Conference: "*Transforming IS & CS Education and Research in a Changing Higher Education Environment*".

# e-Learning and learning management systems (LMS) in a changing higher education environment

Nhlanhla Mlitwa

e-Innovation Academy
Cape Peninsula University of Technology (CPUT)
80 Roeland Street,
Multi-disciplinary Applied Research Centre (MARC) Building
Vredehoek, Cape Town, South Africa

e-mail: mlitwan@cput.ac.za

## Abstract

*The paper draws on recent studies on the patterns of ICT adoption and use in higher education institutions in the Western Cape to show that technology adoption is on the rise at universities. A recent study on ICT, education, and change in higher education is also used to outline the conceptions, meanings, and implications of ICT – from the perspectives of different academics, managers, and IT practitioners in higher education institutions in South Africa. The position that ICT usage is incoherently lower than intake patterns within and between the institutions is put forward, in that there are more technology acquisitions, but less usage. It is also argued that conceptions and meanings attached to ICT by various stakeholders are inconsistent and divergent. As a result, increased adoption patterns of, and the impact that, e-Learning should have on teaching and learning processes are called into question in this paper. In view of a prevailing "conceptual stampede" on higher education and e-Learning vocabulary and practices, the ANT is employed to contextualize the relationship within e-Learning environments. The paper uses an example of high adoption levels against uneven usage patterns to argue for a socio-technical approach to the adoption and use of LMSs. It closes with an argument that e-Learning should not only be recognized but also treated as a socio-technical network between humans (educators, students, administrators), structures (learning groups, educator groups, institutions, policies), technology (a LMS) if it is to be successful.*

# Introduction

Technological innovation has changed the very social, political, economic, and cultural fabric of life (Taylor, 2001) since the end of the cold war. Higher education has not been left untouched, and predictions are that thirty years from 1997, the pressure of the changing times will further reduce *"the big university campuses… (into) relics"* (Drucker, 1997). Universities as we know them, according to Drucker (1997), just *"won't survive"*.

While it is still too early to confirm or dispute Drucker's (1997) prediction, evidence of change in higher education contexts worldwide is compelling. The first is a paradigm shift from the pursuit of knowledge for its own sake, to a *"more pragmatic economically-oriented paradigm"* (Gibbons, 1998). It is a shift towards service to society, knowledge production, accountability and value for money. This is where knowledge production and dissemination, research and teaching are no longer self-contained activities but involve interaction with a greater variety of knowledge producers than in the past. In this situation, *"the connections between the role players will increasingly involve the use of the potentialities of the new information and communication technologies"* (Gibbons, 1998).

Indeed cooperation between universities and business organisations on research and technology infrastructure-sharing has been growing in many countries. Universities worldwide are seeking innovative ways to improve the quality of their activities. They are seeking ways to improve their competitiveness in the new and challenging distributed knowledge production system (Mlitwa, 2005). In this quest, universities are making extensive use of new communication technologies to attract and teach new students (Gutlig, 1999). They are using technology to improve co-operation between themselves and/or their business-sector partners (Middlehurst, 2003).

The reaction in South Africa has been a rapid move by the more established (historically white) higher education institutions - from cultural conservatism, to symbolise the new entrepreneurial university (Gutlig, 1999). Largely because of a growing belief among these institutions, among the business sector, multi-national organisations, non-

governmental organisations (NGOs) and national policy makers that ICT enhances the quality of lives, and ultimately that it can improve the quality of higher education.

From this discussion follows the question of whether the university will survive the pressure of globalisation, the technology revolution and new competition. Secondly, whether a traditional university will meet the increasing demand for higher education in markets beyond the physical borders of the pre-information society era? Survival will depend on how universities re-position themselves in the distributed knowledge production system, what type of partnerships they forge (Gibbons, 1998; van der Merwe, 2004), and how they use available tools and resources such as ICT to improve the quality of their activities.

This paper presents an empirical argument that ICT adoption and use is increasing in South African universities. It further outlines the link between technology and a changing context of higher education. It outlines the motives for the adoption of teaching and learning technologies, and the perceived impact of ICT in teaching and learning processes. It draws on recent and current studies on ICT adoption and use among various institutions in the Western Cape (Mlitwa, 2005; Czerniewicz & Brown, 2004), and the conceptions of ICT, higher education and change by academics and IT practitioners in universities across South Africa (Czerniewicz, Ravjee, and Mlitwa, 2005).

