

Technology for Teaching & Learning in higher education contexts: AT and ANT Analytical Perspectives.

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Abstract

There is a growing body of literature to argue that technology enhances teaching and learning process in higher education. The adoption of teaching and learning technology such as e-Learning and the learning management systems (LMSs) is also on the rise among higher education institutions. The patterns of this growing trend are also incoherent and inconsistent. In addition, there is no general agreement on the meaning of concepts of adoption and use within academia. In the midst of the existing conceptual stampede – it remains difficult to adequately explain emerging patterns. This paper explores a possible framework for the analysis of objective (goal)-directed applications of technology in a teaching and learning environments, and implications thereof. The work of Miettinen, of Rajkumar, and as well as Miettinen and Hasu encourages the use of the Activity Theory (AT) for this purpose. The paper draws on three case studies from technology usability studies to explore a possible AT analytical framework. The AT is found to be helpful for analysis of practical applications of technology, but not without shortcomings. So is the ANT. The AT tends to advocate the instrumentalist view of technology as a neutral tool. The ANT may be handicapped by its symmetrical assumptions at this level of analysis. Technical artefacts do not need to be relegated into a neutrality, or afforded a symmetrical status with human actors. Both an AT and ANT subscribe to the contextual embedded nature of technology but differ on implications and the status of technology in a socio-technical process. The ANT supports the critical view of technology as value-laden, thus encouraging the critical engagement with a technology in social environments. Its symmetrical assumptions however, limit its scope in accounting for differences between human cognitive capabilities and the non-cognitive nature of artefacts. Additional studies towards an AT and ANT framework of contextualising e-learning and LMSs is recommended.

Introduction

Technological innovation has changed the very social, political, economic, and cultural fabric of life (Taylor, 2001) since the end of the cold war. Information and communication technology (ICT) is transforming people's lives, thereby increasing confidence and hope for the future (WSIS TUNIS, 2005). It has been instrumental in social transformations – from the industrial society of the 20th century to the 'network society' of the new age of 'Informationalism' - where even our intercontinental neighbours are now essentially just one button-push away (Castells, 1996).

Higher education has not been left untouched, and predictions are that few decades from 1997, the pressure of the changing times would have further reduced big university campuses into “*relics*” (Drucker, 1997). Universities as we know them, according to Drucker (1997), just “*won't survive*”.

Changes in the context of higher education are evidently unfolding. There is a shift from the pursuit of knowledge¹ for its own sake, to a “*more pragmatic economically-oriented*” paradigm (Gibbons, 1998). The author sees information, awareness, and ability to use information as key features of knowledge. Knowledge production and dissemination, research and teaching are no longer self-contained but involve interactions with a greater variety of knowledge producers than in the past. Universities worldwide are improving their competitiveness in the new and challenging distributed knowledge production system (Mlitwa, 2005). In this quest, they are making extensive use of new ICTs - to attract and teach new students, and to improve co-operation with different stakeholders (Gutlig, 1999; 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 symbolizing the new entrepreneurial university (Gutlig, 1999; van der Merwe, 2004) with minimal clarity in conceptual frameworks (Mlitwa, 2005).

The traditional university is trying to survive the pressures of globalisation, the technology revolution, new competition, and the push for information society. Survival however, will depend on how universities re-position themselves in the distributed knowledge production system, the type of partnerships they forge (Gibbons, 1998; van der Merwe, 2004), and how they use available tools and resources such as ICT to improve their activities (Mlitwa, 2005). ICT for teaching and learning should

be conceptually and operationally clarified if its positive impact is to improve. The purpose of this paper therefore, is to find a theoretical framework upon which e-Learning practices and related implications in teaching and learning at higher education institutions can be contextualised.

The paper opens with a literature background of the role of technology in a changing context of higher education. The author draws on the recent investigation into the meanings and implications of ICT for teaching and learning by educators, practitioners and researchers working in higher education institutions in South Africa (Cerniewicz, *et al.*, 2005) to show the incoherence in existing concepts and held views on technology in education. Andrew Feenberg's (2003) perspectives on technology and social contexts are used to categorise dominant assumptions of technology in teaching and learning. The author acknowledges dominant arguments that call for effective/innovative or even appropriate uses of technology in the literature, and draws on case studies from the technology usability discipline to investigate the meaning and implications of technology usability – and to investigate how this meaning can contribute towards the development of an analytical framework for e-Learning applications.

