E-Learning Environments in Undergraduate Design and Technology Courses

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Abstract

When e-learning and other information and communication technologies (ICT's) became accepted in both distance and face-to-face modes of learning in tertiary education, expectations were high that they would, within a reasonable time frame, yield visible and perhaps irrefutable gains in course delivery strategies and revolutionise both learning content knowledge and access to it. In developing countries it was hoped that there would be benefits in tapping into a knowledge revolution currently dominated by industrialised countries, who are by far the greatest contributors and beneficiaries.

The University of Botswana's (UB) efforts, initiated in 2001, at technological transformation in teaching and learning for meaningful quality processes and outcomes have been evaluated by researchers, reviewers and participants. Comments have been made such as, 'substantial progress, but many challenges" "very useful teaching support tool for large classes, but there is need to address key background issues" , "students share learning through educational technologies, but appropriate learning environments are required" . It has been evident that although a lot has been done at institutional management level to promote adoption and implementation of e-learning as a rule at UB, the ideal situation has not materialised. Much of the problem seems to emanate from the interaction between key players, such as top management, the teaching staff and students.

This paper reports on an on-going qualitative study that was carried out in order to negotiate and establish acceptable quality and effectiveness of e-learning envisaged by both the staff and students in a course that was not online at the time, in preparation of launching the course online in the next cycle. The action learning research study aimed at constructing an environment and a disposition towards e-learning mutually negotiated between students and their lecturers. Data was collected through various student-lecturer and student-student interaction processes such as classroom lecture, internet search, group presentations, tests, assignments, classroom observations, questionnaires, and video script analyses. Preliminary findings indicate that most students are enthusiastic about adopting e-learning if they have been adequately pre-oriented into the method and are consistently guided by caring and competent staff. They also will appreciate quality and effective learning if this is negotiated with someone who can articulate standards of performance.

Key words: negotiation, e-learning environments, technological transformation, design and technology.

1. INTRODUCTION

The teaching and learning fraternity is increasingly responding to pressures arising from the unprecedented upsurge in the generation and use of information and communication technologies (ICT's), described by Herselman and Ray [10] as the major driving forces of globalized and knowledge-based societies. Moreover, there is a renewed advocacy for distance and distributed learning arrangements that promise to ease restrictions of time, place and circumstances for learners, teachers, families and organisations. Yet, for good reason, face-to-face delivery methods still feature prominently at all levels of the education system. Technologies that support either or both face-to-face and distance learning are being developed and improved, and higher education institutions have welcomed technology-enhanced learning and teaching as appropriate for addressing pertinent issues of quality, access, flexibility, and resources, among others [9].

New technologies often promise advantages and new challenges to a system and its users. The ambitious expectations for e-learning in tertiary education have emanated from the successes of ICT's elsewhere, such as in business, information, entertainment and telecommunications. In traditional universities, while it has been anticipated that e-learning would reduce oft-cited inadequacies of the predominant lecture method, situations of technology use to mimic traditional pedagogies still exist. E-learning, it has often been assumed, would within a short time revolutionise classroom learning environments, ridding them of ineffectiveness and declining appeal to a restless generation of increasingly disparate learners hailing from a diversity of socio-educational backgrounds.

Universities in developing countries appear to have been shadows of those in industrialised countries. Information and communication technologies are developed in industrialised countries, and are, invariably embedded in their socio-economic formations and cultures. It is no surprise therefore that the knowledge revolution is currently dominated by industrialised countries, who are by far the greatest contributors and beneficiaries [11]. Developing countries import and adopt knowledge and technologies in anticipation of rapid cultural change, ignoring the possibility that mere acquisition and use of imported western knowledge and technologies is no guarantee for sustainable solutions to fundamental socio-economic problems. Systematic integration of appropriate and beneficial technologies into the existing culture and norms would be ideal, and the process of negotiating cultural change at national level is akin to negotiating learning environments at classroom level.