The Actor Network Theory is used to present an argument of learning through the LMS as socio-technical network. The paper further uses an example of high intake levels of ICT against uneven usage patterns to argue for a socio-technical approach to the adoption and use of LMSs.

## A Changing Context of Higher Education

That higher education systems and institutions world-wide are undergoing contextual transformation is a reality (Czerniewicz, Ravjee, & Mlitwa, 2005; Middlehurst, 2003). It is observed that as society moves away from an industrial economy (where competitive advantage was based on capital) to an "*information/knowledge era (where capital is knowledge and the competitive advantage is innovation and creativity)...change in*

*education becomes necessary"* (Morrison, 1999). Major drivers of this change according to Bates (2000), include "*the changing learning needs of society*", "*the need to do more with less*" and "*the impact of new technologies on teaching and learning*". It is obvious that the context of higher education is changing and structurally transforming (Czerniwicz, Ravjee, Mlitwa, 2005), but why is everyone turning into ICT for solutions? Motives for increased adoption of ICT are discussed in the following passage.

## Motives for Increased Adoption of ICT by Universities

The key objective of a higher education system according to the Green Paper (1996) is to provide the effective advancement of all forms of knowledge and scholarships. This should further be in line with "*internationally observed standards of academic quality*, with sensitivity towards the diverse problems and demands of the *local*, *national*, *Southern African* and *African contexts*" (Green Paper, 1996: Sec 3.4).

The significance of these contextual considerations is clarified by the findings of the survey of 500 universities across Europe, Australia, and the Commonwealth countries. The survey investigated the *Challenges and Choices for Higher Education Institutions* to using educational ICT (Middlehurst, 2003). It identifies these contexts as key "*drivers of change*" in institutional ICT strategies and processes. It clearly refers to *Political*; *Social*; *Economic*; and *Technological Drivers* and *Trends* – on regional, national, and global scale as having various kinds of impacts in higher education (HE) institutional choices, strategies, and practices with ICT (Middlehurst, 2003).

Within the globalisation discourse for example, it argues that technology has breached walls "*created by distance, time zones, and the need to work directly with physical objects..."* (Bowen, 2000:11). The emergence of new providers of HE (*competition driver*), of new kinds of HE provision (*innovation driver*), and of the demand for education (*demand driver*), national policy and global pressures (*push for information society)* further pressurises universities to turn to ICT. ICT carries the hope for success in the changing local and international *economic* and *social* environments (Middlehurst, 2003). The pressure for universities to contribute to the development of (push for) an information society seem to come from various angles. These include the academic, the business, the technological, the policy and the political sectors. As discussed in the

following section, the push for an information society is the strongest of the drivers for the intake of ICT in higher education institutions in South Africa.

## Push for Information Society

An expectation exists within government quarters and academic circles that universities should play a key role in the establishment of the Information Society. President Mbeki for example, suggested in his State of the Nation Address (2001) that higher education institutions should play a key role in the development of an Information Society. They should enable South Africa to "*get onto and stay on the information super-highway*" (President Mbeki, 2001). This view has since been extended to, and emphasized in numerous national policy documents in South Africa.

The National Research and Development Strategy (2002) for example, recommends for the higher education transformation agenda to ensure *"that as many of our people as possible master modern technologies and integrate them in their social activities, including education, delivery of services and economic activity"*. To achieve this, the policy adds a prescriptive argument for academic institutions, that "...*we have to* devote *the necessary resources to scientific and technological research and development*…(p 3)". The prescriptive nature of the argument is likely to influence institutional policy decisions toward technology adoption and use.

Similarly, the National Plan for Higher Education (2001) expects higher education institutions to be the basis of an Information Society in South Africa, in terms of skills development and research (Sec. 1). Accordingly, the National Plan proposes for the higher education system to ensure that all graduates are equipped with the skills and competencies necessary to function in modern society. Particular reference is made to computer literacy, information management, communication and analytical skills, irrespective of the balance in institutional enrolments (Sec.4.3).

A message from these policy statements is that ICT defines transitions into an information society. A link between the activities of a university and the development of an information society is clearly implied. Equally evident is a belief that universities are, and should use technology to advance knowledge.

