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Wholly Online Learning in Environmental Science
Benefits and Pitfalls
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Abstract: In recent years there has been a significant shift in the way courses and subjects are delivered to students in tertiary institutions. Advances in technology have resulted in a change to the traditional face-to-face lecture and tutorial teaching format, with many subjects in tertiary education now available online. Although research has explored the advantages and disadvantages of online learning, there has been little attention paid to this teaching format in the field of environmental science. In particular, there is little evidence in the literature to suggest that this method of teaching is appropriate for studies in environmental science or for environmental science students. This study examined the outcomes from a wholly online subject in environmental science at Deakin University, Australia. More specifically, the study aimed to investigate student views about online learning in environmental science as well as online group work. Questionnaires were distributed to all students who completed the core second year subject Society and Environment in semester 1, 2005. Although many of the responding students (n = 48) recognised the benefits of wholly online learning, the findings suggest that most prefer to learn in a face-to-face environment. This paper examines the implications of these findings for future online teaching methods in this discipline.

Keywords: Online Learning, Environmental Science, Collaborative Group Work

Introduction

Recent advances in technology have changed the way in which subjects are delivered to students in tertiary institutions (Weigel 2002). Many universities now make use of Online Learning Management Systems such as WebCT and Blackboard; and some are moving to an arrangement where all subjects have an online component.

At Deakin University in Victoria, Australia, there is now a requirement for all undergraduate students to complete at least one ‘wholly online’ unit (subject) during their course of study. At this institution, a ‘wholly online’ unit is defined as “a course or unit with no face-to-face component in which all interactions among staff and students, education content, learning activities, assessment and support services are integrated and delivered online” (Deakin University 2003b).

As with any teaching format, there are advantages and disadvantages in delivering material in a wholly online environment. Students learn computer skills, online communication skills, online team-work skills, as well as learning to take responsibility for self-learning. The online environment also allows the teacher to adopt approaches in critical pedagogy where the teacher is not so much the person in authority but more like another learner within the group (Crabtree and Sapp 2003).

However, although there are some positive outcomes associated with online learning, there are also some clear disadvantages for students studying in wholly online environments. Biggs (2003) argues that ‘formative assessment’ is more difficult in online teaching when compared with face-to-face teaching. For example, in an online teaching environment (and indeed other forms of remote teaching), you cannot get immediate feedback from students or observe facial expressions or body language to ascertain if a particular concept is understood. Weigel (2002) also argues that it is difficult to inspire students when teaching online.

There is some evidence in the literature that different groups of students respond differently to online learning. Wiesenberg and Stacey (2005) and Smith et al. (2005) discuss how students from different cultural groups use computers in very different ways. Canadians engage in interactive messaging more often and more skillfully than their Japanese counterparts, who tend to use computers for one-way communication more often. Also, certain subgroups within these cultures behaved differently – with younger male Canadian and Japanese students demonstrating far more tendency to use the Internet to learn in an independent manner, while younger female students of both cultures appeared more comfortable and willing to use the Internet to learn in a more “discussion-based” or collaborative manner (Wiesenberg and Stacey 2005, p.396).
Furthermore, there are issues relating to the suitability and performance of the technology. As Ramsden (2003) explains, “challenges that remain embrace the familiar one of matching the technology to the learning goals in a way that ensures a high-quality learning experience… minimum standards for the quality of online learning should always include stability of the technology…” (pp.161-162).

Although there is now a significant body of research on the use of online teaching and learning, there has been little attention paid to the use of wholly online learning specifically in environmental science university courses. Students studying in this field generally have a strong interest in field work and practical exercises where they can apply their knowledge to real-life environmental issues. The environmental science units at Deakin University that perform best in unit evaluations completed by students are those where there are excursions, contact with professionals working in the field, and opportunities for hands-on practical exercises.

Studies also suggest that, regardless of the teaching format, group work is an important part of the learning process (Biggs 2003). As outlined by Smith (2005), advantages of collaborative group work include:

1. increased motivation of learners;
2. opportunities for learners to develop their skills in critical thinking and problem-solving; and
3. opportunities for an environment in which learners can share and debate ideas, and construct new knowledge.

