

A MODEL FOR INTRODUCING AND IMPLEMENTING E-LEARNING FOR DELIVERY OF EDUCATIONAL CONTENT WITHIN THE AFRICAN CONTEXT

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ABSTRACT:- *In Africa, where we have enormous and varied challenges in accessing higher education, there is need for relevant and customized content that is specific to our needs and challenges. Most of the models that exist to address these challenges have their limitations in terms of flexibility, time and space constraints and hence the need to address the mitigating factors. A blend of different types of information and communication technologies can be used in innovative ways in order to resolve some of these limitations. However, the same technologies brings about other challenges such as the costs that are associated and change of attitude and training on the part of the e-content developers. These challenges must be addressed for successful introduction of the same in an educational setup. In this paper, electronic learning is proposed as one of the main ways of overcoming some of the key challenges in accessing education. We argue that electronic learning models should be sensitive to the level of availability of infrastructure, technical support, and clear policy on implementation, evaluation and curriculum re-orientation. We propose an e-learning implementation model that can be used by educational institutions in introducing e-learning technologies to their staff and students. The model is a modification of Rogers' model of diffusion of innovation in organizations and has been developed from experiences and experiments conducted over a period of three years at the University of Nairobi. The steps involved in the proposed model are described and for each step factors that meliorate the situation are identified and put into perspective. System flowcharts have been developed and used to visualize the processes and the interrelatedness of the steps. We have contextualized the model to suit various parametric values that are dependent on cost, level of infrastructural support and staff motivation and commitment.*

Keywords: *E-learning development process model, e-learning modes, e-content, infrastructure*

INTRODUCTION

Classical instructional methods have been used and will continue to be used in the teaching and learning process. However, their limitations in different circumstances vary depending on student and instructor needs, where they are and who they are. Information Communication and Technology (ICT) provides a window of opportunity for educational institutions and other organizations to harness and use them as complementary tools for supporting the teaching and learning process. In this regard the emerging and evolving changes in the teaching and learning requirements and needs will be addressed. E-learning is an example of the use of these ICT-supported teaching

and learning methods whose use in educational institutions is gaining momentum with the passage of time.

In this paper we synthesize our ideas and experiences in the context of developing an e-learning implementation model which can be adopted by educational institutions. The model discusses applicable modes of e-learning and their variations in implementation and content development issues and delivery options. This model is generic and is applicable in a variety of environments.

This paper first presents a background and a justification for the underlying work. It then presents Roger's model and its adapted version for managing the implementation

of new forms of technology mediated learning systems and managing the associated change. This is followed by a discussion of the various options of delivering electronic materials in the context of the challenges typically found in many developing economies. The paper ends by providing a conclusion and making some recommendations.

BACKGROUND AND JUSTIFICATION

Traditional teaching methods and their limitations

A set of processes put together to achieve the expected outcome is known as a strategy. In the field of education, on one extreme are the teaching strategies referred to as expository learning in which the material is available in almost ready-made form and is exposed by teachers in quality and quantity as decided by them. At the other extreme is the strategy known as heuristic where a teacher plays a minimum role in exposing the new learning material and allows the learner to find out, get or create new material. Most teaching methods used lie somewhere in-between these two extremes (Ayot and Patel, 1992).

The underlying principle of these strategies is the mode of thinking or reasoning – all are based on the proportion of involvement of the teacher and the learner in the learning activities. Similarly, the Inductive-Deductive¹ approach, which is based on the order of steps followed in learning new material, underscores the same principle.

It is possible to integrate or combine approaches like inductive and deductive with expository and heuristic strategies. For example, when a teacher draws different triangles on the blackboard, measures the angles and adds them up to 180° to derive a rule, then we may say that the teacher has used an inductive approach, through an expository strategy. In the same way, if, instead of the teacher doing the experimental work himself, he gives different data to different groups of pupils in the classroom, and then puts their results on the blackboard for them to derive a generalization, then he has used an inductive approach through a heuristic strategy.

These teaching methods present themselves into a continuum: from expository to heuristic. Starting with the Lecture method on the expository end, the next in the continuum is the Demonstration method, then the History

method followed by Discussion or Questioning. Others include the Assignment and Supervised Study method and finally Discovery or Inquiry, in that order. As one moves from the Lecture method through to the Discovery method, the learners' participation increases as the teacher's diminishes. Quite often a teacher may combine these methods during a teaching session. However, some methods are better suited for teaching certain concepts or subjects than others depending on the nature of the learners.

These methods underpin on the process of learning and have worked well in the past. However as pointed out in (Grabowski and McCarthy, 1998), we need to re-examine existing pedagogical strategies in the light of new training technologies enabled by the Internet and other electronic messaging and communications technologies. The teaching processes as explained in the above section ought to be modelled in software and correspondingly the teacher's role changes. With software, it is possible to give instruction using a combination of teaching strategies; the success of which is dependent on the design of the software (Omwenga, 2003). Expository methods such as Lecture method are easily modelled as a series of Web pages, which unfortunately may not always serve the same role as lectures presented in a classroom. However, care must be taken when modeling heuristic methods where the learner is supposed to discover the knowledge by himself. The Internet is like a deep ocean with a large pool of resources that are available for grabs, but requires guidance on where to find them. Well-designed Web-based software can provide such guidance (Omwenga, 2003).