Studies to investigate, describe and evaluate the effectiveness of innovative endeavours such as online education are important to inform policy and practice in institutions of learning. This study sought to raise debate and inspire collaborative multi-level decision-making and engagement, from top administration to the student, on the chosen path of e-learning adoption and technological transformation at the University of Botswana and similar organisations. Starting at the lower level of the hierarchy of e-learning management, and using a design and technology (D&T) course, a case is built for negotiative strategies in search of innovation in learning and teaching delivery. The experiences, insights and recommendations in this study may be useful to a broader user group particularly involving students in science, engineering, technical and technology studies.

The practice of negotiation among e-learning stakeholders may be linked to questions such as: Can students competently perceive and articulate the type of learning environment that is best for them? If not, who can? Aldridge et al [1] have acknowledged student negotiation as one of five key attributes of constructivist learning environments, together with personal relevance, shared control, critical voice and uncertainty. In the constructivist paradigm, students are perceived competent to negotiate both the 'what' and the 'how' of their learning from an early age. Noting that technology provides a link between the learner, the lecturer and subject knowledge, Prammanee [14] laments the problems still faced with online learning environments even after a decade of using the technology. The dimensions of technology enhanced learning (TEL) environments, according to Goodman [8] include space and time, with classroom (synchronous) and distributed (asynchronous)

learning, knowledge, assumptions and beliefs about learning

1.1. Background and Related Literature

In 2001 the University of Botswana (UB) joined other international universities in initiating a university-wide program of technological transformation in teaching, learning and learning support administration aimed at improving quality and productivity in existing academic processes and outcomes. The University of Botswana e-learning initiative (UBeL) instituted the *WebCT* and later *Blackboard* learning management systems. The unfolding impact of the initiative has been monitored over the years. Forster et al's [7] comparative study found that engineering students shared learning with same-level same-programme peers using educational technologies, but appropriate learning environments that ensured an educational focus were still required. Reporting on his formative evaluation case study, Uys [15] noted substantial progress albeit with many challenges, concluding that 'technological innovations need to be implemented within a strategically developed framework based on a clear and shared vision and a central educational rationale.' Eyitayo [5] averred that while e-learning was not a substitute for what happened in classes (face-to-face), the environment created at UB provided a "very useful teaching support tool for large classes", adding that there was need to address other key background issues such as student-computer ratio and provision of adequate technical support, among others. It has been evident that although a lot has been done at institutional management level to promote adoption and implementation of e-learning at UB, the ideal goal is yet to materialise. Results of a snap survey (Table 1) carried out late 2007 showed that despite a period of six years since e-learning was introduced at UB, the technology is still far from being universally adopted at the target user end. It is evident, for instance, that in a whole faculty, only approximately 16% of the courses on offer have been put online, and of those, approximately 85% are actively running. The problem is likely to emanate from interaction (or lack of it) between various stakeholders that include the top university management, the staff and the students.

Table 1: Online course offerings in the Faculty of Engineering and Technology at UB, 2007

DEPART-MENT	TOTAL NO OF Courses (Approx.)	NO. OF ONLINE COURSES			
		Active	Not active enough	Inactive	Total
A	90	2	1	2	5
B	40	8	1	-	9
C	55	2	-	-	2
D	30	17	1	-	18
TOTAL	215	29 (13%)	3 (1%)	2 (1%)	34 (16%)

1.2. Negotiation

The need for formal and informal agreement on the adoption of an innovation is paramount because of the many stakeholders involved in the process. Our perceived hierarchy of the implementation of e-learning at UB is depicted in Figure 1 below. For a successful realisation of set goals, appropriate inter-level and intra-level negotiation is necessary between and among the members in different levels of the hierarchy, in as many combinations as possible, and at the appropriate stages of the transformation process. This study centres on the student-lecturer (client-implementer) level of negotiation.