The paper opens with a discussion of technology in social settings, followed by an elaboration of the concept of e-Learning. An activity theory (AT) as an analytical framework is motivated for and outlined. Three technology usability case studies are used to contextualise the significance of usability considerations in e-Learning platforms such as the LMSs.

Diverse Meanings of Educational ICT

The survival of a traditional university is challenged by the changing global, local, and technology related forces – yet solution seeking attempts through the use of ICT are hampered by a lack of conceptual clarity in higher education. Even in research reports, government and higher education institutional policy documents as well as conversations by academics and IT practitioners – technology is only discussed in relation to different purposes for which it is used (Mlitwa, 2005). The endless nature of technology uses therefore, leads to the endless meanings and implications attached to technology. In the case of educational usage, often references are made to *Educational Technologies* (UCT, 2003), *Learning and E-Learning Technologies* (Badenhorst and de Beer, 2004), *Online Teaching and Learning Technologies* (Van der Merwe and Möller, 2004), *Digital Library Technologies* (Peters, 2002), and *Digital Learning Objects* (Smith, 2004), among others. Technology is further viewed within the context

¹ Bergen.org (www.bergen.org/technology/defin.html) defines technology as “*the technical means people use to improve their surroundings. It is also a knowledge of using tools and machines to do tasks efficiently*”.

of communication, as communication tools and or networks. References are usually made to *IT Networks and Communication Protocols* (University of Natal, 2003), *Electronic Information and Communication Technologies* (Van der Merwe and Pool, 2002), *Information Agent* (Razek, *et al.* 2003), or just *Communication Technology* (Blanchette and Kanuka, 1999), among other concepts. These terms are often used inconsistently, with minimal or no attempt to define them (Mlitwa, 2005).

In rare cases, almost all definitions tend to link a technology with knowledge. Technology also “includes the knowledge and skills necessary to use technology as a tool” (Bergen.org, undated). As a tool for example, it can extend “human capabilities to solve problems” (McLuhan, 1994), and “to assist students in the acquisition of knowledge” (Sanbenito.tx, undated) or to empower teachers and administrators to stimulate learning more effectively. Technology is also conceptualised as a domain either of knowledge, for knowledge advancement (UCT Policy Document, 2003:1) or *for underpinning innovation* (SA R&D Strategy 2002:13). For many practitioners in higher education according to Czerniewicz, *et al.*, (2005) using ICT implies using the web. Hence, the term “web-based” is equivalent to ICTs even when in reality, the two terms are not the same thing. As Muianga (2004:2) contends that “many aspects of ICT relate to a web-based course management system”, this view is a fair reference to the e-Learning version of educational technologies. Uncritical reconciliation view of technology as knowledge in the earlier discussion, with a simultaneous acceptance of technology as the web can be confusing. For example, it may be argued that since both knowledge and the web means ICT, that knowledge and the web means one and the same thing. Immediately the reader will note the sensitivity associated with the diversity and sometimes conflict in meanings attached to ICT. The following section investigates held perspectives on the impacts of ICT in teaching and learning in the literature.

Perspectives of New Technologies on Teaching and Learning

Obviously, ICT is considered part of a solution to addressing the changing learning needs of societies (Garrison and Anderson, 2003). The positive perceptions however, do not imply unanimity of meanings and implications of ICT in teaching and learning. Technology is either viewed as neutral and autonomous (determinist) on the one hand, and or neutral and human controlled (instrumentalist) (Feenberg, 2003). On the other extreme stands the view of technology as both autonomous and value-laden (substantivist), or as human controlled and value-laden (critical perspective). Where technology is seen as neutral and autonomous, the belief is that it is merely a tool and the indifferent instrument. This is the instrumentalist perspective of ICT (Feenberg, 2003).

