

Integrating Technology in Higher Education

¹ Patrick Mutanga, ² Constantine Munhande

¹ Harare Institute of Technology

² Midlands State University

[1pmutanga06@yahoo.co.uk](mailto:pmutanga06@yahoo.co.uk), [2cmunhande@msu.ac.zw](mailto:cmunhande@msu.ac.zw)

ABSTRACT

The field of education in general and the higher education sector in particular is reaching a point at which Science and Technology is playing a vital role. In nearly every phase of the educational process, technology, especially Information and Communication Technology (ICT), plays an important role. The advent of internet has greatly enhanced the role of ICT in instructional design and delivery. This has impacted positively on the Higher Education Sector in Zimbabwe. Tertiary institutions use computers and the internet extensively to improve the quality of teaching as well as in research. This paper focuses on how the integration of ICT into teaching has impacted on the higher education sector in Zimbabwe. It highlights the various impacts of ICT on contemporary Higher education practices and explores potential future developments. The paper suggests the fact that the higher education teacher generally operates in an ICT rich environment can be key in enhancing the capacity of the higher education teacher to engage positively, collaboratively and critically with the growth of learning technologies. It also provides a brief analysis of policy developments on issues such as e-education. Data was collected mainly through a review of recent selected Zimbabwean and international teaching and learning practice which is increasingly becoming ICT based. Reference is also made to wide debates about the enhancement of student achievement through the use ICT in education. The findings show that there are a number of benefits accrued from the use of ICT in instructional design and delivery in the higher education sector. Successful implementation of ICT backed instructional design requires linking teaching activities to the various software applications used for online learning. Embedding ICT in the science and technology disciplines has its own limitations especially on the experimental and practical side. This paper highlights some of these challenges and also highlights some practical way of doing this which can be adopted and introduced into the science and technology curricula. The paper also highlights the fact that ICT technology has effect of raising student motivation and interest in the learning process since it builds upon the student's natural appreciation of computer and internet technology. The paper concludes that technology has revolutionized the field of education, especially in the tertiary sector hence it encourages the development of institutionalized e-learning platforms and other ICT based teaching and learning programs. It also recommends training of university teachers in the use of e-learning in instructional design and delivery

Keywords: *Technology, Integration, Higher Education, Implications*

1. INTRODUCTION

Information and Communication Technology (ICT) is a diverse set of technological tools and resources used to create, store, manage, communicate, and disseminate the information [1]. ICT has transformed many aspects of human endeavor. A look at developments in the fields such as tourism, business, law medicine, banking, engineering and architecture shows massive investment and reliance on ICT especially over the past two decades. However the field of education has been rather slow in embracing the use of technology in the mainstream programs. A number of factors have contributed to the slow uptake and integration of ICT into the education sector. Among some of the factors include lack of funding for the acquisition of the hardware and software associated with ICT, lack of training among established teaching practitioners, a lack of motivation and need among teachers to adopt ICT as teaching tools [2]. This has resulted in ICT playing a peripheral role in many yesteryear educational programs. However, in recent times developments have taken place which have resulted in rapid growth of interest in integrating ICT into educational programs. These include the opportunities for flexible delivery provided by ICTs as well as the capacity of technology to provide support for customized

educational programs to meet the needs of individual learners [3]. ICT has become a crucial tool for education. The experiences of the past few years show a rapid growth of the use of computer based learning. This has resulted in a significant improvement in the provision of educational services. Notable achievements include the introduction of e-learning and online lecture presentations [4]. Much research has shown that students benefit from e-Learning [5],[6],[7]. Today thanks to widespread access to the Internet, e-Learning has emerged as one of the fastest-moving trends in higher education, enabling professionals to learn from afar and keep pace with technological change. Thousands of online courses including degree and certificate programs are now being offered worldwide by universities. Innovative use of the internet helps educators and learners to interact in a more flexible way than in the classroom. Not only can lecture notes and other course material such as syllabi, and assignments be made available on the internet, but online collaboration and discussion can occur. The instructional success of eLearning is dependent on the development of appropriate pedagogies and an integrated use of ICT based on students' prior learning experiences. Its failure can be traced to its conception of learning as the transfer

of knowledge instead of seeing learning as an active process of knowledge creation. Therefore, success on e-Learning platforms can be enhanced if there is a paradigm shift from an emphasis on stand-alone courses and resource-based learning to a process that promotes interaction, communication, collaboration and construction.