Governments have a direct influence on traditional universities in terms of regulation and funding. The prescriptive nature of these arguments is underlined in anticipation of pressure for institutions to comply.

Indeed a positive co-relationship between these policy positions and ICT intake at higher education institutions has been observed in recent studies (Czerniewicz, Ravjee, and Mlitwa, 2005). The question though, is whether the evident growth in ICT is making an intended impact in teaching and learning processes.

## Impact of New Technologies on Teaching and Learning

Obviously, the impact of new technologies in teaching and leaning is seen as positive. ICT is considered part of a solution to addressing the changing learning needs of societies (Garrison and Anderson, 2003).

Recent studies in South Africa however, show divergent and speculative perspectives on the role of ICT, and disagreement on the impact it has in teaching and learning. Constructivists emphasise the significance of a learner in educational processes, arguing that when applied correctly, technology improves the quality of learning experiences. It enables students to actively engage in the construction (rather than the passive receipt) of knowledge. Authors such as Fox and Mills (1997) for example, expect web-technologies to totally change distance education. In this case, web-based distance education technologies should improve education and support new educational systems, thereby radically changing traditional universities.

For some, technology (including e-Learning) will continue to, "…*inevitably transform all forms of teaching and learning in the twenty-first century*" (Brown, 2002). The argument is that just as the new information and communication technologies are changing peoples' behaviour, in quite the same way the *world wide web* (www) will be a transformative medium as important as electricity (Brown, 2002). The www is not only seen as an agent for change, but also the answer to the need to do more with less (Czerniewicz, Ravjee, and Mlitwa, 2005).

On the other hand, most instructivists argue that technology is just the same as any other tool (Mlitwa, 2006). The quality of teaching and learning depends on the method, the

content, the learner and the educator. The argument by some academics is that if these factors are of poor quality, technology will not correct them and change the learning process to be of better quality. It is just how technology is used that matters (Czerniewicz, Ravjee, and Mlitwa, 2005).

Despite a lack of consensus on the actual impact that ICT should have in teaching and learning, the adoption of e-Learning practices is growing in academia. e-Learning is discussed in more detail below.

## What is e-Learning

e-Learning has numerous, related, but also 'somewhat' divergent meanings that are contextually aligned. Each context reflects "*whether or not distance education forms part of the meaning, whether the term relates to networked computers or stand-alone computers* (or even computers at all) (Czerniewicz, Ravjee & Mlitwa, 2005)". Clearly, a computer is presented as a significant part of e-Learning. However, a network and learning are often emphasised more than a computer alone in most accounts. Learning for example, is the ultimate objective for which e-Learning processes are undertaken. The position of this paper therefore, is that a network in the form of a course or learning management systems (LMS) is a significant environment without which, e-Learning processes may not unfold. It can best be defined in terms of its functionalities (see figure1), as a hardware and software environment for network-enabled learning programs and processes (Carliner, 2005).

A LMS can generally be understood as a platform, tool, and environment in which e-Learning takes place. Defining a LMS as an online learning environment however, is inadequate without reference to the functionalities it offers. Fig.1 outlines examples of functionalities that distinguish a LMS from course management systems (CMS).

Fig.1 Learning Management Systems (LMS) vs. Course Management Systems (CMS)

| Functionalities | Course Management Systems (CMS) | Learning Management Systems (LMS) |
|---|---|---|
| Support for ongoing classroom courses | ü | |
| Enrollment | | ü |
| Automatically generated confirmation notes | | ü |
| Course catalog | | ü |
| Skills management list | | ü |
| Checks for prerequisites before allowing enrollment | | ü |
| Seamless link to e-Learning | | ü |
| Automatically generated follow-up correspondence | | ü |
| Grade book | ü | |
| Administers tests and quizzes | ü (with some limitations) | ü |
| Automatically transfers completion information to the permanent record | | ü |
| Discussion board for between-class "conversation" | ü | Sometimes |

**Source:** Carliner (2005), in Learning Cicuits.org, - www.learningcircuits.org/2005/nov2005/carliner.htm

The functionality of a "seamless link to e-Learning" stands out among the rest. It offers an appropriately inclusive context of defining the system – as it positions the purpose within a broader e-Learning aspect of education. A LMS incorporates web-based instruction (WBI) which is also called Web-Based Training – which is the application of a repertoire of cognitively oriented instructional strategies (Clark, 1996) within a constructivist and collaborative learning environment, utilizing the attributes and resources of the World Wide Web (www) (Relan and Gillami, 1997).

