society (WSIS) adopted a declaration of principles aimed at enabling everyone to create access, utilise and share information and knowledge. In this declaration, member states affirmed their commitment to aggressive investment in ICT for social and economic development (Ngwenyama et al 2006).

In Ghana, one of the reasons for low internet use is lack of access (Colle 2005). The problem of access to the Internet seems to impact on educators' readiness for preparing graduates who are able to conceptualise the links between ICTs and development challenges. Obuobi (2006) observes that although there are 12 private universities and six public ones in Ghana, there is a critical shortage of highly qualified professionals and teachers in IT to accelerate economic and academic development. In an earlier study, Unwin (2004) reports that approximately 30,000 untrained teachers worked in various schools in Ghana in 2003. In these contexts, the challenge is how to cost-effectively mentor untrained educators without them leaving the classrooms and how to allow educators to access shared resources. The role of ICTs for life-long learning become evident in such a scenario.

Oyendemi (2003) observes that policy makers and national governments in Africa are faced with the challenge of developing appropriate policies that enhance the universal diffusion of, and access, to ICT services while adopting a holistic approach taking cognizance of the social, cultural and political needs of the community. The need for a holistic approach is echoed by Barnard and Vonk (2003) who postulate that Africa ought to develop a strong collective vision, a plan for ICT implementation and establish an information society on the continent. Hawkins (2002) reports that many ministries of education view computers as a stand-alone subject requiring a curriculum focusing on basic computer literacy skills. While computer literacy represents a start, the integration of computers and the Internet into the broader curriculum is where real learning gains will need to be made.

## Internet Access and Use

It is estimated that 3.6 percent of the people in Africa use the Internet (i.e. 32,765,700 out of a population of 915,210,928 as at 2006) (Internet World Statistics<sup>5</sup>). Internet usage in Africa is 14.1 percent of the world population and this represents 625.8 percent of usage growth (2000-2006). Adeya and Oyelaran-Oyeyinka (2002) observed that new technologies, while holding the promise of creative ways of improving higher education, exert pressure on the university system in Africa to produce better graduates in ICT, engineering and the sciences. Gillwald (2005) contextualises the pressure on HEIs in Africa more succinctly. She states that “ICTs are pervasive and cut across all sectors (from personal use to business to government). With this pervasiveness in mind, it should not be surprising that ICTs are increasingly viewed as prerequisites for modern human development, and the role that they play in development is recognised outside of the ICT and development sphere”. Table 1 shows the phenomenal growth (2000 – 2006) in the use of the Internet among the eight partnership countries.

Country	Population (2006 est.)	Internet Users Dec/2000	Internet Users, Latest data	%Population (penetration)	%Users in Africa	Use Growth
Uganda	27,771,997	40,000	500,000	1.8%	1.5%	1,150.0%
Kenya	34,222,866	200,000	1,054,900	3.1%	3.2%	427.5%
Tanzania	37,979,417	115,000	333,000	0.9%	1.0%	189.6%
Mozambique	19,881,392	30,000	138,000	0.7%	0.4%	360.0%
South Africa	48,861,805	2,400,000	5,100,000	10.4%	15.6%	112.5%
Ghana	21,355,649	30,000	401,300	1.9%	1.2%	1,237.7%
Nigeria	159,404,137	200,000	5,000,000	3.1%	15.3%	2,400.0%
Madagascar	18,475,940	30,000	90,000	0.5%	0.3%	200.0%

Table 1: Internet Usage Statistic in Partnership countries

<http://www.internetworldstats.com/stats1.htm>

The significance of Table 1 is that the Internet has the potential of affecting teaching and research in universities in these ways: “Providing greater student access to education; improving curriculum and quality of instruction; and increasing productivity of academic publications” (Adeya and Oyelaran-Oyeyinka, 2002). There is currently no evidence that the observed growth in Internet usage has led to growth in provision of student access to education or to improved curriculum or to quality of instruction. Mutula (2003) observes that despite the availability of the Internet, most of the

<sup>5</sup> <http://www.internetworldstats.com/africa.htm>

universities in the region have very limited access to modern computing and communications technology.

These statistics are indicative of the yet-unrealized potential of ICTs for education in Africa and of possible ripple effects on economic development. Gillwald (2005) highlights the situation in Tanzania: “only 2 percent of all households in Tanzania have a computer – all in urban areas. Even then, a mere 15 percent of the few households with working computers are connected to Internet, and they almost exclusively live in Dar es Salaam. In general, there is negligible Internet penetration in Tanzania”. Willinsky et al (2005) postulates that what compounds the problem of the digital divide are the formidable inequalities in the basic access to hardware, software and connectivity faced by poor nations.

## **Towards broadband connectivity**

Given all the country-specific challenges, a continent-wide project aimed at integrating the continent's communication by harmonising ICT infrastructure initiatives across Africa is under way. It is envisaged that the project will contribute to bridging the current digital divide.

While good broadband connectivity, for example, is now taken for granted in many of the richer countries of the world, and educational software is increasingly being developed to take advantage of this, such access to the internet is rare and expensive in Africa (Unwin 2004). In August 2006, seven countries signed the NEPAD Broadband ICT Infrastructure Network Project including the East Africa Submarine System (EASSy) in Kigali in Rwanda. An additional seven countries signed the same protocol that seeks to bridge the digital divide on the continent in Cape Town in October 2006.

## **Policy Framework**

The Euro-Afri Pact (2006) reports that the Department of Information Systems for Production and Operations Management at the University of Duisburg-Essen is working towards developing sustainable policies for ICTs as enablers of education in developing countries. It is envisaged that policy will emerge from projects that focus on the integration and convergence of eLearning, knowledge management, and capacity building using ICT within several international and EU-funded programmes.

Priority areas identified in the ICT Policy and Strategy in Mozambique include, but are not limited to, human capacity, infrastructure, business development, content and applications, regulation, and *e-Government*. As the government is the largest IT user by far, it not only has to lead the ICT-for-development agenda by adopting the appropriate policy and legal frameworks, but has also put in place key programmes and projects (Dev Gateway n.d).

South Africa is considered to be one of Africa's leading ICT hubs. Other emerging ICT hubs are Ghana, Kenya and Nigeria. All these countries have relatively strong basic infrastructure with some strong ICT components that include policy development, telecommunications roll-out and technical capabilities (Barnard and Vonk 2003). There is therefore both potential and capacity in these countries to help steer national ICT policy agendas.

The government of Ghana introduced the ICT for Development (ICT4AD) policy in the latter part of 2003. The overall objective of ICT4AD was to engineer a ICT-led

socio-economic development process with the potential to transform Ghana into a middle-income, information-rich, knowledge-based and technology-driven economy and society (Gillwald 2005).

There is evidence that the use of ICT in Tanzania is gaining momentum and that the considerable effort made by the government to liberalise economic policy in recent years is bearing fruit. While the rapid integration of ICT into the economy of Tanzania faces difficulties similar to those found in other countries in the region, the government of Tanzania has shown by word and deed that it is prepared to make a special effort to try to expedite this integration (Hesselmark 2003).

The premise of the next section is that ICT infrastructure alone without human capacity cannot work. The section reviews human capacity using the human development index as a point of departure. The impact of the shortage of skills, training and the quality of training approaches used is discussed.

## **Human capacity in ICT readiness**

### **Human Development Index**

From a skills development perspective, Ngwenyama et al (2006) have reported on a complementary relationship between education and ICT in the analysis of the Human Development Index (HDI), particularly in Africa, and conclude that ICT and education have a positive impact on development. One worrying trend to note (Ngwenyama et al 2006) has been the consistent low ranking of African nations. The 2003 HDI Report warned that Africa in general may be facing “an acute development crisis” with many African countries suffering serious socio-economical reversals. HEI in Africa cannot therefore afford to take a “business as usual” approach. Hawkins (2002) contends that Africa needs to have workers who learn how to learn, and are able to quickly acquire new ICT skills.

### **Impact of skills shortage**

According to Senzige and Sarukesi (2003), higher learning institutions are increasingly orienting themselves in the use of ICT as a means of delivering subject matter. An A level student aspiring to join the top educational echelon will not be able to cope without basic training in ICT use in secondary schools. The problem is more serious when it comes to undergoing training abroad (Senzige and Sarukesi 2003). This acute problem starts at basic education level and permeates into the tertiary level and thus ends up creating shortages of ICT skills required for Africans to produce and compete in the changing African and global markets.