As has been outlined by some of the key education theorists (for example, Bruner and Vygotsky), social interaction in teaching plays an important role in helping learners to interpret events and ideas and construct structures of meaning (Biggs 2003; Stacey 1998). As Vygotsky explained with his ‘zone of proximal development’ theory, every student has a point at which they “cannot… achieve an understanding of a new concept alone… [without] help from a teacher or peer” (Stacey 1998, p.3). Many tertiary institutions now recognise group work as an essential skill for students to graduate with (for example, Deakin University 2002).

Disadvantages of collaborative learning relate mainly to the conflict that can arise between students. This may be for a variety of reasons, for example, personality clashes, differences in opinion about the best way forward, different expectations, or lack of input by some group members. As one of the interview participants stated in Smith’s (2005) study of online group work, “It’s hell! I don’t want a group voice. I don’t think group voice… it antagonizes me to the point that I don’t want to do it [collaborate]” (p.191).

Smith (2005) and Hall (2003) also discuss the constant tension between the need for a student to connect with others and for them to work on their own and express their own individual opinions.

This tension is extremely emotionally laden, usually unconscious, and creates strong, unbearable love/hate feelings toward the group situation (Smith 2005, p.185).

Even though the advantages and disadvantages of collaborative learning are well documented in the literature, we are only now beginning to understand how effectively this approach works in wholly online teaching environments.

Smith (2005) suggests that proponents of online learning have put forward several arguments in favour of online collaborative learning. Learners can contribute in their own time, rather than having to find a time to meet with the rest of the group. Further, Stacey’s research (1999, 2002) has highlighted the importance of group collaboration in online learning for taking students beyond their ‘zone of proximal development’. Drawing on theories of social constructivism, she found that “a socially constructed learning environment is essential for effective learning” in online teaching (p.1). As Kanuka and Anderson (1998; cited in Stacey 1999) stated, social constructivist theory is “currently the most accepted epistemological position associated with online learning” (p.60).

However, there are also many challenges that students must face with this teaching format.

...learners face communication, technical, and sociocultural challenges in their collaborative groups. The limited nonverbal communication cues and communication spontaneity serve to increase the time needed to make decisions (Smith 2005, p.183).

While theories of social constructivism are commonplace in Western educational psychology, the literature suggests that there has been relatively little attention paid to “issues of constructivism in the field of environmental education” (Robottom 2004, p.93). This is especially the case when we consider online teaching in environmental science. Therefore, the aim of this study was to explore:

1. The effectiveness of wholly online delivery of a core unit in an undergraduate, on-campus, tertiary environmental science course.
2. The effectiveness of wholly online group work in a core unit of an undergraduate, on-campus, tertiary environmental science course.
Methods

The Case Study

In order to achieve the aims stated above, this inquiry used a case study approach focusing on the delivery of the 13-week unit *Society and Environment* in semester 1, 2005. This unit (that is, subject within a course of study) is a core second year unit in the four environmental science courses offered at undergraduate level by the School of Life and Environmental Sciences at Deakin University, Victoria, Australia. These on-campus courses include the Bachelor of Environmental Science (Environmental Management), Bachelor of Environmental Science (Conservation Ecology), Bachelor of Environmental Science (Fisheries Management & Aquaculture), and Bachelor of Environmental Science (Marine & Freshwater Science). The Environmental Management and Conservation Ecology streams are offered at the University’s Burwood campus in metropolitan Melbourne, while the Fisheries Management & Aquaculture and Marine & Freshwater Science streams are offered at the University’s rural Warrnambool campus.¹

*Society and Environment* is included in the curricula for the undergraduate courses offered by the School because of the need for students to understand the social and economic dimensions of environmental issues as well as their biophysical or ecological dimensions. This multi-disciplinary approach is now an essential part of environmental education although many courses offered elsewhere still focus primarily on subjects in ecology and biology (Blake and Cock 1987; Jacobson 1990; Jacobson and McDuff 1998; Jacobson, Vaughan and Webb-Miller 1995). As Pearce and Russill (2005) suggest, “interdisciplinary alliances on environmental education projects can effectively address the gap between complex environmental problems in the real world and disciplinary curricula in a university” (p.65).

In previous years, *Society and Environment* has been delivered through lectures and tutorials but was re-designed for 2005 to meet Deakin’s policy for all students to complete at least one wholly online unit during their course (Deakin University 2003a). The unit was delivered through the WebCT system ‘Deakin Studies Online (DSO)” and supported by video and audio material on a CD-ROM.