It terms of the impact on teaching and learning, a LMS can be a useful instructional and/or interactive educational medium. It should be easily accessible. It should support flexible storage and display options, and provide a simple yet powerful publishing format. It can be used to incorporate multiple media elements (Henke, 1997; McManus, 1995) to enable effective and flexible interaction.

Of course the perspectives are not unanimous. As discussed in the following section, different practitioners in ICT and education offer different insights into the role and impact that e-Learning has in higher education processes.

## Practitioner Conceptions of e-Learning

In a recent investigation of conceptions and meanings of ICT, education and change in higher education among academics, policy makers, and IT practitioners across South

African universities, one interviewee described e-Learning as the process where *"a lecturer with and sometimes without students creates a learning environment on the World Wide Web* (www) *and where learning in collaboration takes place* (I.C.)" (Czerniewicz, Ravjee & Mlitwa, 2005).

Central to this definition is not only the presence but also the significance of a network (www) which incorporates a computer and skill to use these tools. Collaborative learning is also emphasized. Another interviewee explained why the term is written with a small 'e' – followed by a capital 'L': *"I think the whole issue is clearer when I write it, I always try to be consistent and make the "e" small and the "L" large to emphasize the learning and the "e" as the small or abbreviation type of thing but the learning is the most important thing ...* (II)" (Czerniewicz, Ravjee & Mlitwa, 2005).

Furthermore, the University of Pretoria's Strategic Plan, 2002-2005 (2002) describes e-Learning as the process where education technology is used in the virtual campus to enhance both distance and residential education processes. In this case the purpose (and intended impact) of "e-Learning" is strictly to enhance the quality of teaching and learning processes. Special mention of a "virtual campus" and related implications is noted. Universal access to e-Learning and adequate literacy by all educators and learners is an obvious implication. The quality enhancement aspect however, suggests that providing access to ICT means very little if not used effectively. Availability should be supplemented by purposeful and effective usage (Broere, *et al*., 2002) towards quality enhancement. The meaning of effective usage however, is both divergent and unclear in the literature.

In the light of divergent perspectives of the role of, and impact that e-Learning should make in teaching and learning process, the Actor Network Theory (ANT) is used to clarify the human and technology interaction in e-Learning processes.

## The ANT and e-Learning

Based on Latour's (1987; 1992), Callon (1991) conceptions, the ANT places a semiotic emphasis on the human and the technical agents. It suggests that it is important to think symmetrically about human and non-human agents (Callon and Latour, 1992). The ANT enables specificity about the technology (Hanseth and Monteiro, 1998). It further

suggests the elimination of all a priori distinctions between the technical and the social (Callon 1986; Singleton and Singleton, 1993) actants in what Law (1987) refers to as a heterogeneous network. By network it implies a "*group of unspecified relationships among entities* (humans and things) *of which the nature itself is undetermined*" (Callon, 1993, p.263), but mutually constitutive. That is, the network is an interrelated and causal connectedness of all factors on any socio-technical account, and that both the technical and the social agents are active actors.

The significance of a network is in its "continually negotiated processes" where both human and artefact actors have a mutual and causal influence in network processes (Tuomi, 2001). Both humans and things (artefacts, either as technical or textual) are actors with symmetrical (or is it, really?) agency status (Callon and Law, 1997). The network generates, and is generated by interactions between the actors. There is no network without actors, and actors cannot act outside of a network. Each actor can only be viewed in relation to, and not separate from other actors or parts of the network (Tuomi, 2001). While a *social network* is merely a set of people, organizations, and perhaps their structures that are connected by a set of social relationships, a *socio-technical network* includes technologies that people construct and use in collaboration (Lamb and Davidson, 2002). Interactive relationships between different parts (actors) are therefore the defining features of any network. This paper takes the position of e-Learning as a socio-technical network. This is a network that comprises of humans (educators, students, administrators), structures (learning groups, educator groups, institutions, policies), technology (a LMS), and resultant learning processes. The role of technology in an e-Learning network is discussed in the following section.