Ochilo (1999) reports on poverty and low levels of ICT capital investment in East Africa by public and private sectors and the absence of fully trained local citizens in ICTs explains the economic disparities between East African states and Southern Africa. The appropriate use of ICT does “give civil society an opportunity to formulate new forms of activism and participation in democracy” Fleming (2002).

Human capacity projects in Kenya have taken various forms. At Moi University in Kenya a collaborative project with Delft University of Technology in the Netherlands helped in raising computer awareness and trained staff in management of information systems and project management (Mutula 2003).

The majority of the Nigerian student population is computer illiterate. Odusanya and Bamgbala's (2002) study revealed that the majority of final year students at the College of Medicine, University of Lagos had limited computer skills and only 23% of the students had used the Internet for medical research. Odusanya and Bamgbala conclude that "the Nigerian student population is computer deficient". In another study, Adomi and Anie (2006) report that Nigerian industry asked universities to deepen the current exit knowledge levels of ICT skills of university graduates. According to Adomi and Anie (ibid.) industry was concerned about levels of graduate skills in online/internet searching, systems management and computer keyboarding.

Contrasting the Nigerian situation to South Africa, a study of the qualifications of employees in South Africa's ICT industry reveals that there are very few post-graduates in the technical group of employees. This poses the question of whether the ICT industry has developed to a level where the services of post-graduates are required, or whether the current employees are just under-qualified (Vukanikids-DTI 2005).

## **Addressing skills shortage**

Detailed studies by Ochilo (1999) suggest inadequate ICT skills training in eastern Africa and reveal that a total of 57.8 percent of professionals coming out of institutions of higher learning rated their institutions as being "less professionally capable of dealing fully with ICT training needs" with only "28.1 percent of the professionals rating the institutions as capable". Of concern here is the content and curriculum of these institutions which has been noted as inadequate to fully cater for the emerging ICT African professional in terms of robust training programmes including data processing, systems management, and advanced computer training. The situation is exacerbated by the lack of "effective dissemination of information" and an "excessive dose of theoretical courses not fully blended with the practical courses that fail to cover the contemporary ICT international issues" (Ochilo 1999).

Contrasting the above African phenomena with Wessels's (2005) account of developed countries' shows the magnitude of seriousness placed on the ICT competency by skilled professionals in other parts of the world. This view is supported by Hostrom and Hunton (1998) who argued that professional educators and their students must either develop high levels of information technology competence or risk becoming functionally obsolete. It can be inferred from this argument that HEIs can become functionally obsolete by proxy.

## **Ensuring quality of ICT training**

There are myriads of inferior quality ICT skills courses in the African marketplace. Few commercial training courses have been accredited, and many potential trainees are duped into paying considerable sums of money for training that is of dubious quality. In the donor community there is also evidence of "re-inventing the wheel" when it comes to developing ICT skills software and manuals, and a number of ICT projects on the African continent seem to develop their own ICT training courses with little consideration for what has already been developed (James et al 2003).

Kenya has a Commission of Higher Education which plays an important role in accreditation of private universities. Kenya also has a Higher Education Loans Board and a Joint Admissions Board, both of which play some important roles, at the

system level, in the areas of access, through loans and admission affirmative action (Foundation Partnership 2004).

## **Ineffectiveness of traditional teaching models**

James et al (2003) note that the model for lecture-based products within the African institutions reviewed has been that of a face-to-face classroom situation, using a variety of media to enhance the learning experience. Thus most of the software packages used in teaching ICT skills are instructor-led as opposed to hands-on practical approaches to learning (Ibid). Other shortcomings exposed in the African learning process include computer use in poorer districts being characterised by drill, practise and remediation. This method has proved to have negative results for students when used beyond primary education (Coupe 2003).

There has been an innovative approach from SchoolNet South Africa Educator Development Network which has been more practical. This approach is currently being tried out in learning institutions in South Africa, with the teaching of ICT skills being approached differently, driven by the assumption “that it can be learnt incidentally while focusing on specific education-related tasks and themes” (James et al 2003).

James et al (2003) look at a 10–20 year perspective and predict ICT resources being widely available for communication purposes throughout Africa, with computer literacy which includes knowledge about more sophisticated office applications, such as databases, document production, spreadsheet usage and specific applications for multimedia, administrative and technical uses (James et al 2003).

As the technology advances, users will find the technology increasingly easier to use and it is likely that little computer literacy will be needed to use the future communication devices. What becomes important is how to use the technology effectively, rather than “what makes this computer/software work?” (James et al 2003).

## **Teaching with ICTs**

In Uganda, there are projects which are using ICTs beyond the “business as usual” mode which is the use of ICTs to support the traditional behaviourist paradigm. Beebe (2004) suggests that ICTs for teaching and learning undergo at least three phases: a substitution phase where traditional teaching occurs with the use of new technologies; a transition phase where new teaching and learning practices begin to appear as established practices start to be questioned; and a transformation phase where the new technologies enable new practices. According to the “Connectivity for Educator Development programme”<sup>6</sup> some projects in Uganda report an improved quality of education when computers were introduced in schools and teachers trained on how to integrate Microsoft Office packages into their teaching.

Hawkins (2002) argues that training must go well beyond basic cutting-and-pasting. Teachers need to be able to transform their classrooms from places where a static one-way flow of information from teacher to student occurs, into dynamic, student-centred learning environments in which learners interact with peers in teams, both in

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<sup>6</sup> <http://www.connected.ac.ug/frameset.htm>

their own classroom as well as with virtual classes around the world through the Internet. Most teachers, however, are intimidated by technology and are comfortable with their own teaching styles. Any teacher training programmes should help teachers see past the technology to the pedagogical and educational gains that use of the technology will bring to the classroom. Furthermore, teachers need to be transformed from information consumers, using the Internet to access resources, into information producers, adapting the information for their particular cultural and educational realities.

## **Higher Institutions of Learning in Africa Overview**

Foundation Partnership (2004) reports that the first universities in Africa were modeled very closely on European origins, particularly in Anglophone and Francophone Africa where the overall purpose “of these institutions was that they were meant to provide the necessary indigenous support staff for the colonial administration”. Within these institutions “there was an overemphasis on the arts and humanities, with little attention given to the sciences, technology, economics and other professional subjects” (Foundation Partnership 2004).

This phenomenon has changed over the last few decades, and there has been renewed interest in higher education in Africa, particularly after years of neglect. The Foundation Partnership (2004) reports on a situation where some institutions have shown a higher aptitude than others for engaging in innovative reforms and sees these institutions as “on the move”, towards transformation, both from an institutional and wider society perspective.

These institutions now offer innovative curriculums such as the introduction of vocational and professional educational programmes, greater subject choice (rather than specialisation), and an emphasis on African culture not only through the study of the humanities but also through incorporating important aspects of indigenous knowledge into courses in medicine, technology and architecture (Foundation Partnership 2004).

It is in light of the current state of the African university that some have argued that innovative reforms offer the best way out of the crisis. In light of broader contemporary global issues, such innovative changes would include “massification of higher education; globalisation, the rise of the knowledge society and the information-driven global economy; the changing labour market; the impact of new ICTs; the internationalisation of higher education and finally, the growing demand for higher education institutions to function as market-like organisations in the context of fiscal constraints.”

One typical characteristic noted in these institutions, though, suggests that these innovations face what has been identified as a “learning gap” (Willinsky et al 2005). It may be noted that the concept of the learning gap has also been highlighted in studies in America, where Greenstein and McKee (2004) conducted a literature review that resulted in the identification of 36 critical information technologies. From their survey of over 1,000 accounting information systems and auditing academics and 1,000 audit practitioners in America, that helped determine self-reported IT knowledge levels and perceptions about the best places to learn IT skills, they identified a potential “learning gap” between educators and practitioners that may occur in five of the 36 critical technologies that they examined (Wessels 2005).

The learning gap is critical to the African professional when the emphasis is on ICT skills competency. It may be possible to contrast the courses offered in the African institutions with those offered in their American counterparts. Theuri and Gunn (1998:101-117) have conducted a detailed examination of the way ICT courses have been designed and structured in American universities and then related these practices to the systems skills expectations of the employers of accounting graduates. Their findings suggest that employers have important preferences regarding the information systems curriculum for accounting students (Wessels 2005).

Ngwenyama et al (2006) have argued about the necessity to establish links in investments in ICT and education. A broad analysis of the higher learning institutions in Africa has shown the need for education advancement and achievement as essential to appreciating the full utilisation of ICT.