2. METHODOLOGY

In this paper we report on a stage in an on-going qualitative case study to illuminate challenges and strategies for expediting e-learning adoption using negotiation among key stakeholders. The stage we report on was carried out in order to establish the acceptable standards and effectiveness of e-learning envisaged by undergraduate students interacting with their lecturers. We engaged a class of 49 third year students in a course that we taught jointly for one semester. The students were enrolled in the four year Bachelor of Design degree, a predominantly practical programme, with many of its courses incorporating drawing, graphics, modelling, design-and-make activities in computer laboratories, workshops, and design studios. Opportunities abound for engagement in technology-enhanced learning activities in Design and Technology (D&T), a problem-based study discipline involving concept generation, creativity, divergent thinking, personal and collaborative organisation,

information gathering, searching for solutions, and reporting. Mealing [12] notes that research has consistently suggested that traditional general education does not reward or nurture the creative student; it turns out conformists rather than freely creative and original thinkers, adding, "The ubiquity of new technology will render all designers conscious of the need for digital skills". E-learning should complement the theoretical and hands-on aspects of D&T.

We used a non-practical course titled *Design, Technology and Society* that integrates theoretical concepts in the practical design courses with relevant aspects of social and occupational life. The course was not yet online, and this study served as a motivation for its launching in the following cycle. The participating third year class of students had not yet successfully embarked on an online course, only having done computer-based tasks in a few courses. Attempts had been made earlier but were abandoned when both the lecturer and the students experienced challenges. The few online courses running in the department at the time were offered to final fourth year students only. We used action learning and participant research techniques involving critical reflection and self-expression following contrived experiences built atop long and short-term prior knowledge and practice, and using the interpretive hermeneutic approach [6]. Data was collected from various student-lecturer and student-student interaction processes in methodological and data triangulation [4] of learning activities (see Table 2) which included classroom lectures, internet search, group presentations, tests, assignments, classroom observations, questionnaire, and video script analyses.

Table 2: Schedule of activities in the action learning exercise

Date	Activity
Week 1	Introducing course
Weeks 2-12	Course delivered
Week 5	Test 1
Week 12	Internet assignment given
Week 13	Group presentations
Week 14	Test 2 and Questionnaire
Week 16	Examinations

In the last quarter of the semester, we had students carry out a specific e-learning assignment to engage them and to generate reaction that would inform our research. The course was launched on the Blackboard learning management system (LMS), the official platform provided and supported by the university. For the initial 12 weeks, blended learning experiences were planned and carried with the students. Course content was delivered in simple, short online lessons carried out in the computer laboratory, and reinforced by traditional face-to-face sessions. After considerable practice, students were given an assignment to test their skills in self-directed study and evaluation of effective utilisation of an online learning management system on their own.

The assignment (See Fig 2) was a single-topic internet search on *waste management technologies* sourced from Wikipedia (an online encyclopaedia). Forty-eight (48) students were organised into 16 groups of three (trios), each trio being allocated a topic in the area of waste management technologies. The trios were then given a week to search for the information on the assigned topic, using at least two internet sources and another source, and then present a paraphrased summary in a word-processed write-up, using quotes and inserting cut-and-paste graphics and pictorials where appropriate. The assignment exercise was essentially a very simple one, operated outside the UBel Blackboard learning management system, and involving asynchronous information gathering using the computer. This was deliberate as a start to get the whole class focussed on one activity, acquiring information from a virtual source rather than the usual face-to-face encounter with their lecturer or from reading printed text. The students used their own free study time for the assignment, using the department's computer laboratory which had about 15 working computers with reliable internet access throughout the day. The lecturers made random visits to the computer laboratory during the week of the assignment to check on progress.

On handing in the assignment the following week, the trios gave short oral presentations to the whole class. For both the write-up and the presentation, the trios were awarded a group mark. In the week following, the class wrote a test (Test 2) in which one of the compulsory questions required the students to select and

describe one of the 16 waste management technologies studied in the foregoing assignment. This exercise provided students with an active approach for easing into e-learning, described as a 'good way to introduce students to more independent learning methods within nevertheless a controlled environment' [2]

For data analysis we used a combination of qualitative and quantitative techniques. The students' use of the online course site was monitored through the learning management tools such as messages and quiz responses, forum discussions and the statistics tool.