As there was no face-to-face interaction between staff and students in this teaching format, an important element of the unit was collaborative online group work. At the beginning of the semester, students were randomly allocated into groups (7-9 students) and commenced work on a small group task. The task asked students to design a behaviour-change program to encourage people to save water. Students could choose to focus on water conservation in a variety of contexts (for example, home, business) and they had to decide which tools or strategies (for example, economic incentives, education, prompts) would be most effective in encouraging a change in people’s behaviour. The objectives of the task were:

1. to develop a learning community within the unit so that students were not working in isolation; and
2. to give students the opportunity to brainstorm what they already knew about some of the topics/issues that were covered in detail later in the semester.

Students stayed in these groups for the whole semester and were required to work together on various aspects of their assessment tasks.

Research Questions

As stated in the introduction, this study aimed to explore:

1. The effectiveness of *wholly online delivery* of a core unit in an undergraduate, on-campus, tertiary environmental science course.
2. The effectiveness of *wholly online group work* in a core unit of an undergraduate, on-campus, tertiary environmental science course.

Specific research questions included:

• Do undergraduate, on-campus, environmental science students enjoy learning in a wholly online environment?
• What are the benefits of wholly online learning in environmental science? What are the disadvantages?
• Are the topics covered in *Society and Environment* suitable for online delivery?
• Do undergraduate, on-campus, environmental science students enjoy group work at university?
• Do undergraduate, on-campus, environmental science students enjoy online group work at university?

Method

A five-page questionnaire was mailed on the 21 September 2005 to all students (165) who were enrolled in *Society and Environment* in semester 1,

¹ Environmental Science courses offered at Deakin University were revised during 2005 and from 2006 include streams in Environmental Management, Wildlife & Conservation Biology, Marine Biology, and Freshwater Biology & Management. For further information, go to http://www.deakin.edu.au/scitech/les/
2005. The cover letter sent with each questionnaire outlined issues of confidentiality and advised students not to write anything on the questionnaire that could make them identifiable. Respondents returned the questionnaire in the postage-paid envelope provided. By completing the questionnaire, respondents were consenting to participate anonymously in the study. The questionnaire was sent to students approximately three months after the conclusion of the unit, after all student grades were finalised, thus eliminating any possibility of coercion on student participation. A reminder letter was emailed to all students two weeks after the initial mail-out. The study was approved by the Deakin University Human Research Ethics Committee (EC202-2005).

The questionnaire, using a combination of open-ended and closed questions (for example, yes/no, Likert scale), was based around three main themes: 1. participant background; 2. attitudes towards online learning; and 3. attitudes towards online collaborative learning.

Of 162 deliverable questionnaires, 48 completed questionnaires were returned constituting a 30% response rate. To check whether or not this sample was representative of the students completing the unit, the demographic profile of the sample was compared with that of the entire student group (see Figures 1 & 2).

Data were analysed using a combination of quantitative and qualitative data analysis techniques. Quantitative data were analysed in SPSS (Statistical Package for the Social Sciences), using descriptive statistics and inferential statistics where appropriate (Chi-square). Comparative data were statistically significant at $P \leq 0.05$. The use of some statistical analysis techniques was limited, owing to the relatively small sample size obtained.

Qualitative data from open-ended questions were typed into Microsoft Word and were analysed by identifying key themes and using respondent quotes (labelled with pseudonyms) to illustrate these themes.

Data were also compared with feedback from several other sources, a method known as triangulation. This process involves collecting data using different methods or different sources, thus increasing the reliability and validity of the data (Erlandson et al. 1993; Robson 1993). This project was designed based on data obtained from the following sources:

1. student feedback obtained during the semester, both online and during informal conversations with students;
2. formal university unit evaluations, containing both quantitative and qualitative feedback; and
3. staff evaluations of the unit and self-auditing through a reflective journal on what worked and what did not work.

Data from these sources were valuable in designing this study. However, their use in this paper was limited due to confidentiality and privacy issues. Broad issues raised by students during the semester and in the unit evaluation conducted by the University were useful in designing the questionnaire and in assessing the reliability of the data obtained in this study.

It is important to note that the findings from this study are limited to one cohort of students, so caution must be used when generalising to other groups of environmental science students. Further, the ‘newness’ of the wholly online format of this unit may have influenced both student and staff experiences (Smith 2005), and may not be indicative of longer-term attitudes toward this style of teaching.

