Monograph "Redefining the Digital Divide in Higher Education"

ARTICLE

Infrastructure, Human Capacity, and High Hopes: A Decade of Development of e-Learning in a Tanzanian HEI

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Abstract

Tumaini University, Iringa University College in Tanzania began to develop technology-enhanced learning in 1999. At the beginning of the process, the college had no public computer laboratories. The e-learning capacity was gradually developed over the following 11 years: computer laboratories, a local area network, an electronic library collection, a dedicated IT support department, Internet connections, electronic presentations, a B.Sc. program in IT, video lectures, and online learning. In this article, we analyse the complex network of challenges that we faced during the development process. We discuss technical issues with ICT equipment, system administration, and networks, and we analyse socio-cultural issues with training, funding, and pedagogy.

Keywords

e-learning, developing countries, IT education, technology enhanced learning, e-pedagogy

Infraestructura, capacidad humana y grandes esperanzas: una década de desarrollo de e-learning en una institución de enseñanza superior de Tanzania

Resumen

La Escuela Universitaria Iringa, de la Universidad de Tanzania, empezó a desarrollar el aprendizaje mejorado gracias a la tecnología en 1999. Al principio del proceso, la escuela universitaria no disponía de laboratorios informáticos públicos. La capacidad de e-learning se desarrolló gradualmente durante los 11 años siguientes: laboratorios informáticos, una red de área local, una colección de biblioteca electrónica, un departamento de soporte TI dedicado, conexiones a Internet, presentaciones electrónicas, un programa de licenciatura en TI, conferencias de vídeo y aprendizaje en línea. En este

artículo, analizaremos la compleja red de desafíos a los que nos hemos enfrentado durante la fase de desarrollo. Tratamos temas técnicos con equipos TIC, administración de sistemas y redes, y analizamos temas socioculturales mediante formación, financiación y pedagogía.

Palabras clave

e-learning, *países en desarrollo, educación TI, aprendizaje mejorado gracias a la tecnología, pedagogía electrónica*

1. Introduction and background

Various kinds of e-learning solutions are frequently presented as panacea for all problems in education (e.g. Bork, 2003). There is a plethora of initiatives that aim at improving education through the introduction of information and communication technologies (ICTs), each initiative from its own viewpoint. Take, for instance, mobile learning (Masters, 2004), the One Laptop Per Child initiative (Kraemer et al., 2009), open content repositories,[www1] TV-broadcast classes (Bitew, 2008), and lecture podcasts (McKinney et al., 2009). There are massive online repositories of all kinds of best practices and guidelines for using ICT to support all levels of education, published by, for instance, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the Institute of Electrical and Electronics Engineers (IEEE), as well as numerous other groups in the EU and the United States.

Implementing various e-learning solutions in developing countries has, however, often turned out to be problematic (e.g., Bitew, 2008; Masters, 2004). Differences in geographical and economic conditions, different educational backgrounds and pedagogical views, language and content issues, usability and technical literacy issues, attitudes and prejudices, and even differences in climate have posed challenges to initiatives in technology-enhanced education. There definitely are success stories in e-learning, but the challenges unfortunately often go unrecorded and unreported. In this article we portray a story of a long process of developing e-learning in a Tanzanian higher education institution, along with the successes and challenges of the process. Our process is not over – and it never *should* be over – but after more than ten years of work on this topic at one location, our experiences in this field have crystallized into a number of lessons learned. In this article, we describe a number of ups and downs of the process that has taken us to successfully and sustainably utilize e-learning in Sub-Saharan Africa.

1.1. Tumaini University, Iringa University College

Iringa University College (IUCo) of Tumaini University is a higher education institution (HEI) organized under the Evangelical Lutheran Church of Tanzania. The college was established in 1994, and today IUCo is one of Tumaini University's six constituent colleges, others being Kilimanjaro Christian Medical College, Makumira University College, Dar es Salaam College, Stefano Moshi Memorial University College, and Sebastian Kolowa University College. Iringa University College is located in the north-eastern corner of Iringa town in the southern highlands region of Tanzania, 502 km inland from Dar es Salaam. Iringa town is the capital of the Iringa region, and the town has a population of about 150,000 people.

Iringa University College is the largest of Tumaini University's constituent colleges, and it offers degree courses in five faculties: Law, Business and Economics, Arts and Social Sciences, Science and Education, and Theology. Student enrolment at IUCo has increased steadily throughout fifteen years of history. Currently the college hosts around 3,000 students with a roughly 1:1 female/male ratio. Most students are high school graduates from Tanzania and neighbouring countries (e.g., Botswana, Burundi, Rwanda, Uganda, Zimbabwe, and Kenya), and the college annually attracts foreign exchange students. Although the college was founded by the Lutheran (Christian) church, students from all religions are admitted, which contributes to the diversity of the college's student population: IUCo's students form a diverse mixture of cultural, ethnical, tribal, national, and religious backgrounds.