We present here descriptions of our observations and make interpretations of students' responses to open-ended questions in the questionnaire. We also quantified data from closed-ended questionnaire items, from the assignment, test and examination scores, performing simple statistical calculations such as range, mean and standard deviation.

3. RESULTS

The goal of this study was to engage D&T students in activities that would make them reflect and express their views about adopting e-learning and creating favourable learning environments in most of their courses. Students were thus expected to participate and to voice their views about their engagement and in a process aimed at bringing about technological transformation affecting their learning.

3.1. E-learning aptitude and readiness

At the start, the students had mixed reactions about embarking on the planned course and e-learning in general, with some resisting, others uncertain and yet others enthusiastic. Citing previous frustrations with computer-assisted learning tasks for non-technical assignments, one student complained;

> *Why don't you just teach us the usual way? In the past we have tried this (computer skills courses, internet and online learning) and it has not worked. We have wasted time crowding on few working computers, arguing and just*

> *conversing, and sometimes a whole lesson passes without us having any notes or discussed anything useful.*

We explained that with e-learning, face-to-face classroom encounters were not abolished, but were complemented by both real-time virtual classroom and delayed chat sessions, using emails and websites, engaging in 'any-time-any-place learning' [13]. Students' 'usual' ways of learning, or their prior pedagogical experiences, seem to have prejudiced their motivation to embark on a novel, unfamiliar venture. They were keen to maintain their comfort zones, hiding behind problematic earlier attempts to adopt the new technology. To explain what appeared like rejecting computer-enhanced learning and preferring 'older' methods of learning that promoted memorising facts for reproduction in tests and examinations, a representative response was,

> *We are not saying we don't want to use computers. We do enjoy using them for creative and graphical work using AutoCAD, SolidWorks, etc. But for reading and discussion which could be done in class we find it a waste of time.*

The students denied being technophobes, saying they were comfortable accepting new technologies outside learning situations, such as cell phones, MP3 players, iPods, and others which were slowly gaining popularity. In comparing their own attitude towards e-learning with fellow students in other programmes within the university, they indicated that they shared similar sentiments. The optimistic and supportive group's comments were:

> *We need to do these things so that we become like students in other universities. The problem is the preparation (readiness) and the time, as well as (the availability of) computers. Lecturers and technicians should be organised and treat their work seriously. We need lecturers who know more than us and teach us what they know.*

One student explained further about the role of lecturers and the observation that students were resisting change:

Lecturers should do their work before facing students with new ideas. As students we need adequate practice be able to do new things. Lecturers who respect and care can influence students to face any challenges. Lecturers should treat us as their own children.

3.2. Negotiation through e-learning performance

In the internet search task, there were variations in the accuracy and quality of submitted essays, with scores ranging between 12 and 15 out of 15. All 16 trios (100%) searched for the required information on the internet in the prescribed website. Of the sixteen trios, one (6%) presented information obtained from the prescribed web-site only and did so very poorly, three (19%) satisfactorily presented the information obtained from the prescribed web-site only, three trios (19%) included additional information from sources other than the internet (mainly textbooks), and another nine trios (56%) searched and satisfactorily presented required information from at least one other web-site (See Table 3).

Table 3: Evaluation of students' internet search presentations

Description of written work presented	No. of Trios	Group mark (Out of 15)
Prescribed internet web-site only, poorly presented	1	12
Prescribed internet web-site only, satisfactorily presented	3	13
Prescribed internet web-site, plus additional non-internet source, satisfactorily presented	3	14
Prescribed internet web-site, plus additional internet source, satisfactorily presented	9	15

In the oral presentations the following observations were made:
- The overall quality of presentations was generally satisfactory, key content areas were outlined and explained as in the given guidelines. Thus the variation in performance scores between best and worst presenters was small.
- There was often one dominant presenter (See Figure 3, holding the script) who would have monopolised the presentation if not interrupted and urged to involve group mates. This suggested to us that in some cases the assignment might have been done by that one person (no teamwork). Some trios denied this, while others confessed it had happened. Indeed in the few observations we made during the search week, some members of the trios were absent. We suspected that this was a case of negative attitude towards the new task and being unfamiliar with the nature of collaboration used.
- During the early presentations, the audience were generally quiet, and some were observed writing, perhaps preparing their own presentations. However towards the end, there was some relaxation, interjections and follow-up discussions.