In fact, recent studies in South Africa show divergent and speculative perspectives on the role and impact of ICT in teaching and learning (Czerniewicz, *et al.*, 2005). For the constructivists, technology should be learner- centred. Arguments are that when applied correctly, technology improves the quality of learning experiences (Tinio, 2002) or education (Muianga, 2004). Its decentralized nature frees the learner from the educational provider (Khan, 2000). E-Learning technologies should enable students to actively engage in the construction (rather than the passive receipt) of knowledge (Muianga, 2004). It could even help eliminate some debilitating factors in education, such as time, space, and pace (Sekgwelea, 2004). Authors such as Fox and Mills (1997) even expect web-technologies to totally change distance education. Technology such as e-Learning for example, will continue to “...*inevitably transform all forms of teaching and learning in the twenty-first century*” (Brown, 2002). The following passage discusses implications of these sentiments on e-Learning.

Interpretations of e-Learning

e-Learning is also discussed within the contexts that mostly reflect “*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, et al., 2005)*”. A computer is obviously presented as a significant part of e-Learning. Most academics and IT practitioners in higher education institutions however, tend to emphasise a network and learning more than a computer (*ibid.*). A network in the form of a course or learning management systems (LMS) therefore, is a significant environment, a platform, and tool without which e-Learning processes may not unfold. A LMS can best be defined as a hardware and software environment for network-enabled learning programs and processes (Carliner, 2005) and in terms of its functionalities.

A LMS as a “seamless link to e-Learning” (Carliner, 2005) offers an inclusive approach to defining the system. It positions the purpose within a broader e-Learning aspect of education. As a web-based training platform (Clark, 1996), it is largely described as a constructivist and collaborative knowledge environment on the World Wide Web (www) (Relthe and Gillami, 1997) to advance guided independent learning (Rich, *et al.*, 1999). Note the alignment of LMSs with constructivist learning! It is said to enable “flexible”, “participative” and “contribution oriented” learning (Collis and Moonen, 2001). It can be used to incorporate multiple media elements (Henke, 1997; McManus, 1995) that further enables effective and flexible interaction. These perspectives reflect various understandings of what e-Learning does, and less on how and why.

The following section discusses insights on e-Learning technologies in a higher education context, from the perspective of the academic and IT practitioner interviews.

Practitioner and Policy 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, *et al.*, 2005). Central to this definition is not only the presence, but also the significance of a network (www) which incorporates a computer and the skill to use these tools.

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 of “e-Learning” is strictly to enhance the quality of teaching and learning. Special mention of a “virtual campus” and related implications is noted. Universal access to e-Learning and adequate literacy by all is the obvious implication. The quality enhancement aspect however, suggests that the availability should be supplemented by purposeful and effective usage (Broere, *et al.*, 2002). Purposeful-usage implies the process where technology is specifically applied to achieve predefined human goals.

How universities are adopting e-Learning technologies (such LMSs) and practices in the midst of this conceptual stampede is discussed in the following section.

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). As it is shown below, the increasing adoption of ICT at an institutional infrastructure acquisition level is paralleled by varying degrees of usage of ICT for teaching and learning by academics. All institutions in the region are making equally ambitious investments on ICT infrastructure. The extract from the UWC sample illustrates this point in terms of student computer ratio, the high level of staff access to computers, all accompanied by limited usage of ICT in teaching & learning:

- Academic staff access: 100% of all academic staff respondents confirmed that they have computer and internet access in their workstations (Mlitwa, 2005).
- Student computer density: Student to computer ratio is 13:1 (14,648 students ÷ 1,095 computers = 13, 4 or just 13 students per computer at the beginning of 2004). An ideal ratio would be 1:1, which remains utopian for most countries, and unrealistic for a developing country. The 13: 1 ratio compared well with international trends and best practices (of between 8 and 15 students per computer in most US institutions) (Mlitwa, 2005).
- Limited usage by staff: Less than a ¼ or 23.4% of all UWC academic staff were using computers daily for teaching and research (in 2004). Science faculty staff had the most frequent users of computers and Internet for teaching and research, with 29.0% of the staff using it daily and 54.8% using it weekly. Science is followed by health sciences with 27.8% of daily usage and 44.4% of weekly usage. Economic and Management Sciences (EMS) ranks third with 19.0% of daily usage and 61.9% of weekly usage. Humanities staff has the lowest daily usage of 13.0% and 78.3% weekly usage (Mlitwa, 2005).

