

# Preparing Students for the World of Information and Communication Technology for Development (ICT4D): The Role of the Internet in the Teaching and Learning Process

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## Abstract

A variety of technologies are currently being used to deliver education on the Internet. These technologies include the use of the World Wide Web (WWW) for online lecture notes, newsgroups for collaborative discussions and class announcements, e-mail correspondence between students and instructors, interactive video over the Internet for remote participation in classes and discussions, and virtual reality for exploring three dimensional scenes. Multimedia is increasingly being used in online education to enhance the learning process. A critical question that needs to be asked is *“how effective are Internet-based learning methods?”*. This paper sought to review existing Internet-based technologies and implementations for education with special focus on encouraging developing countries to adopt and use ICTs in their education systems. The paper uses current examples of Internet-based learning and analyses the benefits and limitations to the student and the institution. The paper established that the main advantages of ICTs and e-learning to the student are the flexibility to pursue education at personally convenient times and to progress in the course material at the student's own pace. However, the paper also noted that the feeling of isolation, lack of motivation, or lack of support and feedback can lead students to drop out. The main advantages of Internet-based education for the institution providing courses is the ability to re-use lecture materials, provide links to externally stored resources materials on the Internet, and a potential source of new revenues. A review of technologies and student learning styles showed that no one technology is suited for all students and all courses. The paper argues that technologies should be chosen to support the types of students expected and their learning styles. Individual learning styles are described with examples of appropriate Internet technologies to support each style of learning. A summary of evaluations of these technologies is then given.

**Keywords:** Internet, teaching, learning, World Wide Web, technology, email.

## 1. Introduction

Creativity and innovation have been found to be among the key pre-requisites for development and industrialisation. Today the most important driving factor in creativity and innovation centres on mastering the use of information and communication technologies (ICTs). ICTs, especially the internet and computers, have invaded every sphere of life. More so when we assess how the Internet and computers have revolutionised education systems throughout the world. Thus, if developing countries like Zimbabwe want to catch up with advanced and developed economies, there is no other way except integrating ICTs in education. Embracing ICTs would enhance creativity and innovation resulting in socio-economic development for the benefit of everyone. Today, the world over, people connect to the Internet using multiple devices and social networks. We therefore encourage the education sector to teach learners how to connect to the Internet to widen learning for application of the knowledge to everyday life situations. In this paper we review existing Internet-based technologies and implementations for education. We describe current examples of Internet-based learning and analyse the benefits and limitations to the student and the institution. Individual learning styles are described with examples of appropriate Internet technologies to support each style of learning. A summary of evaluations of these technologies is then given. The paper concludes with suggestions on how to choose appropriate technologies for Internet-based education.

## 2. Statement of the Problem

As already alluded to in the introduction to this paper, ICTs have taken centre stage in development and

education initiatives and debates. In the developed world, integration of ICTs in school curriculum has not only improved the quality of instruction but also the product (graduates) for the industry. Several studies (Keraro and Wachanga, 2014; Abdo and Semela, 2010; Gravoso, et al, 2008; Neo 2007; Egorov, et al, 2007; Rakes, et al, 2006; Kadzera 2006; Rakes, et al. 2006; Abdelraheem and Al-Rabane, 2005; Baylor and Ritchie, 2002; Aggarwal 1995; Nkuuhe 1995) show that teachers' use of ICTs in the classroom sustain students' attention, increase the meaningfulness of abstract concepts, encourage deep processing, and boosts class performance through increased content acquisition. It has been argued that the coming of ICTs calls for modification of students' and teachers' roles as it triggers a shift from teacher-centred to constructivist modes of classroom instruction (Neo, 2007; Rakes, et al, 2006). These developments cause teachers to confront their established beliefs about instruction (Earle, 2002). As these educational innovations change the modes of school instruction in the developed world, they are also felt in different parts of the globe including developing countries like Zimbabwe. This calls for all countries to be alert and strive for better performance through adopting the new technologies, especially with regards use of the Internet in their education systems.

### **3. Statement of Purpose**

This paper sought to review existing Internet-based technologies and implementations for education with special focus on encouraging developing countries to adopt and use ICTs in their education systems.

### **4. Methodology**

This paper is based on qualitative research design. The study made use of content analysis or literature review, and experiential observation as research instruments. The writer is a lecturer at an open and distance learning university that delivers some of its learning resources and information to students through the Internet and cell phones.

### **5. The Internet, E-Learning and Education**

According to Rwambiwa (2001), Internet is a large, international computer network linking users around the world. A network consists of two or more computers that are connected to share data. The Internet uses a combination of phone lines, coax cables, fibre-optic cables, satellites and other telecommunications media. Internet is used by many people for sending and receiving electronic mail or to obtain information on almost any subject.