The performance in the internet search-related item on the follow-up test revealed a few interesting points. Twenty-four out of 48 students (50%) chose the same topics that they presented on earlier in trio presentations, while 50% changed topics. This was unexpected, considering that all students wanted high marks for their continuous assessment. We hypothesised that those who changed topic had not been active in the internet search and were ill-prepared to answer the test question. Indeed those who changed topics scored significantly lower (mean 8.375) on the test than those who did not (mean 11.69). A closer analysis of those students that changed topics showed that the majority (66.7%) chose the topic 'Recycling', followed by 'sewage treatment' (12.5%) and 'anaerobic digestion' (8.3%). These topics appeared elementary to the ordinary person compared to others, and are encountered in daily life or in other studied subjects. Thus most students who chose 'recycling', for instance, answered it using the layperson's description, not as a technology as described in the website. The mean score for students who chose recycling was 7.9 out of 15,

compared to the mean of 8.375 for all those who changed topic, and to the whole test mean score of 10.03, and a mean score of 11.69 for those who did not change topics.

Table 4: Comparison of assignment and test scores

	Assignment mean score	Test mean score
Changed topic N = 24	14.33	8.375
Did not change N = 24	14.04	11.69
Whole group N = 48	14.25	10.03
Significance (0.05) t-value	1.012	6.8517

In essence, those who changed topics performed worse than those who did not change. When asking the class later why one would change topics, many admitted they went for the apparently easy one, which meant they were not assimilating much information from their trio presentations. One student however said:

> I chose a different topic because I felt I had tried the first one in the assignment, and now I wanted to discover how I would perform on a different topic. This I did in case one of the topics will come in the examination.'

The above exercise was done to predict how seriously the students considered group learning using internet for learning without the lecturer in a face-to-face encounter.

The end-of-semester examination paper had six equally weighted questions from which students were to answer any five. One of them was on waste management technologies. Thirty nine students (81.25%) selected this question. This is only slightly less than the expected frequency of 83.33% if all six questions had an equal probability of being picked. This shows that the learning experiences of the students on this topic, including the internet search, did not make the topic more likely to be chosen by the students. The mean score for those who picked the question was 10.7/20 (or 53.5%), compared to

the mean score for the whole examination of 59%. In essence the students did not seem to have been advantaged by using the internet.

3.3. Student negotiation through reflection

On their feelings about their involvement in the internet search assignment on *waste management technologies*, the majority (38%) felt the exercise itself was very interesting or just interesting (41%), and the most common explanations were:

> I enjoyed interacting with the computer. We were made to search a lot. I learned some techniques I was not familiar with. It gave me some experience (insight) of how waste can be managed in other countries. It shows that books and teachers are not the only sources of information.

The comments from those who felt that the exercise was uninteresting (9%) were stronger;

> Computer-based tasks have to be done individually. We learnt on our own but we didn't get to learn other technologies and it's going to be a problem when they come up in examinations. It was just a mix-up. I don't have a clue of how these technologies are conducted because there no pictures in the internet.

There were students who felt strongly about the course itself, rather than the methods used to teach it.

> I don't see the importance of this course in relation to the program we are pursuing in Industrial Design. This course is rubbish (sic) and I don't think I will tell anyone that I did it because it didn't have a role in my life or it's not related to my programme. Replace it at least with a sketching course for industrial designers and leave this course for those doing D&T Education.

Those with alternative opinions wrote:

> Keep it up. It was an interesting and good course overall.

Others offered advice:

The syllabus must be reviewed since it's more like social studies in senior secondary schools and this tends to make the course boring.