The extracts indicate that access to infrastructure is not the problem in higher education institutions in the Western Cape, yet usage and purposes thereof are incoherent. Interview with the head of the e-Learning division at the University of Stellenbosch, Avan der Merwe (2004) suggests (though not in so many words) that a decision to adopt a proprietary learning management system (WebCT) may not have been initiated from the top management structures rather than bottom up. As a result, there is widespread usage of the system due to a compulsory intake clause, but minimal engagement with the system by academics (van the der Merwe, 2004).

A similar LMS is used in the Cape Peninsula University of Technology. There was no written policy to direct the development and use of learning technology in 2004 (Mlitwa, 2005). In both institutions, the LMS is predominantly used as a learning transfer medium. E-Learning was driven by a champion, the executive director of Information and Communication Services (ICS) – Professor Derek Keats at the University of the Western Cape (UWC). The open source software (OSS) based system (www.kewl.uwc.ac.za) is home-grown and developed (Mlitwa, 2005). However, it is unclear whether the system and the potential it offers to e-Learning is understood by all academics at UWC. Full interactive engagement between the social and the technical actors in this e-Learning environment was yet to be fully realised during the time of this research.

The University of Cape Town (UCT) has the open process of consulting educators and student users of its technology when making decisions. The UCT community can choose between proprietary (WebCT) and home-grown systems (e.g. Connect or Vula), 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). 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. Instead, the issue of cost and whether a system is in the open-source or proprietary format – dominates debates and adoption decisions (Mlitwa, 2005). A satisfactory account of the interwoven relationship between technology and organisational transformations is also minimal in the literature and practice (Hanseth and Monteiro, 1998; Mlitwa, 2005).

In the quest for a useful contextual framework, and in acknowledging dominant arguments for appropriate application/usage, the author applies the activity theory (AT) approach to technology-usability case studies by Bjoko (2006); Sheng-Cheng Huang (2006); and Kreitzeberg (2006) to explore the appropriateness of the AT and usability arguments in the understanding of e-Learning and LMSs.

AT and Technology Usability

The AT can best be explained in terms of its key terms: internalization, mediation, subject, object, tool, transformation (process), rules, community, division of labour, and outcome (Engestrom, 1987). The subject is an individual, the object is the motive for action, the tool is an artefact while the community represents social groups, as well as rules and arrangements such as the division of labour. All these factors are jointly called the activity system (Rajkumar, 2005; Miettinen, 1997). An AT originates from Vygotsky's (1979, in Miettinen, 1997) concepts of mediated action, where he argued that human action is more than a function of internal biological processes. It is also mediated by culture and artefacts (including signs and tools). Leont'ev (1978) added that human activity is also socially mediated. Too often though, focus is placed on human action: hence the activity theory (and system). An activity theory (AT) is a concept, a theoretical approach or perspective (Sandars, 2005) that has been used and interpreted by a number of theorists and researchers in most cases – to analyse the actual material conditions of human activity from a means-ends, user-needs perspective (Rajkumar, 2005; Miettinen,

1997; 2002). Since the purpose of this paper is to improve the analytical framework for goal-specific uses of technology in social settings, the author finds an AT useful.

The relationship between subjects (humans) and objects (motives) is mediated by the rest of the factors: tools, rules, community and the division of labour, among others. The mediation process is regarded as transformation that results into the outcome or motive (Miettinen, 1997). While a list of artefacts may be indefinite, the relationship between them and humans is purely that of a tool that merely serves to advance activities for the purpose of furthering motives. Subjects (humans) are mediated by culture, tools, rules and contexts (Rajkumar, 2005; Miettinen, 1997). They create artefacts on a continuous basis in the activity system to better enable transformation processes towards outcomes. An equivalent version of this perspective “describes the use of ICTs for local benefits” (Erwin and Taylor, 2004) is made in Community Informatics (CI) literature.

This paper presents the LMS within e-Learning as an equivalent of the activity system in AT. The activity systems recognize interactions between subjects (humans) – mediated by artefacts, tools, symbols, rules, cultures, communities, among other non-human things (Miettinen, 1997; Rajkumar, 2005). The relationship is that of a human and tool, with other influences. This relationship within the activity system is compatible with the instrumentalist view of technology, where the neutral tool only serves to achieve human goals or to mediate between humans and their objectives. This is how the theory has been used in recent projects. Miettinen *et al.* (2002) has used the AT to articulate the needs of the user of a high technology product. Similarly, Rajkumar (2005) cites and supports this work.