2. THE ROLE OF TECHNOLOGY IN LEARNING: CONSTRUCTIVIST PEDAGOGICAL APPROACHES

Technology normally provides means to achieve desired aims and objectives. In higher education the role of technology is to improve efficiency of learning. The integration of technology into educational programs is facilitated by transformation of pedagogical practices from teacher centred to student centred approaches. The strengths of constructivism lie in its emphasis on learning as a process of personal understanding and the development of meaning in ways which are active and interpretive. In this domain learning is viewed as the construction of meaning rather than the memorization of facts [8]. Learning approaches using contemporary ICT provide many opportunities for constructivist learning through the provision and support for resource-based, student centred settings, and enabling learning to be related to context and practice [9]. Thus, any use of ICT in learning settings can act to support various aspects of knowledge construction and as more and more students employ ICT in their learning processes, the more pronounced the impact of this will become

For constructivist educators learning is a result of construction, collaboration, reflection, and negotiation within a rich context in which learning is situated [10]. Technology has the potential to support constructivist learning and be used for active, authentic, reflective and collaborative activities [11]. Pedagogically sound uses of technology can provide an environment within which learners can take control of their learning and become active builders of knowledge while collaborating with others on solving problems. The instructional success of e-Learning is dependent on the development of appropriate pedagogies and an integrated use of ICT based on students' prior learning experiences. Its failure can be traced to its conception of learning as the transfer of knowledge instead of seeing learning as an active process of knowledge creation [12]

3. ICT IN HIGHER EDUCATION: EMERGING ISSUES

A number of issues have arisen as a result of the uptake of ICT in teaching and learning in higher education. According to [13] these issues include changes to the makeup of the teacher pool, changes to the profile of who are the learners in the courses and changes in the costing and economics of course delivery

3.1 Expansion of the Teacher Pool

The profile of the higher education teacher has greatly changed as a result of the integration of ICT in higher education. Whereas in the past the university lecturer had to be a highly qualified individual in his or her own area of study the contemporary teacher has to have ICT skills also. The rapid changes that are characteristic of the ICT industry means that the teacher has to be versatile in order to keep pace. Apart from this changing role of the teacher the integration of ICT into the higher education sector has also provided opportunities for other people with different competences to participate in education processes. These include workplace trainers, mentors, ICT experts and other specialists. This trend seems set to continue to grow with new ICT developments and applications. And within this changed pool of teachers will come changed responsibilities and skill sets for future teaching involving high levels of ICT and the need for more facilitative than didactic teaching roles [13]

3.2 Expansion of the Learner Pool

Whereas in the past access to higher education was limited, the integration of ICT has resulted in the expansion of students with access to education. The pool of students is changing and will continue to change as more and more people who have a need for education and training are able to take advantage of the increased opportunities. Interesting opportunities are now being observed among, for example students studying university courses and worker undertaking courses from their desktop. As such technology has been a key driver for learning at work [14]. In higher education and adult training, there is some evidence that educational opportunities are being opened to individuals and groups who are constrained from attending traditional universities.

3.3 The cost of Education

Traditional thinking has always been that technology facilitated learning would provide economies and efficiencies that would see significant reductions in the costs associated with purchase of equipment, construction or retrofitting of physical facilities, initial materials production, and the like [15]. But studies of the use of computers in classrooms, for example, show that installation of hardware and retrofitting of physical facilities account for only between 40% to 60% of the full cost of using the computers over their lifetime, or its total cost of ownership [16]. Total costs of computer ownership include:

3.3.1 Fixed Costs

- Retrofitting of physical facilities
- Hardware and networking
- Software
- Upgrades and replacement (in about five years)

3.3.2 Variable or Recurrent Costs

- Professional development

- Connectivity, including Internet access and telephone time
- Maintenance and support, including utilities and supplies[16]

4. ICT IN RESEARCH

The role of ICT in higher education is particularly powerful in research. Some of the most important uses of ICT in research are in the following areas: data processing, text search and linking researchers globally.