## **Quality of education**

The diminishing funding of HEIs in Africa coupled with increased enrolment of students has led to a decline in quality of education. Nwaka (2005) observes that as a consequence, Nigerian universities are now only a shadow of their former glory. According to Nwaka (ibid.) the quality of scholarship and of the knowledge generated is constrained by the limited exposure of our scientists to current literature and modern techniques, and hence isolation from global discourse and trends in their fields. In addition, scholars often tend to communicate only among themselves or with their captive student audience/market (Nwaka 2005). The ramifications of the state of the Nigerian universities ought to be seen in the light of Olukoju's (2002) argument that South Africa and Nigeria dominate the production and dissemination of knowledge in Africa. ICTs have been shown to improve the quality of student learning in South Africa (Ng'ambi and Brown 2004) and dissemination of research in Nigeria (Olukoju 2002).

## **Free “Open access” to resources**

African countries have realized the potential benefits of ICTs and currently many programmes have been rolled out. As an example, the “Southern African Non-Governmental Organisation Network (SANGONeT) and the International Institute for Communication and Development (IICD) joined an international project, Electronic Distance Training on Sustainability in Africa Local Governments (EDITOSIA), to identify existing knowledge in this area in order to make policy recommendations for the promotion of electronic distance training on sustainability for officials in African local government” (Barnard and Vonk 2003).

The African scholarly community can also not take advantage of using ICTs to access free online publications. The provisions have been made available through efforts by selected publishers to provide free online access to thousands of journals (Health InterNetwork Access to Research Initiative – HINARI; Access to Global Online Research in Agriculture – AGORA) represent the emergence of “open access” publishing models in scholarly publishing (Willinsky et al 2005). The irony is that many people who can benefit from open access do not have access to Internet.

## **African Virtual University**

Many African institutions have partnered with the African Virtual University (AVU) programme while sharing a mutual vision for improved ICT education and sustainability. It may be noted that the AVU is currently transformed from being a project of the World Bank to an independent inter-governmental organisation based in Nairobi, Kenya. It currently includes over 57 learning centres across 27 African countries (AVU 2006).

The AVU's modus operandi is working in collaboration with the African universities and in partnering with other renowned world universities while helping to identify essential programmes needed for Africa's ICT development.

Based on these models, the AVU "offers Computer Science Degree programmes from the Royal Melbourne Institute of Technology in Melbourne (Australia) and from Universite Laval in Quebec (Canada), as well as Business Studies programmes from Curtin University in Perth (Australia)" (AVU 2006).

AVU students are exposed to modern technology through the use of various technologies, which includes WebCT, WebLearn, CD-ROM, and Video Cassettes. Given the inadequate access to ICTs for the majority of learners in Africa, AVU assigns students to specific computer laboratories where students use computers to access online learning resources. Obuobi (2006) observes that "AVU is capital intensive".

## **Inter-Institutional Collaboration**

Some countries have established online networks or communities-of-practice, in which 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 (Hawkins 2002).

ICTs are also being used for research collaboration and to build scientific research capacity. At Makerere University, for instance, a project aimed at promoting interdisciplinary and inter-university collaboration in scientific research is specifically exploring solutions to local development problems and concerns through production of scientific knowledge (Roberts and ACU 2005). In addition to research collaboration, the need to share courseware and other teaching resources will soon happen given that "the universities of the East African Community (Kenya, Uganda and Tanzania) now accept each others' credits and the East African Inter-University Council has already been suggested" (Foundation Partnership 2004). Mutula (2003) reports that the East African Community is putting in place an optical fiber transmission system to link capital cities and a number of major towns in Kenya, Uganda and Tanzania aimed at improving trade relations among the three countries.

In the next section University-initiated innovations and projects are discussed. The contribution of HEIs to development through teaching, research and social responsiveness is highlighted in the projects. Donor funding to various projects in Africa is acknowledged and is substantial.

## University-Initiated Innovations/Projects Donor-Funded ICT projects

Many public universities in Africa depend largely on grants from national governments for most of their recurrent and capital budgets. In the last decade, there has been pressure on public universities in Africa and in other developing nations to cut back on their budgets as a result of declining government grants, occasioned largely by political and economic structural changes in the local and international environments (Mutula 2003).

Some donor-supported projects in Uganda target specific development goals. For example the government of Uganda has prioritised improvement of education and some donor funded projects are set up to contribute to this government imperative. Barnard and Vonk (2003) report that the United States Agency for International Development (USAID) is supporting the Connect-ED project in its various activities aimed at improving the quality of education. The initiative is a joint venture between Uganda's Ministry of Education (UMOE) and the United States Education for Development and Democracy Initiative (EDDI). The initiative is supportive of economic development as LearnLink (2006) observes that through encouraging increased use of ICTs in education, the Connect-ED activities promote democracy and increases access to economic opportunities.

As part of its Institutional Development Programme, the Norwegian Agency for Development (NORAD) is funding ICT-related activities in Uganda over a five-year period. The project aims at building human capacity in general ICT planning, an ICT support centre, development of administrative and management information systems and strengthening the university's instructional capacity in ICT (Foundation Partnership 2006). There are currently several donor-funded projects<sup>7</sup> in East Africa, which include a Village Phone Uganda Project funded by the InfoDev Program. The Village Phone Uganda project aims to break the cycle of poverty in rural communities of Uganda by improving communications services. The lessons learnt from this project will be used to develop a model to be used in other rural areas of Uganda and will be shared with the commercial telecommunications sector.

HEIs and Research Institutions will play major roles in seeking and implementing solutions and methodologies which allow for the expansion of the use of ICT for production processes, provision of services, improvement of teaching and learning, research, and so on in order to improve living conditions for the people of Mozambique (ICT4D 2000). The majority of Norwegian projects concentrate on inter-university research and community engagement between Norwegian HEIs and various HEIs in Africa (Kubler 2005).

In 2005 the European Commission formulated a new strategy for Africa and suggested a new framework for development policy in order to accelerate Africa's growth. In this new framework the digital divide was addressed through a proposed "*EU-Africa Partnership for Infrastructure*" for the purposes of access to knowledge and transfer of know-how initiatives (Euro-Afri Pact 2006).

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<sup>7</sup> <http://open.bellanet.org/afscan/index.php?op=showregion&rid=3>

## Industry-University ICT projects

In Kenya, Japan is funding a project at the Jomo Kenyatta University College of Agriculture and Technology aimed at improving infrastructure such as material resources, classroom spaces, laboratory facilities, and improving processes of management and teaching (Roberts and ACU 2005). According to Roberts and ACU the Kenya Science Teachers College undertook a project aimed at building a foundation in young people for further studies in engineering, biomedical research, and finance. The project involved providing financial resources to recruit and train young maths and science teachers for secondary schools in Kenya and throughout East Africa.

The UUNET Multinational Service Provider plans to provide free cyber cafe services to students in rural colleges in Kenya for communication and to support student research (Mutula 2003). This is an example of providing access to ICTs and bridging the digital divide between urban and rural communities.

One of the projects the International Institute for Communication and Development (IICD) supports in Tanzania is called DiLES (Distance Learning and Education Services). Students who have access to the Internet can find course material on the DiLES website, while the project also provides cheap hard-copies from the digitised materials.

In South Africa, the University of the Western Cape (UWC) learnt from an expensive trial and error process that an institution needs a strategy to use ICT cost-effectively. Lessons from Keats and Darries (2003) assert that other universities in Africa can learn from their integrated information strategy<sup>8</sup>.

In the next section the emerging technologies are discussed with particular reference to how social practices are changing. The ramifications of changing social practices on teaching and learning are reviewed. The section also discusses mobile and wireless technologies.

## Emerging technologies and social practices

### Changing Social practices

ICTs have far too often been interpreted merely in the very restricted notion of the use of computers and the Internet for teacher training, rather than in the wider sense of the technologies used to deliver a diversity of learning solutions (Unwin 2004).

The Association of African Universities' Working Group on Higher Education (2004) reports that new approaches to teaching and learning are inevitable when new educational technologies are introduced in education. In a study conducted in South Africa, Czerniewicz and Brown (2005) observe that effective ways of using education technologies should be considered in conjunction with specific teaching strategies that support particular learning experiences. It can be inferred from Czerniewicz and Brown (ibid.) that ICTs impact on pedagogy and curricula. Philip et al (2004) report on the HEI study in Africa and recommend that eLearning ought to be implemented within a strategically developed framework based on a clear and unified vision and a

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<sup>8</sup> <http://www.uwc.ac.za/ics> (OpenContent Licensed)

central educational rationale. It can be argued that a strategically developed framework addresses “physical, technical, pedagogical, professional and environmental elements” (Bassoppo-Moyo and Temba, 2006) thereby advancing economic development.