The objective of the analysis is to explore the clarity of the key terms used in technology-usability research, as well as related implications.

Usability Case Studies

By highlighting key terms and attributed meanings in table 1 below, the author seeks to contextualise what researchers and technology users consider as important for technology usability. This will be used to establish the meaning of “technology-usability” as implied by researchers, and to develop an AT based analytical framework that supports arguments for the usability (user-friendly) of LMSs.

In the first case study Bjoko (2006) used the eye-tracking methods to compare the user-friendliness of the American Society of Oncology’s two web designs in 2005. The Clinical Oncology Society had initiated a new improved website, and the objective of Bjoko’s study was to test and compare the

usability of the original against the website. The study findings confirm the usability of the new website as superior to the original website (in terms of the given criteria in table 1 below).

Table 1: Selected Technology Usability Studies

Author	Case Study + Technology Type	Purpose of Case Study	Criteria per Case Study	Meanings/Implications
Bojko, 2006	Using eye-tracking to compare web page designs	Comparing user-friendliness of two web designs	<ul style="list-style-type: none"> - enable goal achievement - enable efficiency - ease of use - meet user needs/ expectations 	<ul style="list-style-type: none"> - Determinant of success or failure - Improves processes to the final goal - Does not add unnecessary physical strain - Does not force unnecessary user-adjustments
Sheng-Cheng Huang, 2006	Empirical evaluation of a popular cellular phone's menu system: theory meets practice	Determine effectiveness, efficiency, & user satisfaction of a cell-phone's menu system	<ul style="list-style-type: none"> - effectiveness - efficiency - user satisfaction - accuracy -clear labelling & descriptions -meet user expectations -compatible with intended task 	<ul style="list-style-type: none"> - Enable successful goal achievement - Saves time, works fast, reliable - Users say it satisfy needs (user choices show) - Do only what it is intended to do, reliably - Should not be confusing - Relevant. No unnecessary user-adjustments
Kreitzberg, 2006	Can collaboration help redefine usability?	Opening debate for platforms that collaborate related information easy access, reference & use	<ul style="list-style-type: none"> -collaborated knowledge bases -single entry-points to knowledge 	<ul style="list-style-type: none"> - Info. fragmentation complicates usability - Info. Collaboration improves cross-discipline interaction

Reconstructed to reflect the findings of the case studies: Bjoko (2006); Sheng-Cheng Huang (2006); and Kreitzberg (2006).

Sheng-Cheng Huang (2006) had also evaluated a Nokia Cell-phone menu system to compare the convergence between the theoretical and practical aspects of cell-phone menu usability in 2005. The findings offer an insight into what should be more usable cell-phone menu functionalities. On a slightly different angle, Kreitzberg (2006) introduces content provision as a significant aspect of website usability. The focus of this paper is not on the details of methodologies and findings of respective studies, but to draw lessons on the objectives and the key terms used for inferences into the usability of LMSs. The AT framework is used to analyse the terms and emergent meanings attributed to technology usability in three case studies. For example, the central AT term: subject (which implies the individual), is central to technology usability considerations in all three case studies. Evident in all three case studies is that good (highly usable) technology applications should enable the “satisfaction of the subject (the individual user) interests, goals, and meet their expectations – with ease”.

Just as Bjoko (2006) is concerned with user friendliness of the webpage, Sheng-Cheng Huang (2006) is concerned with user-satisfaction of cell-phone menu systems. Kreitzberg (2006) is also concerned with the improvement of information provision methods in websites, thus suggesting a collaboration of different information platforms and sources to improve user access.