4.1 Data Processing

The unprecedented growth in bandwidth and computing power provide opportunities for analyzing and processing huge amounts of data and performing complex computations on them very fast accurately and reliably.

4.2 Searching Text

Another important use of ICT in research is the use of online full text databases and online research libraries and virtual libraries. These libraries and data bases provide

researchers with online access to thousands of books, research reports and peer reviewed journals.

4.3 Linking Researchers Globally

ICTs have transformed research from being an individual or group endeavor to an activity involving instantaneous sharing and collaborative generation of new knowledge by networks of researchers located around the world. The rapid transformations in the ICT industry and the emergence of social networks has greatly facilitated speedy sharing of information within the research community

5. STAKEHOLDER INFLUENCE ON ICT

A number of stakeholders influence and are influenced by the introduction of ICT in teaching and learning in higher education. When the future of education is considered it is important speculate on for whom the change will have the greatest effect. Table 1 lists principal stakeholders and shows that the stakeholders for whom technology will have the greatest influence and change are the students. So while institutions are pondering how they will be influenced in years to come, whatever outcomes the beneficiaries of the activity and change are the students

Table 1: The influence of ICT on education and its stakeholders

	What is learned and how much	How is it learned	When is it learned	From whom in it learned	Who is learning	What does it cost
Students	X	X	X	X	X	X
Employers	X			X		
Lecturers	X	X	X	X		
Institutions	X		X	X		
government	X	X	X	X	X	X

6. BARRIERS TO INTEGRATION OF TECHNOLOGY IN EDUCATION

Research has shown that computers are used less often in the classroom than in other organizations. The principal reason for the limited use of technology in education is the dominant culture of teachers' beliefs about what teaching, learning and knowledge are rather than the lack of funds for acquisition of technology, indifferent administrators, and limited teacher skills [17] Efforts at technology integration provoke a variety of responses from teachers that range from enthusiasm, skepticism to fear and uncertainty. A long history of technology use in education shows that the first reaction is to use new technology in the same traditional way as the old technology. However continuing old practices with new technologies will not change or improve education.

Another obvious challenge encountered in bringing ICT to the higher education sector is the cost associated with acquisition, installation, operation

and replacement of ICTs. This problem is more prevalent in the developing world than in the industrialized countries Inexperience in the procurement of institution wide hardware and software and the related services can also cost institutions heavily as they may end up with wares that are outdated and subject to unworkable but binding supplier contracts[18]. The use of unlicensed software can also cause a lot of problems for institutions as the can bring about legal challenges as well as maintenance challenges. Even under ideal circumstances of licensed hardware and software acquisition, lack of capacity in equipment maintenance can pose serious implementation problems [12] clear policies and procedures for acquisition of ICT hardware need to be put in places to prevent such problems. The four most common mistakes institutions make in introducing ICT into teaching are

- Installing learning technology without reviewing students' needs and content availability
- Imposing technological systems from top down without involving faculty and students

<http://www.ejournalofscience.org>

- Using inappropriate content from other regions of the world without customizing it appropriately
- Producing low quality content that has poor instructional design and is not adapted to the technology in use.[18]

7. E-LEARNING

Innovative learning systems based on various electronic devices have been around for some years now and numerous terms have been used in various learning contexts. These include computer mediated learning, web based learning and most recently e-Learning [19] Computer-mediated learning is defined as the use of personal computers for education and training [20] The concept of computer mediated learning has been further enhanced by development of the internet and the World Wide Web. An e-Learning system provides a configurable infrastructure that integrates learning materials, tools and services into a single solution in order to quickly, effectively and economically create and deliver training or educational content. It has become an important alternative to classroom learning. E-Learning can be implemented at many levels and complexities, ranging from the provision of simple information solutions to the development of e-books and e-textbooks. In order to provide better understanding of certain phenomena, special effect presentation and animation are often found to be quite effective. E-learning demands the students' self-discipline to make themselves available and attend classes with others at the scheduled period [21] The introduction of e-Learning in education engendered high expectations that would transform the organization and delivery of higher education. It prompted significant investments in starting up new virtual universities by universities in Europe and the United States. These include New York, Columbia, and the US Open University. Elsewhere numerous Virtual Universities such as the UK e-University, the Digital University in the Netherlands, the Bavarian Virtual University, the Virtual University in Finland, the Net University in Sweden and the African Virtual University were launched [18]