There might be a tendency to argue that there is nothing wrong with the current pedagogies for instruction, and that we need to look for the technology that is fit for the particular pedagogy. This argument might be valid but we know that classical teaching methods such as face-to-face are not suitable in situations where instruction must be given at a distance. We also know of some of the failings of such methodologies such as inability to enable learners to learn at their own pace and keep up with new information and knowledge that becomes available day by day (Staes, Nov. 2002). Technology-mediated instructional arrangements supports these two factors and hence the need for e-learning.

¹ On one extreme is the inductive approach in which one starts with some particular examples of the same type of events or a process repeated to study its consistency, and on the basis of constant or similar observations, conclusions are drawn. Once the generalisation is reached, then it can be applied in similar situations to predict phenomena. The method of starting from generalisation and applying it to specific example to justify the principles, is the deductive approach..

ICT and open learning

The possibilities of almost unlimited access to information and global communication offered by ICTs give a new dimension to the concepts of open and life-long learning. An open-learning institution is one dedicated to helping individuals overcome the barriers of entrance requirements, time constraints, financial demands, geographical distances, and social and cultural barriers, as well as those of gender. It is a gradual trend towards the democratisation of education (Harry, 1994).

Emerging technologies provide a means of overcoming some of these traditional barriers to education. They can potentially offer individuals the opportunity to control and direct their learning and continually extend, renew and update their knowledge and skills by providing the possibility of easy access to new developments in all fields of knowledge. When put at the service of the wider community, particularly in educationally and socially disadvantaged areas, the new technologies can become catalysts for both individual and collective development and change.

At the University of Nairobi, for example, a model which was found to work well with off-campus learners utilized existing regional centers (extra-mural centers) of the University. The University plans to use these centers to deliver its academic programmes electronically to both urban and rural communities in Kenya.

E-learning technology

E-learning is a revolutionary way to empower learners with the skills and knowledge they need in a convenient time and space-independent means (CISCO, 2002). It is the online delivery of information, communication, education, and training providing a new set of tools that can add value to all the traditional learning modes - classroom experiences, textbook study, CD-ROM, and traditional computer based training. Old-world learning models don't scale to meet the new world learning challenges. E-learning can provide the tools to meet that challenge. However, E-learning will not replace the classroom setting, but rather enhance it, taking advantage of new content and delivery technologies to enable learning (Omwenga, 2003).

It has been argued that retention for a learner varies, based on content type and the delivery vehicle. The better the match of content and delivery vehicle to a learner's style,

the greater the retention, and therefore the greater the results.

ROGERS' MODEL AND CHANGE MANAGEMENT

Rogers' Model

Rogers' work in understanding factors that facilitate or impede the diffusion of an innovation in an organisation (Rogers, 1983) has served as a valuable theoretical framework in a number of implementation projects (for example, Northrup (1997) and Abou-Dagga and Huba (1997)). Rogers' model indicates that the main attributes that influence an instructor's response and uptake of an innovation in his or her teaching include: (see Table 1)

Table 1: Rogers Model

Aspect	Explanation
Advantage to current practice	being convinced of its relative advantage to the current practice,
Trialability	having a non-threatening way to gain experience before actual course usage,
Observability	that the results of one's efforts to change will be noticed, and appreciated,
Complexity reduction	that the complexity of the innovation be broken down and supported as much as possible,
Compatibility with current practices	instructors can retain control over the intellectual ownership of their courses and as much as possible extend what they already do well, but over time and distance.

Rogers' model has been augmented here to include the overall implementation process which takes into consideration scarcity of resources for effective planning in the use of new didactics, particularly in developing countries. Developing countries may have other priorities other than the use of state-of-the-art technologies in the delivery of courseware. However, we contend that the very priorities may be quickly and better realised if the use of technology for teaching and learning is carefully implemented, managed and sustained. We need to train many people and retrain many more through in-service programs while on the job; we need to offer a variety of course types to a changing student demographic composition while still maintaining quality and standards; we need to free the ever-busy lecturer to engage himself/herself with other activities while still empowering him/her to be in full control of his/her course.

Applying Rogers' Model in Implementing E-learning in Institutions

Implementation of e-learning in institutions requires careful planning and consideration of various factors that may affect the process. In (Omwenga, 2003) Rogers model has been broadened and extended to create a proposed model that caters for institution-wide implications and perspectives during e-learning implementation. Below we present the proposed model.