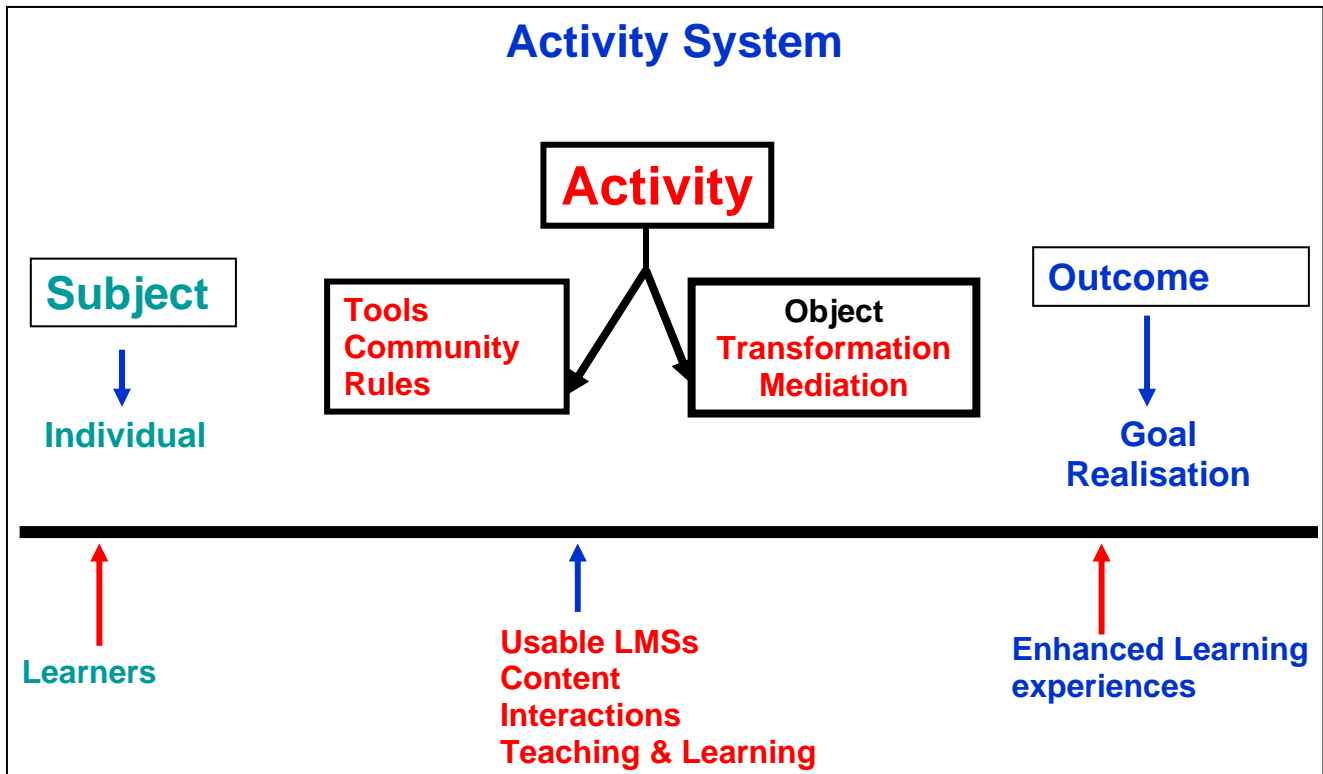
Terms used in all case studies tend to present an instrumentalist perspective of technology as a somewhat neutral tool (Feenberg, 2003) whose purpose is to adequately satisfy user-ends. Technology usability in the case of web pages for example, is high if technology functionalities enable goal achievement, enable efficiency, ease of use, and meet user needs/expectations (Bjoko, 2006). Sheng-Cheng Huang (2006) uses the terms of effectiveness, efficiency, user satisfaction, accuracy, clear labelling & descriptions, meet user expectations, and compatibility with intended tasks to make a similar point about the usability of cell-phone screen menus.

Keitzberg (2006) discusses the content delivery aspect of information technologies. The argument is strictly that of enhancing usability by improving the process towards access to information (motive for using a web-page). Collaboration rather than disintegration of information sources according to Keitzberg (2006) enhances information access processes.

By technology usability therefore, the case studies suggest the capacity of a technology to improve processes towards achieving the final goal of the user (in respective contexts and purposes). Direct arguments are that a technology should not add unnecessary physical strain to the user. It should not be confusing. It should meet user needs, expectations, and should be easy to use (Bjoko, 2006). Keitzberg (2006) adds efficiency, effectiveness, and accuracy to concur with other two studies. The focus is clearly on subject activities and processes towards the outcome.

