An Environmental Engineering Web- Based Course - Supporting Lifelong Learning

R. Ziegler[1], I. Omar[2]

[1,2]Cape Peninsula University of Technology, Bellville, Cape Town, South Africa

zieglerr@cput.ac.za[1], omari@cput.ac.za[2]

Abstract

It is important for engineering education to become more responsive to the various educational needs of local and global societies. Supporting and enhancing lifelong learning is an important aspect of meeting constantly changing educational needs. With changing educational needs and modes of delivery, the introduction of Web-based learning has provided a convenient medium for offering important courses such as environmental engineering, to "non-traditional" learners. Using the World Wide Web, the Cape Peninsula University of Technology (Bellville Campus) in Cape Town, South Africa, has been able to offer a web-based, environmental engineering course to learners outside of the traditional classroom setting. In so doing, providing global access to knowledge and information sharing on critical environmental issues.

This paper focuses on the contribution that the environmental engineering course makes towards supporting lifelong learning by reflecting on learner feedback on the educational value of the course.

1. Introduction

The Department of Mechanical Engineering at the Cape Peninsula University of Technology (CPUT) in Cape Town, South Africa, offers a semester course in Environmental Engineering as part of the Bachelor of Technology degree. The decision to offer such a course was partly the result of a realization that environmental issues require a place in the engineering curriculum, particularly so given the increasing importance for engineers to understand how their decisions could impact the environment and what roles they could play in contributing to sustainable development. The course was specifically designed to provide a balanced and more informed view of how the decisions that engineers take in the workplace, could impact on the environment and the promotion of sustainability.

Given the transdisciplinary nature of engineering, decisions are often not made solely by engineers. Thus, the importance of environmental engineering is a necessity for all who contribute to decision-making processes. Developing an open-source, web-based, distance learning, environmental engineering course seemed to be a logical step towards becoming more responsive to the educational needs of a broader society. In this regard, the course has gone beyond the traditional boundaries of engineering education and is offered as a non-degree, web-based distance learning course to a broader community of learners outside the institution. This group of diverse learners has, since the inception of the course, generally included professionals and non-professionals, engineers and non-engineers who have wanted to learn or further enhance existing skills, knowledge and competencies in Environmental Engineering that would be important and useful in their communities and workplaces. In so doing, the course has become an opportunity for lifelong learning. As Van Niekerk (2003: 199) asserts, "The notion of lifelong learning should be seen as a principle underlying curriculum development in any field and the challenge is to find ways to incorporate it into the curriculum."

The term lifelong learning implies learning throughout one's life. Xingfu,et al. (2005) provide an apt definition of the term by saying that it is " …an activity whereby individuals are able to choose learning resources and strategies based on their career requirements and personal needs, and to engage in learning at any time, in any place and with any curriculum" . Literature on lifelong learning suggests that the concept of lifelong learning is one that has developed over time. The term lifelong learning developed from the term lifelong education (Medel- Anonuuevo, Ohsako and

Mauch, 2001). The term lifelong education was associated with the development of "more humane individuals and communities in the face of rapid social change " with an emphasis on "structures and institutions", whilst the term lifelong learning was associated with "retraining and learning new skills that would enable individuals to cope with the demands of the rapidly changing workplace", emphasizing "individual agency" (ibid: 4).

Vakalisa (2000) argues that it is a misconception to think that learning is only relevant in preparation for employment and that once learning opportunities have been missed they are no longer available. McIntosh (2005) points out how unrealistic it is for anyone to expect that a qualification can mark employability, and that once employed, there is no need for continuing education. Lifelong learning provides room for attaining missed educational opportunities. Halimi (2005) refers to three categories in Teichler's classification of the "clientele" who seek to embark on the life-long learning journey. These include postponers (those who put off their education at end of secondary education), the returners (those who come back for further education and have already benefited from further education) and the second chancers (those who have not had the opportunity to study further due to lack of finances, lack of qualifications and so on). Offering of the environmental engineering course at CPUT, as a web-based distance learning course supports the notion of lifelong learning and caters for learners in either of these three categories, as some of the distance learners already have first degrees or diplomas, while others have post-graduate qualifications.

This paper focuses on the contribution that the environmental engineering course makes towards supporting lifelong learning by reflecting on learner feedback on the impact and educational value of the course. The data was sourced from recent distance learner feedback through a survey questionnaire.