While ICTs are impacting the African education systems in the advancement of science, technology and education, Hawkins (2002) observes that the ways students learn and teachers’ teach have still remained largely unchanged. Ngwenyama et al (2006) assert that ICTs are “said to exert a revolutionary impact on the way the world does business and more importantly on the way the world and its citizens communicate. New systems are created to allow for the opportunity for engagement and possible shifts in power”. The impact of ICTs in changing the traditional role of teachers as sources of information to facilitators of learning is yet to happen.

The Internet, beginning with email, is transforming the “knowledge management” practices of researchers in relation to the “pre-internet era” (Willinsky et al 2005). Similarly there are situations where ICTs have been accorded the potential of transforming governance, and improving the ability of marginalised groups to participate (Fleming 2002). A student in Senegal noted that “our teachers, because of our participation in collaborative projects and Internet access, have to do a better job. They carefully prepare their lessons before coming to class. We challenge them; we are no longer passive receivers of information. We analyse and question things.” (Hawkins 2002).

## **Changing teaching and learning**

New pedagogies are emerging such as field-based learning and problem-based learning. Problem-based learning is a variant of field-based learning now in use in a number of universities including the Faculty of Medicine at Moi University (Foundation Partnership 2004). At the University of Cape Town, an ICT-based constructivist learning environment is used to scaffold student learning and to support acquisition of critical thinking skills (Ng’ambi and Johnston 2006).

Hawkins (2002) observes that a relevant education is more important today than ever, because today’s networked world demands a workforce that understands how to use technology as a tool to increase productivity and creativity. These skills include “information reasoning”, a process in which reliable sources of information are identified, effectively accessed, understood, contextualised, and communicated to colleagues (Hawkins 2002).

According to Tanedu (2006), a good example of the empowering effect of ICT in Tanzania is seen in education. ICT stimulates a new didactic style. Rather than “chalk and talk” learning, simply listening to a teacher and repeating what he says, students are encouraged to find their own way, act by themselves, take initiative. Thus, they realise that their own power to act is much greater than they thought.

The use of ICT for teaching and learning at HEIs in Mozambique is of concern. In a three-month Orient Foundation course, digital libraries are used. Students taking biochemistry are expected to present their projects on a home page, and physiology is to follow suit. Groups of students gather information and transfer their reports to a home page. The goal is to help students understand that there are different ways to convey information, but the problem is that there is no follow-up, so that students can easily forget the web development skills that they learn (Foundation-Partnership n.d.)

South Africa's Educator Development Network (SchoolNet) is using innovative practical approaches to teaching ICT skills premised on the thesis that, while focusing on specific education-related tasks and themes, learning happens incidentally (James et al 2003).

## **Supporting distant learners**

Although all HEIs in Tanzania have access to the Internet and educators use it for communication to complement textbooks and lecture notes, the use among learners is hampered by the associated cost and lack of expertise in developing local content (Senzige and Sarukesi 2003). In Mozambique, despite the forward-looking ICT planning and policies at Eduardo Mondlane University, students there are not yet making full use of technology (Foundation-Partnership n.d.).

However, the situation in distance education has been different. There has been an increased use of e-learning to complement distance education systems in countries such as South Africa, Tanzania, Zimbabwe, Kenya, Ghana, and Zambia where distance education previously depended heavily on print media (Mutula 2003). E-learning is becoming one of the most common means of using ICT to solve teacher-demand problems and equally provide education to students both on and off campus. The term "e-learning" is used in a variety of ways and literature shows that it can mean online learning, computer-based learning (CBL), web-based training (WBT), online resource-based learning (ORBL), computer-supported collaborative learning (CSCL) and others (Yieke 2005).

One of the areas of growing realisation of the potential of ICT has been in knowledge dissemination with particular focus on solving distance learning problems. Barnard and Vonk (2003) acknowledge an increased awareness that when effectively utilised, ICTs can be incorporated into distance training programmes that involve a combination of ICT tools for electronic distance learning, in conjunction with print materials and face-to-face teaching.

The interplay between research, teaching and quality improvements is also being explored. The Swedish development agency, SIDA, is supporting a project at University of Dar-es-Salaam, aimed at providing research which seeks to strengthen sciences across a range of disciplines, from information technology and engineering to the health sector, marine biology, and the natural sciences (Roberts and ACU 2005).

## **Mobile and Wireless Technologies**

The challenge in Africa is "finding a technology that is affordable, easily adoptable by novice computer users, and functional in environments where electricity, Internet connectivity, and landline and cellular telephony might be limited or unavailable, and dust, glare, and other unfavourable conditions are the norm" (SATELLIFE 2005: 21). Thus, in this section emerging technologies and their appropriateness for development in Africa are analysed.

### **New learning approaches meet with new technologies**

There is a convergence occurring between mobile technologies, and new notions of learning. Sharples (2005) observes that new ways of learning (i.e. personalised, learner-centred, situated, collaborative, ubiquitous and lifelong) are converging with

new technologies (i.e. personal, user-centred, mobile, networked, ubiquitous, and durable). Suggested in Sharples' argument is that new technologies have the potential for supporting new ways of learning. The challenge for HEIs is how to exploit the value of new technologies to support new learning approaches. In a keynote paper Roschelle (2003) argued that "research attention should be directed at identifying those simple things that technology does extremely and uniquely well, and to understanding social practices by which those new affordances become powerful educational interventions" (p. 269).

## **Mobile phones**

In most countries in Africa, the diffusion of the cellular (mobile) phones has been remarkable. Molina (2006) contends that "cell phone technology, converging just about every communication medium, will influence higher education in the administrative area, in the classroom, in student affairs, in security matters both on and off campus, and soon, in information delivery of all varieties" (p. 119). In order to realise these outcomes, HEIs may require a mobile learning strategy. Siff (2006) postulates an institutional mobile technology strategy that aims at: improving student retention; creating community; leveraging resources; providing high-quality teaching, learning and research; and playing a positive role regionally (p. 7). HEI in Africa may have to consider exploiting the success of cellular technology for teaching and learning. In their recent book Jones and Marsden (2006) outline some reasons why mobile phones are successful in Africa:

*Physical access to technology* – as most telecentres are located in urban areas, users would need to commute to and from to access the centre. Rural villages can have access to wireless networks, making it a much more appropriate technology. In South Africa, some 97 percent of the population has access to the cellular network.

*Appropriateness of technology* – many desktop-based systems need a constant supply of electricity and need to be stored in a cool, secure location. Not only can mobile technology go for several days without being plugged in, their low power drains means they can be recharged from solar cells or clockwork generators.

*Affordability of technology* – one of the great things about cellular handsets is that the cost of the hardware is subsidised by the network. The handsets are sold at little or no profit in the hope that revenue will be made through network access. While there is still a cost attached to the device, it is pared to the minimum possible.

*Human capacity training* – how much training do people need to use the technology? Mobile handset interfaces are familiar to most users in a way that Windows or Linux is not. Building an application which mirrors the menu structure of a cellular interface has a much greater chance of success than one based on a "standard" desktop Graphical User Interface (GUI).

*Locally relevant content and applications* – this is constant across all platforms.

*Integration into daily routines* – will the technology add an extra burden to the users? Life in developing countries is hard in a way that is difficult for those on the outside to understand – when was the last time you had to carry water into your house for your daily needs?

*Local economic environment* – any access to the outside world has the potential to help the community. Cellular phones are more likely to succeed than non-mobile systems.

*Macro-economic environment* – any ICT development work in a developing country is often viewed as an expensive indulgence (wouldn't the money have been better spent on water pipes?).

One of the most popular features of the cellular phone is short message services (SMS) also referred to as texting. Adeya and Oyelaran-Oyeyinka (2002) observed that in Nigeria and Kenya use of email for communication was hampered due to lack of access to networked computers and telephone. The challenges seen in the light of the advantages of cellular phones as Jones and Marsden outlined above has led to pervasive uptake and use of SMS in virtually all strata of the African population. Ng'ambi (2005) contends that students own their mobile phones, are connected most of the time and are communicatively competent with SMS.

Mobile devices are expanding the boundaries of higher education into "anytime/anywhere" experiences. Wireless networks and mobile communications coupled with personal computing devices present new means for students to access classroom information and communicate with peers and teachers, and for faculty members to alter the concept of the classroom (Wentzel et al 2005).

A collaborative e-Learning project involving the University of Cape Coast (UCC) of Ghana and the University of Massachusetts Amherst is investigating the integration of *cost-effective* and *appropriate* technology to improve teaching and learning in education at Cape Coast. The project is premised on the argument that "the most appropriate learning technology, given the African situation, should be the one that is sustainable and would enable students to learn anytime and anywhere without reliable Internet access" Obuobi (2006). At the University of Cape Town the communicative competence of students with Short Message Services (SMS) is used for peer learning, knowledge sharing and anonymous consultation (Ng'ambi, 2005).