Table 2: Modifying Rogers' Model to suit our Tasks

Rogers' Aspect	Stage in our Proposed Model
Advantage to current practice	1 - Identify the benefits involved - Cost benefit analysis
Trialability	2 - Evaluation of current status - Establish channels of communication - Sensitization of the benefits, demos, etc.
Observability	3 - Involvement of staff - Training of trainers (TOTs) - TOTs training others
Complexity reduction	4 - Fitting curriculum onto technology and vice-versa - Avoidance of the "not invented here" syndrome
Compatibility with current practices	5 - Changes in policies - Implementation plans and options

Rogers' model assumes that an organization is a stable hierarchical system of individuals working towards a common goal. In contrast, an educational innovation is an evolving, decentralized system of individuals working in partnership towards mutually negotiated goals that fit their personal agenda. It is for this reason that we replicated some of the steps, especially training on e-content development, during the piloting stages.

The model also assumes that an innovation is a stable entity and yet information technology innovations are unstable and evolving. Two factors dictate such an evolution: the environment and the time period of the study. The period in which this model was applied at the University of Nairobi did not experience any drastic changes within the environment of the study.

Another key assumption of the model is concerned with diffusion. Usually, diffusion starts at the top and works its way down the hierarchical organization. In contrast, information technology innovations start as loose partnerships between practicing teachers and available resources, often with support from universities, and they diffuse horizontally because of the typical use of the "trainer of trainers (TOT)" model. At the University of

Nairobi, a key strength in the strategy was the involvement of the entire top-level university management through an awareness and sensitization workshop before we mounted workshops to develop a pool of TOTs.

While taking into account the above assumptions, the proposed model fits into a series of steps, which (Omwenga, 2003) refers to as the "Formative stages of e-learning implementation". Each of these stages translates quite intuitively into a flowchart.

FORMATIVE STAGES OF GOING E-LEARNING

Perceived benefits within a specific situation

Besides the general benefits already identified for using electronic learning environment (ELE) such as on-job training, remote access, flexibility, Just-On-Time training, cost reduction (to student and to course provider), on-demand training and currency of material, different situations may have unique needs which dictate unique implementations of the technology. Such uniqueness may translate into different levels of appreciation of the technology and hence the need to identify and evaluate the perceived benefits of implementing the technology within the specific environment, and project the same over a period of time. Below we consider some of these issues.

Pressures related to the increasing changing demographics of the student population with corresponding increase in the diversity of their needs has had profound effect on the way education is offered. While principles relating to good teaching and learning in higher education may be constant over time, the characteristics of the students in higher education are not. Students in the normal intake routes, directly from secondary school and resident at or nearby the physical campus, are being joined by increasingly diverse cohorts, diverse in age, educational backgrounds, experiences, distances in which they live from the campus, and even cultures and native languages (Langlois, 1997). Lifelong learning is not only becoming a desire but a necessity, in a context of increasing career mobility (Krempf, 1997). Students will increasingly require educational programmes tailored to their own situations, rather than fitting a standard model of the young full-time student, living on the campus and needing a full range of courses for a certain degree. There are moral, social, and financial reasons to adjust university programmes to these increasingly diverse cohorts. But how do we maintain a commitment to the principles of good teaching and learning described above as students have increasingly different needs and situations? How do we do this while retaining

respect for students' needs relating to efficiency and clarity, and to instructors' constraints relating to time? We believe the answer is in more flexible education.

The need to provide more-flexible education

Flexibility means allowing the learner some critical choices in the learning situation so that it better meets his or her needs and individual situation. There are several aspects of flexibility. These relate to time, content, entry and completion, instructional approach, learning resource, technology use, interactivity and communication, course logistics, as well location (Collis, Vingerhoets and Moonen, 1997).

Given all the possible permutations on individualisation that can fall under the category of making our instruction more flexible, the following have been identified by (Collis, 1998) as the most important for combining principles of good teaching and learning with the needs for increasingly diverse student cohorts:

Improving *flexibility in location* of where a learner can carry out different learning activities associated with a course.

Improving *flexibility in programme* e.g in taking care of learners previous experience, subgroups of courses can be chosen in terms of the learner's needs and interests.

Improving *flexibility in types of interactions* within a course

Improving *flexibility in form of communication* within a course, so that learners and instructors have a wider variety of ways for more targeted and responsive communication.

Improving *flexibility in study materials*, so that students have a wider choice of resources and modalities of study materials from which to choose.

Evaluation of Current Status

The next stage is that of making a decision on whether to proceed with the plan or not. Although the analysis of the benefits may yield a favourable outcome, one need to consider other factors that may hinder successful implementation of the technology. The current status must be evaluated in order to establish what kind of technology that already exists and the merits and demerits of engaging the new technology vis-à-vis continuation with the existing ones. Is there a need to repackage courseware for use in the new technology so as to realise better results? What is

the institution's policy and strategic plan in the use of new training technologies? Would the necessary support be forthcoming? How will the use of the new didactics benefit different students studying using different modes, e.g. regular students (full-time, face-to-face), module II (part-time, self-sponsored) and external students, for example, in the University of Nairobi? Is there commitment from the staff and do they see the competitive advantage of implementing the new technologies? These are some of the pertinent questions that need to be answered.

While still on the process of decision-making, we need to establish the status of the infrastructure on which the implementation of the new technologies will be done. How well does that infrastructure fit into the problem at hand? If not, then what options are available to enable a viable implementation of the new technologies? What combinations of technologies are suitable for the particular situation?