[www1] http://ocw.mit.edu/

Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen

UOC

1.2. Historical overview

The first plans for developing IUCo's ICT and e-learning capacity were drawn up in 1999. An American volunteer drafted plans for IUCo's future ICT activities, and those plans involved a general vision, goals and objectives for ICT-related development of IUCo (Kemppainen, 2006:64). At the beginning of 1999, IUCo had eighteen 486/386-level computers running Windows 3.1 / Microsoft Office 4.2, as well as twelve matrix printers for students, teachers, and staff to use. The technical aspects of the plan were gradually developed by local staff and a foreign expert who worked for the Finnish Evangelical Lutheran Mission. Iringa's climate and environment, as well as IUCo's existing infrastructure, posed severe challenges to the whole project, which took several years to overcome (Kemppainen, 2006).

The first plans, however, did not take the local context into account sufficiently well, and more tangible steps for developing IUCo's ICT facilities and e-learning strategy were taken in 2000 in a plan that outlined development of a local network, a library, computer classrooms, and technical support (Kemppainen, 2006:64). ICT facilities were improved in a project between 2001 and 2003, the Internet connection was updated in 2002, the ICT department and its own budget were established in the 2002–2003 academic year, library facilities were improved between 2001 and 2003, and the ICT facilities improvement project continued in 2004.

Since then, Tumaini University has focused on maintaining and expanding its computing infrastructure, on developing shared resources (such as shared printers as well as shared teaching folders for teachers to distribute

their material), and on educating teachers to use modern presentation tools to support their lectures. In 2005, we upgraded our Internet connection from 128/64 kbps (operated by TTCL, who at the time lacked qualified staff and suffered from service problems) to a 704/128 kbps (operated by SimbaNet). In 2006 the Tanzania Education Authority (TEA) donated 100 new Pentium 4-level computers to the college, which enabled us to take all Pentium 3-level Windows 98 computers off the local area network, tremendously increasing network security. In addition, TEA provided IUCo with two heavy-duty printers, which made it possible to centralize printing for staff and students. Before that, if students wanted to print out documents, they gave their text on a disk to an assigned printer operator, who printed the text and returned the printouts and diskette in an envelope.

After several years of planning, IUCo started a modern, contextualized IT program in 2007 (Tedre et al., 2009b). This program was established to educate IT professionals who have the necessary knowledge and skills for IT work in the environmental, economic, and sociocultural context of Tanzania and the Iringa region. The next steps in development of e-learning were taken along with the establishment of the IT program. The program introduced the e-learning and content management platform *Moodle*, and the aim of the program coordinators was to first introduce *Moodle* in a few classes, then extend its use first to all classes in the IT program, after that to all classes in the Faculty of Science and Education, and finally to introduce *Moodle* throughout the university. The overall history of development of technology-enhanced learning at Tumaini is presented in Figure 1.
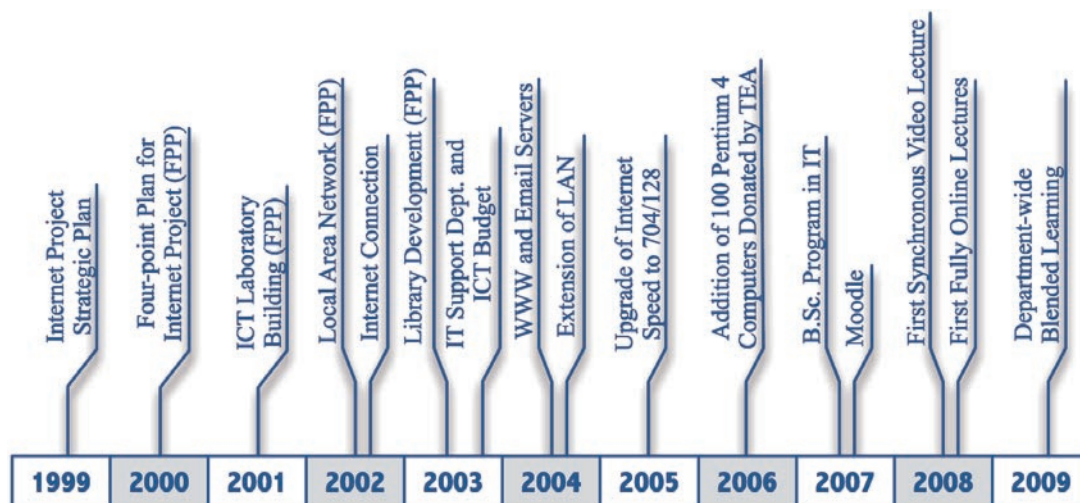

Figure 1. History of e-Learning at Tumaini University / IUCo
Source: Own material

Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen

The pace of development in Figure 1 may seem slow, but it certainly did not feel like that at the institution (see, e.g., Kemppainen, 2006). A number of international visitors have contributed to IUCo's e-learning as well as to the college library's electronic databases and collection. Previously, charities donated most of IUCo's ICT equipment, which was a mixture of various brands, ages, and conditions, and thereby meant a significant amount of technical work at the college. The development was planned in collaboration with local university management, foreign experts, and, at some point, with the end users.

