Information and Communication Technologies in Higher Education in Africa: Initiatives and Challenges

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Abstract

African higher education institutions are at a stage where they are striving to improve their information and communication technologies (ICTs) infrastructure, content, and skills; making resources available to meet the growing needs of students and faculty; and responding to the pressure for effectiveness. They are also confronted with a dilemma of turning ongoing ICTs initiatives into opportunities and understanding what ICTs mean to the transformation of higher education in general and to research, teaching, and learning in particular. This paper examines the increasing role of ICTs in African higher education, ongoing initiatives, progresses made, and the dilemmas and challenges.

Résumé

En Afrique, les établissements d'enseignement supérieur s'évertuent à améliorer leurs technologies d'information et de communication (TICs) en termes d'infrastructure, de contenu et de capacité. Ils fournissent également des efforts énormes pour la mobilisation des ressources afin de répondre aux besoins croissants des étudiants et des facultés. Dans le même sens, ces établissements travaillent à se hisser à la hauteur de la pression des revendications avec efficacité. Mais ils restent confrontés au dilemme suivant: comment transformer tout ce qui est offert par les TICs en opportunités? Le rôle des TICs dans la transformation de l'enseignement supérieur en général, de la recherche, de l'éducation et de l'apprentissage en particulier. Cette contribution examine la place grandissante qu'occupent les TICs dans l'enseignement supérieur en Afrique, surtout en ce qui concerne les initiatives en cours, les progrès réalisés, les dilemmes et les défis.

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Introduction

Higher education institutions have been undergoing transformations in response to a wave of education sector reforms and the promise of ICTs[2] in teaching, research, and learning. Recent increases in the number of students entering colleges, matched by declines in the number of qualified teachers, the mounting demand for accountability, and apprehensions about the social and economic roles of higher education, have compelled academic institutions to work towards "successful, self-sustaining client oriented providers of education in a rapidly changing borderless education world" (Till, 2003). The fast growth and convergence of ICTs have also forced academic institutions to react to the new way of knowledge creation, management, and distribution. Yet, African higher education institutions have remained very much behind other regions in embracing sector reforms and ICTs. They have also lacked research on what ICTs mean to the reform process, their students, and teachers and to their evolving organizational structures.

In the past, there was not much of a connection between the provision of ICTs and the higher education reform process in Africa. ICTs were isolated from the reform process, often added on as extras by a few technology-oriented departments like electrical engineering and computer science or by technology-savvy individuals. The latest reform process, which began around the mid 1990s, proceeded without changes to academic work practices or deliberations on ICTs. Most recently, it became apparent that higher education reform could not take place without paying attention to ICTs, particularly to applications in education management and administration and access to knowledge in support of teaching, research, and lifelong learning.

Progress on the adoption of ICTs in Africa has remained uneven. While some universities and colleges that had the funds for ICTs have embraced them enthusiastically by creating their corporate IT departments, others who lacked the resources have adopted a piecemeal add-on approach. ICTs in most universities in Africa have remained clutters of computers and networks that have either worked badly or are islands of low bandwidth connections with frequent breakdowns. Although universities in Algeria, Botswana, Côte d'Ivoire, Egypt, Ghana, Kenya, Lesotho, Madagascar, Mauritius, Morocco, Mozambique, Namibia, Senegal, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe[3] have made some

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2   Information and Communication Technologies in this paper means tools for communication and access to information that seamlessly integrate to open Internet standard.

3   A list of online universities in Africa provides a fair picture of ICT situation in academic institutions is available at: http://www.chem.ru.ac.za/afuniv.html

progress in applying ICTs, their venture to effective use of ICTs in higher education has proved rather complex.

One symptom of this intricacy is the quality and speed of connectivity available to universities throughout the region. The underlying infrastructure is adequate anywhere in Africa, while the low level of awareness and commitment by higher education administrators is discouraging. With few exceptions, universities have been unable to develop and implement institutional ICTs strategies that integrate a host of parallel ICTs development programs, such as advanced research in networking, computer science, community applications, and programs that promote technology-savvy intellectual capital. Economic factors ranging from the lack of capacity to pay for costly infrastructure to sustaining computer networks introduced through donor funding weighed on the universities as their budgets continued to get slashed.

Nevertheless, significant commitments and promises for ICTs uptake in Africa have been registered recently, mainly driven by the increased sophistication and cost reduction of ICTs tools, the availability of open source software, and the resurgence of international and national support for universities. This paper examines the increasing role of ICTs in African higher education, as well as ongoing initiatives, progress made, and some of the challenges on the horizon for ICTs in African higher education.

Context of ICTs Diffusion in African Higher Education

The recognition of the evident link between the rates of participation in higher education and economic growth (Dollar & Collier, 2002); the ongoing search for solutions to challenges of increasing number of students; and other chronic problems such as brain drain, frequent labor strife, campus closures, and declining educational quality have prompted significant interest in higher education reforms in Africa. Another significant challenge to higher education has come from the development and convergence of ICTs over the past decade. ICTs not only increased opportunities for the rapid information exchange that facilitates teaching, research, and lifelong learning, but they also led to the globalization of higher education. In most education circles, ICTs are regarded as a solution for the problem of having to do more with less, providing access to increasingly diverse demography of students and faculty and improving both the quality and quantity of educational content. Students and faculty are not only expected to participate in the conventional "chalk 'n talk" teaching and learning process but are also required to be part of the virtual knowledge enterprise. The creation of new types of education providers through ICTs has also begun to challenge traditional models that were adopted and put into practice throughout the world.

Despite these promises, enormous benefits, and real progress, ICTs applications in African higher education have been and remain far from satisfactory. For some time, policymakers were not interested in the universities in the region because higher education was considered to be something that benefits only the individual elite, rather than all of society. Investments in a national system of innovation were diminished on the advice of the World Bank that countries reduce their spending, privatize their industries and services, de-value their currencies, and open their markets to foreign investments. Most countries transferred resources from universities to spend on their elementary and secondary schools, which were regarded as having a higher social return. In fact, in the 1980s and 1990s, when international financial institutions aggressively promoted structural adjustment programs that slashed most funding for public higher education, universities suffered to the extent that, for example, they cut journal subscriptions altogether. (The symptom of this particular void is evident when one visits the serial departments of most African libraries.) Although this undervaluing of higher education has begun to change, the low status accorded to higher education by governments and multilateral and bilateral agencies over the past twenty to thirty years has greatly influenced the level of ICTs diffusion in African higher education institutions.