### **Personal Digital Assistants (PDAs)**

The use of handheld devices in healthcare services is an increasingly common phenomenon. SATELLIFE (2005) has developed strategies for combating information poverty by: identifying cost-effective ICT tools to connect health professionals to each other and to vital information resources; using these tools to deliver content that meets their needs; and building local capacity so that user and technical support personnel are able to use and support the technology into the future, well after SATELLIFE has left the scene.

In wealthy nations, information is the lifeblood of medical practice. A typical patient in Africa has no expectation about the role that information will play in her care. She knows that the nurse in the village's one-room clinic has no computer to consult, no textbook, and maybe not even a telephone to call a neighbouring village for advice. There is simply no recourse to health information, no matter how complicated the case. The quality of care she receives, regardless of her condition, will be limited to whatever knowledge the nurse has retained from basic training (SATELLIFE 2005: 15).

The above scenario exemplifies a situation where the potential of handheld devices, in particular the personal digital assistant (PDAs), are indispensable. According to Dr Bob Trelease, Associate Professor of Pathology and Laboratory Medicine, UCLA School of Medicine, "PDAs will be as common as the stethoscope".

Many development projects in Uganda are exploiting the fact that Uganda has one of the best cellular telephone networks in Africa (Kintu et al 2005). For example,

HealthNet is pioneering the use of PDAs to improve the health of millions of Ugandan citizens. In the rural parts of Uganda access to medical information could mean life or death choices as Phipps et al (2003) explain: doctors in rural areas do not have access to medical information and are often faced with choices of either delaying a patient's treatment until further medical information is sought or treating the patient with insufficient information.

While existing infrastructure is being exploited, other projects are aimed at improving Internet access. The establishment of a Rural Communications Fund to support building Internet infrastructure in rural areas is a useful example. The project aims to make Internet access affordable for the majority of people (Tusubira et al 2005).

## Emerging Free Open Source Initiatives

### Demand for Open Source

The rising cost and inflexibility of commercial learning management systems such as WebCT, Blackboard, eCollege, ANGEL Learning and Desire2Learn has created demand for open source alternatives (Molina 2006). Although WebCT and Blackboard currently dominate the LMS market (Obuobi 2006), both traditional face-to-face and distance HEIs are migrating from proprietary or in-house products to open source projects, with the best-known projects being moodle and Sakai (an OpenSource collaboration and learning environment for education). For example in South Africa, the University of South Africa<sup>9</sup> (UNISA), a leading distance education institution with 80,000 students and 3,000 staff, has adopted Sakai as a university learning management system along with the University of Cape Town and University of the North-West. In the UK, the Open University is moving to moodle.

The African Virtual Open Initiatives and Resources (AVOIR<sup>10</sup>) has developed an e-learning application, KEWL.NextGen<sup>11</sup> based on an open source framework. The primary goal of AVOIR is to facilitate collaboration between universities for the purpose of creating free software developers able to design and develop educational and business applications that contribute to realisation of Africa's development goals.

The use of a learning management environment enables learners to become active participants in the learning process, work with peers and tutors from a variety of organisations and countries, and provides the advantages of flexible forms of delivery. It can be used in a variety of ways: virtual library assistance and feedback, online discussions with experts from around the world or within a particular organisation, provision of additional support to learners who are involved in face-to-face interaction (F2F) programmes or distance learning programmes (Yieke 2005).

In Uganda, the East African Centre for Open Source Software (EACOSS<sup>12</sup>) has been established to promote access to open source software and in human capacity development. EACOSS has five main objectives: to create an improved understanding of the role of Free Open Source Software (FOSS) for the development of civil society; to contribute to national development by empowering people with

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<sup>9</sup> [http://sakaiproject.org/index.php?option=com\\_content&task=view&id=293&Itemid=312](http://sakaiproject.org/index.php?option=com_content&task=view&id=293&Itemid=312)

<sup>10</sup> <http://avoir.uwc.ac.za/avoir/index.php?module=cms>

<sup>11</sup>

[http://avoir.uwc.ac.za/avoir/index.php?module=cms&action=viewsection&id=gen12Srv48Nme23\\_33](http://avoir.uwc.ac.za/avoir/index.php?module=cms&action=viewsection&id=gen12Srv48Nme23_33)

<sup>12</sup> <http://www.eacoss.org/>

appropriate skills in FOSS for job creation and entrepreneurship; development of the local ICT industry; reducing the barriers in ICT access; and standardization of FOSS skills in the market.

In 2002, Kenya, Uganda, Ghana and South Africa were instrumental in forming the Free Software and Open Source Foundation for Africa (FOSSFA<sup>13</sup>) which was launched in Geneva in 2003. FOSSFA focuses on three thematic areas: Open Source in Government; Open Source in Health, and Open Source in Education<sup>14</sup>. The FOSSFA secretariat is based at the Meraka Institute<sup>15</sup> in South Africa. Some of the successes of FOSSFA in Health include the use of a free Open Source Software product, Care2X at the Church Hospital in Kenya.

## **Web 2.0 – Should Africa “fasten seat belts”?**

The World Wide Web (WWW) is changing from being a read only to a read and write medium. D’Souza (2006) postulates “the web is evolving to become more like an area for social and idea networking. The web surfer negotiates the connections within a social or idea network, exchanges bits of content, creates something new, and the cycle begins again” (p. 6). Web 2.0 enables collaboration and information sharing; and gives users a desktop experience. Web 2.0 is an evolving technology<sup>16</sup> which is relevant for higher education.

Web 2.0 applications offer a lot that is often lacking in traditional campus services: a tailored network experience, a social venue, and the opportunity – through blogs, tagging, and voting – for users to shape their environment. Rather than dismissing these resources, perhaps those of us in higher education information technology should help guide our users to make the best choices and to begin to experiment with our own mashups (Molina 2006: 118).

Molina (2006) outlines key characteristics of Web 2.0:

*They are collaborative* – beyond blogs and wikis, web 2.0 applications include online “malls” and sharing/tagging collectives such as Facebook, MySpace, Flickr, and del.icio.us, all claiming collaboration as central theme.

*They use thin, cross-platform technology on the client side* – in most cases, all a user needs is a web browser.

*They “think big”* – in addition to the “folksy” applications, the wave of Web 2.0 application provide office and computer desktop functionality.

*They are free* – it’s hard to beat the price of many of these Web 2.0 applications, especially when a gigabyte or more of storage is part of the package.

*They are constantly upgraded* – unlike standard applications and operating systems, Web 2.0 applications are continually upgraded in small increments. Most often, these changes are largely invisible in the interface.

*They are highly interwoven* – Web 2.0 applications draw on other Web 2.0 applications to create new applications. One example is the selective recombination of information and resources collected from various Web 2.0

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<sup>13</sup> <http://www.fossfa.net/fossfa>

<sup>14</sup> <http://www.wougnet.org/ICTpolicy/opensource.html>

<sup>15</sup> <http://www.meraka.org.za/>

<sup>16</sup> <http://www.educause.edu/EvolvingTechnologiesReports/>

applications to create another Web 2.0 application, such a diggdot.us<sup>17</sup> () (p. 115-116).

In Africa, the potential for Web 2.0 for development in general and HEIs in particular is phenomenal. As D'Souza (2006) explains, "if you look at the idea of publishing web pages, we would consider the real web as something that was more inclined for the geeks. Where there was some need to understand a server-side language, use file transfer program (FTP), maybe Hypertext Markup Language (HTML), or a number of tools to create and publish web content. Now, in less than 10 minutes you could set-up a weblog<sup>18</sup> on Blogger.com and have your idea first posted. It would probably take you longer to come up with the ideas for the first post than to set up the weblog. I would call this a transformation from geek to sleek" (p. 6).

The implications for education both in terms of future curriculum design and pedagogy shaped by the Web 2.0 phenomenon is on the agenda for researchers and educationalists. The notion of e-Learning 2.0<sup>1920</sup> is used to encapsulate this impact of Web 2.0 on e-Learning and educational developments. Africa's ICT skills shortage meant that the web as we have known it could not be fully exploited and that Web 2.0 might provide new ways of using ICTs for economic development which was not previously possible. However, most Web 2.0 applications assume broadband Internet connectivity. In view of the NEPAD's broadband ICT infrastructure initiative, Africa may have to "fasten seat belts" because the Web 2.0 is on the run-way.