We, the authors, have been with the university from the beginning of the development of technology-enhanced learning at Tumaini University and over the years we have gained significant first-hand knowledge about technology-enhanced learning in Tanzania. In the following chapter we discuss six aspects of e-learning that must be understood in their context of implementation in order to successfully utilize ICT in everyday teaching practices. We describe some of our successes, as well as some of the challenges we have faced along the way (some of which we have not yet overcome). First we discuss the technical issues of the equipment. Secondly we discuss some well-known issues of networking in Sub-Saharan Africa. Then we give an overview of the challenges of system administration work in Iringa followed by a discussion of staff training issues in a broad sense. In the fifth point, we briefly consider some financial concerns and finally, we present some open questions about e-pedagogy in Tanzania.

2. Challenges and Prospects of e-Learning

It is often the case that project successes are reported to funding agencies, at conferences, and in journals, but challenges and mistakes are glossed over (e.g., Smillie, 2000). There are various reports of miracle projects that have used modern information and communication technologies in novel ways to empower individuals, communities, regions or groups. Numerous success stories have been told about transformational technological interventions in developing countries (e.g., Jensen, 2007). In addition to our successes, in this article we also discuss some of the challenges that we have faced during more than ten years of development of technology enhanced learning at our institution.

The reasons for successes and struggles with development of e-learning at Tumaini are various, yet in this chapter we paint a picture of the complexity of myriad factors for development that we faced during the development of various aspects of e-learning at IUCo. Although some aspects presented in this chapter are unique to IUCo, many of them can be generalised to East Africa, other developing countries and industrialised countries.

2.1. Equipment

One of the most topical issues at IUCo is the lack of computers available for students. A sufficient number of available workstations on campus is a *sine qua non* of computer-based learning – especially at IUCo, where we cannot expect students to have computers at home. Although quite a large percentage of IUCO's students (38%) have access to a computer at their homes (Tedre & Chachage, 2008), not all of these computers are in good working condition or can only run very old software. In addition, although in a previous study 8% of students reported that they have an Internet connection at home (Tedre & Chachage, 2008), the costs of pay-per-megabyte Internet and slow speed usually render distance learning over the Internet unfeasible.

The current number of computers on IUCo's campus does not permit large-scale e-learning or blended learning practices, except in the IT program, where the student/computer ratio is 1.9:1, and where students can access computer labs around the clock. A calculation of how much computer time is allocated to each of Tumaini's 3,000 students paints a bleak picture. The current ratio of 3,000 students to 50 public computers, with 94 hours per week of operational time in the public computer laboratory, equals a weekly quota of 1.5 hours per student. We have, however, set a target of 4 hours per student per week.

A time quota of 4 hours per week per student does not allow e-learning on a large scale. In order for e-learning to succeed, students should have enough computer time to first read lecture material on screen; secondly, search the web for additional readings, and then do their exercises and type them in at the computer lab. The first item on the list – being able to read class material on-screen instead of printing it out on paper – is essential to e-learning. This is due to the fact that printing out material on laser printers is prohibitively expensive for IUCo's students (roughly 600 Tanzanian shillings per page), and the benefits of electronic content delivery do not justify such extra costs for students. If large numbers of paper copies are needed due to a lack of computers they can be used for class reading material, as offset printing is significantly cheaper than laser printing in Tanzania.

The second item on the list – being able to search the web for resources – is often necessary for homework and essays, as well as for supporting students' own study and

Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen

UOC

research interests. And the third item on the list – being able to return homework in e-learning or content management system – is one of the basic functionalities of e-learning. Taking only these three basic functions into account, four hours per week is barely enough for one course, not to mention several courses. Furthermore, any additional e-learning function, such as self-administered quizzes, collaborative learning, or streaming video, each requires additional computer time per student. In order for each student to get 20 hours of computer time – which we consider to be enough for abandoning the system of time allocation – the college would have to install 588 additional computers for students. That is a tenfold increase: we have calculated that it would require a large new building with 10 large computer laboratories, it would triple IUCo's electricity bill, and if those computers were connected to the Internet, it would render our outgoing Internet connection useless. As most large grant and funding agencies have a policy of only working with national universities, our funding applications have often been rejected out of-hand without reading our application.

Also, the small number of available computers causes problems with practical examinations. Practical examinations and computer-administered examinations are difficult to set up, because each student should sit at one computer for a certain period of time. As groups are quite large, there are not enough computers for the whole class to take the test at the same time, which causes logistical problems at the college. In addition, as all the computers are running at maximum usage, they are prone to mechanical wear and tear, recurring hardware and software problems, and epidemics of viruses. We have recurring problems with power: brownouts, shortages, blackouts, and power spikes. The harsh natural environment damages computing equipment through, for instance, dust, dirt, heat, humidity, and UV radiation (Brewer et al., 2006). When equipment breaks down, we find that manufacturers' support networks are far from sufficient in Sub-Saharan Africa, that warranty terms are usually poorer than warranty terms in industrialised countries (Tedre & Bangu, forthcoming), original parts and quality tools are not readily available, and counterfeit business as well as piracy are rampant. Most of the time several computers from the students' computer lab are undergoing maintenance, waiting for spare parts to arrive.