The anxiety about the low status of ICTs in African higher education was widespread around the end of the millennium. The Association of African Universities (AAU), with over 100 universities and colleges as its members, and the Inter-University Council for East Africa were among those who voiced their concerns about the grave ICTs situation at the end of the last century. During its 10th General Conference, AAU emphasized the need for connecting all its member universities to enable them to track students, faculty, and budgets; facilitate teaching and learning in class rooms; and enhance communication and networking of academics to participate in global research networks (AAU, 2001). AAU observed that ICTs could expose learners and faculty to international contexts and offer opportunities for making African research results available to a global audience.

This regional call was not translated into a cohesive strategic action that improved ICTs in higher education institutions, however. In most universities, ICTs are just extras that are not integrated into the education system. Why did the international community that was fascinated by ICTs impact on communities in the mid 1990s choose not to invest in African universities? Why did governments choose not to promote ICTs in higher education as a basic element of the reform process? Will African universities be part of the global knowledge discourse, or are they going to be overwhelmed by the growing internationalization of trade in education services?

Obviously, African universities are losers in the knowledge revolution. First and foremost, they require a higher level of knowledge and skills and enormous amounts of resources just to participate in the knowledge society discourse. Although African universities have much to contribute, the continuation of northern domination over the flow of knowledge from "center" universities in the north to "periphery" institutions in the south will not go away. Some of the global knowledge discourse tends to perpetuate this trend.

In the developed world, governments have played a key role in creating conducive environments for the flow of knowledge; in sharp contrast, most African governments put up constraining barriers, making it harder for ICTs and knowledge diffusion. Most of the progress toward ICTs use in higher education came from individual faculty efforts and through support from foundations like the Carnegie Corporation of New York, the Ford Foundation, and the French Cooperation. Although these were substantive in many ways, they were unable to bring a cohesive development of knowledge institutions across the region.

On the other hand, the promise of ICTs for flexible learning in initial and continuing education has increased donor interest in the adoption of ICTs in Africa. This interest gained some momentum in the late 1990s, with the introduction of the African Virtual University (AVU) by the World Bank, to deliver higher education based on materials and faculty from "center" universities in the north to "peripheral" African universities. AVU invested a considerable amount of resources in seventeen African countries during its first five years.

Despite the failure of its technology-driven, uni-directional flow of content to create the confidence, community, content, and care needed to advance distance learning in Africa, the AVU scheme was useful in increasing awareness of the use of ICTs in continuing education. The scheme also showed that online learning is "about Africa's own initiative and more of imaginative improvisation based on best practices elsewhere" (Uys et al., 2003). Distance learning institutions like the Open University of Tanzania; business schools in South Africa and Ethiopia; the University of South Africa, Pretoria, Free State, Potchefstroom, and Stellenbosch; and others in Ghana, Nigeria, and Uganda have begun experimenting with various ICTs applications to provide access to their tutors and students.

On the whole, differences in donor interventions, the level of economic development, and the status of infrastructure led to different levels of adoption of ICTs by higher education institutions across Africa. While some institutions have moved a step further in integrating ICTs in teaching and research and experimenting with the use of course management software such as Black Board and WebCT, the majority of institutions linger around emerging stages of ICTs

usage, where administrators and faculty members are just beginning to explore the possibilities of ICTs in educational management, teaching, and research (Buettner et al., 2000). A few exceptions, like the University of Western Cape in South Africa, have developed exemplary open source applications like the Knowledge Environment for Web-based Learning (KWEL)[4] now being used by many universities in the region to manage online courses. Different levels of social and other constraints affect the contexts of ICTs in higher education in Africa, and these differences vary from one country to another or from one institution to the next.

Constraints to ICTs Diffusion in Higher Education in Africa

Comprehensive, up-to-date information on the ICTs status in African universities is not readily available, although many universities have now invested in computers and networks. The speed with which ICTs change at institutional and national levels and a lack of incentives for gathering data are two of the barriers to gathering information on ICTs in higher education. Attempts by organizations like the Association of African Universities to collect such data have proven complex. Not only did gathering ICTs data through lengthy questionnaires prove inadequate, but the results were unusable since the data was out of date by the time the completed questionnaires had arrived.

The majority of higher education institutions in Africa have neither well-established ICTs strategies nor management information systems that provide consistent figures on their ICTs situation. Different departments and units often receive ICTs equipment through donations and direct purchase without central coordination. In effect, coordinating and integrating parallel ICTs activities into a cohesive campus-wide program is one of the most difficult tasks facing corporate ICTs units in Africa. Even if the information were available, the lack of historical or baseline data means that it would be difficult to establish with any reliability how ICTs were advancing from a lower base over the years. Moreover, a recent increase in the number of technology-savvy private universities in Africa in the delivery of ICTs-led higher education makes generalization across institutions rather difficult.

It is possible to extrapolate an overall perspective on the situation of every African country from the general ICTs trends at the national level, however, using information on web presence. The status of ICTs in African higher education mirrors the overall e-readiness of their respective countries. Qualitative analysis of universities' web presence could provide a glimpse of the extent to which higher education institutions value knowledge sharing.