## Technology in a Network

The ANT is built on the arguments that knowledge is embedded in social processes, conceptual systems, and material artefacts that are used in social practices (Callon, 1991; Latour, 1992). Society, organizations, agents, and machines are all effects generated through interactions of actor-networks. They are always linked to a heterogeneous network of resources and actors that define each aspect as an agent within a network (Callon and Law, 1997).

Looking at e-Learning from the ANT perspective therefore requires recognition of a negotiating interplay between the human and machines in an e-Learning environment.

Through a LMS, e-Learning qualifies as a socio-technical network that incorporates a computer, network, applications, learning material, learners, educators and/or mediators. Just as human and non-human actors assume identities according to prevailing strategies of interaction in the ANT (Hanseth, and Monteiro, 1998), the parties to the e-Learning network should be mutually engaging, but also supportive.

The view streamlines the argument of this paper into the constructivist rather that instructivist pedagogical stream. As opposed to the 'instructional' view, constructivists describe learning as an innovative and participative process that can be enhanced through e-Learning platforms. This view is a basis of the ANT thinking. The question though, is whether technology assumes such a meaningful role in real-life e-Learning processes at higher education institutions, and whether it is engaged as an active actor in an e-Learning network. The following section analyses an observed interplay between actors within an e-Learning network at higher education institutions in South Africa.

## LMS Adoption in Higher Education Institutions

Different LMS adoption patterns among all universities in the Western Cape were observed in 2004/5 (Czerniewicz and Brown, 2005; Mlitwa, 2005).

In the first university, the University of Stellenbosch, decisions to adopt a learning management system was not an outcome of a full interaction between the agents of the social (let alone the socio-technical) network. A decision to adopt a proprietary learning management system (WebCT) was taken from the top management structures and imposed on educators. As a result, there is widespread usage of the system due to a compulsory intake clause, but very minimal engagement with the system by academics (van der Merwe, 2004).

A similar proprietary LMS (WebCT) is used in the second university, the Cape Peninsula University of Technology. There is no policy or forum among the community of users to engage the choice of the system (Mlitwa, 2005). In both institutions, the LMS is used as a learning transfer medium.

E-Learning and the adoption of a LMS is driven by a champion, the executive director of Information and Communication Services (ICS) – Professor Derek Keats at the University of the Western Cape (UWC). An open source software (OSS) based system (www.kewl.uwc.ac.za) is home-grown and developed (Mlitwa, 2005). However, there are challenges with the adoption and usage. It is unclear whether the system and the potential it offers to e-Learning is understood by all academics. Full interactive engagement between the social and the technical actors in this e-Learning environment therefore, is yet to be fully realised.

The University of Cape Town (UCT) has an open process of consulting educators and student users of its technology when making decisions. The university community has choices between proprietary (WebCT) and home-grown systems (e.g. Connect), or no system at all. The level of adoption and usage has not been ascertained. It was established however, that educators do not have adequate time to engage the system and pedagogy at UCT (Czerniewicz and Brown, 2005). Often LMSs are used as a transfer medium rather than in the true constructivist sense (Mlitwa, 2005). In other words, the potential of e-Learning to unfold as a true socio-technical network has not been fully realised in higher education institutions in the Western Cape during the time of researching and writing this paper.

It is also unfortunate that a more satisfactory account of the interwoven relationship between technology and organisational transformations is minimal in the literature and practice (Hanseth and Monteiro, 1998; Mlitwa, 2005). There is no indication of the technical aspect of learning management systems being engaged at a socio-technical agency basis. Instead, the issue of cost and whether a system is in the open-source or proprietary format – dominates debates and adoption decisions (Mlitwa, 2005).

## Conclusion

This paper has put forward the argument that ICT adoption is rising in academic institutions. All academic institutions studied have some form of an e-Learning project. They are either adopting an OSS or proprietary based learning management system. However, studies between different institutions show discrepancies between the adoption of a technology (or system) by an institution – and usage patterns by academic staff.

The Actor Network Theory has been used to reconcile conflicting perspectives on the position of learning technologies in social processes. The final argument is that learning management systems should not only be seen, but also conceptualized and treated as socio-technical networks. This will enable coherent engagements between humans (educators, students, administrators), structures (learning groups, educator groups, institutions, policies), technology (a LMS), and resultant learning processes in the network. In turn, it will contribute to the realization of intended benefits of e-Learning – within varying contexts in which it is engaged.