Curriculum Vs. Technology Fit

The next stage is to match the curriculum into the technology and vice-versa. To match curriculum into the technology will need the engagement of the various actors in the development of courseware in order to avoid the "not invented here" syndrome. Curriculum changes might be necessary to enable implementation (e.g. use of multimedia, reorganisation of content, inclusion of certain courses such as "introduction to computers"); while implementation of the technology might need to be modified to suit the curriculum (e.g. use of CD ROMs where Internet connectivity is too expensive or not available or establishment of e-learning centers is not possible).

The Implementation Plan: Observability and Complexity reduction

The stage that follows is the development of an implementation plan and carrying out the necessary projections. Having made the decision to go ahead with the implementation, having been given the necessary support from the relevant arms of the administration and having demonstrated that the technology is viable, we need to develop an implementation plan with milestones and achievable targets. Various implementation options need to be considered and costed accordingly.

Rogers' model identifies two stages that deal with the implementation of the technology: the Observability and the Complexity reduction stages. At the Observability stage, we need to involve staff in the process of implementation. On the other hand, as we break up the implementation

stage into atomic sub-stages, we are also reducing complexity in the implementation process. The exploded version of the overall deployment model as shown in Fig. 1.2 gives a detailed account on how this is done. For instance, as we establish the e-learning modes that fit the situation and then tackle context-specific issues, we are in a position to identify appropriate technologies for each of the modes selected. In essence we have simplified the process even further.

Below we represent this model, using flowchart diagrams. This model is currently being used to implement a University-wide e-learning pilot at the University of Nairobi - Kenya. Data collected from the pilot will be used to enable extensive validation techniques to be applied.

Figure 1 gives the overall e-learning deployment model. Benefits analysis will spell out the reasons for deploying the technology while evaluation of the current status (Figure 1.1) is the stage that will establish what exists and the appropriateness of that technology for the curriculum. Then the rest of the stages will follow possibly with iterations if some of the results of the post-implementation review are not adequate. During the study, a detailed questionnaire was used to collect the information. A cross section of staff who included management staff within the university were asked to give their views on issues pertaining to specific stages. Their responses were evaluated - results of which were used during subsequent stages. For instance, in Figure 1.2, we needed to know when to accept a pilot as adequate or not. To answer this question, we relied on information collected from the staff who went through the system. Valuable feedback was given and it was evaluated. The staff made presentations and areas of weakness were identified and corrective measures made. The process was iterative in nature and up to four pilots were conducted. At each stage of the process, and at each subsequent pilot, adjustments were made in order to accommodate the new ideas.

IMPLEMENTATION AND COMPATIBILITY WITH CURRENT PRACTICE

Figure 1.2 is an explosion of the Implementation phase in the Overall E-learning Deployment Plan shown in Figure 1.1. The eleven stages involve establishing appropriate e-learning modes and tackling context-specific issues for the deployment of a mode before content is developed, validated and then mounted into the ELE for piloting. Experiences from the pilot will help identify any shortcomings with the ELE deployment model, make the necessary changes and then carry out further review. We consider each of the stages of this flowchart and give an account for each as far as this study was concerned.