2. Course Background

2.1 Historical development

The distance learning course evolved from an existing Environmental Engineering subject offered as part of the Bachelor of Technology degree in Mechanical Engineering and a pilot Distance Learning and Information Sharing Tool (DLIST) run by EcoAfrica (EA) Environment Consultants under the auspices of the World Bank. This initial pilot course was developed by EA and World Bank (WB) staff in 2002 and ran with a small cohort of four students in 2003. The content was developed by EA while the IT platform was done largely by the WB.

It was agreed that on completion of the pilot, it would be devolved to a Higher Education Institution. As a result of EAs collaboration on the Environmental Engineering course with the then Peninsula Technikon (now CPUT), it was suggested that Peninsula Technikon take it on. In 2004, the course was developed for placement on the DLIST platform (http://dlist-benguela.org).

In line with the aims of DLIST, offering the Environmental Engineering course as a DLIST option to people outside Peninsula Technikon was to provide persons with skills, knowledge and competencies in Environmental Engineering that would be important and useful in their communities and workplaces. These people usually work in Community Based Organisations, Non-Governmental Organisations and in government departments as planners, consultants, researchers, administrators and so on. The initial intake in 2004 was exclusively South African. However, it has grown to have predominantly Namibian students, although there have been distance learners from Tanzania and Cameroon.

Over the five years that it has been offered as a DLIST option, the course has been adapted to accommodate comments from students, presenters and external moderators. The focus is on providing certain competencies and knowledge in some critical technical areas such as energy, waste and water (see table 1 for the 2008 course outline).

In addition to the DLIST web-based component of the course, the contact learners (both full-time and part-time) at CPUT have the benefit of attending the weekly lectures as well as the course material available on the DLIST web-site. For these learners, the course is web-assisted.

Table 1: Course Outline for 2008

Introduction	Course Structure Information Literacy Electronic Searches & Databases
Our Coastal Areas	The Modern Environmental Crisis Field Trip - Peninsula
	General Environment Field Trip – Port of Cape Town
	Activities
Tools and Governance	Law & Ethics
	EIA
	Project Management
Water	Water Quality
	Water Conservation & Demand Management
Energy	Energy Resources Field trip – Palmiet Pumped Storage Plant & Klipheuwel Wind Farm
	Energy Management Systems
Air Quality	Air Quality Management
	Transportation Case Study
Wastes & Effluents	Effluents Field Trip - Bellville WWTP & Bellville South Landfill
	Wastes & Effluents

The Environmental Engineering course offered at CPUT is an important way of introducing learners to key environmental concepts. It was developed specifically to provide engineering learners with a more balanced and informed view of how the decisions that they make, when in the workplace, could impact on the environment. Since environmental issues impact a broader society, it became necessary to share the Environmental Engineering course offered at CPUT with a broader community of learners. In this way the boundaries of conventional engineering education could be extended to be more inclusive, not only of its educational offering, but also by engaging with a more inclusive 'clientele' in responding to the knowledge needs of the broader society. The course is therefore offered to people who are involved in decision-making (at various levels), but who are not necessarily registered for a formal engineering qualification.

The World Wide Web, an increasingly popular technology has made it possible to create a "virtual" space where dialogue between diverse groups of people, for example, students, planners, decision-makers or the local person who relies on the environment for their livelihood, could take place. This information sharing platform was created in order for engineering environmental education to be accessed by non-contact learners. Thus, contributing to the expansion of a knowledge society by developing expertise on broad environmental issues, beyond the traditional classroom environment, indeed beyond national borders. In so doing, providing relevant, environmental education, for non-degree purposes, to those who do not necessarily have access to formal classroom education. White (2005: 165) refers to this provision of learning opportunities as *"one of the longstanding hallmarks of distance education"*.

2.2 Course assessment

Assessments include both individual and group work and are varied in the specific competencies that are needed to complete them and attempt to encourage learners to do research and present their work in a professional manner, both written and orally. Learners are introduced to Information Literacy tasks which require the demonstration and integration of Information Literacy principles of searching for and locating relevant information, extracting what is needed and synthesising this information in order to produce a well-structured document. Emphasis is placed on referencing and acknowledgement of sources of information.

When learners eventually start on their four content assignments, they are more capable of doing research and presenting their work. Work-based group projects form part of the assessments. This enables learners to collaborate in groups of up to four learners. Learners collaborate using e-mail after agreeing to work together. A written report and an electronic presentation of what they would have used in a face-to-face oral presentation are submitted. Group tasks in particular are allocated to give learners the opportunity to work collaboratively and to support and learn from each other. The social constructivist view of learning is that it "emerges" through interaction and "occurs as learners exercise, test, and improve their knowledge through discussion, dialogue, collaboration, and information sharing" thereby creating knowledge as it is shared (Hadjerrouit, 2006:122).