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4   http://kwel.uwc.ac.za/

Table 1: African Countries Sorted by Their ICTs Status in 2002

Country	Number of Telephone	Penetration	Mobiles	Penetration	Internet	Penetration	Personal Computer	Penetration	Bandwidth	Bits/capita	Index
Seychelles	65,500	79.97	44,100	53.87	262	31.99	12,000	14.65	3	6.21	197.67
Mauritius	677,200	55.95	350,000	28.91	3,462	28.6	130,000	10.83	35	3.41	142.57
South Africa	16,976,000	37.75	12,081,000	26.58	238,462	53.51	3,300,000	7.26	900	9.1	141.02
São Tomé & Principe	5,400	3.63	-	3.63	927	61.8	-	-	0.378	8.67	83.73
Botswana	458,600	27.28	415,000	24.13	1,273	7.57	65,000	3.87	4.5	8.38	74.2
Gabon	295,300	23.4	258,100	20.54	79	0.61	15,000	1.19	5	13	60.66
Morocco	7,326,100	24.71	6,198,700	20.91	2,680	0.09	400,000	1.37	80	6.74	55.51
Cape Verde	113,100	25.77	42,900	9.78	48	1.09	35,000	7.97	2.45	7.04	55.29
Namibia	217,400	11.9	150,000	8	4,632	25.36	100,000	5.47	15	0.76	53.95
Tunisia	1,445,400	14.9	389,200	4.01	341	0.35	255,000	2.63	70	7.73	34.77
Egypt	9,482,200	14.69	4,412,000	6.72	3,061	0.47	1,000,000	1.55	100	8.29	32.65
Swaziland	98,100	9.5	63,000	6.1	1,142	11.2	-	-	20	0.95	29.69
Nigeria	2,335,100	1.94	1,633,100	1.36	1,030	0.09	800,000	0.68	60	20.55	24.79
Zimbabwe	640,900	5.51	353,000	3.03	3,494	3.04	600,000	5.16	25	0.81	21.85
Mayotte	10,000	6.98	21,700	14.66	-	-	-	-	-	-	21.64
Mauritania	277,700	10.35	245,700	9.16	79	0.29	27,000	1.03	0.96	0.28	21.48
Gambia	90,100	6.74	55,100	4.12	568	4.14	17,000	1.27	3	1.53	19.14
Côte d'Ivoire	1,363,200	8.27	1,027,100	6.23	4,397	2.67	118,000	0.72	13	0.4	18.83
Senegal	778,000	7.94	553,400	5.65	761	0.78	200,000	2.04	15	0.01	17.49

Table 1 (Continued): African Countries Sorted by Their ICTs Status in 2002

Country	Number of Telephone	Penetra-tion	Mobiles	Penetra-tion	Internet	Penetra-tion	Personal Computer	Penetra-tion	Band width	Bits/ capita	Index
Djibouti	25,100	3.83	15,000	2.29	498	7.59	100,000	1.52	0.85	0.04	15.95
Congo	243,800	7.41	221,800	6.74	36	0.11	12,000	0.39	0.2	0.04	14.72
Libya	660,000	11.8	50,000	0.9	70	0.13	-	-	4	1.08	14.27
Togo	168,400	3.62	120,000	2.58	80	0.17	150,000	3.2	1.7	0.33	14.17
Equat. Guinea	35,800	7.34	27,000	5.53	3	0.06	4,000	0.72	0.2	0.14	14.13
Kenya	1,653,300	5.18	148,300	4.15	2,963	0.93	175,000	0.56	35	0.89	13.31
Mozambique	242,100	10.35	152,700	0.86	16	0.01	70,000	0.4	6	1.17	12.96
Algeria	1,980,000	6.42	300,000	0.96	821	0.26	220,000	0.71	75	2.67	12.62
Lesotho	126,000	5.82	92,000	4.25	60	0.28	-	-	0.75	0.36	10.94
Cameroon	411,400	2.67	563,000	3.57	439	0.28	60,000	0.39	7	0.59	7.79
Benin	184,000	2.86	125,000	1.94	574	0.87	11,000	0.17	4.5	0.33	6.55
Zambia	227,600	2.13	139,100	1.3	1,095	1.03	80,000	0.75	7	0.48	6.19
Uganda	448,300	1.81	393,300	1.59	2,242	0.91	70,000	0.29	10	0.41	5.26
Sudan	826,600	2.65	190,800	0.59	-	-	300,000	0.92	9	0.31	4.73
Tanzania	575,400	1.71	427,000	1.27	1,478	0.44	120,000	0.36	30	0.33	4.41
Rwanda	86,500	1.09	90,000	1.1	1,233	1.51	-	-	2.7	0.07	4.02
Ghana	435,900	2.08	193,800	0.93	313	0.14	70,000	0.33	15	0.2	3.87
Eritrea	35,900	0.9	-	-	859	2.16	10,000	0.25	2.5	0.13	3.66
Angola	215,000	1.54	130,000	0.93	8	0.01	27,000	0.19	16	0.52	3.48
Madagascar	205,900	1.33	147,500	0.95	234	0.15	40,000	0.26	10	0.17	3.09

Table 1 (Continued): African Countries Sorted by Their ICTs Status in 2002

Country	Number of Telephone	Penetra-tion	Mobiles	Penetra-tion	Internet	Penetra-tion	Personal Computer	Penetra-tion	Band width	Bits/capita	Index
Malawi	159,100	1.52	86,000	0.82	22	0.02	13,000	0.13	3.5	0.2	2.95
Guinea	81,200	1.07	55,700	0.73	251	0.33	32,000	0.42	4	0.19	2.94
Comoros	10,300	1.35	-	-	11	0.15	4,000	0.55	0.49	0.18	2.65
Burkina Faso	132,600	1.14	75,000	0.64	409	0.34	17,000	0.15	20	0.17	2.6
Mali	95,200	0.92	45,300	0.44	158	0.15	14,000	0.13	6	0.44	2.37
Sierra Leone	49,600	1.01	26,900	0.55	277	0.56	-	-	1	0.08	2.34
D.R. Congo	170,000	0.32	150,000	0.29	134	0.03	-	-	4.5	1.6	2.25
Guinea-Bissau	12,000	0.98	-	-	20	0.16	-	-	0.25	0.52	1.98
Burundi	50,700	0.74	30,700	0.45	3	0.01	-	-	0.3	0.07	1.36
CAR*	19,900	0.53	11,000	0.29	6	0.02	7,000	0.19	0.7	0.12	1.23
Chad	33,000	0.43	34,200	0.43	11	0.01	12,000	0.16	0.9	0.02	1.1
Ethiopia	418,600	0.62	50,400	0.07	43	0.01	100,000	0.15	6.5	0.06	0.98
Niger	23,800	0.21	2,100	0.02	119	0.1	6,000	0.05	2	0.2	0.69
Africa Total	52,738,800	6.6	33,563,500	4.19	281,184	4.95	8,708,000	1.23	1,688	2.31	20.29

Source: International Telecommunications Union.

