

The role of ICTs in higher education in South Africa: One strategy for addressing teaching and learning challenges

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ABSTRACT

One of the most common problems of using Information and Communication Technologies (ICTs) in education is to base choices on technological possibilities rather than educational needs. In developing countries where higher education is fraught with serious challenges at multiple levels, there is increasing pressure to ensure that technological possibilities are viewed in the context of educational needs. This paper argues that a central role of educational technology is to provide additional strategies that can be used to address the serious environmental and educational challenges faced by educators and students in higher education. The educational needs manifest in South African universities include addressing general lack of academic preparedness, multilingual needs in English medium settings, large class sizes and inadequate curriculum design. Using case studies from one higher educational institution, this paper shows how specific and carefully considered interventions using ICTs can be used to address these teaching and learning concerns. These examples serve to demonstrate some ways in which teaching and learning may be enhanced when uses of educational technology are driven by educational needs. The paper concludes that design of educational technology interventions should be driven by educational needs within the context of a broader teaching and learning strategy which requires buy-in of both educators and learners.

Keywords: *Educational challenges, higher education, educational technology, student diversity*

INTRODUCTION

It has been suggested that information and communication technologies (ICTs) can and do play a number of roles in education. These include providing a catalyst for rethinking teaching practice (Flecknoe, 2002; McCormick & Scrimshaw, 2001); developing the kind of graduates and citizens required in an information society (Department of Education, 2001); improving educational outcomes (especially pass rates) and enhancing and improving the quality of teaching and learning (Wagner, 2001; Garrison & Anderson, 2003).

While all of these suggest the potential impact of ICTs in education in general and South Africa in particular, it is still difficult to demonstrate the potential of technologies in addressing specific teaching and learning problems faced by South African higher education institutions. The thesis of this paper is that the potential of ICTs is sandwiched between increasing pressure on higher education institutions from government to meet the social transformation and skills needs of South Africa, and the varying student academic preparedness, large class sizes and multilingualism currently experienced in these teaching and learning contexts. Our thinking aligns with others (such as Kirkup & Kirkwood, 2005; Wagner, 2001) who argue that it is the contextualised teaching and learning needs that ought to drive the ICT intervention, rather than the technology itself. In South Africa, contextualisation of teaching and learning requires a tightrope walk between higher education imperatives and social-cultural context of the educational landscape. This paper illustrates by means of examples drawn from one higher education institution how educational needs can drive design of learning environments and technological use.

The question driving this paper is: *How may educational technology interventions address the teaching and learning challenges faced by South African higher education institutions?* We discuss the general and specific educational challenges. These challenges then provide a context for an ICT intervention framework which is described and examples of the use of this framework in curriculum projects are discussed.

CHALLENGES FACING HIGHER EDUCATION IN SOUTH AFRICA

General challenges

Currently, higher education in South Africa is under increasing pressure to meet the social transformation and skills needs of the new South Africa (Kistan, 2002). At the same time it is under immense external and internal pressure to improve on its policy and delivery performance (De Clercq, 2002). One of the indicators of social transformation in education is increasing the demographic representation among graduates and reducing the demographic difference between student intake and graduate throughput. The National Higher Education Plan (2001) outlines the role of higher education institutions in the new South Africa:

The key challenges facing the South African higher education system remain as outlined in the White Paper: 'to redress past inequalities and to transform the higher education system to serve a new social order, to meet pressing national needs, and to respond to new realities and opportunities' (White Paper: 1.1). (Department of Education South Africa, 2001.)

Furthermore, recent government policy has added pressure on higher education institutions by linking funding to throughput. In other words, unlike in the past when institutions were funded on the number of registered first year students, funding is now linked to graduate throughput.

Improving efficiency and addressing the equity needs of the country raises conflicting challenges for higher education institutions (Scott, 2004: 1). These challenges are exacerbated by the fact that most students enter university under-prepared and therefore require more support to bridge the gaps in the required knowledge and skills (Paras, 2001). Furthermore, in 2005 quality assurance audits¹ focusing on the institutional management of core functions of teaching and learning, research and community engagement were conducted at South African higher education institutions. The challenge for higher education institutions is therefore not only about increasing throughput in terms of numbers and the diversity of its student population but also involves ensuring quality educational provision.