The coming of massive open online courses has made education really global, and thus today we talk of global education. Usually these online courses are aimed at large-scale interactive participation and open access via the World Wide Web. Some leading universities are making their top professors available free of charge. In Khan Academy's free (open) educational resources learners watch videos on the subjects they are studying either at home or elsewhere outside the classroom ([www.khanacademy.org](http://www.khanacademy.org)). Teachers then use class time to discuss problems, work on ideas, and encourage group collaboration. If adopted by developing countries this innovation is likely to perform wonders. In most developing countries, access to localised resources is limited, text books are out-dated and expensive, and funds for developing new materials are in short supply. Also, access to learning beyond basic education is largely limited by economic status. Therefore, free access to educational resources as in the case of Khan Academy will improve the quality of life for many people who cannot afford a formal education in these less privileged countries.

The scenario described and demonstrated by the case of Khan Academy above is referred to as e-learning. Derek (2003) defines e-learning as the delivery of learning, training or educational programme by electronic means. He goes on to explain that e-learning involves the use of computer and other electronic devices like mobile phones to provide training, educational or learning material. Moeng (2004) defines e-learning as the use of innovative technologies and learning modules to transform the way individuals and organisations acquire new skills and access knowledge.

Open universities like the Zimbabwe Open University (ZOU) in Zimbabwe, the University of South Africa (UNISA), and many others, have thousands of people studying for both undergraduate level courses and postgraduate degrees. These universities and other professional institutes like the Institute of People Management (IPMZ), Chartered Institute of Marketing (CIM), among others, offer professional development programmes in management, education, health and social welfare, manufacturing and computer applications. Thus courses are delivered to the students in their own homes or places of work by computer, the Internet, surface mail, and via national broadcasts.

While traditional resources such as textbooks are used, students also draw on the extensive resources already available on the Internet (Reinhardt, 1995). Class material and assignments are posted on the World Wide Web at a site open only to those students taking the course. Students submit assignments that can be posted to the Web for others in the class to view. For example, International University College (IUC) offers a Master of Arts in Business Communication Programme. The primary way students communicate with teaching faculty,

administrative staff, and other students, is through e-mail. IUC uses mailing list managers (listservs) to enable course discussions, and these listserv discussions are an important portion of the course grade. Students submit written assignments to teaching faculty through e-mail, and assignments are returned with comments and suggestions in the same fashion. Listservs allow students to discuss group projects with other members of the class, and to send questions or comments to teaching faculty or classmates.

The University of Paisley Online Education WWW Server provides degree courses from accredited universities aimed at working professionals. The courses can lead to degrees such as a B.Sc. in Health Studies, M.B.A. in Marketing, M.Sc. in Computer Aided Engineering and M.B.A. in Total Quality Management. Each online education student is supplied with an advanced personal computer, a high-speed modem and a printer, which are delivered and set up in the student's home. Students interact with tutors by connecting to the Electronic Campus on Internet. Some students that are frequent travellers use notebook computers that allow them to continue studying anywhere. Course materials are pre-loaded in the computer and consist of notes in hypertext, together with a suite of general Windows software for word-processing, graphics, analysis and communication. Students engage in live teleconferencing; closed and open discussion forums; and electronic mail (E-Mail) through which students send their assignments to their tutors for marking, and receive them back with any relevant comments. An on-line library on the Internet is also available.

City University's EDROADS (Education Resource and Online Academic Degree System) offers more than 80 programmes at the undergraduate and graduate level that cover a variety of academic fields such as business management and technology to humanities, social sciences, natural sciences, counseling and teacher preparation. A Master of Business Administration and Master of Education degree programmes are also offered. Students enrolled in courses at EDROADS can engage in "live" dialogue with other students, instructors, and special guests using *Live Forums*. Students can enter forums as observers or as active participants. Live forums are held at three levels. Programme forums are open to all students pursuing a particular degree and consist of scheduled, moderated discussions that may include guest speakers. The number of students that can actively participate is limited and they need to sign up in advance. The number of students who may observe is not limited. Students who miss a scheduled forum can download discussion notes from the Online Document Centre. Course-specific Live Forums, or Study Groups, are open only to students enrolled in a particular course. These forums allow students to participate in focused discussions about course content and assignments. Instructors can hold study group discussions for group students. Student Forums provide an opportunity for students to chat with each other about general topics in the Student Lounge.

Athens University, which is administered by the Virtual Online University, provides liberal arts education to students in as inexpensive and accessible a manner as possible over the Internet. Athena has developed a Virtual Educational Environment (VEE) that can be accessed from anywhere on the globe via the Internet. Students in VEE can collaborate, debate, and interact with fellow students and instructors. VEE uses a technology called MOO, where MOO stands for MUD Object Oriented, and MUD stands for Multi-User Dungeons. In a MOO, students encounter other people who talk by typing, listen by reading. Students can encounter objects, find out properties about objects, and manipulate objects in a highly interactive environment. Examples of objects that students can construct include "things" like historical periods, atomic processes, Latin phrases and sentences or any dynamic process that responds to input on the part of the student.