*Central African Republic

Without over-generalization, it is safe to say that countries that enjoyed high bandwidth and a high-level of Internet penetration had significant ICTs access in their higher education. A quick picture of the higher education use of ICTs can be obtained from basic indicators such as Internet hosts, the amount of bandwidth, penetration of telephones, mobile phones, and computers. Table 1 shows basic ICTs statistics for African countries based on ITU data in 2002 sorted by the sum of all the indicators. Using the sum of the indicators and online content it was possible to recognize that the top 30 countries have well-connected universities, in relative terms and in comparison to the lower 20 countries.

The data above and an analysis of African higher education online content show that countries like South Africa, Botswana, Swaziland, Senegal, Namibia, Morocco, Mauritius, Tunisia, Egypt, Algeria, Kenya, Tanzania, and Uganda have achieved increased ICTs penetration as well as a relatively advanced use of ICTs in their higher education sectors. The rate of growth in the number of computers was also high in these countries thanks to the availability of cheap clones and a vibrant local private sector. South Africa, Tunisia, Morocco, and Mauritius have vibrant ICTs private sectors that rely heavily on innovations in the universities.

Table 2: Web Presence Comparisons among Universities in Africa

Countries with better university web presence	Countries with lower university web presence
Algeria, Angola, Benin, Botswana, Côte d'Ivoire, Egypt, Ghana, Kenya, Lesotho, Madagascar, Mauritius, Morocco, Namibia, Senegal, Seychelles, South Africa, Tunisia, Uganda, Zambia, Zimbabwe	Burundi, Cameroon, Comoros, Congo, DRCongo, Djibouti, Eritrea, Ethiopia, Gabon, Guinea, Guinea Bissau, Equatorial Guinea, Libya, Mali, Malawi, Mauritania, Mozambique, Niger, Rwanda, Somalia, Sudan, Swaziland, Tanzania

Based on: A list of online universities in Africa http://www.chem.ru.ac.za/afuniv.html

The data also indicates that there is a great deal of disparity between African countries. South Africa accounts for about 50% of Internet users. Egypt and South Africa account for about 50% of personal computers in the region. The gap between the highest and lowest country is astronomical. This suggests that a one-size-fits-all approach or translating models designed for the developed world to Africa or from one country to the other will face difficulties.

Countries at the bottom of the list, like Niger, Ethiopia, Central African Republic, Burkina Faso, and Malawi are significantly behind the rest of the region in terms of ICTs investments and development. These countries face infrastructural limitations and operational challenges like low quality human resources, inadequate political will, and limited financial resources and capacity to implement university-based ICTs project effectively. They lack necessary supportive infrastructure basics, such as working phone lines, a reliable power supply, and meaningful content. National policies do not adequately support the growth of ICTs in education in most of these countries, as well.

On the whole, there are broad categories of constraints that affect all higher education institutions in the African countries listed above. Lack of adequate bandwidth is at the top of the lists of ICTs constraints for almost all African universities. Obtaining high bandwidth circuits is a challenge, due to high tariffs on international connections. Even in countries like South Africa and Egypt, which have relatively high ICTs capacities internet bandwidth in academic institutions is very congested. In addition, academic institutions face financial constraints on sustaining and upgrading ICTs. Creating an interactive e-learning content that involves students and faculty in generation and use is a significant bottleneck, as well. Technical skills are generally scarce with the exodus of highly skilled people from public and academic sectors to the private sector or abroad, in search of better jobs. Universities also face cultural problems such as the unwillingness of faculty to adapt to the changing circumstances in networked environments. The following section discusses four outstanding constraints facing African higher education institutions in some detail.

Bandwidth Constraints

Bandwidth is the scarcest ICTs resource in African universities mainly due to prohibitions on academic institutions' accessing international circuits and to high licensing fees for connecting to advanced circuits or for obtaining authorization. Most countries do not have adequate international bandwidth. A survey by Jensen (2002) shows that almost 60% of African countries have bandwidth that is less than that of a typical institution in the developed world. Only six African countries have a reasonable outgoing bandwidth. Table 3 shows distribution of outgoing bandwidth in Africa.

As a result of insufficient bandwidth, a typical university of 6,000 students and 300 staff members is often limited to a 128 Kbps connection. Studies on how such a low bandwidth is actually used are absent in African higher education, but experience elsewhere shows that low levels of access could be far more frustrating than having no bandwidth. An exasperating information search on the net can create more damage to academic enterprise than hunting for a

book in a library or elsewhere. Experience also shows that whatever bandwidth is available to academic institutions it is often quickly filled up, suggesting a need for investigation into how available bandwidth is actually used in African universities. Such information would allow institutions to develop strategies for conserving their available bandwidth by looking at options like hosting local caches, implementing good traffic management techniques such as dynamically assigning existing bandwidth to web and email traffic, and creating digital libraries. More bandwidth cannot resolve the current access problem by itself.

A serious barrier to acquiring bandwidth in Africa is its high cost. A survey carried out by Partnership for Higher Education in Africa (2002)—an initiative by Ford, MacArthur, and Rockefeller Foundations and Carnegie Corporation of New York— by shows that a typical 128 Kbps uplink and 512 kbps downlink cost between US$4,500 to $12,000 per month, ten times the cost of similar capacity in the developed world.[5] Ideally, mass deployment of Very Small Aperture Terminal (VSAT) technology could bring the equipment cost down to US$2,000 and internet bandwidth at US$200/month or less. The license fee then becomes the largest cost of accessing the Internet unless African regulators and policy makers adopt enabling policies that encourage universal access.