Learners have access to a dynamic pool of on-line resources which include the on-line Environmental Resource Centre (ERC) portal through the university's website at http://erc.cput.ac.za. Through this portal learners can find a video library and the learner Wiki. Learners publish on and maintain the Wiki as part of their project work. The Wiki is a type of "social software" (Chen, et.al., 2005: n.p.) where learners engage in various discussion forums. A Discussion forum is available so that learners (contact and distance) can engage with each other and the course co-ordinator on course-related matters. Thus, blurring the lines of interaction between contact and distance learners. Learners are also able to engage in discussions with other interested parties and subject experts. Learners do two Wiki tasks, one individual and one as part of a group. Students post their contributions to the ERC site.

The course culminates in a written final test which carries a 40% weighting of the course. Students who reside in Cape Town write the test at CPUT, while most Namibians write at the Polytechnic of Namibia, with whom there is an agreement to administer the test on the CPUT's behalf. Other students write under the supervision of their seniors at work, with whom the course co-ordinator liaises by sending the question paper. Once the learner has completed in the allocated time, the answer pages are scanned and returned via e-mail.

3. Learner Feedback

3.1 Learner expectations

The majority of the learners who did the course in 2008 are adult learners who are employed. Their positions range from administrators, technicians and consultants. Their workplace responsibilities range from water sampling, managing data, projects and compiling reports, administrative duties, conducting research and conducting environmental impact assessments to coordinating outreach projects. Thus, a diverse group of learners with a diverse range of competencies and skills.

The learners' expectations of the course contain the same emphases on learning more, gaining knowledge and understanding of various environmental issues.

All the learners, except one, indicated that the course had met their expectations and some indicated that they gained more from the course than they had anticipated. One learner expressed ambivalence in responding yes and no in this regard. However, the reasons for the ambivalence suggests perhaps an idealistic expectation of the course. The learner responded by saying: *"I learnt a lot about the problems we face, but not why we are not working harder to fix things."* This may perhaps be indicative of the seriousness with which the learner sees the environmental problems, and feels that more practical activities should be adopted to address the problems.

3.2 Motivation

Learner motivations for registering to do the course suggest that many of the learners want to learn more, want a better understanding of issues and want to improve their knowledge. As the course offers a varied selection of topics of interest, for example, air pollution, energy and so on. A keen interest in the environment and the importance of knowing more and having a better understanding of environmental issues in order to make the best possible decisions as to how to go about providing solutions was expressed. These learners have either grown up in a community

in which they have noticed environmental degradation or have been sensitized by their workplaces or projects that they have been involved in.

Despite a few mentioning that their motivation is work-related, many express enthusiasm for wanting to develop skills and know more in order to help their communities and their country. The enthusiasm is almost one that stems not from personal gain, but a sincere need to help beyond the self, to help others. This can be seen in the following student responses:

"I am interested and worried about our environment."

"I have lived along the coast and have seen how our environment is being depreciated…and the only way for me to contribute my quota for the betterment of our environment was to learn more as the course offers a comprehensive background to environmental management."

Thus re-emphasising the importance of learning and knowing, in order to make a positive contribution to society.

Medel- Anonuuevo, Ohsako and Mauch (2001) describe a lifelong learner as someone who is self-actualising and reflective. A learner who is self-actualising is motivated by extrinsic and intrinsic factors. Intrinsic motivation centres around the need to fulfill ones potential, whilst extrinsic factors relate to basic, primary needs. Learning for self-actualisation is mainly intrinsically motivated (Medel- Anonuuevo, Ohsako and Mauch, 2001). They claim that learner reflexivity can be encouraged by creating an organized learning environment that enables the learners to make sense of their learning and to become critically aware of how they can become active problem solvers. Understanding logic and associations, learners should be enabled to engage in problem solving actively and creatively in their exploration of the world.

The learners seem to be acutely aware of what they need to know and what they want to know. Their responses seem to suggest a confidence in the realization that they learn not because they have to, but because they want to and need to, in order to make their contributions to promoting a sustainable environment and society.

It is interesting to note how the learners came to know about the course. Some looked on the internet and managed to peruse the course outline which they found interesting. Here the value of the open source nature is evident, as anyone is able to freely access the course information. One learner looked for available courses and was by chance linked to the CPUT course. This is a clear indication that the World Wide Web certainly provides ready access to educational offerings and that learners have the luxury of picking and choosing what they want. The only requirement to gain a course credit is by registering formally, paying the requisite fees and submitting all the assessments to the required standard.