There is no indication within institutions of higher learning in the Western Cape that this is the case. Institutions are struggling to engage even at a social (let alone the socio-technical) network level. Patterns of non-negotiated, but top-down impositions of e-Learning policies (Stellenbosch), limited understanding of the benefits of a LMS accompanied by resistance to change by academics (UWC), a lack of engagement at any level (CPUT), and limited time to engage technology and pedagogy (UCT) are cases in point.

It should be noted however, that major developments are unfolding to develop e-Learning practices in various institutions as this paper is written, and improvements are forthcoming. A doctoral study is also unfolding to find explanations to the status quo as it stands, or to changes and motivations thereof.

# References

Bates, A.W. (2000).Managing Technological Change: Strategies for College and University Leaders. Jossey-Bass Publishers, San Fransisco, Carlifonia, USA.

Bowen, W.G. (2000). At a Slight Angle to the Universe: The University in A digitized Commercialised Age. The Rumanes Lecture for 2000, Delivered at Oxford University , 17 October, 2000. Published in Princeton University Press, Princeton, New Jersey, 2001. (in http://arl.cni.org/newsltr/216/romanes.html accessed on 28 Feb 2006)

Broere, I, Geyser, H. & Kruger, M. (2002). Technology Development: Imperatives for Higher Education. *South African Journal of Higher Education.* 16(3): 5-12.

Brown, D.G. (2002). Proven Strategies for Teaching and Learning. Presentation in the New Education Benefits of ICT in Higher Education Conference, Rotterdam, September 2002

Callon, M.(1986). Some elements of a sociology of translation: domestication of the scallops and the fishermen – in John Law editions, 196-229

Callon, M. (1991). Techno-economic networks and irreversibility; Pp. 132-165 in A Sociology of Monsters: Essays on Power, Technology and Domination, edited by John Law. London: Routledge.

Callon, M.(1993). Variety and irreversibility in networks of technique conception and adoption. In D. Foray and C. Freeman (Eds.) Technology and the Wealth of Nations: The Dynamics of Constructed Advantage. London, Pinter Publishers: 232-268.

Callon, M, and Latour, B. (1992). "Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley." In Pickering, A., ed., *Science as Practice and Culture.* Chicago: University of Chicago Press.

Callon, M. and Law, J. (1997). After the individual in society: Lessons on collectivity from science, technology and society. *Canadian Journal of Sociology*, 22, 2, 165-182.

Carliner, S. (2005). Course Management Systems Versus Learning Management Systems(in www.learningcircuits.org/2005/nov2005/carliner.htm, accessed on 27 April 2006).

Clark, G. (1996). Glossary of CBT/WBT Terms, Available at www.clark.net/pub/nractive/alt5.htm, pages 1-2 [accessed on 24 February 2006]

Czerniewicz, L & Brown, C (2005). Access to ICTs for teaching and learning – from single artefact to inter-related resources. Report for the Council for Higher Education (CHE), Unpublished.

Czerniewicz, L., Ravjee, N., & Mlitwa, N. (2005). *Mapping the landscape ICTs in Higher Education in South Africa.* Report for the Council for Higher Education.

Department of Arts, Culture, Science and Technology (DACST) (2002). South Africa's National Research and Development (R&D) Strategy, August 2002, Government Printers, Government of the Republic of South Africa, Pretoria.

Department of Education (DoE) (1996). Green Paper on Higher Education Transformation, December 1986, (in www.info.gov.za/greenpapers/1996/highereduc.htm accesses on 28 April 2006)

Drucker, P. F. (1997). Cover Story. *Forbes*.

Fox, G. and Mills, K. (1997). Web Technologies and the Potential for Innovation in Distance Education, International Journal of Modern Physics, Volume 8 (1), p 107.

Garrison, R. & Anderson, T. (2003). *E-Learning in the 21$^{st}$ Century: A Framework for Research and Practice*. Routledge Falmer, London.

Gibbons, M. (998). *Higher Education Relevance in the 21st Century*. Paper presented at the UNESCO World Conference on Higher Education. Paris: October 5-9, 1998. Online: http://www1.worldbank.org/education/tertiary/publications.asp. accessed on 08 Feb, 2006

Gutlig, J. (1999) *Globalisation and the idea of the university in post-apartheid South Africa.* Paper presented at the Kenton Conference, South Africa.