Technically, the necessary bandwidth is already accessible through the SAT/WAF3[6] submarine cable now connecting 11 countries in west and southern Africa and may soon be available from foot prints of low cost Satellite technologies that promise to cut costs by 1,000% and guarantee access to landlocked and remote areas. Recent discussions about extending submarine fiber cable to east Africa and an ongoing initiative by the Southern African power company ESKOM to carry digital fiber over power lines also promise regionwide bandwidth availability for higher education needs in medium terms.

Clearly, African policies and regulatory frameworks make up the major bottleneck in the availability of adequate bandwidth. Current policies not only restrict access to satellite technologies but also impose higher license charges on installation of networks. Insufficient private sector investments in the telecommunications infrastructure and the lack of competition has led to arbitrary pricing-setting that has set the cost of ICTs beyond the reach of most universities.

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5   Partnership for Higher Education in Africa, ICT for Teaching, Learning and Research, Proceedings of a Workshop for African Universities, Addis Ababa, 29 July–1 August 2003.

6   Undersea communications cable running from Portugal through to South Africa connecting a number of countries in western and southern Africa.

Table 3: African Outgoing Bandwidth

Countries	Bandwidth Mbits/sec	%
Egypt, South Africa, Morocco	100–500	6
Algeria, Senegal, Tunisia	50–100	6
Botswana, Gabon, Kenya, Nigeria, Sudan, Tanzania, Zimbabwe	10–50	13
Angola, Cameroon, Côte d'Ivoire, Libya, Mali, Namibia, Uganda, Zambia	5–10	15
Benin, Burkina Faso, Burundi, Cape Verde, Central African Republic, Chad, Comoros, Congo, DR Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mauritania, Mauritius, Mozambique, Niger, Rwanda, São Tomé & Principe, Seychelles, Sierra Leone, Somalia, Swaziland, Togo	< 5	60

Source: http://www.idrc.ca/acacia/divide, Mike Jensen

African higher education institutions confront additional challenges that need to be addressed concurrently with policy reforms that aim to address access and high costs of bandwidth:

- The majority of universities cannot afford the cost of megabits of connections even if bandwidth is readily available. Higher education cannot afford the current pricing models.
- Most universities do not have plans regarding how to optimize their existing bandwidth and manage the traffic and usage.
- The underlying infrastructure—such as electricity, local loop, and technical skills—are inadequate to support high bandwidth intensive applications.
- There is lack of political will and regional cooperation throughout Africa to benefit from an economy of scale or aggregated bandwidth.
- There is limited knowledge on what types of technology (optical fiber, satellite, etc.) are appropriate for different settings in Africa.

A significant amount of pressure on government is needed to modernize African policy and regulatory environment to facilitate affordable and universal access to the Internet for higher education institutions. At the same time, ana-

lyzing different technical options and strategies for aggregating and optimizing existing bandwidth is important. Similarly, developing the necessary skills for high-bandwidth intensive applications is necessary.

E-learning Content

Introduction of ICTs into higher education is not only about promoting access and communication but is also about stimulating the flow of electronic content (e-content) that promotes teaching and learning, including electronic learning (e-learning). Creating and promoting a content rich e-learning environment that satisfies teaching and research needs is a daunting task even in the developed world. E-content is one of the most overlooked areas in higher education institutions in Africa. Actually, African higher education institutions have double tasks ahead that make their jobs even more difficult. On the one hand, universities need to promote access to globally available and appropriate content; on the other, they have to stimulate locally produced content by faculty and students.

Appropriate and improvised content ranging from learning materials such as textbooks, journals, web pages, video, television, radio, audiotape, and multimedia packages to learning support tools such as study guides, exam sheets, worksheets, laboratory manuals, and field exercises are in short supply in higher education institutions in the region. The dearth of learning materials is particularly evident when one compares African higher education libraries to the developed world. A typical developed country's institutions' libraries subscribe to tens of thousands of journals, while those in Africa can hardly afford more than a hundred. Globally there has been a substantial surge in e-learning materials on the Internet, ranging from course syllabi and e-books to online journals that are freely available. The net has not been fully exploited for assessing and adjusting learning materials to local settings, however, due to problems of the underlying ICTs infrastructure, the lack of information literacy to search and evaluate online information, and the lack of information on various possibilities that are available to developing countries.

Creating local e-learning content has proved more difficult in Africa, partly because the academics in the region are not conversant with courseware tools and digital environment. Most importantly, academics have excessive loads and limited time, skills, and incentives to develop e-learning materials suitable to their local needs. The educational reward system was not designed to encourage faculty and students to own and get involved in e-learning content development and use. Moreover, maintaining an e-learning environment requires consistent improvisation and skills that are not readily available to most of the African universities. It is also a resource intensive enterprise. A typical

US university pays US$25,000 to develop an online course and a further US$5,000 a year to maintain it (Nwuke, 2001).

Nevertheless, a number of innovations can be adopted to address the e-content challenge in Africa. Incremental deployment of courseware material, collaborative development of open content, and sharing of courseware materials among group of countries that follow compatible syllabi (Keats, 2002) are some of the possibilities proposed by experts based on experiences around the world. Achieving such a collaborative development environment proved more difficult in practice than in theory, however.

Improving the information literacy of and incentives for faculty could increase the availability of local e-learning content. In the long run, a serious look at e-learning in Africa is essential to understanding the factors that contribute its uptake in different settings, as well as the dilemmas, uncertainties, and implications of e-content to relatively weak educational standards in Africa. Studies on the impact of e-learning and online content to critical thinking, research, and development will be indispensable in the future.

Skills and Awareness

The pervasiveness of the Internet has recently increased the awareness of the significance of ICTs to higher education in Africa. Yet this overall awareness has not been matched by advanced skills that could assist institutions and individuals to choose different technologies, tools, systems, and networks suitable to their particular setting and to develop e-learning content. While ICTs literacy is generally on the rise, skills for the application of ICTs to subject areas in natural sciences, engineering, medicine, social sciences, and art have not been fully developed. In most universities, ICTs in education commonly means teaching learners how to use computers. Information literacy skills to access, navigate, assess, and evaluate information within global networks are not taught in universities and colleges. Academic policy makers also lack overall understanding about how to reorient teaching, learning, and research with the digital domain. This general trend in Africa implies a need for a significant shift in the training of students and faculty on ICTs literacy to promote the ability to access, assess, use, and evaluate information from different sources to solve problems and add value to knowledge.