Other learners heard about the course either by word-of-mouth from previous learners who had done the course or in project meetings where someone favourably made mention of the course. Thus, either motivating the learners to register for the course because of the positive feedback or by stirring their curiosity. As one learner indicated: *"…at the time it was pure curiosity. But it is helping now because my duties involve integrated coastal area management."*

3.3 Educational value

Different learners found different aspects or topics of the course valuable. Educational value seems to have been accentuated when learners could make direct links between what they learned and their real life situations. However, even in situations where learners did not find immediate application for what they learned, they still found many areas of interest. As one learner says: " The most important and interesting area has been waste water and solid waste, although I do not use it in my work."

Another learner response indicates how the course was able to assist the learner in seeing issues from a different

perspective. *"It has opened my way of thinking, outside the box."*

The course has acted as a stepping stone for some learners who have continued their learning by taking on other courses after the environmental engineering course. As suggested by the following learner response:

"After I completed the course I went ahead to do my Honours Degree in Applied Science…and I did not face any major problems as I had the understanding of what was going on in the line of environmental engineering."

Another learner indicated the intention to start a Masters course in Environmental Studies. Even though the learners receive a certificate after successful completion of the course, they have attributed a high educational value to the course. One learner responded by saying: "It is high value, post-certificate level."

This shows that the learners are in control of their own learning and Van Niekerk (2003) points out that such learners are able to continue learning and engaging in important issues beyond course completion. Thereby continuing their learning experience.

3.4 Contribution to learning

The learner responses indicate that the course has contributed greatly to their overall learning. What has been learned includes necessary skills in searching for and accessing information, writing reports and editing their written work. Learners have become skilled navigators of the on-line resources. In addition, they have become critical and independent thinkers who have learned to work independently as well as in a team.

Learners have been able to take the knowledge gained from the course to help make decisions in the workplace (where applicable) and have even been able to use their knowledge to help educate others. One learner in particular has used the knowledge to develop a booklet for Grade 6 learners on coastal conservation. Knowledge gained is not only useful in the workplace, but also in learners' personal lives. *" …in my personal life I am much more careful of the use of water and electricity and recycling."*

Van Niekerk (2003: 199) refers to the 1996 UNESCO Report which states that there are four pillars upon which education is built, namely, learning to know, learning to do, learning to live together and live with others, and learning to be. It would appear that the distance learners have begun to walk the path of meaningful learning as they recognize the importance of learning to know in order to be able to do. Their responses suggest that it is important for them to learn in order to make meaningful, individual or collective contributions to improving the environment not only for themselves, but also for others.

One learner indicates that the reading habits cultivated during the course will be continued in the future. Some learners indicated that their learning throughout the course has contributed to their personal as well as professional development and has given them the confidence to not only embark on further studies (as mentioned earlier), but to start new research and business ventures that centre around environmental issues.

Knowledge gained has contributed to being considered to take on more responsibility at work. *",,,the knowledge I gained from this course has added to being selected as the lead coordinator/manager of this Unit."*

Another learner indicated that what was learned in the course has led to going into partnership with someone and starting a small environmental solutions (consulting) company.

Another learner indicated that the air quality module has motivated in interest in developing a project that looks at the impacts of fish meal factory smoke on air quality and human health.

The course is highly recommended by all the learners and their reasons for recommending the course are encourag-

ing. As one learner put it: "…I have already recommended a few of my friends as they just like me are seeing the importance of this course. I am actually looking forward to the next level of this course."

To this end, we are collaborating with the Polytechnic of Namibia on the development of a Cleaner Production course that will become available to lifelong distance learners on the DLIST platform. Further, learning material of an Integrated Coastal Zone Management course is currently available open-source on DLIST.

4. Conclusion

This paper initially describes how the Environmental Engineering course at CPUT has changed from a web-assisted contact offering to a web-based course on the DLIST platform. However, it emphasizes the need to make the offering available to a wider pool of potential lifelong distance learners located in a non-engineering environment. Namely, where their work or living situations demand that they have an appreciation and understanding of how engineering and development impact on the environment, and how to better manage these impacts in order to promote sustainability.

These lifelong learners who have successfully completed the course are generally upbeat about their learning experience, indicating the positive influence their knowledge and competencies gained in the course have had on their work or living contexts. In some instances, the learners have gone on to complete further formally accredited courses, or others have expressed the desire to do follow-up courses.

The course certainly seems to be fostering the promotion of life-long learning not only intrinsically by learners completing the course successfully and applying their acquired knowledge and skills, but extrinsically by motivating successful participants to be true lifelong learners. In this way, they are contributing positively to their personal development, making informed decisions in their work and living situations that are environmentally sensitive and thus promoting sustainability.

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