Despite all the above, the majority (75%) indicated they were ready and willing to take up more challenging aspects of e-learning in more courses in future,

3.4. Student interaction, autonomy and control

On student-lecturer interaction, shared control and negotiation processes, students indicated that lecturers should set and maintain the pace for learning, allowing for more input by students but keeping students from straying. They were happy to see the lecturer wield more control in decisions on course content, pace of study, assessment procedures and class conduct, while students could have a bigger say on methods of learning and lesson progression.

I feel I need direction as I study. The lecturer is needed for guidance.
The lecturer has to give us the introductory info before we go out to search for more.
Some concepts are clearer when discussed or presented by someone with more knowledge on the content.

Apart from interacting with the course lecturer, the students suggested that some matters on curriculum and provision for learning were best negotiated with the Faculty Dean and the university top management.

4. DISCUSSION

The negotiation strategy in this study involved action learning aimed at gradual transformation from traditional student-lecturer contact towards a technology enhanced e-learning environment in a design and technology undergraduate programme. The study found that engagement, reflection and negotiation improved the perceptions of students about adopting a new learning culture. After going through prescribed experiences of computer-based study in a collaborative format, with or without success, students felt ready to try full-scale e-learning in

future studies. The dialogue and self-expression is thought to have removed anxiety and uneasiness among students who initially would have preferred to continue with their 'usual' ways of doing things. Since technology is becoming universal and irreversible, students in developing countries rightly realise that they can ignore it at their own peril.

The students lamented the lack of authoritative and systematic pre-orientation into e-learning that would take into account their previously deprived backgrounds. The level of student control that they sought allowed the lecturer to maintain a firm position to occasionally and consistently whip weak students into line. The students' view seems to agree with Coates [3] that it is important that staff are perceived by students as caring, both about the interaction, and about the needs of the individual learner. Coates adds, "Students need to represent their understandings, confusions and anxieties to teachers. … As long as instructors do not reveal the difficulties inherent in learning, students will not perceive that their struggles to understanding are part of that same process." The way forward, given the sentiments expressed above, seems to depend on the results of the *negotiation-after-engagement* process. Concrete experiences from the engagement allow for honest negotiation, the desirable outcome of which is sincere articulation of future directions. We see sense in the students' belief that the role of competent and caring staff (the implementers) cannot be downplayed. It could, however, be enhanced by knowledge, enthusiasm and freedom of expression on the part of students (the clients). This is not a mere articulation of standards of performance for students, but an invitation to them to feel empowered, and then participate to craft a

When initially they wanted to continue with face-to face learning, the students were expressing a preference for social gratification (personalised interaction and communication) rather than functional gratification (mediated communication). The latter was mistrusted because the students had not been sufficiently oriented into distance learning. The students were alluding to the notion that the UB technological transformation effort should not be merely to substitute lecturers for technology. They needed the knowledgeable and competent adult for guidance and

mentoring, just like they needed the inquisitive and industrious fellow student in collaborative group work for peer assistance and benchmarking.

5. CONCLUSION

The pursuit of the goal of technological transformation in an organisation located in a predominantly non-technological background is never an easy one. However, buoyed by both successes and challenges, UB has continued to sustain the dream through policy and practical interventions, reviews of inputs, performance and outcomes, equipment upgrades, training and other necessary capital investment. An increase in the number and usage of Computer Laboratories and Smart Rooms has been witnessed, and to strengthen UBel and UB's international visibility in e-learning, a committee on Digital Scholarship was inaugurated, convening its first international conference in December 2007. Such efforts speak well of universities striving both to be relevant and effective locally and to improve their world-class profiles. The involvement of the negotiation process between participants, together with appropriate role-modelling by knowledgeable mentors, appears to enable students to respond more favourably to change. The assumption should not be entertained that university students and their lecturers will quickly embrace a new way of learning and teaching without some deliberate orientation or motivation. The relevance of e-learning to D&T courses provides an opportunity for lecturers to seek ways to reach out to their students in more interesting and learner-centred strategies of content presentation.

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