8. MULTIMEDIA BASED E-LEARNING

The emergence of multimedia presentations using technology presents opportunities both for technological breakthroughs and for theoretical advances in online learning [19] While technology itself does not determine learning outcomes, technologies differ significantly with respect to the learning environments they foster. Multimedia technologies combine several communication media such as text, graphics, video, animation and sound. Multimedia refers to a computer based presentation that delivers information integrating two or more media [22]. Multimedia technologies such as audio/video encoding and decoding algorithms, compression and decompression techniques, computer representation of sound, sampling rate, MIDI devices, and WAV files are examples of promising multimedia technologies [19]. For many learning tasks, multimedia methods are not only more appropriate, but also more

efficient, and multimedia instructions frequently motivate learners more effectively [23].

9. IMPACT OF ICT ON HOW STUDENTS LEARN

Through technology- facilitated approaches, contemporary learning settings now encourage students to take responsibility for their own learning. In the past students were comfortable to learning through transmissive modes where information is presented to them by others. However the growing use of ICT as an instructional medium is changing and will continue to change many of the teaching and learning strategies employed by lecturers. When considering the impact of ICT in education there tends to be a focus on whether and to what extent, ICT can raise pupil attainment. It is often difficult to establish hard evidence of improved pupil attainments as result of using ICT. It is difficult to isolate ICT from other factors that affect attainment. However positive relationships between ICT use and improvement in subject related learning have been found in several subject areas[24]. A study by BECTA (British Educational Communication and Technology Agency) found evident of statistically significant positive association between ICT and higher achievement in exams for science and design and technology. In the Becta study impact refers to the outcomes of an intervention designed achieve an underlying policy goal namely to improve students' examination grades [26]. Figure 1 shows the diagrammatic representation of impact of ICT on education

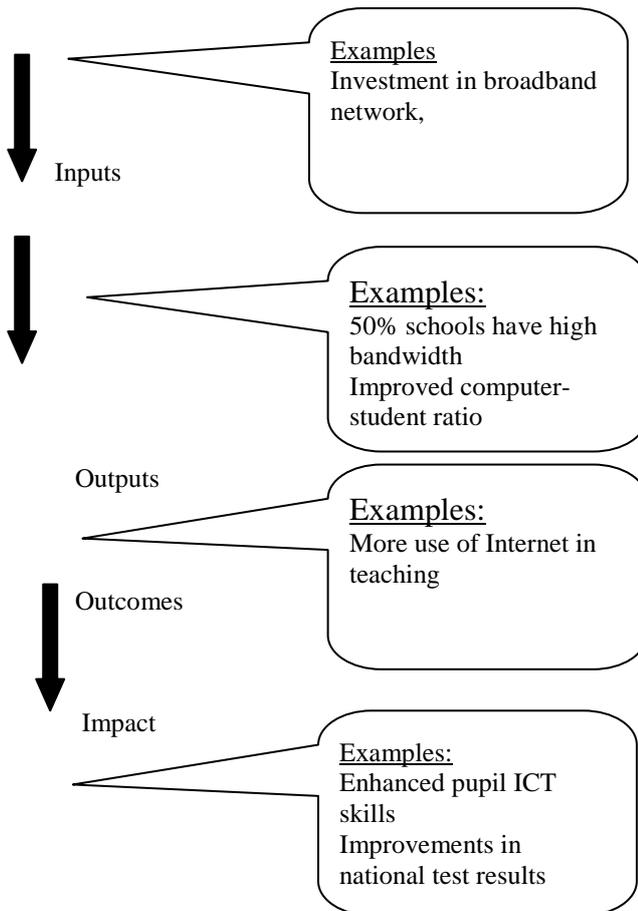


Fig 1: Description of impact

The intervention has four dimensions: input, output, outcome and impact. Inputs refers to the provision of broadband, funding institutions to buy laptops. These inputs lead to direct quantifiable outputs such as the percentage of institutions with broadband or improved student: computer ratio. Outcomes are the broader results achieved by ICT investments, such as greater use of ICT in teaching. Impact is the overall achievement of the intervention on the educational system and can be described by quantitative indicators such as enhanced pupil ICT skills or improvements in national test results

The e-Learning Nordic study [25] also explains the impact of the introduction of e-learning on education. Though the study differs in its approach with the Becta study it also has the dimensions of input, output and impact as shown in figure2.