Overall E-learning deployment model

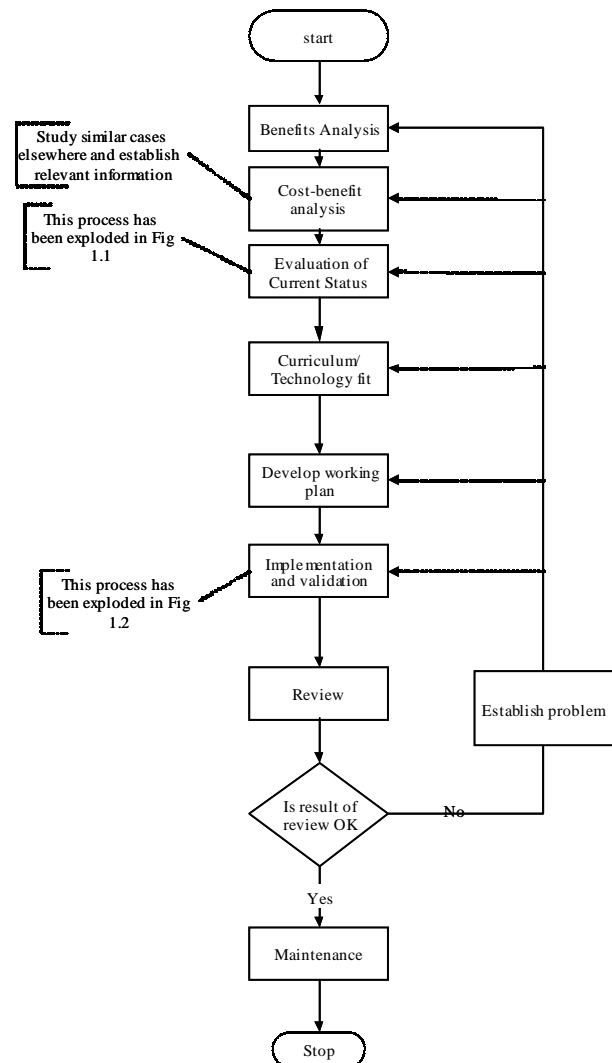


Figure 1: Tentative Overall View of the Model

CHOOSING AN APPROPRIATE MODE OF E-LEARNING

A combination of synchronous and asynchronous modes of communication provide a more comprehensive e-learning implementation. Bulletin and message boards and other chatting techniques enable synchronous learner-learner as well as learner-instructor communication. Email is an example of asynchronous communication. All these modes of communication are possible within an intranet and Internet availability may not be mandatory. However, for external communication, one needs to have Internet connection to enable synchronous mode of access while email is used within a store-and-forward configuration.

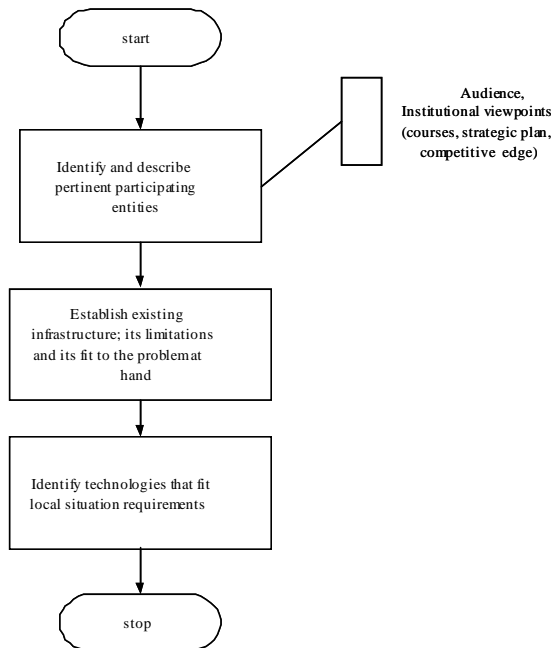


Figure 1.1: Evaluation of current status

Most university campuses in developing countries are rapidly developing Internet infrastructure and the above modes of access are increasingly becoming possible. However, in order to offer off-campus programs using e-learning, a number of limitations must be overcome. Besides dwindling finances, existing infrastructure to support distance education may not be available or adequate. Electricity and telephone facilities are still lacking in most areas and where they are available, the cost can be prohibitive.

In order to overcome such barriers, there needs to be a change of attitude and resolve that with careful planning, we can formulate appropriate technologies that can be beneficial to dispersed learners. We propose some alternatives for solving these limitations.

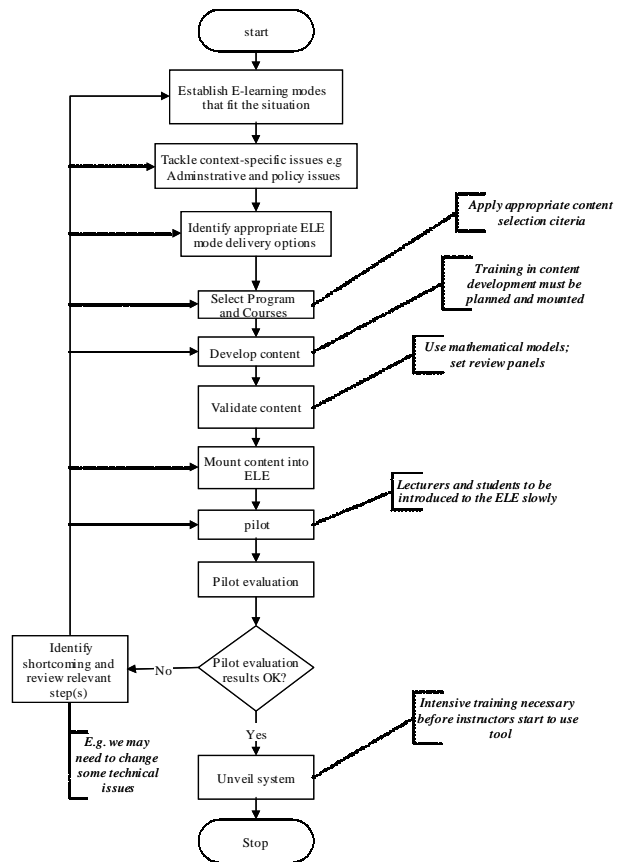


Figure 1.2: Implementation

Offline access of content on CDs with regular updates (e.g Monthly or weekly)

This remote access option offers a practical way of solving the problem of poor infrastructure in remote parts of the county-side in developing countries. These CDs can be used in e-learning centres or in home computers, which may be shared among friends. Distance learners may also use these CDs in cyber cafés or hired computer facilities in nearby urban centres. The CDs may be regularly updated or replaced and students can follow missed online discussions and correspondences from the Instructor.

Offline access with dial-up

This option will enable a learner to access content through a dial-up connection and download current content together with any missed synchronous communication. In this case the learner may send email to colleagues and instructor.