The South African government has identified the use of ICTs for teaching and learning as an important priority. For example, the e-Education policy states:

Every South African manager, teacher and learner in the general and further education and training bands will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need as lifelong learners to achieve personal goals and to be full participants in the global community) by 2013. (Department of Education South Africa, 2004: 17)

Thus, the ultimate goal of the policy is the realisation of ICT-capable managers, educators and learners by 2013. Read together with the National Higher Education Plan, these two policies have ramifications for instructional designers, educators, students and researchers. The underlying argument of this paper is that the realisation of the policy's goals largely depends on the extent to which current educational challenges are re-conceptualised in the context of the role that ICT can play in teaching and learning. The current focus on teaching and learning coupled with growth in educational technology in South African higher education institutions (Czerniewicz et al., 2005:

61) requires that we begin to ask questions about the ways in which educational technology contributes to addressing the educational challenges in the new South Africa.

Educational challenges in South African higher education

As is the case in higher education globally, South African higher education is under pressure to increase participation from diverse groups of students and to produce the skills required for a rapidly changing society. In the UK, for example, participation in higher education has increased since the 1940s but participation of higher socio-economic groups still exceeds that of lower socio-economic groups (DFES report, 2004). While similar, these challenges take particular forms given South Africa's unique history. For example, global disparities are defined in terms of class; in South Africa the educational disparities are manifested along racial lines due to the political, economic and social policies of the pre-1994 era. Redress of marginalised groups and social transformation is therefore central to the policies of post-1994. The South African government has made it clear that one of its aims is to achieve equitable access to higher education for previously disadvantaged learners, with diverse educational backgrounds (Hardman & Ng'ambi, 2003). Education is viewed as one of the key mechanisms of achieving social transformation.

It is in this educational context that new opportunities for educational technology have arisen. Although we are aware that educational challenges demand multi-pronged approaches, which may include both traditional teaching approaches and innovative non- digital instructional designs, it is the role of educational technology that is the focus of this paper.

Specific teaching and learning challenges

The major teaching and learning challenges facing higher education revolve around student diversity, which includes, amongst others, diversity in students' academic preparedness, language and schooling background. Teaching and learning in higher education in general can largely be characterised as follows:

[...] instruction that is too didactic, a lack of personal contact between teachers and students and among students, assessment methods that are inadequate to measure sophisticated learning goals and too little opportunity for students to integrate knowledge from different fields and apply what they learn to the solution of real-world problems. (Knapper, 2001: 94)

Teaching and learning in South African higher education fits the above description but in addition it has to contend with deep-rooted complex issues and problems stemming primarily from a previously racially divided and unequal education system. In addition, large classes are an endemic feature of most university courses posing an additional challenge in the teaching of a diverse student population.

South African higher education institutions are faced with a myriad teaching and learning challenges. In this paper we focus on a few of these: academic preparedness, multilinguism in a first language context, large classes and inadequate curriculum design. In the next section, we look at ways in which ICTs have been used to respond to these challenges at one South African higher education institution.

Academic preparedness

Students from disadvantaged educational backgrounds as well students from privileged backgrounds generally enter higher education with gaps in the knowledge and skills required for studying particularly in key areas such as mathematics (Paras, 2001, Howie & Pietersen, 2001) and science.

Given the pressure to increase the diversity of the student population of South African higher education, assessing students' potential for success in higher education has gained increasing importance, particularly since the school-leaving certificate is currently viewed as an inadequate measure of a student's potential for success in higher education.

In a country such as South Africa, for instance, school-leaving certification has had a particularly unreliable relationship with higher education academic performance especially in cases where this certification intersects with factors such as mother tongue versus medium-of instruction differences, inadequate school backgrounds and demographic variables such as race and socio-economic status (Yeld, 2001; Badha, et al, 1986; Scochet, 1986; Potter & Jamotte, 1985). (Cliff et al., 2003)

Alternative placement tests have therefore been used in conjunction with school-leaving certificates to admit students with potential into higher education studies (Cliff et al., 2003). Consequently, many of these students may be under-prepared in that they may not possess the necessary language or mathematical proficiencies required for higher education or may have gaps in the foundational disciplinary knowledge. Furthermore, university tasks present challenges for under-prepared students (Hardman & Ng'ambi, 2003). Although support programmes to address academic under-preparedness of students from both advantaged as well as disadvantaged groups are offered at many South African higher education institutions, they are resource intensive. It is therefore worth paying attention to additional resources and expertise offered by educational technology.