2.2. Networks

The high cost of bandwidth constitutes a serious obstacle for IUCo to benefit fully from e-learning efforts. Until June 2009, Tanzania's only Internet connections were satellite-based, and the Seacom cable[www2] that arrived in Dar es Salaam in July 2009 is not expected to relieve IUCo's situation in the very near future. That is due to the fact that there is no national Internet backbone that can deliver cheap and fast connections to Iringa. It is also uncertain how much the Seacom cable and the competing Eassy (Eastern Africa Submarine Cable System) cable[www3] will lower prices, for according to the current plans neither will be opened for free markets, which could potentially discourage price drops and hamper the reach of the national network. Although the Tanzanian government has made great progress in this matter, there are some voices of pessimism. Southwood (2009) attributed the failures of broadband cables in West Africa and Kenya to governments' and service providers' self-interests and blocking tactics, and called some aspects of that regulation "highway robbery".

Currently IUCo pays more than 4 million shillings (2140€ ≈ 3100$)[1] per month for a dedicated 704kb/128kb satellite connection that serves the college's 300 computers. In comparison, a basic European home Internet connection of 2Mb/2Mb fixed bandwidth costs roughly 20€–30€ per month. In addition, IUCo's Internet connection is often down for hours, sometimes days. With the current transmission speeds, even with the current number of computers at IUCo it is difficult to utilize externally stored e-learning material in teaching. Currently it is almost impossible to read online e-books. It is impossible to watch streaming educational videos or do distance video teaching between 8:00 and 22:00. Local mirrors and caches do help, but they do not allow free search of material on the Internet.

Mobile phone operators play an important role in providing Internet connections to Tanzania. The mobile phone data connection is potentially very fast in urban areas, notably in Dar es Salaam where 3G or HSDPA (High-Speed Downlink Packet Access) can theoretically reach 14Mbps speed. But in rural areas, GPRS (General Packet Radio Service) speed is the norm. Second-generation GPRS usually provides 56kbps speed, which in Europe and the U.S. was a common modem speed at the turn of the century.

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1. Currency amounts calculated using October 3, 2009 mid-market rates.

[www2] http://www.seacom.mu/

[www3] http://www.eassy.org/

*Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen*

UOC

Our experience of mobile Internet in Tanzania, outside Dar es Salaam, is that it is sufficient for text-only email and very light web surfing. Mobile network coverage in Tanzania is, however, far from extensive (no official data is available). In addition, unlike the typical situation in industrialised countries, the bottleneck in Internet connections in Iringa is not always the last-mile connection between the user and the mobile phone tower. That is because instead of a fibre-optic cable, Iringa is connected to Dar es Salaam by microwave links, which have narrow bandwidth and are affected by environmental effects, such as rain fade. Microwave links are, nevertheless, usually UPS-protected and generator-powered, which keeps Internet connections up even during large-scale blackouts.

The concerns with networks in Tanzania are not limited to the Internet and mobile phone networks. Tanzania's power-distribution network poses another major challenge to nation-wide prospects of e-learning. According to the African Rural Energy Enterprise Development (AREED) project of the United Nations Environment Programme (UNEP), only 6% of Tanzanians are connected to the national power grid (AREED, 2009), and most schools do not have power. In addition, the electricity supplied is not stable, and fluctuates during use, which affects durability and reliability of ICT equipment. Uninterruptible power supplies (UPS), power surge protectors, and voltage stabilizers can be used to protect equipment from power problems, yet protective equipment is costly and requires additional knowledge of the whole system, that consists of computing equipment and software, power protection equipment, electrical grid and wiring, grounding, shielding, and the environment.

2.3. System administration

Most system administrators in Tanzania hold a certificate in IT, often from a theoretical track, and many get their practical experience through trial and error during their first years in the job. Similarly, IUCo's IT staff gain their practical experience slowly, by working at the college, which means that occasionally, small problems escalate to system-wide problems. In Tanzania it is not always the case that system administrators work proactively and methodically to secure systems from failure, secure data from loss, or ensure availability of spare parts in advance. Instead, problems are often fixed when they arise, which causes minor problems to grow disproportionately before anyone deals with them and which slows down service and sometimes halts productivity. The country's prevailing theoretical orientation to ICT teaching, lack of practical training, and

the unique challenges of the Tanzanian infrastructural and socioeconomic context contribute to the poor situation in all institutions.