### **Is Africa ready for vortals?**

HEIs as hubs of knowledge have had to do more to disseminate their activities to communities and industry. Oyedemi (2003) argues that the purpose for extending ICT infrastructure in Africa was to facilitate access to a wide range of information that could be useful in the daily lives of people. In South Africa, Vaal Triangle Technikon implemented a programme to market library services to industry (Mutula 2003) and the Department of Information Systems at the University of Cape Town invites industry annually to showcase students' final year ICT projects. All these make a good case for Vortals.

The word vortal comes from two words, vertical and portal. Molina (2006) explains that "a vertical portal, or vortal, is a community-based Web location that provides a self-managed, personalised, and customised information environment. This information is focused on servicing the needs of particular constituencies within the community" (p. 120). A learning management system such as Sakai is an example of a learning vortal. To the extent that vortals enable particular constituencies to easily create their own web locations, share and manage their content using blogs<sup>21</sup>, podcasts<sup>22</sup> etc vortals have huge potential for HEIs and for research dissemination than has been previously possible. The advantage of vortals is that it is possible to have as many vortals as there are constituencies. Molina (2006) gives an example of a research services vortal as being able to: "streamline data collection, organisation, and retrieval; simplify administrative tasks for faculty; assist research investigators with crucial compliance issues by leveraging computer-mediated communication that

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<sup>17</sup> <http://diggdot.us>

<sup>18</sup> <http://en.wikipedia.org/wiki/Wiki>

<sup>19</sup> <http://www.elearnmag.org/subpage.cfm?section=articles&article=29-1>

<sup>20</sup> <http://elearningtech.blogspot.com/2006/02/what-is-learning-20.html>

<sup>21</sup> <http://en.wikipedia.org/wiki/Weblog>

<sup>22</sup> <http://en.wikipedia.org/wiki/Podcasting>

will manage, archive, and monitor research events; and create appropriate electronic venues by which investigators can collaborate and can share information about research activity with both internal and external constituents” (p. 120).

Creating portals is one thing and ensuring that they are accessed by people who need them is another. This leads to the question as to whether Africa is ready for portals.

## Conclusion

The paper began with a review of Africa’s ICT challenges as espoused in the 2006 United Nations Development goals. It highlighted the need to ensure that ICT projects are aligned with local development goals. In making the argument, the paper warned against the trap of colonial developmentalism. It was also noted that HEIs in Africa were initially set up to service colonial administrations and there is a danger of becoming irrelevant.

Although ICTs are not a panacea for development, they play an important catalytic role. The paper has illustrated projects that have used Africa’s constraints as opportunities for innovation. Although these are early days, Africa’s collective development vision is bearing fruit as evidenced in the growth of Internet usage statistics. It is encouraging to note that ICTs are top priority on many governments’ agendas. Given that government is one of the stakeholders of HEIs, the prioritisation of ICTs has implications on the activities of universities. The paper reviewed the status of ICT skills and the ineffectiveness of traditional teaching approaches. Higher education in Africa was discussed in terms of the quality of education, the potential of open access to digital resources and the vital role of the African Virtual University.

The notion of Africa lagging behind in terms of economic development suggests a need for a “catch up” game. One way of doing this is to exploit Africa’s existing technologies to support development goals. The argument led to a discussion of mobile and wireless technologies, highlighting projects that are using these technologies in resource-poor communities. The paper concluded by highlighting the evolution of the WWW, the Web 2.0 and the possibilities it offers Africa.

In grappling with the affordances of new technologies in education, research is needed in the following:

- Understanding how teaching and learning processes are changed through use of Web 2.0 and ensuring that educators understand how these changes happen.
- Understanding how Web 2.0 enables learning and how learners are effectively supported.
- Understanding how Web 2.0 is used to support existing teaching practices and what new teaching practices arise from using Web 2.0.
- Understanding integration issues and usage of collective thinking, collaborative writing, faster publishing, and podcasting for enhancing teaching and learning experience.

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## References

- Adeya, N. C. and Oyelaran-Oyeyinka, B. 2002. The Internet in African Universities: Case Studies from Kenya and Nigeria. United Nations University. [Online]. Available: <http://www.globalequality.info/reports/IDEaf.pdf> [ 18 October 2006]
- Adomi E. E. and Anie S. O. 2006. An Assessment of Computer Literacy Skills of Professionals in Nigerian University Libraries. *Library Hi Tech News*, (23)2: 10-14 Available:<http://www.emeraldinsight.com/Insight/ViewContentServlet?Filename=Published/EmeraldFullTextArticle/Articles/2390230203.html> [18 October 2006]
- Banard, D. and Vonk, T. 2003. Information and Communication Technologies in African Local Governments. EDITOSIA – Electronic Distance Training on Sustainability in African Local Governments. *ICLEI European Secretariat GmbH*. Freiburg, Germany.
- Bassoppo-Moyo and Temba C. 2006. Evaluating eLearning: A Front-end, Process and Post Hoc Approach. *International Journal of Instructional Media*. (33)1: 7-22.
- Beebe, A. M. 2004. Impact of ICT Revolution on the African Academic Landscape. Paper presented at the *CODESRIA Conference on Electronic Publishing and Dissemination*, Dakar, Senegal, 1-2 September.
- Cassel, N. L., Gorgone, J. and Impagliazzo, J. 2000. *ACM Policies/Procedures on Recommendations for Curricular Proposals*. [Online]. Available: <http://www.acm.org/education/curr-proposals.html>. [17 October 2006]
- Charmonman, S. and Chopothong, N. 2005. Digital LifeStyle and the Road Ahead. Special Issue of the *International Journal of the Computer, the Internet and Management*. (13)3.
- Chen, Y. and Zhu, J. 2004. Measuring Information Technology's Indirect Impact on Firm Performance, *Information Technology & Management Journal*, (5)1-2: 9-22.
- Colle, R. D. 2005. Building ICT4D capacity in and by African universities. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*. (1)1: 101-107.
- Coupe J., Goveia J., Haichour H., Ilukena, A. 2003. Is Constructivism Universal: In Search of Meaningful Technology in Morocco and Namibia. In *Adapting Technology for School Improvement: A Global Perspective*, D.W. Chapman and L. Mahlck, Eds. UNESCO/IIEP.
- Crafts, N. 2003. Quantifying the Contributing of Technological Change to Economic Growth in Different Eras: A Review of Evidence, *The London School of Economics*: Department of Economic History.
- Czerniewicz, L and Brown, C. 2005. Information and Communication Technology (ICT) use in teaching and learning: practices in Western Cape higher education institutions. *Perspectives in Education*. (23).
- D'Souza, Q. 2006. RSS Ideas for Educators. [Online] Available: <http://www.teachinghacks.com/wpcontent/uploads/2006/01/RSS%20Ideas%20for%20Educators111.pdf>. [11 October 2006]
- Development Gateway. *Mozambique Turns to e-Government; In Partnership with Italy and Development Gateway* [Online] Available: [www.developmentgateway.org](http://www.developmentgateway.org) UNDESA: Aire Hoekman. [2 October 2006]