African universities also face a critical shortage of skilled workers that understand basic and advanced programming to plan, design, and implement distributed information systems and manage large-scale e-learning projects. The high turnover of skilled technical personnel is another problem for universities, which have seen constant deterioration over the years in their ability to pay salaries that are competitive with the private sector. African higher education institutions have

found it difficult to attract technicians to help them expand, migrate, and build campus-wide networks and develop and manage administrative, research, and courseware applications.

Some higher education institutions have tried to work around this problem by launching extensive and ongoing professional development programs for their staffs and exploiting their computer science and electrical/network/computer engineering departments. Corporate computing centers at Makarere University in Uganda, the University of Western Cape in South Africa, the University of Dar es Salaam in Tanzania, the University of Eduardo Mondlane in Mozambique, and the University of Chiek Anta Diop in Senegal have been able to garner national and international support that created the necessary incentives for their computer center staff. The majority of universities have relied on training as many student technicians as they can. Experiences from these universities suggest that it is important to share experiences on how to cope with staff shortages and to attract and retain valuable technical personnel.

Resource Constraints

Despite a mainstream claim that investing in ICTs is cost effective, the total cost of ownership of ICTs has remained high for universities. Therefore, higher education's investments in ICTs require long-term planning that should take into account sustainability and the developments that ICT-enhanced education may bring (Sayed, 2003). ICTs costs often include that of computers and peripherals, video equipment, specialized tools like digital microscopes, electrical wiring, internet access, lighting, air-conditioning, space, network equipment, software, manuals, books, videos, audio-tapes, and other supplies. Despite the continuous decline in ICTs prices, the total ownership cost of modern ICTs, including maintenance, upgrading, skills development, etc. remains staggering.

Universities in Africa seldom plan or budget for ICTs, since most of their investments come through donations. Ongoing cuts of government budgets; competition from other equally deserving sectors of the economy, like health and social development; and economic stagnation have all contributed to the limited foresight shown by universities regarding ICTs. Except for the end of the year, when universities have some residual budget funds left over, ICTs do not feature on the list of institutional investment priorities or considerations. On the contrary, during the year, ICTs are often relegated to the bottom of institutions' priorities list when compared with other important items like paying staff salaries or maintaining utilities.

Besides limited interest in ICTs and the lack of centralized financial planning, universities are often unable to coordinate their different departments and faculties that receive equipment through donations or as part of project grants. This "island approach," where equipment is purchased and received by

individual departments without a cohesive institutional ICTs strategy, not only increases competition for scarce donor funding but also limits the value placed on cooperation to share other intangible resources like knowledge. The experience of the Kenya Education Network (Kenet) shows that cooperation that transcends institutional barriers could be effective in cutting costs and increasing the exchange of content between universities, professional training institutes, post-secondary institutions, schools, colleges, research institutes, and libraries. The involvement of parents, families, businesses, industry, government agencies, private foundations, and social, religious, and professional organizations could also be effective in mobilizing ICTs resources for the growing demands of innovation and access.

Overall, and despite the above challenges, African higher education institutions have been actively innovating around harnessing ICTs for administrative, teaching, research, communication, and networking purposes. The last ten years have also seen a considerable amount of interest paid by national and regional institutions in spending on initiatives aimed at improving ICTs in schools and colleges in Africa, as part of the overall information society and digital opportunity discourse. The following section discusses some of these initiatives and their implications to higher education.

ICTs Initiatives for Higher Education in Africa

ICTs initiatives relevant to higher education institutions in Africa can generally be grouped into three broad categories: 1) individual institutions' initiatives aimed at expanding access to ICTs, as part of an institutional or national education network, 2) regional initiatives that cover most countries or universities, and 3) initiatives aimed at increasing the flow of content in higher education.

National Initiatives

Almost all tertiary education institutions in Africa have some form of ICTs activities that fall into two main stages of development:

1) The emerging stage, where ICTs are used by staff and selected students for basic chores such as word processing, communications, and access to learning resources on the Internet and CD-ROMs. The majority of institutions in the region fall into this category, although some have been moving forward to integrate ICTs into teaching and learning. This transition was nicely summed up by Musisi and Mwanga in a study entitled "Makarere University in Transition 1993–2000: Opportunities and Challenge."[7]

… As Makarere builds its ICTs infrastructure, users will need training not just in using technology but also in information retrieval skills. A CD-ROM or Internet search can pull up thousands of citations unless the searcher has phrased his/her search question properly. Learning how to evaluate Internet search results is another important skill. The Library needs to begin thinking about subscriptions to materials that are available online. Faculty need to incorporate new information technologies into their teaching techniques: syllabi can be posted, as well as lecture notes and assignments. Students can send in papers and homework and pose questions by e-mail. Teaching staff needs to consider using ICTs to improve the way courses are taught. Planning and exploration should begin now while the infrastructure is being put in place. Adequate resource allocation to ICTs must be an on-going strategy because of the rapidity of technological change…

<div align="right">Musisi and Mwanga, 2001</div>

Other universities and colleges that have developed their strategic plans to move towards the ICTs integration stage include the Eduardo Mondlane University in Mozambique, the University of Dar es Salaam, and the University of Rwanda. These and a couple of others were able to build considerable experiences in campus wide networks and in developing and implementing an ICTs policy at the college level.

2) The integration stage, where ICTs are fully incorporated in content and in providing access to coursewares and campus services to staff and students. A few universities at this stage were able to implement an elaborate management information system for managing finances, research outputs, student enrolment, course transfers and online libraries. Academic institutions in Botswana, Egypt, Mauritius, Morocco, Namibia, Senegal, South Africa, and Tunisia have been striving to integrate ICTs fully into their teaching and learning processes. The University of Botswana, for example, has introduced a robust ICTs infrastructure, where every staff member has access to the internet, and faculty and students actively participate in shaping its e-learning platform.