As an example of issues with inadequate training of system administrators, we found that the reason for our Sun Solaris thin client system's frequent problems was the practice among some staff members to just switch off the server power instead of properly shutting down the system, which led to broken files, broken links, and accumulation of cache garbage, which in turn led to system irregularities and finally to complete malfunctioning of the system. The reason for the problem is clear: when the system was set-up, our IT staff were never trained to shut down a Unix system, nor were they taught about the problems that a hard shutdown or cold boot can cause in the system. Similarly, in 2004, all our servers and UPSs were configured for automatic shut-down in case of power cuts, but in 2007 none of the configurations worked anymore due to hardware problems and system re-installations. At some point each power cut (which are frequent in Iringa) indeed cut all running systems off, which compromised the university's email system, Active Directory and file servers, proxy and printer servers, and all other vital IT functions. Many users are still unaware of the importance of shutting down the system properly in case of a power cut – many continue to work until the UPS batteries run out. Usually, power cuts are shorter than 15 minutes, and a UPS can provide power over the whole blackout period, which gives some users a false sense of security.

Counterfeit products are a continual problem for system administration in Tanzania as well as in other developing countries (OECD, 2007). It is often hard to distinguish a counterfeit product from an original one, and sometimes vendors sell counterfeits as originals (at the price of an original product). Economic constraints also often force system administrators to purchase cheap alternatives – which may, in the long run, turn out to be more expensive as cheap equipment breaks down more often, causing lost workdays and increasing the need for spare parts. Major manufacturers have set their computer prices high in developing countries, and currency exchange rates are rarely favourable to Tanzania.

Rampant malware (viruses, adware, Trojan horses, spyware, and worms) is another headache for system administrators at IUCo. In fact, malware seriously hinders the use of ICTs for effectively supporting higher learning throughout Tanzania. Popularity of Internet cafes (we call them "virus cafes") makes matters worse, as students use their USB sticks in Iringa Town's Internet cafés, where there is usually no virus protection. Students then use these

USB sticks on campus. This is something of a paradox, as Internet cafes offer a wonderful service for people who cannot afford to buy their own computers or cannot afford a permanent Internet connection, yet those same cafes put our systems at risk. As with vaccination, there needs to be a certain level of saturation of anti-virus measures in order for them to be really effective. Over the 11 years of developing Tumaini's ICT facilities, the virus situation has gradually improved, but vulnerable points remain, and once in a while a virus attack paralyses our network. IUCo pays an annual fee to an antivirus software company, but, occasionally, late payment of fees or failure of centralised updates cause virus definition databases to expire.

2.4. Staff and Training

Resistance to change is another hindrance to e-learning all around the world (Henderson, 2003). A notable portion of Tanzania's academic and support staff received their education in the conventional, rather instructivist or even behaviourist educational system, where the teacher is a guru and where the students' role is to receive and store knowledge instead of actively processing or creating it. In addition, most staff members in Tanzanian higher education institutions never used modern e-learning tools in their own studies, and hence have no previous knowledge on how those technologies could or should be used.

At IUCo we started teaching the basics of technology-enhanced learning by introducing teachers to electronic presentation tools as well as by teaching them to use shared "teaching folders" on our intranet. Each teacher has a shared network folder, which is used for delivery of study material. Many teachers utilize those folders for content delivery, but implementation level is still relatively low. In addition, teaching folders are only available on computers running under Windows. Regarding presentation tools, the university management attempted to support electronic presentations by obtaining a number of data projectors and laptops, which could be moved between lecture halls. Unfortunately, a number of enthusiastic staff members adopted the laptops for their own offices, and other dedicated staff members locked the data projectors in their offices so that they could always have a data projector available for their lectures. We solved the issue by installing a ceiling-mounted fixed projector and a dedicated, cable-locked laptop computer in each larger lecture hall. Staff members use this equipment very often for their presentations, although the implementation and development process is still underway.

Another of the problems that we face concerns lack of confidence in the security of e-learning material and equipment. There is a widespread opinion in Tanzania that electronic data transfer and email are not as secure and private as paper-based traditional methods. For instance, Tanzanian lawyers are discouraged from using electronic correspondence with clients. When we suggested a highly reputed CEO a total online solution for his company's banking needs, his response was: *"I don't trust these online services, I want to sign all my checks personally."* This fear is also reflected in the worry that it would be easier to steal teaching material if this were stored on-line, than if the same material were on paper. The issue of immaterial property rights is, in fact, one of IUCo's biggest hindrances in shifting to blended learning using *Moodle* or other content delivery platforms.

The issue of immaterial property rights arises from some deep-rooted misconceptions about education. Many staff members in Tanzanian universities consider their lecture slides and other lecture material to be the biggest asset in their work. It seems to us that many lecturers feel that if their material is made available to students for downloading, the lecturers will risk their most important asset being copied from student to student, finally spreading to competing organizations and to competing educators. They seems to reason along the lines of: *"If all my competence is packed on a series of lecture slides available for students and staff, what ensures that the university will not fire me and continue to use my lectures after I am gone?"* Rarely do teachers seem to think that their expertise and teaching abilities are more important than the material they use. Not only do such attitudes undermine e-learning but they especially discourage creation of open courseware, even though teachers are not opposed to *using* open courseware.