## 6. Benefits and Limitations of Internet-Based Education

Many countries have now integrated the use of ICT in education to enhance and more effectively personalize the learning process. Internet delivery of education provides many benefits and limitations to both the student and the educational institution.

For Alsalloum *et al.* (2012) some of the key benefits of the Internet and e-learning include:

- exceeding the constraints of time and place in the educational process;
- enabling educational institutions to achieve the optimal distribution of their limited resources, taking into account the individual differences among learners;
- enabling learners to complete their learning process in suitable environments;
- ease of access to teachers even outside official working hours;
- raising a student's feeling of equality in distributing the opportunities in the educational process;
- breaking the barrier of fear and anxiety they have, and enabling learners to express their ideas and search for facts and information by means that are more useful than those followed in traditional classrooms; and
- e-learning spreads the culture of self-learning and training in the society which can improve and develop the abilities of learners at lower cost and less effort.

Soloway (1995) identified the following benefits of Internet-based courses to the student:

- flexibility to pursue education at personally convenient times;
- ability to take time to compose thoughts contributed to class discussions on newsgroups or listservs (asynchronous communication);
- ability to interact with classmates in different locations using real time text, audio, or video (synchronous communication);
- reduction or elimination of travel cost to attend lectures;
- wider range of students in a class (regional, national or global participation) resulting in a wider range of opinions and views shared in class discussions;and
- ability to progress in the course material at the student's own pace (self-paced learning) and in order of their own personal needs (non-linear learning).

However, Marchionini and Maurer (1995), argue that not all students are suited for Internet-based education. Below are some problems, difficulties and limitations of Internet-based courses for the student as identified by Marchionini and Maurer (1995):

- lack of motivation can lead students to drop out;
- the Internet methods of communication (email, newsgroups, listservs) may be intimidating or awkward to use for some students;
- students may not be able to express themselves as well using the computer based communication methods as they would in either direct conversation with their professor or in classroom discussions - as a result, not all questions may be asked by the student when using computer mediated communications;
- cost of computer equipment and communications infrastructure may limit the number of students that can afford an Internet-based course;and
- students will have a lack of technical support in their homes to use the software tools needed in the course -poor technical support or tutorial help can lead to incorrect usage of software tools needed to do assignments.

Soloway (1995) further argues that there are also benefits and limitations in providing Internet-based courses to the institution and instructor. Below are some of the benefits of Internet-based education to the institution according to Soloway (1995):

- lower cost in electronic publication of course material compared to printing the same material;
- faster methods for electronically revising and re-distributing course materials and documentation compared to print materials;
- using the World Wide Web for delivering courses allows instructors to develop content a single platform, yet the content is accessible by students using a wide range of computing platforms and WWW browsers;
- ability to re-use lecture materials by simply providing links to previous electronic course modules or externally stored resources materials on the Internet;
- ability to automatically track student's online behaviour;
- ability to have automated registration and billing using commerce WWW servers;
- larger number of students can take courses (not limited by geographical region);
- potential source of new revenues;and
- automation of the student evaluations with online interactive quizzes.

Despite these benefits, organisations and professors may still resist changing from existing methods of teaching to Internet delivery. Below are some of the disadvantages of Internet-based coursesSoloway (1995):

- relatively high cost of setting up reliable computer equipment and the technical support for that equipment;
- requires investment of time to learn methods and procedures;
- lack of incentives for instructors to learn and use new technology;
- instructors that feel uncomfortable with technology may resist using new instructional methods;
- lack of support for training instructors with new technology may cause instructors not to learn new technologies and methods;
- unreliability of equipment being used can cause problems in the delivery of courses over the Internet, which can be reflected in poor student evaluation of such courses;
- the World Wide Web limits the expression of the content to current authoring features-using extensions to the authoring language poses restrictions on the types of browsers that can be used to properly view the content;
- the bandwidth limitations can make some interactive multimedia applications too slow for effective learning;and
- students typically have a wide range computing power on their personal machines which necessitates

the development of lecture content in both high bandwidth and low bandwidth formats. This requires more time to develop and to maintain the content (Marchionini and Maurer, 1995).

## 7. Learning Styles

The Internet has provided an opportunity to introduce new ways for supporting individual learning styles for students and created new paradigms for instruction (Marchionini and Maurer, 1995; Reinhardt, 1995). It has been argued that connecting schools to Internet is not enough to change the quality of education, but rather what is needed is a change from emphasizing accumulation of knowledge, to new ways of communicating and assisting students to learn (Soloway, 1995). Some of the changes occurring to education as a result of new technologies include:

- a shift from classroom lectures to computer networked access to educational resources (enabled with hypermedia and the WWW);
- a shift from student as a passive recipient of education to a self-directed student learning;
- a shift from individual learning to team learning and group discussion; and
- a shift from homogenous and stable educational content to fast-changing content presented in a wide range of formats (Soloway, 1995).