- Elijah, A. O. and Ogunlade, I. 2006. Analysis of the uses of information and communication technology for gender employment and sustainable poverty alleviation in Nigeria. *International Journal of Education and Development using ICT*. (2)3. [Online] Available: <http://ijedict.dec.uwi.edu/viewarticle.php?id=172&172&layout=html>. [17 October 2006]
- Employer system skills expectations. *Journal of Accounting Education*.(16)1:101-121.
- European-African Pact. 2006. *European-African Pact on ICT Development: Creating synergies by supporting the emerging knowledge societies in developing countries through the European IST Programme*. Germany: Hoffmann & Reif Consultants (HRC).
- Fleming S. 2002. Information and Communications Technologies (ICTs) and Democracy Development in the South: Potential and Current Reality. *EJISCD*.(10)3: 1-10.
- Foundation-Partnership. 2006. *Higher Education in Mozambique; A Case Study: ICT policies and Use*. [Online] Available: <http://www.foundation-partnership.org/pubs/mozambique/index.php?chap=chap6>. [16 October 2006]
- Frempong, G. and Stork, C. 2005. Towards an African e-Index: Household and individual ICT access and usage across 10 African countries . In *Research ICT Africa*. A Gillwald, Ed. The LINK Centre, Wits University School of Public and Development Management. [Online] Available: [www.researchictafrica.net](http://www.researchictafrica.net). [13 October 2006].
- Gillwald, A. 2005. Towards an African e-Index: Household and individual ICT ACCESS AND USAGE across 10 African countries. In *Research ICT Africa*. The LINK Centre, Wits University School of Public and Development Management. [Online] Available: [www.researchictafrica.net](http://www.researchictafrica.net). [13 October 2006].
- Gillwald, A., Esselaar, S., Button, P., and Stavrou, A. 2005. South Africa. In Towards an African e-Index; Household and individual ICT ACCESS AND USAGE across 10 African countries. *Research ICT Africa*. A. Gillwald, Ed. The LINK Centre, Wits University School of Public and Development Management: 130-152. [Online] Available: [www.researchictafrica.net](http://www.researchictafrica.net). [13 October 2006].
- Grace J., Kenny C., Qiang C., Liu J., and Reynolds T. 2001. Information and Communications Technology and Broad-Based Development: A Partial Review of the Evidence. *World Bank*. [Online] Available: [2 July 2006] <http://wbln0018.worldbank.org/ict/resources.nsf/eDocsPublications?OpenView>.
- Greenstein, M. and McKee, T.E. 2004. Assurance practitioners' and educators' self perceived IT knowledge level: an empirical assessment. *International Journal of Accounting Information Systems*. (5): 213-243.
- Hawkins, R. J. 2002. Ten Lessons for ICT and Education in the Developing World. In World Links for Development Program. *The World Bank Institute*. [Online] Available: [www.cid.harvard.edu/cr/pdf/gitrr2002\\_ch04.pdf](http://www.cid.harvard.edu/cr/pdf/gitrr2002_ch04.pdf). [19 September 2006]
- Herselman, E. M. and Hay R. H. 2003. Challenges Posed by Information and Communication Technologies (ICT) for South African Higher Education Institutions. [Online] Available: [ 16 October 2006] <http://proceedings.informingscience.org/IS2003Proceedings/docs/119Herse.pdf>.
- Hesselmark, O. 2003. *ICT in Five African countries*. [Online] Available: [http://www.com.washington.edu/ict4d/upload/2004041522570097\\_00140794.pdf](http://www.com.washington.edu/ict4d/upload/2004041522570097_00140794.pdf) [17 August 2006].
- Hofstede, G. 2001. *Culture's Consequences*. Sage Publications: Thousand Oaks, CA.
- Hostrom, G.L. and Hunton, J.E. 1998. New forms of assurance services for new forms of information: the global challenge for accounting educators. *International Journal of Accounting*. (33)3: 347-358.
- ICT4D National Policy. 2000. *ICT for Development: Policies Mozambique*. [Online] Available: <http://www.cominit.com/trends/ictpolicies/ictpolicies-12.html>.

- [2 September 2006]
- Ifinedo, P. 2005. Measuring Africa's e-readiness in the global networked economy: A nine-country data analysis. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*. (1)1: 53-71.
- International Monetary Fund –IMF. 2004. Republic of Madagascar: Joint Staff Assessment of the Poverty Reduction Strategy Paper Progress Report. *IMF Country Report No. 04/403*. [Online] Available: <http://www.imf.org/external/pubs/ft/scr/2004/cr044403.pdf>. [11 October 2006].
- James T., Hesselmark O., Akoh B., Mware L. 2003. Review of Basic ICT Skills and Training Software For Educators in Africa. *IMFUNDO*. [Online] Available: <http://imfundo.digitalbrain.com/imfundo/web/papers/ictreviewfolder/Final%20Report.pdf>. [17 October 2006]
- Jones, M. and Marsden, G. 2006. *Mobile Interaction Design*. John Wiley & Sons: West Sussex, England.
- Keats, W. D., and Darries, M. 2003. Institutional Arrangements and Strategy for ICTs in Higher Education Institutions: The Case of the University of Western Cape. In *Africa dot edu: IT Opportunities and Higher Education in Africa*. M. A Beebe, Kouakou, M. K., Oyeniyinka, O. B., and Rao, M., Eds. Tata McGraw-Hill Publishing Co. Ltd: New Delhi: 332-348.
- Kintu, F., Obot, D., and Elder, L. 2005. The Uganda Knowledge and Information Society: Early Lessons From ICT Projects. In *At The Crossroads: ICT Policy Making in East Africa*. Etta, E. F., and Elder, L., Eds. East African Educational Publishers: Nairobi.
- Kirchofer, T. 2001. *HELINA-L: Handhelds in Africa: Savior, not scheduler*. [Online] Available at: <http://www.uku.fi/english/organizations/helina-l/msglog/2001/0049.html>. [ 18 September 2006].
- Kozma, R. 2005. Monitoring and Evaluation of ICT for Education Impact. In *The Impact of ICTs in Education for Development: A Monitoring and Evaluation Handbook*. Wagner, D., Day, R., James, T., Kozma, R., Miller, J., and Unwin, T., Eds. Pre-publication Draft.
- Kubler J. 2005. African Higher Education Activities in Development: The AHEAD Database, *Association of Commonwealth Universities (ACU) London*. [Online] Available: <http://www.acu.ac.uk/policyandresearch/publications/aheadpaper.pdf>. [12 October 2006]
- Ladd, H. 2005. Letter from the Executive Director. In *Handhelds for Health: SATELLIFE's Experiences in Africa and Asia*. [Online] Available: <http://pda.healthnet.org/download/pdapaper1.pdf> [15 August 2006].
- Learnlink. 2006. *Learnlink Projects; Ghana, Uganda, Namibia*. [Online] Available: <http://learnlink.aed.org/Projects/ghana.htm>. [17 August 2006]
- Martinez, A. J., and Alemañy A.J. 2004. Personal Digital Assistant: Ubiquitous Computing. *International Paediatrics* .(19)4: 198-203.
- Millennium Development Goals report. 2006. United Nations: New York. Available:<http://unstats.un.org/unsd/mdg/Resources/Static/Products/Progress2006/MDGReport2006.pdf>. [18 October 2006]
- Ministry of Communications (MoC-Ghana). 2006. *Accountants Must Contribute To National Dev* [Online] Available: <http://www.moc.gov.gh/modules.php?op=modload&name=News&file=article&sid=70&mode=thread&order=0&thold=0>. [29 September 2006].
- Molina, G. P. 2006. Pioneering New Territory and Technologies. EDUCAUSE Evolving Technologies Committee. *EDUCAUSE review*. September/October issue
- Mutula, S. M. 2003. Assessment of Africa's Telematics, Policy and Regulatory Infrastructure: Potential for E-learning. Paper presented at the *NTESU International Conference in Durban*, University of Natal, South Africa.