The attitudes of universities' managers towards ICT tremendously affect the success of e-learning in Tanzanian institutions. Management gives permissions to acquire ICT facilities, approves staff training days, authorizes digital content delivery and open courseware, and is responsible for many other things. Sceptical and resistant management can bring down otherwise well-planned e-learning initiatives, whereas enthusiastic and supportive management can strongly foster e-learning initiatives. We have seen both happen in Tanzania. Luckily, IUCo belongs to the latter group: the university management has been very progressive and open-minded about the possibilities of e-learning, and they have strongly supported e-learning initiatives through various financial, organisational, and pedagogical arrangements.

Finally, governments set policies, laws, and regulations that may support or undermine e-learning initiatives. The

Matti Tedre, Fredrick Ngumbuke and Jyri Kemppainen

UOC

situation is the same worldwide: some governments fail to understand or appreciate the benefits of ICT, whereas other governments have unrealistic plans concerning ICTs in education. Government decisions have proven to be crucial to many aspects of e-learning in Tanzania. For instance, the Tanzanian government has set a 0% import tax on computing equipment that is bought for educational purposes. However, regardless of the tax exemption, computers are still more expensive in Tanzania than in Europe and the United States (Tedre & Bangu, forthcoming). Government decisions on regulation of Seacom and Eassy submarine cables will be crucial for broadband prices and connection speeds, and, coupled with proper building and pricing of a national Internet backbone, could potentially bring Tumaini's connection speeds on a par with the rest of the world. There is, however, widespread pessimism about Africa's submarine cables, as a result of experiences in Kenya and West Africa, where the gatekeepers of the new bandwidth – bandwidth providers and governments – have not been willing to bring the prices down, but instead reap massive profits by selling today's cheap bandwidth at former high prices (e.g., Southwood, 2009).

2.5. Funding

Another factor that hinders IUCo's e-learning aspirations is the common use of part-time staff. Part-time teachers come from other institutions of higher learning and from IT industries, which limits the time and commitment they are willing to spend on implementing e-learning or blended learning solutions. Furthermore, there is a high turnover among regular staff, caused by a nationwide lack of skilled manpower and the pull of industry, where salaries are higher than in universities.

Money, of course, is a persistent question. The income base of many private universities in developing countries is based on student fees, donations, and sometimes government support. Each of these income sources is volatile: numbers of students fluctuate depending on the national and global economic situation, donations depend on the goodwill of donors, and governments vary the amount of their support. In some developing countries, governments seem to consider private universities a competitor to national universities, and sometimes impede their operational preconditions. When a university's financial assets depend on the number of incoming students, there is a constant push to increase student enrolment in order to increase revenue. In the case of technology-enhanced learning the needs for equipment and training constitute a high initial investment cost, along with running costs of supplying the

services, increased electricity bills, and maintenance of e-learning equipment.

2.6. Pedagogical issues

In many developing countries, most students who join higher learning institutions have no ICT-related knowledge or skills at all. Although many schools in Tanzania do have a small number of donated computers (which might actually work and be up-to-date), generally speaking our students are not computer literate when they enter the university. Students' ICT skills come mainly from their experience with mobile phones (Tedre & Chachage, 2008). Upon entering Tumaini University, however, students become frequent computers users. In an earlier study (Tedre & Chachage, 2008) we found that 84% of IUCo's students use the college computer systems weekly or daily, with additional use at Internet cafes (51% use them weekly). In the same study, we found that 92% of students have an email address, and every respondent (n=61 out of IUCo's 2526 students in 2007) owned a mobile phone.

A great number of things that are usually not a concern in industrialized countries – extreme poverty, the post-colonial condition, and tribal traditions – affect the pedagogical approach in Tanzania (Tedre et al., 2009a). Tumaini University students come from a variety of religions, tribes, and cultures, the combination of which makes it almost impossible to find a "fit-for-all" pedagogy (a fit-for-all pedagogy might not be even desirable). Differing views of ethics, debate, modes of working, and linguistic backgrounds create diversity in Tumaini's programs. That variety of backgrounds offers great possibilities for Tumaini's e-learning insofar as it can be used to support students' own learning styles, yet the same variety poses challenges in terms of adjustability and adaptability of e-learning systems.

Today Africa's educational system is a mixture of Western education, Islamic education, and traditional African education (Farrant, 1981, p. 34). These different educational traditions pose a challenge to constructivism-oriented e-learning. One of the challenges of constructivist learning is that often a student's previous education has relied on learning by rote, with individual learning initiatives not encouraged (cf. Tedre et al., 2009a). Hence, many students do not feel they are capable of finding information or coming up with answers or solutions themselves. That leads to challenges in independent work. In addition to lack of confidence, African communalism discourages students from struggling alone with their tasks, although a deep-rooted communalist culture of sharing and helping

Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen

14

UOC

others is a good base for a dynamic culture of sharing and collaborating in academia (e.g., Farrant, 1981, p. 31).