Multilingualism in a first language environment

South Africa is a multilingual society with 11 official languages. This diversity is reflected in the student population of South African higher education institutions. A recent study by Czerniewicz & Brown (2005) on higher education students' and academic staff's access to and use of computers in five South African universities found that 39% of respondents spoke English as a home language and 54% spoke other languages. At the University of Cape Town, on average 65% of the student population declared English as their first language while 35% have home languages in the other South African official languages and other international languages (Spiegel et al., 2003).

English is therefore a second or foreign language for many South African higher education students. In most black South African schools, English as a subject is taught as a second language. Higher education students from disadvantaged educational backgrounds therefore have to learn in their second or third language. A considerable body of research (Cummins, 1996; Gee, 1990) has shown that language and academic success are closely related and that academic language proficiency is far more difficult to acquire in a second language. Students learning in their second or third language are therefore at a disadvantage which is compounded by poor schooling background.

The relationship between language and academic success is reflected in the throughput rates of English second language students when compared to the throughput rates of English first language students. At the University of Cape Town, for example, the difference in throughput

rates between English first language and second language students in 2002 was more than 20% in several degrees/programmes (Spiegel et al., 2003).

Large classes

The growth of mass higher education has made large classes an endemic feature of several courses at higher education institutions. Large class sizes make it difficult for teachers to employ interactive teaching strategies (Nicol & Boyle, 2003) or to gain insight into the difficulties experienced by students. Large classes pose problems for all students but students who are under-prepared are particularly affected. It is these contexts that provide useful opportunities for educational technologies.

Curriculum design

Curriculum design is a relatively under-engaged area within higher education debate, policy formulation and practices (Barnett & Coate, 2005). Pressure to transform curricula at a macro-level to the needs of industry and the economy in South Africa is reflected in the National commission on higher education's policy framework (1996) for higher education transformation.

There is a strong inclination towards closed-system disciplinary approaches and programmes that has led to inadequately contextualised teaching and research. The content of the knowledge produced and disseminated is insufficiently responsive to the problems and needs of the African continent, the southern African region, or the vast numbers of poor and rural people in our society.

In response to policy intentions, South African higher education has implemented a curriculum restructuring policy aimed at the development of inter- or multidisciplinary degree programmes (Moore, 2003). While policy has resulted in curriculum shifts on a macro level, curricula contents at a micro-level are driven by disciplinary specialists. Undergraduate curricula remain predominantly theoretical but require that students have some knowledge of the contexts to make sense of theory.

In this paper, we are concerned with the way in which ICTs can play a role in shaping curriculum design at the micro-level. ICTs open up new ways of accessing information thereby changing the relationships between students and between students and their teachers. Access to primary sources in the form of video, audio and photographs which may be contained in digital archives have the potential to influence the content of curricula because it makes previously inaccessible information available. In addition, ICTs enable lecturers to transform their teaching practices by facilitating student-student discussion and collaboration or by simulating 'real-world' problems thus providing students with authentic learning experiences.

In this section, we discussed some of the teaching and learning challenges experienced by educators and students in higher education. In the next section, we examine the role of educational technology in responding to these challenges and provide some examples.

RESPONDING TO THE CHALLENGES

Since the teaching and learning challenges are multi-faceted, multi-pronged approaches are needed in order to attempt to solve some of these problems. Dede (1998) postulates:

[...] information technology is a cost-effective investment only in the context of a systemic

reform. Unless other simultaneous innovations in pedagogy, curriculum, assessment, and school organization are coupled to the usage of instructional technology, the time and effort expended on implementing these devices produces few improvements in educational outcomes – and reinforces many educators' cynicism about fads based on magical machines.

We infer from Dede that there are several inter-related factors that influence improvements in educational outcomes. Thus together, pedagogy, curriculum, assessment and organisation contribute to bringing about improvements in the educational process.

Although educational technology is not the panacea for educational challenges, it does leverage and extend traditional teaching and learning activities in certain circumstances and hence has the potential to impact on learning outcomes. Knapper (2001) argues that:

[...] technology may be a good solution for some instructional problems, and in some cases it may be a partial solution. But in other instances technology does little to address the fundamental teaching and learning issue or – even worse – provides a glitzy but inappropriate solution to a problem that has simply been misconstrued. (Knapper, 2001: 94)

The trick is to identify situations where educational technology will be appropriate and when and how to use educational technology in these situations. There are times where technology may not be useful and may indeed be counter-productive. However, there are many times when educational technology offers a solution for problems that would be difficult, cumbersome or impossible to resolve in a face-to-face environment.