Online access at cyber cafés or at e-learning centres

This option has a promising future as the cost of Internet comes down. Effective policy formulations may see cyber cafés lowering costs as they respond to challenges of “education for all” initiatives. Individual universities may wish to invest in e-learning centres which may double-up as extra-mural or community learning centres.

In all of these cases e-learning can serve as an alternative mode of instruction or as a complimentary mode to other instructional methodologies for various learning options. As much as possible we should have options that in their totality are inclusive and not exclusive. Unlike most universities in the developed world which offer distance courses wholly through electronic means including video conferencing and Internet-based tools, mixed modes in which face-to-face classroom teaching and/or printed notes accompany new didactic technologies are becoming common in developing countries.

A new technology of downloading content has been proposed by a company called Worldspace (<http://www.worldspace.com/>). The company’s goal is to create a new form of electronic media with a vision to spread knowledge for the good of mankind. Africa, Asia, the Middle East, and Western Europe are covered using satellite technology. The company’s presence within the African countries is expanding steadily although the technology’s use for educational purposes has not quite picked up. One exception is in the Kenya Institute of Education where the Institute is using Worldspace infrastructure to deliver courses to both primary and secondary schools through cheap receivers. We hope that this technology will outgrow its teething shortcomings and become a viable cost-effective delivery mode.

CONTEXT-SPECIFIC ISSUES

One of the stages of e-learning implementation is to tackle contextual issues that might impede effective deployment of didactic technologies. We have already mentioned infrastructure, cost and attitude. Others include manpower availability, accessibility, and hosting issues, which may vary from country to country.

Skilled manpower for the administration of the e-learning environment’s technical issues is crucial to the success of the methodology. Content must be updated as and when it is necessary, hosted and made available for access. Where CD-ROMs must be cut for remote access, such activities must be done speedily and availed with minimum delay. Configurations at e-learning centres and technical support

need to be handled with a sense of professionalism and with speed.

Although we have described various implementation issues, each will have its own accessibility limitations. For instance the number of shared computers may not be sufficient to mount concurrent online discussion groups or the available bandwidth in a country may not be large enough to allow for effective online access and as such web-site hosting or mirroring may need to be done on a server in another country that can provide more efficient access.

Context specific issues that have a bearing on implementation

The potential benefits, which the new technologies can bring to education, if implemented and exploited effectively do not seem to be in question. However, fundamental issues need to be considered relating to the possibilities and practicalities of integrating them in a meaningful way into education systems. There are major obstacles to their use in educational institutions and the wider community especially in the third world countries. While the problems faced by developing countries are clearly of a very different magnitude, and often of a different nature to those factors affecting developed countries, there are many issues which are common to both. This sub-section will summarize the principal ones.

(a) Costs

The price of hardware and software, although constantly decreasing, remains considerable for many educational institutions’ budgets in most developing countries, with Kenya not an exception. They are also under-equipped with personal computers, CD-ROM drives and appropriate and adequate software packages. In addition to ordinary maintenance costs, the rapid evolution of information and communication technologies implies constant upgrading of equipment and facilities if educational institutions are to keep abreast of these developments in the classroom.

The cost of on-line telephone charges for use of the Internet remains high and it is a major deterrent to the use of Internet in many institutions. Installation of faster connections such as ISDN digital telephone lines or fibre-optic cable, which would in theory reduce time spent on the network, is also expensive.

A 1990 cost analysis of computer instruction in Belize (Rock *et al.*, 1991) showed recurrent, non-capital costs including personnel, maintenance and miscellaneous expenditures

to account for an average 70 per cent of all annual costs. This study observed that “declines in the price of computer hardware will most likely have only a limited effect in technology accessibility for a large number of developing countries”, equipment costs for schools in their study never being higher on average than 20 per cent of total annual costs.

Developing countries are often severely lacking in even the most basic technological infrastructure for widespread installation of ICTs in schools and communities, with wide disparities between urban and rural areas. In addition to the poor infrastructural facilities, education budgets are usually very low, and the scarcity or non-existence of more traditional educational facilities and equipment in many areas often makes suggestions for introducing the sophisticated new technologies into the education system or into grassroots communities seem a denial of reality. However, gradual implementation of these technologies starting from areas which have the basic infrastructure may be the way forward.

(b) Poor Infrastructure

Besides the high cost of using the technology and maintaining it, the existing infrastructure in developing countries is poor. Telephone density in the rural areas is still low while Internet access is concentrated only in urban centers and a few higher learning institutions. In Kenya, the *teledensity* stands at about 0.16 fixed lines per 100 people in the rural areas and about 4 lines per 100 people in the urban areas (Communications Commission of Kenya, June 2001). In terms of telephone penetration factor (percentage of households/offices with a telephone), nationally, about 4.2% of the households have a telephone line. This factor, however, varies widely from 0.1% in the very remote districts to 27.7% in the city of Nairobi. However, most of the telephones in the urban areas are within offices rather than households.