Farrant's (1981, p. 31) notion of communalism in African schools is supported by independent studies conducted at Tumaini. Larsen and Loft Rasmussen (2008, p. 51) reported that Tumaini's IT students collaborate through group discussions, doing assignments together, and explaining lectures and concepts to each other. Teachers in the BSC-IT program have found that collaboration is a much more productive motivator than competition. In line with Farrant's (1981, p. 31) argument, Tumaini's IT students often unite when they demand change. Some clashes arise, however, from different student and staff views on education, for instance, on the syllabus and collaboration. Whereas students perceive only the benefits of collaboration, teachers struggle with side effects such as plagiarism from the Internet as well as copying home assignments from each other (Larsen & Loft Rasmussen, 2008, pp. 58-59).

Western educators have often, and in many ways, failed to understand that an educational system that works well in one context may be a profoundly disturbing force in another (Farrant, 1981, p. 33; Freire, 1970: p.75). Developers of e-learning must take this into account. Farrant (1981, p. 39) argued that the key to successful African education is in an educational system that is truly national, democratic, modern, and authentically African. We do not know what a successful, truly Tanzanian e-learning pedagogy would be, but are currently keeping our e-learning open to all kinds of technical, organisational, and procedural innovations.

A survey conducted at IUCo in 2009 supports continuing development of e-learning at Tumaini University (Tedre & Kamppuri, 2009). In that study, second-year IT students at IUCo, who are the most experienced students at IUCo in terms of e-learning, ranked e-learning to be among the easiest IT-related part of their studies. There was an almost unequivocal (95%, *n*=20) feeling among respondents that the learning management system *Moodle* made studying easier, and most respondents (85%) also wanted to use *Moodle* in the future (Tedre & Kamppuri, 2009).

In IT students' ranking of the most important issues in their learning, aspects of e-learning ranked high on their lists. Access to Internet was ranked second out of 22 items, good web material ranked fourth, PowerPoint slides were considered to be the sixth most important item in studies, yet the availability of PowerPoint slides after classes ranked thirteenth and *Moodle* environment for each course

fourteenth on the 22-item list (Tedre & Kamppuri, 2009). A high number of computers per student was at the other end of that list (16th), as was 24-hour access to computer laboratories (19th). Nevertheless, it ought to be noted that IT students are not a representative sample of the college's student population, as they get unlimited computer time and have dedicated IT labs for themselves, whereas other students have to cope with a 4-hour weekly quota.

3. Future challenges

E-learning offers a number of promises, but the escalating digital divide blocks developing countries from making these a reality. Bandwidth-intensive activities are increasing in number but remain out of reach of students in developing countries. Such activities include, for example, podcasts and video material, video lectures and video conferencing, synchronous collaborative learning over the Internet, as well as most aspects of web 2.0. The arrival of new submarine cables to East Africa have awoken great expectations among universities in Sub-Saharan Africa, but discouraging experiences from West Africa curb enthusiasm. The Tanzanian government has given Tanzania's national telecommunications company the mandate to extend the connection to the whole nation, and the current developments are encouraging. There is, however, little open discussion on this matter, and rationales for decisions are not always made public. We prepare to continue with the current connection situation indefinitely, prepare for a drop in national backbone prices, but we are already looking forward to Google's O3B high-bandwidth satellite launches.[www4]

The growing student population requires heavy investments in ICT to maintain the current level of services. Capital-heavy investments, such as imported technology and buildings, are a problem in most African countries, and as today the European aid is increasingly channelled to budget support, private universities are often ignored. It is important to have a clear plan that links increase of student numbers with ICT purchases – and it is important to also stick to that plan. But even on the technical side, having IT equipment is not enough. When IT equipment is in place, the next challenge that arises is IT support and administration staff. Without competent professional staff, it is not possible to sustain a quality service that is required for e-learning. In addition, sustainable development of IT

[www4] http://www.o3bnetworks.com

Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen

UOC

services is only possible when there are enough people who are motivated to stay with the college long enough for planning and implementing IT projects at technical, organisational, and pedagogical levels.

Our biggest challenges in e-learning on the teaching side are, however, social, cultural, and educational challenges. A small number of technical experts cannot cope with the constantly changing pressures and requirements of technological change. Our first and foremost challenge is getting the staff to feel at home with e-learning software, methods, and pedagogy. We aim at making blended learning the normal mode of learning and teaching at IUCo. This requires continual staff training and development of ICT facilities. Collaboration with our international partner universities, such as the University of Eastern Finland, the University of Southern Denmark, North West University in South Africa, and the University of London at Royal Holloway, offers us possibilities for sharing knowledge and lecture material, for student and staff exchanges, and for research collaboration for developing novel innovations for e-learning.

Success of our e-learning aspirations also depends on institutional issues: governments must stick to the promises of international, national, and regional connectivity.

Multinational corporations, such as Cisco, HP, Dell, and Apple, have a special responsibility to get their prices in Africa down to European and American levels. As we are a small private university, we do not expect much support from international aid projects, but they do play an important role in bridging the digital divide in Sub-Saharan Africa at large.