Hanseth, Ole, and Monteiro, Eric (1998), Understanding Information Infrastructure. Manuscript 27. Aug., 1998; at http://heim.ifi.uio.no/~oleha/Publications/bok.html

(Accessed on 15 March 2006)

Henke, H. (1997). *Evaluating web-based instruction design* [online]. Retrieved on 12 March 2006, at http://www.chartula.com/evalwbi.pdf

Keats, Derek, et al (2002): Poised for takeoff: using ICT to transform

teaching-and-learning at the University of the Western Cape http://www.foundation-partnership.org/linchpin/poised.htm

Lamb, R. and Davidson, E. (2002). Social Scientists: Managing Identity in Socio-Technical Networks. Proceedings of the Hawai'i International Conference on System Sciences, January 7-10, 2002, Big Island, Hawaii

Latour, Bruno (1987). *Science in Action*. New York: Library of Congress in Publication

Latour, B (1992). The sociology of a few mundane artifacts. In Bijker, Wiebe & Law, John. (Eds.). Shaping technology/Building society studies in sociotechnical change. Cambridge, MA: MIT Press.

Lund, A. (2003). The Teacher as Interface - Teachers of EFL in ICT-rich environments:

Beliefs, Practices, Appropriation. Dissertation submitted for the degree of Philosophia Doctor (ph.d), Faculty of Arts, University of OSLO, September 2003

Mbeki, T (President of South Africa); State of the Nation Address (2001), in http://www.anc.org.za/ancdocs/history/mbeki/2001/tm0209.html

Mcdonald, H. & Ingvarson, L. 1997. Technology: A Catalyst for Educational Change. *Journal of Curriculum Studies*. 29(5): 513-528.

McManus, T.F. (1995). Special considerations for designing internet-based education. *Technology and Teacher Education Annual, 1995, 32*, 51-57.

Middlehurst, R (2003); *Competition, Collaboration and ICT: Challenges and Choices for Higher Education Institutions*; University of Surrey, UK (Unpublished)

Mlitwa, N. (2005). Assessing the adoption and use of ICT for teaching and learning in higher education institutions – a case of UWC. HictE website, www.hicte.uwc.ac.za: unpublished

Mlitwa, N. (2006). Information Society Networks, Community Informatics, and Socio-technical identities: An ANT Perspective. Paper prepared for the CIRN2006 Conference, Monash University, Prato, Italy (in Press).

Morrison, J. (1999). Using Information Technology Tools in Education: An Interview with Rodney L. Everhart. *On the Horizon, 7*(6).

National Plan for Higher Education in South Africa (February 2001), Department of Education. URL: www.polity.org.za/html/govdocs/misc/higheredu1.htm?rebookmark=1#Section%203

Presidential National Commission (PNC) on Information Society (IS) for the national vision on IS, at www.pnc.gov.za/is [accessed on 1 June 200].

Rosswall, Thomas (1999). The role of ICT in higher education at the beginning of this new millennium. Rector of the Swedish University of Agricultural Sciences, in http://online.kennis.org/eva/eva06/ictslu.htm [accessed on 31 May 2005]

Relan, A. and Gillani, B.B. (1997). Web-Based Information and the Traditional Classroom: Similarities and Differences. In Khan, B.H., (Ed.), Web-Based Instruction, Educational Technology Publications, Englewood Cliffs, New Jersey, page 43.

Singleton, V. & Singleton, M. (1993) 'Actor-Networks and Ambivalence: General Practitioners in the UK Cervical Screening Programme,' Social Studies of Science, Vol 23: 227-64.

Taylor, Mark, C. (2001). The Moment of Complexity: Emerging Network Culture. The University of Chicago Press, Chicago, 2001

Toumi, IIKKA (2001). Internet, Innovation, and Open Source: Actors in the Network. First Monday, volume 6, number 1 (January 2001), (http://firstmonday.org/issues/issue6_1/tuomi/index.html accessed on 4 April 2006)

University of Pretoria Strategic Plan: Inspiring the Innovation Generation 2002 – 2005 (2002), (in www.up.ac.za/beta/about/eng/strategic_plan.pdf, accessed on 5 March 2006)

Van der Merwe (2004). Evaluating the Integration of ICTs into teaching and learning activities at a South African higher education institution. A doctoral dissertation, Science and Technology stdies, Centre for Science Studies, University of Stellenbosch, South Africa. Unpublished.