Numerous manuals, websites and articles have been devoted to suggesting, explaining and modelling the ways that educational technology can be used to support teaching and learning. We agree with Laurillard (2001) that it is important that educational technology-based resources be appropriately matched to both teaching and learning activities. Table 1 adapted from Laurillard (2001) usefully explains how educational technology can be integrated into the curriculum.

Laurillard's guidelines are useful in that they provide a framework which relates ICT-based resources to particular teaching and learning activities. The guidelines therefore suggest particular uses of ICT for particular teaching and learning situations. The effectiveness of ICTs for teaching and learning, however, is largely dependent on how much the context is understood. Thus, there is a need to relate educational technology to actual challenges experienced by both students and lecturers in the South African educational context. O'Hagan (1999) suggests that educational technology can be used to present and provide content, assess students learning, provide feedback, scaffold student learning and enable peer-to-peer collaborative learning.

The choice of appropriate teaching and learning activities is dependent on a range of factors such as the curriculum or course objectives; i.e. the purpose of the teaching and learning, the educator's preferred teaching approach, the learning styles of the student and the nature of the curriculum content. Although we advocate that teachers should use the teaching approach that suits their paradigm of teaching and learning, we believe that the use of educational technology provides teachers with opportunities for traversing an entire continuum of possibilities as may be appropriate to their teaching needs. Educational technology creates affordances for a range of different teaching and learning activities which the teacher may not have used or considered.

Table 1: Teaching and learning events and associated media forms

Teaching & Learning Event	Teaching action or strategy	Learning action or experience	Related media form	Examples of non-computer based activity	Example of computer based activity
Acquisition	Show, demonstrate, describe, explain	Attending, apprehending, listening	Narrative Linear presentational. Usually same 'text' acquired simultaneously by many people	TV, video, film, lectures, books, other print publications	Lecture notes online, streaming videos of lectures, DVD, Multimedia including digital video, audio clips and animations
Discovery	Create or set up or find or guide through discovery spaces and resources	Investigating, exploring, browsing, searching	Interactive Non-linear presentational. Searchable, filterable etc., but no feedback	Libraries, galleries, museums	CD based, DVD, or Web resources including hypertext, enhanced hypermedia, multimedia resources. Also information gateways.
Dialogue	Set up, frame, moderate, lead, facilitate discussions	Discussing, collaborating, reflecting, arguing, analysing, sharing	Communicative Conversation with other students, lecturer or self	Seminar, tutorials, conferences	Email, discussion forums, blogs
Practice	Model	Experimenting, practising, repeating, feedback	Adaptive Feedback, learner control	Laboratory, field trip, simulation, role play	Drill and practice, tutorial programmes, simulations, virtual environments
Creation	Facilitating	Articulating, experimenting, making, synthesising	Productive Learner control	Essay, object, animation, model	Simple existing tools, as well as especially created programmable software

Czerniewicz & Brown (2005) adapted from Laurillard (2002)

Responding to the challenges: examples from curriculum projects

The affordances of educational technologies provide ways of being sensitive to wide-ranging and differing learning needs. In this section, we describe some curriculum projects that have attempted to respond to some of the educational challenges faced by students at the University of Cape Town (UCT). For the sake of brevity only overviews are provided.

Using interactive spreadsheets to develop mathematical literacy skills

As discussed above, many under-prepared students entering university have potential but do not possess the relevant mathematical literacy skills required for certain courses (Frith et al., 2004). These students are often expected to pursue an extended undergraduate degree programme that offers additional support to address mathematical literacy skills. In this case, the teaching challenge is that of finding ways of developing students' mathematical literacy skills. Self-contained interactive spreadsheet-based tutorials were developed for use on the mathematical literacy support courses at UCT and were used in conjunction with face-to-face lectures. A typical tutorial consisted of interactive presentation of relevant mathematics content, examples and exercises. Students were able to work at their own pace and receive immediate feedback. Frith et al. (2004: 163) found that 'while the lecture room tutorial taught students how to calculate the various statistics, the computer tutorial was more effective in giving them an understanding of the concepts and they retained better what they had learned.' This effect, they argue, is possible due to the shift in emphasis in the computer-based tutorials away from mechanical calculations to demonstrating conceptual understanding. This curriculum project illustrates how educational technology was used to complement teaching and learning and to support the development of students' mathematical literacy skills.