We started our blended learning experiment with one program, and over the next two years we aim to extend it to all courses in that program. After that, the aim is to involve the whole faculty in e-learning development, followed by extension to all faculties at the IUCo. In 2007 we defined our approach to adoption of e-learning starting with some courses in one department, then extending them throughout the department, then to a faculty, and finally to all relevant courses at the university. Being a leading Tanzanian institution in terms of implementation of blended learning, we hope to lead the way for the whole nation.

4. Conclusions

Comparisons between Tanzania and industrialised countries are not always valid, and neither are recommenda-
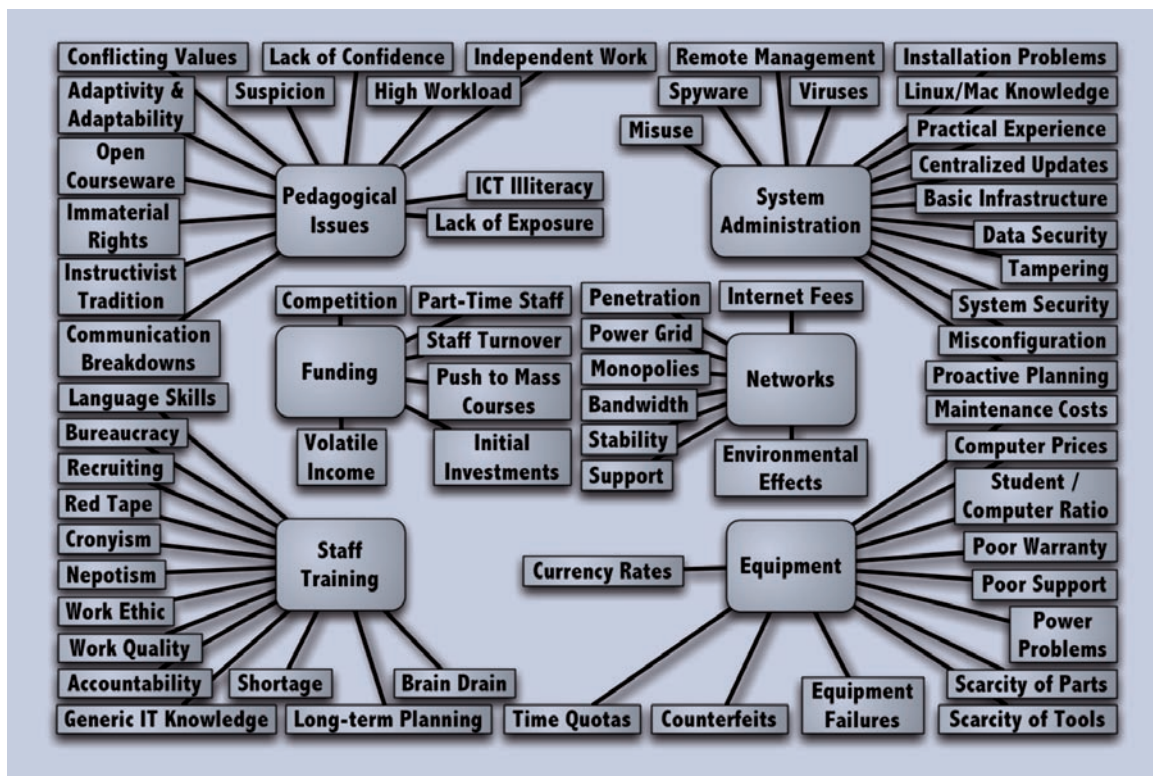

Figure 2. Some Challenges of E-Learning in Developing Countries
Source: Own material

Matti Tedre, Fredrick Ngumbuke and
Jyri Kemppainen

tions for Tanzania's e-learning based solely on success stories in industrialised countries. Online educators in the country must come up with solutions that utilize local strengths, get around the obstacles, and while preparing for global collaboration, respond to local challenges. Many imported technologies do work well, we have successfully used a number of technical tools for supporting learning, but e-learning systems are socio-technical not technical systems. And as socio-technical systems, knowing technology is important, but understanding the sociocultural, economic, and geographical context is imperative for successful projects.

Developing e-learning at the IUCo has been a long process, but we have already witnessed numerous successes that have greatly improved the quality of education at the IUCo. Access to learning material has been centralised and made simple, teacher presentations have improved through the use of presentation software, students will no longer leave the university computer illiterate, a large number of courses have already been taught in a blended mode as well as fully online, and there is an increasing body of knowledge of e-learning pedagogy as well as experience on e-learning. During the development process, however, we have faced many problems which have sometimes required quite innovative and unconventional solutions (e.g., Kemppainen, 2006). Numerous technical and social issues are interweaved throughout the process into a fabric of challenges, where none of the issues stood alone, but were linked with other issues. We present our list of challenges for e-learning in Figure 2.

We faced most of the problems presented in Figure 2 personally. Some of them were dealt with as a result of discussions with colleagues in other Sub-Saharan universities, some remain unsolved, and some cannot be decisively solved but require coping strategies to be designed. While many of the items shown in Figure 2 are very local by nature, many others are also issues in industrialised countries.

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