There is a correlation between the level of integration of ICTs in academic institutions and national ICTs policy making. In some countries, like Mozambique, the academic institutions played a key role in setting national ICTs policy. Countries that saw advanced ICTs use in their higher education

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7   Musisi, Nakanyike and Nansozi Mwanga, 2003. Makarere University In Transition 1990-2003: Opportunities and Challenge. http://www.foundation-partnership.org/case_studies/makerere.php.

sectors were able to develop national ICTs strategies in general and electronic education (e-education) plans in particular.

South Africa is one such example where ICTs have been promoted all along through partnerships between government, proponents of ICTs, the academic community, and the private sector. In South Africa, internet connectivity that began in early 1990s through funding from the Foundation for Research and Development culminated with the rise of a Tertiary Education Network (TE-NET),[8] which now provides internet access and technical support to universities, technikons, and research institutions. TENET was jointly founded in August 2000 by the Committee of Technikon Principals (CTP) and the South African Universities Vice Chancellors' Association (SAUVCA), but it was also supported by the government, universities, and donor agencies.

The presidential EDUNET initiative in Tunisia is another example of strong government support that was instrumental in providing full connectivity to universities and schools since 1997. Senegal and South Africa introduced special education rates (e-rates) to facilitate ICTs access to schools and colleges. Mauritius has gone even farther towards establishing a university of science and technology to capitalize on ICTs development. These experiences suggest that strong government support is a key for advancing ICTs availability and usage in higher education as a broad social and economic development enterprise.

Countries that have seen expanding academic use of ICTs have also shown considerable interest in building technology parks, ICTs clusters, innovation hubs that aim to increase access to capital, and advanced technologies for those who would like to pursue ICTs entrepreneurship. Gauteng and Cape Town in South Africa and El Ghazala in Tunisia have become attractive to foreign investors with spillover to the area of higher education institutions. The cities of Giza in Cairo, Port Louis, Abidjan, Rabat, Dakar, and Accra are also striving to become innovation technology hubs that could support the advancement of ICTs in the universities.

The private sector has also been contributing to this endeavor. Universities in most African countries, particularly those in West Africa like Benin, Burkina Faso, Chad, Niger, Togo, and Ghana, have signed agreements with UNDP and CISCO to become CISCO academies and are training hundreds of ICTs entrepreneurs and students in new internetworking technologies. These initiatives have not only boosted the institutions' technical capacities for managing their networks but have also provided enough experts to support the local public and the private sector needs.

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8   http://www.tenet.ac.za

Sustaining meaningful ICTs utilization in an academic environment remains a problem for all the institutions, however, particularly to those universities that rely on donor funding. The transition from the early stage of ICTs utilization to their full integration in learning, teaching, research, and institutional management will remain a test for higher education institutions in the years to come.

Regional Initiatives

In addition to institutional initiatives, there were a number of regional initiatives that promoted ICTs use in higher education. The majority of these initiatives focused on harnessing ICTs to deliver higher learning from a distance. Institutions in this category range from the African Virtual University to the Open University of the United Kingdom, which provided training to senior policy makers and teachers in Africa. Other institutions tend to deal with policy and regulatory issues facing higher education and analyzing the economic impact of higher learning and ICTs in Africa. The Economic Commission for Africa falls in this category. The rest provide funding for research and development of institutional ICTs capacities.

The Partnership for Higher Education in Africa and the Agence Universitaire de la Franchophonie are the two major organizations that spent a considerable amount of energy and resources in funding various activities aimed at sharing experience, transforming universities, improving their ICTs situation, and advocating for wider recognition of the importance of African universities as key knowledge producers in the information age. Table 4 lists the major ICTs initiatives relevant to higher education in Africa.

Table 4: ICTs Initiatives Relevant to Higher Education in Africa

Initiative	Description	Web site
Partnership for Higher Education in Africa	An initiative of the Ford, MacArthur, and Rockefeller Foundations and Carnegie Corporation of New York, it aims to generate and share information about African universities and higher education issues, discuss strategies for supporting universities, support universities to transform themselves, encourage networking and advocate for wider recognition of the importance of universities to African development. The Partnership supports ICTs infrastructure, research, networking, and other related activities.	http://www. foundation-partnership.org/ corestatement. php
Agence Universitaire de la Francophonie	The Agency works with universities in French speaking Africa to integrate ICTs into their teaching and learning processes, harness new technologies in distance education, and promote e-learning content, campus networks, and exchange of experience.	http://www. auf.org
UN Economic Commission for Africa	The Commission through the African Information Society Initiative supports various policy initiatives pertaining to ICTs in Africa. AISI focuses on connectivity, policy advice, development of national strategies, and the promotion of ICTs application in key sectors including education.	http://www. uneca.org/aisi http://www. uneca.org/adf99
E-Africa Commission	The Commission is the digital opportunity arm of the New Partnership for African Development (NEPAD). E-school is one of the flagship projects of the Commission that is believed to have a spill over to higher education.	http://www. eafrica commission.org/

Table 4: Continued

Initiative	Description	Web site
WorLD	WorLD is an initiative of the World Bank to link students and teachers around the world using ICTs to improve educational opportunities and build global awareness.	http://www. worldbank. org/worldlinks/
Imfundo: Partnership for IT in Africa	UK initiative dedicated to using ICTs to enhance teacher training and improve education and management of information systems.	http://www. imfundo.org
African Virtual University	A World Bank initiative to increase access to tertiary education, it has now established a satellite-based learning centers in 17 African countries.	http://www. avu.org

E-content Initiatives

The third and perhaps most important area that has gained some attention lately is the promotion of e-content to support systematic management and sharing electronic information. Apart from considerable support by the Agence Universitaire de la Franchphonie in improving content in French speaking universities, the efforts supporting e-learning content remained ad hoc and scattered. Systematic knowledge management and sharing are still main challenges to African higher education institutions. Initiatives tend to promote regional e-content over building the capacities of the institutions to manage and share e-content. Table 5 lists some of the knowledge exchange initiatives relevant to higher education in Africa.