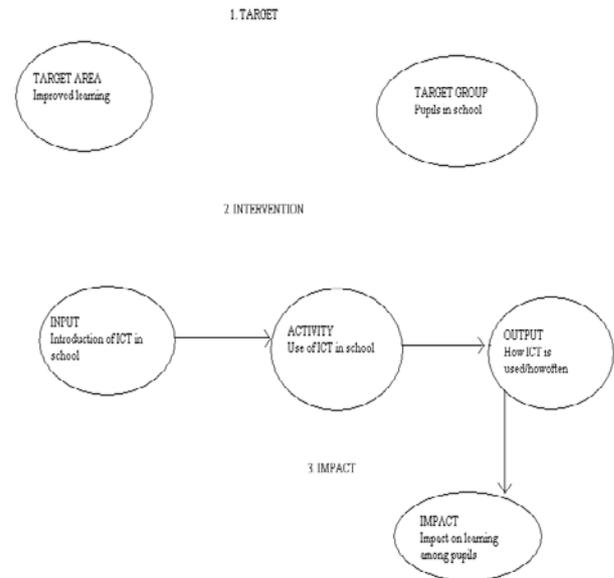


Fig 2: Description of impact of e-Learning

The wider target is to improve people's learning. The intervention has three elements: input, activity and output. The input is introducing ICT in educational institutions. Activities carried out, like measures to increase the use of ICT, leads to outputs, the direct and more quantifiable results of activities such as the number of computers purchased or number of lessons using ICT [25]

10. RECOMMENDATIONS

10.1 Policymakers

There is need to plan for the process of transformation and management of change of which ICT is a tool which facilitates and amplifies. If universities fail to appreciate new technologies educational practices will not change and will miss out on the opportunities availed by technology. Taking into consideration that teachers embrace new technologies in a step by step process any changes must be supplemented by process management and connected to realistic visions. Universities must experiment with new technologies with given boundaries.

There should be new approaches to staff professional development which enable lecturers to upgrade their ICT skills on a continuous basis. Staff should also enhance and align their pedagogical skills to the new realities posed by developments in the ICT industry. An experimental approach using ICT in everyday practice is a very important factor in increasing lecturer pedagogical competence. Professional development programs should be tailor made to suit the needs of individual lecturers as well as the needs of different subject areas.

University should invest in infrastructure that supports the use of ICT and motivate lecturers to acquire

<http://www.ejournalofscience.org>

requisite ICT skills. A reward structure for those lecturers that integrate ICT into their teaching. Actions should be built into policies that encourage teachers to use ICT more effectively. Institutions should capitalize on learners' positive attitudes towards the use of technology in educational programs.

11. RESEARCH AND DEVELOPMENT

Education is a very complex field and as such qualitative methods should be used to investigate impacts. There is need to go beyond pure observations and evaluate more concretely university contexts, learning situations and teaching processes to show under which circumstances ICT based activities can enhance learning and improve skills. To achieve this some form of qualitative interpretation of the impacts of ICT on education need to be made. This would require a holistic approach to the whole educational system.

There is need to link research and practice by embarking on more fundamental, small scale, focused research on specific ICT tools, results of which should be made easily available to lecturers.