The Government’s objective is to improve telephone penetration in the rural areas from the present 0.16 lines to 1 line per 100 people and in the urban areas from the present 4 lines to 20 lines per 100 people by the year 2015. These targets translate to the installation of over 375,000 lines in the rural areas and 2 million lines in the urban areas. At an estimated cost of between 800 and 1,250 US dollars per line, the total investment is estimated to cost between US \$ 2 billion and US \$ 3 billion, an enormous investment requirement, which calls for new initiatives to attract capital into the sector.

It also calls for institutions of higher learning and the private sector to prioritize investments in this sector in order to accelerate growth in offering Distance Education programs as well as enhancing delivery of educational content in general.

Poor ICT infrastructure in some of the campuses in the University of Nairobi is likely to slow down the implementation of some of the technology-supported instructional methods. We hope that with a new e-learning platform and increased awareness, as well as the desire for more flexible delivery alternatives, the University will find reason to move even faster and extend the existing infrastructure to the remaining campuses, including finding viable and cost-effective alternative communication technologies to distance learning centers out of the city.

(c) Professional competence

Teacher education is considered to be the single most important factor in ensuring the successful use of ICTs in education (Walker, 1989; Duguet, 1989; Lally, 1989). Its importance has tended to be overlooked or underestimated in the development of initiatives for introducing these technologies into educational institutions with the result that projects may fail outright or are never developed to their full potential. This is true not only of developing countries but also of industrialized ones. Teacher education is not only vital for equipping educators with the necessary skills for using ICTs effectively in the classroom, but for helping teachers to overcome their often strong resistance to these technologies and to develop positive attitudes towards them.

Walker (1989) indicates the need for two levels or types of training: 1) an introduction to the technologies and preparation to operate and manage the hardware; and 2) training in the pedagogical use of the technologies. The latter poses a particular challenge since it remains a relatively new area of teacher education with further research needed into the most effective ways of using the technologies to promote learning.

(d) Teacher attitudes

Teachers are likely to resist the introduction of ICTs into the classroom for a variety of reasons. Their unfamiliarity with the technologies, the additional time and effort necessary for their effective use, and perhaps the feeling that ICTs pose a threat to their professional role and image, are some of the reasons for this resistance. We pre-empted potential dangers posed by these threats by constantly

involving the staff concerned in the logistics of implementation, courseware preparation, experimentation and piloting of the e-learning system.

(e) Conflict with the curriculum

Problems arise with much educational software which may be imposed on teachers without their being involved in its selection, development or evaluation. Educational software, such as the e-learning system developed at the University of Nairobi, are very costly and time-consuming to produce. "Serious" educational software are often not being seen as commercially viable products (Cole, 1996; Industry Research Task Force on Educational Software and Multimedia, European Commission, 1996) while educational CD-ROMs are often not curriculum-based and teachers have to spend a lot of extra time devising appropriate ways to incorporate them into the regular curriculum (McFarlane, 1996). Ideally, teachers should be involved in the development and evaluation of educational software in order for it to genuinely meet their needs and be acceptable by them as valid teaching material. In the developing world the issue of educational software poses far greater problems.

In order not to introduce undesirable variables into the system, the requirements specification of the research model was made in such a way as to replicate, where appropriate, the structure of the existing courseware while taking into consideration the objectives of good interface design and user-friendliness.

(f) Lack of technical expertise

In some cases, Kenya like most other developing countries, lack technical expertise in this domain at all levels. Their limited resources mean that the country usually has neither the local capacity to develop the necessary human resources in this field nor the means to attract highly skilled and expensive experts from abroad.

(g) Lack of information

A significant obstacle to the use of ICTs in education in Kenya is the lack of information that is available both to educational decision makers and practitioners. The type of information lacking is broadly of two categories: information about the role and value of these technologies in education and more specific information relating to available hardware and software and how to use it in the curriculum.

(h) Content development

Content is the driving engine of any information system. It is often realised, after beautiful websites have been developed, that there is not enough content to justify the investment and hence failure to update them often. However, for educational purposes, it is not content that is lacking but the development of such content into appropriate modes for use in the new instructional technologies. This is especially worrisome in developing countries.

DELIVERY OPTIONS

E-learning materials can be delivered in different modes. Choosing a mode will depend on such factors as proximity to the Internet facilities, access to the central server where the material is held, and access to computing facilities. A mix mode of e-learning with printed materials, classroom face-to-face teaching, chatting tools and even video-conferencing is sometimes preferred by students. Each combination will suit different situations. Below we describe the four main modes of rendering content.

(a) Content on Media

This is content organized into logical units and made available in portable media such as CD-ROMs. The content may have limited interactivity inbuilt into it. Graphics, animations, audio and video forms of content can be included. This option is quite suitable for students in remote places.

(b) Content on Intranet

Any content on CD can be made available within an intranet as a shared resource. The presentation of such content is largely similar to the one above but limited asynchronous interaction can be enabled by email.

(c) Content on Web

This kind of content is similar to content on Intranet but is accessed using web browsers and therefore can be available on the Internet. An advantage of this, is that content can be regularly updated and made more current.