   Interestingly, apart from the two initiatives stated above, the rest do not have comprehensive ICTs packages for higher education or resources that link local efforts to regional and e-content initiatives. Most initiatives and donors also tend to invest where local activities are significant. It is, therefore, imperative that higher education institutions take charge of their knowledge initiatives in order to advance ICTs use and garner support from the international community.

Table 5: Knowledge Exchange Initiatives in Africa

Initiative	Description	Web site
International Network for Availability of Scientific Publications (INASP)	INASP is a co-operative network of partners aiming to improve worldwide access to scientific information. It provides training to information providers. INASP is widely known for its African Journal Online project and resources on electronic publishing. INASP has also played a key role in promoting availability of online journals free of charge to developing countries.	http://www. inasp.info
The Association for the Development of Education in Africa	ADEA is a network of partners promoting the development of effective education policies based on African leadership and ownership. ADEA uses ICTs to share information with policy makers and development aid agencies.	http://www. adeanet.org
Database of African Thesis and Dissertation (DATAD)	The initiative is a project implemented by the Association of African Universities with funds from Ford and Rockefeller Foundations. It aims to facilitate capturing, organizing, and disseminating African theses and dissertations electronically.	http://www. aau.org/datad

Conclusion

This article provides an examination of the constraints and the institutional and regional initiatives that show that, despite some progress, the ICTs situation in African higher education remains far from adequate. Universities across Africa are at a cross-roads of making ICTs useful to their academic enterprise and at the same time understanding their implications to learning, teaching, research and institutional development. Despite enormous potential benefits, it is still unclear what impacts ICTs may have on teaching and learning and research particularly at resource-poor, low quality, peripheral universities in Africa.

Arguably, ICTs present enormous opportunities, particularly in the non-formal education delivery, in opening up to the world of information and in

facilitating interactions that otherwise would have been unthinkable. ICTs have made distance education more attractive both to the growing body of students and to universities transforming from elite to mass education. ICTs can improve the role of the Diaspora in creating a strong knowledge bond with higher education institutions in Africa. This knowledge network may well be as significant for African development as financial remittances from the Diaspora. ICTs are critical for future students to secure employment in the knowledge economy. It is imperative for the storage and retrieval of a vast array of information, including course materials that improve the quality of instruction and learning. ICTs could transform organizational patterns of higher education by making all institutional tasks more effective.

Equally and conversely, ICTs present a considerable challenge to African higher learning. It is not clear how low quality higher education will cope with floods of "Googles" and "Yahoos" in the long term. Universities in the region need to promote a high-level of critical thinking without compromising access to the vast array of information. The gap between those with access to ICTs at national and institutional levels and those without is a key concern. It is the duty of all African universities to strive towards achieving some form of universal ICTs access to all students and faculty. Constraints ranging from bandwidth availability and expense to the changing of the culture of academics and students, both cited above, should be addressed.

The dilemma suggests that, beyond the rhetoric, relatively little is known about how ICTs are actually used on African campuses and how they impact students and faculty. Most of the work in this area is largely rhetorical and lacks detailed consideration on the ways in which ICTs can be deployed in local context. ICTs involve a multifaceted social negotiation between different actors both on and off campus and, at a broader level, within the backdrop of university transformations and organizational reforms that have implications to the future of knowledge. This complex social negotiation process includes interactions of heterogeneous network of actors, artifacts, and systems whose outcome are not so obvious.

Comprehension of the actual use of ICTs on African campuses against the background of limited flow of information, resource constraints, problems of attracting quality faculty, less committed and badly trained students, and other social factors that endorse or stall its uptake is important. Neither the role of ICTs in African education nor the role of academics in the transition to knowledge society has been identified or fully understood. An African-led research agenda on ICTs and higher education is crucial to understanding the emerging complex negotiations between different actors at local, regional, and interna-

tional levels and the implications of ICTs applications to social, political, and organizational development.

The main and immediate obstacle to the use of ICTs in Africa remains universal access to higher bandwidth. Providing universal access to higher education is costly and complex. The need to create a robust bandwidth capability throughout Africa exposes the various constraints that need to be addressed at the institutional, national, and regional levels. Strategies for improving bandwidth and conserving existing circuit capacity should be developed and promoted widely.

More coordination and resource sharing between African academic institutions could be beneficial as universities move to fully integrate ICTs into their teaching and learning. Regional platforms for sharing information on ICTs policies and courseware and exchanging experiences are critical to increasing the positive contribution of ICTs to higher education.

Experiences have shown that a lot can be achieved in higher education by identifying and supporting campus ICTs champions and creating a network that brings these key players of e-learning together. Initiatives like the Santec[9] network, which aims to contribute to educational technology and e-learning in southern Africa, should be encouraged and replicated throughout the region. Also important are south-south collaborations between higher education institutions in Africa and their Asian and Latin American counterparts that have gone through some of the troubles of building a robust bandwidth, creating appropriate e-learning content and motivating students and staff to participate in networked education.

The creation of ICTs and knowledge management strategies at higher education institutions within the framework of their reform process are vital. Equally important is the strengthening of ICTs research and development on African campuses. Universities cannot actually build a good e-learning environment without strong teaching, research, and improvisation in networking; open software; and modern computer applications development. Highly skilled human resource development is also a foundation of ICTs in higher education.

The importance of ICTs in higher education has wide-ranging national implications. A well-articulated, networked learning environment in higher education requires significant government intervention. Government policy has a real impact on strategic initiatives in universities and often determines the parameters of such initiatives through laws, regulations, and the allocation of funds. At the same time, higher education institutions should play a key role in

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9   http://www.santecnetwork.org

articulating national e-strategies. Universities could play a monitoring, mentoring, and evaluation role in shaping ICTs laws and regulations.

Developing effective tri-partite partnerships between government, higher education, and the private sector is also central to reaping the full educational benefits of ICTs. Governments should encourage the private sector to play a more socially responsible role by improving national infrastructures. With greater institutional ICTs infrastructures, universities could produce highly skilled human resources for the ICTs industry and the public sector. ICTs partnerships between higher education, government, and the private sector could elevate technology from a campus tool to a truly social service that advances the flow of knowledge and ultimately contributes to the social and economic well-being of African people across the continent.

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