The reasoning in the three case studies supports the activity system paradigm of the AT. Human-technology interaction according to this model of thinking is equivalent to a social network joined together by the use of tools where a negotiated relationship is limited to subjects (humans) who interact by manipulating artefacts. Following this thinking, a framework for understanding the LMS within the AT paradigm is constructed in table 2 below:

Table 2: AT, Technology Usability Studies & LMS



An LMS in this framework would represent the activity system where learners are the subjects with activity taking place in their interaction with the hardware, software, content, and other learning applications. It is the usability of the LMS applications and the entire learning environment that mediates and transforms the object (learning) through the activity of learning – into the final outcome: enhanced learning and learning experiences. While this thinking seems fairly logical in many instances, it tends to carry simplistic implications that leave numerous questions unanswered. Too much credit is given to the subject (the individual user). When a technology is a certain way (high usability) for example, then the user will simply apply the rules in the activity system to easily achieve intended goals. But this may not always be the case in practice. Because human action is already mediated by culture and artefacts (of which technology is a prominent part) social processes, then using technology is simply a mediation process that goes all the way to achieving desired ends. Surely there is more to socio-technical interactions than the technology simply (and un-problematically) enabling the realisation of outcomes. Given the AT bias towards technology-neutrality perspectives, the question arises whether this framework is adequate to contextualise e-Learning through LMSs. The application of the neutral technology thesis in e-Learning processes is critiqued in the following section.

e-Learning and the Neutral Technology Thesis

The neutral technology thesis is common in instrumentalist vocabularies that tend to see technology as the indifferent tool that merely stands to serve user purposes (Henrickson, 2000; Feenberg, 2003). This thinking is based on assumptions of essentialism and the social abstraction (Kellner, 1998) of technology as a means to the end. The neutral-technology thesis tends to limit the socio-technical interaction debate to issues of resistance or adoption, reducing the problem into a mere technical literacy challenge where all that matters is for humans to know how to use a technology for goal realisation. Our identities according to this perspective are uniquely pre-given, fixed, and rationally independent (Henrickson, 2000). The role of technology in shaping human action (and identities) is non-existent (or rather, neutral) in instrumentalist accounts. So, we shape technology for our purposes and not the other-way round.

In the AT's own terminology however, the activity system emphasises the process of mediation and transformation of activities into end goals. Where the end-goal is learning which includes cognitive, cultural and shaping, assumptions of technology-impact neutrality on the "learning outcome" becomes questionable.

Czerniewicz, *et al.*, (2005) reports numerous interview statements that subscribe to this thesis. Most respondents presented teaching and learning ICT (including the web) as the neutral means to furthering user-ends. Instructivists claim that technology is too neutral to teach, but only a tool for use by teachers to instruct (transfer knowledge). In this case, e-Learning is successfully or unsuccessfully used to transfer content. Technology therefore, is not value-laden but neutral. It has no implications on the user since it is just how you use it that matters (Czerniewicz, *et al.*, 2005). Instructivists therefore tend to fall under the neutral-instrumentalist stream. The limitation in its focus on tools, uses, resistances to use, and adoptions, tend to overlook the interaction of technology with cognitive processes (as propagated by Vygotsky, 1978), failing to take cognisance of the socio-technical discourse.

The determinist on the other hand sees technology not only as neutral, but also autonomous. Determinism is aligned with descriptions of technology as a determinant of progress and change (Feenberg, 2003) in higher education (Czerniewicz, *et al.*, 2005). A number of uncritical constructivists who accept technology at face value as the agent for change fall under this category. In this model of thinking, technology enhances education, and is a measure of enlightenment that should not be questioned. It enables *independent learning, it influences or drives the theory of learning, it breaches*

many walls created by distance and times zones; it unites people and creates powerful and synergistic partnerships at local, regional and global scales; it motivates students and energises classrooms (Czerniewicz, *et al.*, 2005; Mlitwa, 2005). Most constructivist commentators interviewed by Czerniewicz, *et al.*, (2005) however, saw the impact of e-Learning as the enabling of user engagement with learning – where a learner becomes the active participant in the construction of knowledge.

Collaborative learning was also emphasized. The interviewee even 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, *et al.*, 2005). Implications were however, largely aligned to the neutral thesis that as long as e-Learning is designed as a user-friendly tool for the learner, and is applied to further constructivist principles, it should enable the unproblematic construction of knowledge. The reader should note that divergent understanding of technology is evident even within a single “neutral thesis” school of thought, which in turn opposes the value-laden perspective of technology.