(d) Content on ELE

An Electronic Learning Environment (ELE) is an elaborate Instructional platform that enables the development and delivery of content to learners. It also supports content

development that follows sound pedagogical principles. Such content can be used for individualised learning within or off campus. Special tools are used for creating such ELEs and the content itself, that is the client to the system, requires people with specialised training to effectively create it.

Through a dial-up connectivity it is possible to enable the above content rendering variations even in situations where the Internet or local area networks are not available.

PROGRAM SELECTION

A number of factors will be considered when selecting a program for which to develop content. A program will comprise several courses which are taught by different members of staff. Selecting a program (and courses) will therefore depend on whether the staff concerned are motivated to participate in content development. In this study, several members of staff from different academic programs were willing to take part.

CONTENT DEVELOPMENT

The next stage in the process of implementation is to develop the content. Content development can be a daunting task. It may involve training of the content developers in the use of the required technologies as well as training them on how to develop the content itself. During the pilots of this study, staff were trained in e-content development techniques before being engaged in developing content in various subject areas.

CONTENT VALIDATION

Group participation in content development was preferred than individual efforts. Working in groups tended to yield better content which required little input from reviewers before deployment.

POSTING OF THE CONTENT

Once the content has been developed and validated, it has to be disseminated through one of the preferred modes either by the content developers themselves (where applicable) or by an administrator in-charge of the system.

CONDUCT A PILOT

The whole study was indeed a pilot. We however designed the various parts of the study in such a way as to allow for replication of some of the steps. For instance it

was possible to conduct several training workshops on e-content development while using the experiences gained to improve on the rest of the process.

PRELIMINARY RESULTS FROM PILOT

The approach taken in testing this model took into account the time constraints within which the activities were to be accomplished. Some of the activities required longer periods to be tested fully while others were validated within a shorter period of time. In this paper we present some preliminary findings in the area of implementation, validation and the context-specific challenges experienced.

Implementation teams

A crucial stage in the deployment of the model was on content development. Adequate training was required before staff were able to develop e-learning content. This was achieved by forming teams of similar interests and encouraging them to work collaboratively in small groups of three or four.

Model validation

It is by using the model that we can validate its viability. Some stages can easily be replicated while others are quite complex and may require longer periods of time to repeat. The implementation phase of the model has been applied to four pilots of training of trainers workshops and results indicate a positive outcome so far.

Feedback from students for Maintenance purposes

Students were involved throughout the stages of implementation. Their feedback was captured during the time they were taking e-learning pilot courses. This information has been used in ensuring that the system is well maintained.

Context specific Challenges

Rogers' model assumes that diffusion will always start at the top and work its way down the hierarchies. While in this study we recognized this fact, we, on the other hand recognized that this can be a shortcoming in information technology innovations. To adequately tackle the problem, we involved both the top university management in terms of giving the process legitimacy and credibility as the innovation tricked down to the level of training of trainers. At the lowest level of the process, it was observed though that staff needed to be trained on how to use the technology. It was not enough to assume that staff should

possess the necessary entry level requirements before participating in the implementation process. The problem of lack of relevant IT knowledge can partly be attributed to the lack of sound ICT policy within the institution where the pilot was taking place as well as a wanting state of the ICT infrastructure.

At the content development stage, staff were concerned with ownership and copyright issues of the content developed. Others were keen to get compensation not only for their participation but also as content developers for courses that they may not permanently be in-charge of. This was an important factor as it impacted on the sustainability of the innovation in terms of the financial and human resource capability.

Finally a challenge that came out clearly and needed attention was the process of content development. It became an extremely challenging issue due to the level of competence, commitment and skill that was required to develop good content. This was resolved by applying a new approach to e-content development called Objective-driven e-content development approach.

CONCLUSIONS AND RECOMMENDATIONS

We have sampled key issues in technology-supported instruction. We have discussed Rogers' model and its relevance in the implementation of Electronic learning in institutions of higher learning. From experiences in the deployment of e-technologies at the University of Nairobi, an extension of Rogers' model has been described and its application in implementing these technologies in respect to change management in e-learning has been presented. The extended model has been presented using flowcharts and narrative descriptions of each step. We have brought out the relevant context issues that should be considered in the deployment of e-learning systems based on the Kenyan context and our early experiences in implementing a pilot e-learning system in the University of Nairobi. We believe that at the end of the pilot, we shall be able to validate the extended Rogers' model. We recommend that other educational institutions implementing technology mediated distance learning should use the model and disseminate their findings in order for other interested institutions to learn from each others experiences. This will in turn increase the chances of successful deployment of technology mediated learning systems for the benefit of individual countries.

ACKNOWLEDGEMENT

The authors wish to acknowledge the support that was given during the period of conducting the study. Many thanks to the Belgian government through VLIR Program, UNESCO/ANSTI and the University of Nairobi for the financial support of one kind or another.

Special thanks to Mr. James Kariuki for his administrative roles in supporting the e-learning system and all the students and staff who have been instrumental in running the pilots.

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