REFERENCES

- [1] Blurton, C., "New Directions of ICT-Use in Education". Available online <http://www.unesco.org/education/educprog/lwf/dl/edict.pdf> accessed 7 November 2011
- [2] Oliver, R (2002) The role of ICT in higher education for the 21st century: ICT as a change agent for education) accessed at <http://elrond.scam.ecu.edu.au/oliver/2002/he21.pdf> on 14 November 2011
- [3] Kennedy, D. &McNaught, C. (1997) Design elements to interactive multimedia. Australian Journal of Educational Technology, 13(1), 1-22
- [4] Pulist, S.K.(2008) use of ICT for providing value-added student support services in open and distance education The 5th Pan-Commonwealth Forum on Open Learning. London. Jul 2008
- [5] Potashnik, M. and J. Capper. (1998)."Distance Education..."p. 42, 44
- [6] Hiltz, S. R. and B. Wellman (1997). "Asynchronous Learning Networks as a Virtual Classroom." Communications of the ACM 40 (9): 44-49.
- [7] Means, B. (1994). Introduction: Using technology to advance educational goals. In B. Means (Ed.), Technology and education reform, San Francisco: Jossey-Bass Publishers.
- [8] Lebow, D. (1993).Constructivist values for instructional systems design: Five principles toward a new mindset. Educ. Technol. Res. and Develop. 41(3): 4-16.
- [9] Berge, Z.L. (1998). Barriers to online teaching in post-secondary institutions. Online Journal of Distance education Administration.1(2). Summer.[Online.]<http://www.westga.edu/~distance/Berge12.html>accessed 2 November 2011
- [10] Vrasidas (2000) 'Constructivism versus Objectivism: Implications for Interaction, course design, and evaluation in distance education', International Journal of Educational Telecommunications, 6(4), 339-362
- [11] Johanssen, D.H., Peck, K.L., and Wilson, B.G. (1999) Learning with technology: A constructivist perspective Upper SadleRiver,NJ: Prentice Hall
- [12] Balasubramanian K., Clarke-Okah,W. Daniel,J Ferreira,F.,Kanwar,A. a Kwan,A., John Lesperance, Background paper from the Commonwealth of Learning UNESCO World Conference on Higher Education Paris, 5 to 8 July 2009
- [13] Gupta, S. ICT (2013) ICT- A Catalyst of Teaching – Learning process. New York: Scholars World
- [14] Consortium for School Networking,"Taking TCO to the Classroom: A School Administrator's Guide to Planning for the Total Cost of New Technology"; available from <http://ctap.fcoe.k12.ca.us/ctap/dhs3.4/tco2class.pdf> ; accessed 3 October 2011, p. 10
- [15] Wanjala, M.S. Khaemba, E and Sindabi, O. (2010) The Role of ICT in Higher Education for the 21st Century: ICT as a Change Agent for Education. Kenya Journal of education, 12 (2) 109-115
- [16] Oliver & Towers (2000) benchmarking ICT literacy in tertiary learning settings
- [17] Cuban, L. (1993). Computers meet classroom: Classroom wins. Teachers College Record, 95, 185-210.
- [18] J., Joshua Mallet J., Umar, A.West, P (2009) ICTs for Higher Educationhttp://www.ascilite.org.au/conferences/coffs00/papers/ron_oliver.pdf . Accessed 29 October 2013
- [19] Anaraki, F. (2004) Developing an Effective and Efficient eLearning Platform. Thailand: College of Internet Distance Education

<http://www.ejournalofscience.org>

- [20] Hilary, P. and Charlotte, C. (2000) Applying New Technologies And Cost-Effective Delivery Systems In Basic Education. UNESCO: International Research Foundation for Open Learning
- [21] Bruminhent, S. (2004) eLearning: A process that Must be Well Planned. paper presented at the International conference on eLearning for Knowledge-Based Society. Bangkok, Thailand August 4-5, 2004
- [22] Beckman, M. (1996). The Web goes interactive. Macworld, 13(7), 92-99
- [23] Megarry, J. (1998) Hypertext and compact discs: the challenge of multimedia learning In R. Tucker & J. Tucker (Eds) Interactive Media: Human Issues. UK: Kogan Page Ltd.
- [24] Balanskat, A., Blamire, R., Kefala, S. (2006) The ICT Impact Report. Education and Culture: European School net. Accessed at <http://www.insight.eun.org> accessed 7 November 2011
- [25] Ramboll Management (2006) 'E learning Nordic 2006: Impact of ICT on Education', Denmark: Ramboll Management.
- [26] Becta (2006) 'The Becta Review 2006: Evidence on the progress of ICT in education', UK: Becta. Accessed at <http://www.becta.org.uk/corporate/publications/documents/TheBectareview2006pdf> accessed 7 November 2011