Technology as Value-Laden

On the other extreme, technology can be autonomous and value laden, but not human controlled. Feenberg (2003) calls this view the “substantivist” perspective of technology. In other words both the means and ends are linked in a system. Technology therefore, influences academic processes and change, but is also influenced by those processes. It can also be human controlled and value-laden. Feenberg (2003) calls this perspective, the critical theory of technology. In this case technology is used as a value-laden tool that carries with it the context of its design, the language and cultural connotations of its location, to influence its destinations (Vygotsky, 1978). It is never neutral but value-laden (Feenberg, 2003) and has a potential to shape (transform) social inter/action and social identities. The embedding of American English in most computer applications for example, means that the Mongolians, the Chinese, and the Russians should now adopt the foreign language in order to effectively interact with the Western technology. Therefore, it is because of this value-laden nature of technology that critical theorists interrogate the possible connotations of its use.

In summary, the focus of the neutral technology thesis is clearly on human activity where the interaction of human and technology is that of improving user-interests. The critical theoretical framework of which

the actor network theory (ANT) is a critical offers an alternative value-laden perspective of technology. The value-laden notion of technology gives more credit to the social and contextual embedded aspects of technology. Technology is seen as a tool that interacts, shapes, and is in turn shaped by contexts. The ANT and e-Learning contextual framework is discussed in the following section.

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. 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) actants in what Law (1987) refers to as a heterogeneous network. Unlike the implications of the AT where the activity system represents human actions that are mediated by neutral artefacts, the ANT presents a network as a sum of interrelated and causal connectedness of all factors on any socio-technical account. 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). 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).

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), environments (contexts) and resultant learning processes.

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). Looking at e-Learning from the ANT perspective therefore requires recognition of a negotiating interplay between the human and machines in the 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. This view tends to streamline the arguments of this paper into the constructivist rather than instructivist pedagogical stream. As opposed to the 'instructional' view, constructivists describe learning as the innovative and participative process that can be enhanced through e-Learning platforms. The question though, is whether ICT assumes such a meaningful role in technology assisted education practices and whether it is engaged as the active actor in the e-Learning network.

The author of this paper shares the mutual shaping view of actors in a network, and that a network constitutes both human and material actors. This paper however, does not subscribe to the symmetrical notion of humans and non-human actors. Human actors have higher order cognitive capabilities (Vygotsky, 1983) and intentional action that are lacking in artefacts. Artefacts (and animals) also have other characteristics that humans lack. So, as much as the mutual shaping argument is accepted, it is not accepted that it follows a linear and equal negotiation pattern.

Conclusion

Literature on existing conceptions of ICT and education has shown that the meanings and perceptions of ICT in educational technologies are divergent. A recent investigation of the thoughts of academics, practitioners and managers have also shown that conceptual disagreement is not only limited to the literature, but also to perceptions of practitioners in the field.

This paper opened with the argument that all academic institutions are either adopting the open source software (OSS) or proprietary based learning management system. In the midst of the existing conceptual stampede however, studies show discrepancies between the adoption of a technology in higher education by institutions – and usage patterns by academic staff. In a quest to find a useful framework for understanding teaching and learning ICT, dominant calls for effective or appropriate usages of technology were acknowledged by a synopsis of the technology usability studies. The AT framework has been applied. It adopts the neutral instrumentalist view of technology as a means to achieving ends. This makes it useful only to analyzing better uses of technology to improve the satisfaction of human needs. It is not helped by a neglect of issues of power relations that stems from the social embedded nature of technology. This is where the ANT comes in. The ANT has been used to reconcile conflicting perspectives on the position of learning technologies in social processes. It supports

the critical view of technology as a social and culturally embedded actor in a socio-technical network. It supports the view that technology shapes, and is shaped by contexts and environments.

The ANT offers a helpful approach in encouraging the critical engagement of a technology in social environments such as e-Learning, but it is not without shortcomings. The symmetrical implication between technical and human actors just pushes the role of technology a bit too far. The problem as Vygotsky (1978) would put, it is that human are graced with cognitive mental capacities which artefacts and animals do not have, and as such the symmetrical argument remains questionable. The final argument therefore, is that an AT's socio-technical activity system should be extended into a socio-technical network without the symmetry implications. The LMSs 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.

Further investigations into the AT and ANT in teaching and learning technologies in higher education is recommended.

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