- Mutume, G. 2006. Africa Renewal (New York) News. September 7, 2006. [Online] Available: <http://allafrica.com/stories/printable/200609070731.html>. [11 September 2006]
- Ng'ambi, D. 2005. Mobile Dynamic Frequently Asked Questions (DFAQ) for student and learning support. Presented at the *4th World conference on mLearning* Available at: <http://www.mlearn.org.za/CD/papers/Ngambi.pdf>. [12 October 2006]
- Ng'ambi, D. and Brown, I. 2004. Utilisation-Focused Evaluation of ICT in Education: The Case of DFAQ Consultation Space. *Educational Technology & Society*, (7)3: 38-49.
- Ng'ambi, D., and Johnston, K. 2006. An ICT-mediated Constructivist Approach for increasing academic support and teaching critical thinking skills. *Educational Technology & Society*. (9) 3: 244-253.
- Ngalinda and Mutagahywa 2005. Tanzania. In Towards an African e-Index; Household and individual ICT ACCESS AND USAGE across 10 African countries. *Research ICT Africa*. A Gillwald Ed. The LINK Centre, Wits University School of Public and Development Management: 154-160. [Online] Available: [www.researchictafrica.net](http://www.researchictafrica.net). [18 October 2006].
- Ngwenyama, O., Andoh-Baidoo, K. F., Bollou, F., and Morawecynski, O. 2006. Is there a relationship between ICT, Health, Education and Development? An empirical analysis of five West African Countries from 1997-2003. *The Electronic Journal on Information Systems in Developing Countries (EJISDC)*. (23)5: 1-11.
- Nwaka G. I. 2005. Higher Education, The Social Sciences And National Development In Nigeria. Presented at the *11<sup>th</sup> General Assembly of the Council for the Development of Social Science Research in Africa (CODESRIA)*, Maputo, Mozambique. [Online] Available: [ 16 September 2006] [http://www.codesria.org/Links/conferences/general\\_assembly11/papers/nwaka.pdf#search=%22higher%20education%20collaboration%20nigeria%22](http://www.codesria.org/Links/conferences/general_assembly11/papers/nwaka.pdf#search=%22higher%20education%20collaboration%20nigeria%22).
- Obuobi, D., Richards. W., Adrion K. W. 2006. Applying Information Technology to Improve Teaching and Learning in an African University. The *36th ASEE/IEEE Frontiers in Education Conference*. M4C-22. San Diego, CA.
- Ochilo O. P. 1999. *The Growing Gap Between Training And Employment In Communications In Anglophone Africa: Diagnostic And Strategies For Intervention In Tanzania, Kenya And Uganda*. [Online] Available: [16 October 2006] [http://www.orbicom.uqam.ca/in\\_focus/publications/archives/orbi99a.html](http://www.orbicom.uqam.ca/in_focus/publications/archives/orbi99a.html).
- Odusanya O. O. and Bamgbala O. A. 2002. Computing and information technology skills of final year medical and dental students at the College of Medicine University of Lagos. *Nigeria Postgrad Med Journal*. (9)4: 189-93.
- Olukoju, A. 2002. The crisis of research and academic publishing in Nigerian Universities: The twentieth century and beyond. Presented at the *28<sup>th</sup> Annual Spring Symposium: African Universities in the Twenty-First Century*, University of Illinois/CODESRIA, Dakar, Senegal.
- Osborn, D. 2006. *Future of handhelds + expansion of cellphones in Africa = ?* [Online] Available: <http://lists.kabissa.org/lists/archives/public/a12n-forum/msg00458.html>. [6 Mar 2006].
- Oyedemi, T. 2003. Universal Access Wheel: Towards Achieving Universal Access to ICT in Africa. *The Southern African Journal of Information and Communication* (5). [Online] Available: <http://link.wits.ac.za/journal/journal5.html>. [22 October 2006]
- Perrault, H. A. and Gregory, L. V. 2000. Think Global, Act Local: the challenges of taking the website global. *International Federation of Library Associations and Institutions, Division of Special Libraries (INSPEL)*. (34) ¾: 227-237. [Online] Available: <http://forge.fh-potsdam.de/~IFLA/INSPEL/00-3pean.pdf>. [17 October 2006]
- Peters, K. 2005. Learning on the move – mobile technologies in business and education. *Australian Flexible Learning Framework*. Commonwealth of Australia. [Online] Available:

- [http://pre2005.flexiblelearning.net.au/projects/resources/2005/Learning%20on%20the%20move\\_final.pdf](http://pre2005.flexiblelearning.net.au/projects/resources/2005/Learning%20on%20the%20move_final.pdf). [4 April 2006].
- Phipps, K., Sangudi, G., and Woolway, S. 2003. What Works: HealthNet Uganda's Evolution from NGO to Sustainable Enterprise. *World Resources Institute*. [Online] Available: [www.digitaldividend.org/pdf/healthnet.pdf](http://www.digitaldividend.org/pdf/healthnet.pdf). [4 March 2006]
- Roberts, L., & ACU 2005. African Higher Education Development and the International Community. *Association of Commonwealth Universities (ACU)* London. [Online] Available: [www.acu.ac.uk](http://www.acu.ac.uk). [4 March 2006].
- Rodriguez F. and Wilson E. 2000. Are Poor Countries Losing the Information Revolution?, University of Maryland, Paper prepared for *InfoDev*. [Online] Available: [www.infodev.org/library/working.htm](http://www.infodev.org/library/working.htm). [17 October 2006]
- Roschelle, J. 2003. Unlocking the learning value of wireless mobile devices. *Journal of Computer Assisted Learning*. (19): 260-272.
- SATELLIFE, 2005. Handhelds for health: SATELLIFE'S Experiences in Africa and Asia. [Online] Available: <http://pda.healthnet.org/download/pdapaper1.pdf>. [1 October 2006]
- Senzige, J. P. and Sarukesi, K. 2003. An Approach to ICT based school education in Tanzania. *African Studies Association of Australasia and the Pacific Conference Proceedings – African on a Global Stage*.
- Sharples, M. 2005. Towards a Theory of Mobile Learning. Presented at the *4th World conference on mLearning*. [Online] Available: [www.mlearn.org.za/CD/papers/Sharples-%20Theory%20of%20Mobile.pdf](http://www.mlearn.org.za/CD/papers/Sharples-%20Theory%20of%20Mobile.pdf). [6 March 2006]
- Siff, H. F. 2006. Mobility and Higher Education: Not Just the Next Big Thing. *EDUCAUSE Research Bulletin*. issue 22.
- STI. 2002. STI OUTLOOK: Country Response to Policy Questionnaire-South Africa. Tertiary Graduates In Ghana. *World Bank/ National Council For Tertiary Education*
- The National Accreditation Board Project Accra. [Online] Available: <http://www1.worldbank.org/education/tertiary/documents/Ghana%20Tertiary%20Labor%20Market.pdf>. [2 July 2006].
- Theuri, P.M. and Gunn, R. 1998. Accounting information systems course structure and employer systems skills expectations. *Journal of Accounting Education*. (16)1: 101-121
- Trucano, M. 2005. Knowledge Maps: ICTs in Education. *InforDev*. Washington DC.
- Tusubira, F. F., Kaggwa, I., and Ongora, J. 2005. Uganda. In *Towards an African e-Index; Household and individual ICT ACCESS AND USAGE across 10 African countries*. *Research ICT Africa*. A. Gillwald, Ed. The LINK Centre, Wits University School of Public and Development Management:162-177. [Online] Available: [www.researchictafrica.net](http://www.researchictafrica.net). [18 July 2006].
- UNESCO 2004. *Higher Education in a Globalised Society. UNESCO education position*. [Online] Available: [http://www.unesco.org/education/higher\\_education/quality\\_innovation](http://www.unesco.org/education/higher_education/quality_innovation). [8 August 2006]
- Unwin, T. 2005. Towards a framework for the use of ICT in Teacher Training in Africa. *Open Learning*. (20)2: 113-129.
- Uys, M. P., Nleya, P., and Molelu B. G. 2004. Technological Innovation and Management Strategies for Higher Education in Africa: Harmonizing Reality and Idealism. *Educational Media International*. (41)1: 67-80.
- Viens D. and Lynch J. 2000. Madagascar: A Decade of Reform and Innovation in Higher Education Institutional Capacity-Building in a Developmental Perspective. Africa Region Findings; *The World Bank Group No 159*. [Online] Available: <http://www.worldbank.org/afr/findings/english/find159.htm>. [3 August 2005]
- Vukanikids-DTI. 2005. An Analysis of the ICT Skills Audit for the dti and ISETT SETA. *Department of Trade and Industry (DTI) –South Africa*. [Online] Available: [http://www.isett.org.za/downloads/ICT\\_Skills\\_needs.pdf](http://www.isett.org.za/downloads/ICT_Skills_needs.pdf). [8 August 2006]

- Waema, M. T. 2005. A brief history of the development of an ICT Policy in Kenya. In *At The Crossroads: ICT Policy Making in East Africa*. Etta, E. F. and Elder, L. Eds. East African Educational Publishers: Nairobi.
- Wagner, A. D. 2005. Monitoring and Evaluation of ICT for Education. In *The Impact of ICTs in Education for Development: A Monitoring and Evaluation Handbook*. Wagner, D., Day, R., James, T., Kozma, R., Miller, J., and Unwin, T., Eds. Pre-publication Draft.
- Wentzel, P., Lammeren, R., Molendijk, M., de Bruin, S., and Wagtendonk, A. 2005. Using Mobile Technology to Enhance Students' Educational Experiences. *EDUCAUSE Centre for Applied Research Case Study 2*.
- Wessels, P. 2005. Critical information and communication technology (ICT) skills for professional accountants. *Meditari Accountancy Research*. (13)1: 87-103.
- Willinsky J., Jonas R., Shafack R. and Wirsiy C. 2005. Access to Research in Cameroonian Universities. *EJISCD*. (21)2: 1-15.
- Working Group on Higher Education. 2004. *Higher Education in Sub-Sahara Africa, Association of African Universities*. Accra, Ghana.
- World Bank. 2002. An Analytical Study of The Labour Market. *World Development Report 2007*. [Online] Available: <http://siteresources.worldbank.org/INTWDR2007/Resources/1489782-1158107976655/overview.pdf>. [8 October 2006]
- Yieke, F. A. 2005. Towards Alternatives in Higher Education: The Benefits and Challenges of E-Learning in Africa. *CODESRIA Bulletin*, 3 &4: 73-75.
- Zezeza, T. P. 1997. Manufacturing African Studies and Crises. *CODESRIA Dakar-Senegal*.