Using educational technology to develop academic literacy in an economics course

Economics at university level poses particular difficulties for students since lecturers assume prior knowledge of the economy. Unfortunately, many students from previously disadvantaged communities have very limited knowledge of the economy at the start of their university careers. Under-prepared first year students encounter further difficulties due to a lack of academic literacy skills. The Industry Research Project (Carr et al., 2002) was designed to address economic literacy while simultaneously dealing with language and communication skills of UCT economic students. Interactive excel spreadsheets in conjunction with short writing tasks in the form of online discussions, short essays, reports and presentations were used in academic development economics courses at UCT. These tasks or activities provided a range of opportunities for students to develop understanding of economic discourses through writing in economics. Although Carr et al. (2002: 5) found it difficult to measure the impact of these tutorials, which formed a small part of the first year economics curriculum, they observed that the interactive spreadsheets were effective teaching tools in that tutors were able to focus students' attention on economics issues rather than procedural issues and that the quality of articles produced by students improved due to the online feedback provided during the process of drafting articles online. This curriculum project demonstrates the use of educational technology in conjunction with face-to-face activities in addressing students' academic literacy skills.

Using educational technology to manage tutorials in large classes

Commercial-Off-The-Shelf (COTS) based tutorials system called MOVES were developed around Excel and Word to teach computer literacy to first year Information System students at UCT. MOVES incorporated computer-assisted marking techniques and provided feedback to lecturers and students. The significance of this project is that it typifies the problems of teaching a large and diverse class.

The computer literacy levels of these students are diverse, with some students not having touched a computer before to students who have had home computer and internet facilities since the age of five. The immediate challenge this diversity poses on teaching is that it is not practical to pitch the lecture at an appropriate level to meet all students at their level of knowledge. The other challenge is in providing feedback messages that are relevant and useful to individual students. (Ng'ambi & Seymour, 2004: 255).

Ng'ambi and Seymour (2004: 257) report that the MOVES tutorials saved time for tutors since tutorials were marked and results captured electronically, lecturers had access to student performance and students found the immediate feedback useful in that misconceptions could be dealt with immediately. The significance of this project is that it illustrates how educational technology is used to facilitate teaching and learning in large classes.

Influencing curriculum design

Many university courses are theory driven and assume that students have knowledge or real world experience and can therefore make the links between theory and practice. Students often have limited experience or practical knowledge and therefore have difficulty in understanding theory. Deacon et al. (2005) report on the use of educational technology to simulate film editing. The *Director's Cut* was produced and used in a Film and Media course at UCT to provide students with insights into the practical processes involved in filmmaking without engaging in the actual process of editing. Exposing students to actual editing is expensive and impractical in a large course. The intervention provided individual students with an authentic learning environment through a simulation. Students sequenced film clips, hence simulating the role of an editor through a simplified version of the editing process. In this way, the focus is on key learning aspects of film narrative and spectatorship and linked theory to the 'practice' of film editing.

Similarly, Carr et al. (2004) report on an International Trade bargaining simulation developed for an economics course where students assumed the role of national trade negotiators representing specific countries. Lecturers and tutors assumed the role of World Trade Organisation (WTO) officials in a semi-authentic process designed to teach students negotiation and bargaining skills similar to those required by professional trade negotiators.

The two projects reported here exemplify ways in which educational technology was used to impact on the design of the respective curricula by providing students with experiences which are difficult to provide in face-to-face environments.

CONCLUSION

South African universities face increasing pressure from government to meet the needs of social transformation in education. South African government policy on social transformation in education requires increasing the representation of Black South Africans and women among students and graduates and significantly improving the graduation rates and throughput of Black South African students. Given the social-historical context of South Africa, meeting the

educational challenges associated with this noble goal requires re-conceptualisation of how educational technologies are applied so as to make an impact. The paper has proposed a model for teaching and learning activities that are associated with media forms. The model has been substantiated with examples of the application of educational technologies to teaching mathematical literacy, academic literacy, management of large classes, and ways of influencing curriculum design. Our argument is that technology alone is not a solution to the educational challenges faced in South Africa. The challenges lie in identifying and conceptualising ways that educational technology can usefully contribute to student learning experiences, curriculum and pedagogical designs. The paper demonstrates and argues that educational technology has a key role to play in South African higher education as one of the strategies for addressing teaching and learning concerns. This challenges learning designers to rethink the role of educational technology within broader educational interventions that are shaped by educational needs rather than being technologically driven.

Endnote

- ¹ The rationale of the quality assurance exercise as De Clercq (2002) points out, ‘...is that the more employees are forced to focus on their planning and performance indicators, the better they will perform and the more knowledgeable they system will be about developmental support systems needed’ (p. 96).

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