One of the most prominent trends in distance education is the emergence of *Open Learning*, which has been defined as "a student centred approach to education which removes all barriers to access while providing a high degree of learner autonomy" (Maxwell, 1995). The Internet supports the open learning concept by providing students with the ability to connect to educational resources when it is convenient for them, and allowing students to explore the educational resources in an order that suits their needs. In an open learning environment the teacher no longer serves as the keeper of knowledge. Instead the teacher acts as a tutor, facilitator, and resource to assist in the student's learning process (Butcher, 1995).

## 8. The Effectiveness of Distance Learning Technologies

Any distance education course could be evaluated with the following criteria:

- **Accessibility** - What type of bandwidth is required to properly view the content? How much will it cost to access the system? How difficult will it be for students to install the appropriate hardware and software?
- **Communication** - How well can a student communicate with the instructor or other class mates? What limitations are there on communication as a result of the communications medium chosen? How effectively can feedback be given? How isolated do students feel?
- **Content** - What types of content can be delivered? How can interactivity and multimedia be used?
- **Flexible** - How easy is it to re-use previous educational modules? How much flexibility is there for students to view the information at their own pace and in their own chosen order? (Marchionini and Maurer, 1995)

One of major problems with Internet-based learning is the isolation that students feel from their instructors and ineffective methods for dialog. E-mail communication helps to some extent but lacks the visual cues and facial expressions that convey messages of understanding, or lack of comprehension, of questions and responses between the student and instructor. Group discussions on newsgroups provide students a chance to compose their thoughts, but lack some of the dynamics on classroom discussions and favour students that are comfortable with e-mail and newsgroups. Low cost interactive video over the Internet provides students with some of the dynamics of a classroom discussion but lack methods to moderate or facilitate discussions. Real time interactive video solves many of the above problems but raises the cost of the system to such a high level that it limits those that can access the system. Thus, type of interaction needed by the students will determine which technology is most suited.

E-mail has been effectively used by groups of students in Hawaii and Dallas to collaborate on solving complex business problems (Wild and Winniford, 2003). In another case, listservs were used by students to discuss gender issues for a class project (Bender, 1995). Students reported in the final feedback of the course that they felt they had a free exchange of ideas that enhanced their learning of the topic. However, others have found that the use of e-mail by students not to be as effective. Tsikalas (1995) found that only one quarter of all messages were found to be related to course work and the remaining messages were social in nature.

Newsgroups and Bulletin Board Services (BBS) have also been used to complement video lectures (Kearsley, Lynch, and Wizer, 1999). A survey of 117 students showed that 97 percent of students agreed that discussion groups improved communications among students, and 82 percent felt that the discussion groups helped students assume the role of teacher themselves. In another case study using discussion groups, 47% of students reported that courses which combined electronic discussion groups with occasional face-to-face discussion meetings improved communications and learning.

Interactive video has been used to deliver lectures to students, allow students to ask questions to the instructor remotely, and for class members to discuss topics. In an experiment comparing high (2 Mbps) and low bandwidth (384 Kbps) interactive video, students reported that the quality of sound was more important than the quality of video (Hansford and Baker, 1990). Students also felt that smaller group video conferences were preferred over large classroom lectures transmitted to remote users. The most important concerns expressed by the students were the clarity and appropriateness of instructional material shared over the video link, and the ability of the instructor using them. Their conclusion was that the "effectiveness of a delivery system is unlikely to be constant over settings and applications". Thus, the needs of the students and the course content should be key considerations in choosing a delivery method.

## 9. Conclusion

In this paper we have shown the widespread use and availability of ICTs and Internet-based education. We established that the main advantages of ICTs and e-learning to the student are the flexibility to pursue education at personally convenient times and to progress in the course material at the student's own pace. However, we also noted that the feeling of isolation, lack of motivation, or lack of support and feedback can lead students to drop out. We also noted that there are also benefits accruing to the institution that adopts and practice Internet based learning. The main advantages of Internet-based education for the institution providing courses is the ability to re-use lecture materials, provide links to externally stored resources materials on the Internet, and a potential source of new revenues.

However, the development of Internet-based courses takes an initial investment of time and money, and may not be well suited to all existing instructors. A review of technologies and student learning styles showed that no one technology is suited for all students and all courses. Our final conclusion and final recommendation is that technologies should be chosen to support the types of students expected and their learning styles. The chosen technologies should also support the type of content to be shared with students and the expected learning outcomes.

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