Results & Discussion

Sample Profile

Of the 48 students responding, 65% were from the Burwood campus and 35% from the Warrnambool campus; 46% were male; 42% were 18-20 years of age, 31% were 21-26 years of age and 27% were over the age of 26 years; 31% were studying Environmental Management, 27% were studying Conservation Ecology, 6% were studying Fisheries Management & Aquaculture, 21% were studying Marine & Freshwater Science, and 15% were studying in other courses. Only three out of the 48 respondents had studied a wholly online unit or course at university before completing this unit.

The campus profile and gender profile of the sample were compared with that of the whole student group to ascertain how closely the sample matched the population. Figures 1 and 2 suggest that the sample obtained was broadly representative of the student group.
Effectiveness of Wholly Online Delivery of an Environmental Science Unit

One of the main aims of this study was to examine the effectiveness of delivering a core, on-campus, undergraduate tertiary environmental science unit in a wholly online format.

The majority of respondents (67%, \( n = 48 \)) said ‘yes’ to the question ‘Do you think there are benefits to be gained from wholly online study?’ Respondents suggested that wholly online study allows them to further develop their skills in using computers, communicate and work in teams online, and gives them flexibility in time and space. The following responses reflect these ideas:

I liked the way it was wholly online, that way it could be done at a time that suited you best (Jane, 27-32 years).

Limits the need to travel, and many references such as databases and journal searches can be done online also, limiting the need to use physical references recommended for unit (Ben, 18-20 years).

However, even though many recognised the benefits, almost all respondents highlighted the disadvantages associated with this style of learning, with 98% responding ‘yes’ to the question ‘Do you think there are disadvantages associated with wholly online study?’ Many respondents stated that the lack of face-to-face contact resulted in a perception that work could be ‘put on hold’ until later in the semester. Others commented on the effect of online learning on the ‘university experience’ with a reduction in the social benefits of learning at university. The following responses highlight these views:

It was a good unit, but online format makes it difficult to give it the time and respect it deserves. Often people treated it as a last minute task (Alice, 18-20 years).

Reduced the ‘university experience’ to some extent. It meant I only had 2 contact days, reducing social benefits (Ben, 18-20 years).

Some respondents expressed a belief that it costs less to deliver a wholly online unit, even though in this case it actually costs more when technical support, CD-ROM production, and staffing are factored in to the total unit delivery cost.

Was a good unit online… however I feel the fee should be lowered that we have to pay… (Sally, 18-20 years).

Seventy-three percent of respondents said that they would have enjoyed the unit more if there had been some face-to-face classes, echoing Hamilton’s view (2001, cited in Weigel 2002) that “learning on-line is… always second best”. These findings are consistent with other studies that have found those using virtual field trips or other online tools (for example, Brierley, Hillman and Devonshire 2002; Meyers et al. 2003; Pereira and Brilha 2000; Warne, Owies and McNolty 2004) tend to favour them as a tool to be used in a laboratory setting or to complement the real field trip rather than using them as the only delivery format.
To further examine the effectiveness of delivering a core, on-campus, undergraduate environmental science unit in a wholly online format, the views of different demographic groups were compared. Although these comparisons were limited as a result of small sample sizes, there do not appear to be any significant differences between the views of students of different ages or genders in relation to online learning in this particular case. For example, 32% of male respondents and 31% of female respondents either agreed or strongly agreed with the statement ‘I enjoyed learning about Society and Environment in wholly online format’ (χ² = 0.00, df = 1, P = 1.00). Similarly, 55% of male respondents said ‘yes’ to the question ‘Do you think there are benefits to be gained from wholly online study?’, while 77% of female respondents gave the same response, a statistically insignificant difference (χ² = 1.77, df = 1, P = 0.18).

No significant differences were found between respondents of different ages, with 40% of 18-20 year old respondents either agreeing or strongly agreeing with the statement ‘I enjoyed learning about Society and Environment in wholly online format’ compared with 25% of respondents over the age of 20 years (χ² = 0.62, df = 1, P = 0.43). Similarly, 70% of 18-20 year old respondents said ‘yes’ to the question ‘Do you think there are benefits to be gained from wholly online study?’ compared with 64% of respondents over the age of 20 years (χ² = 0.01, df = 1, P = 0.92).

Overall, there were mixed views about the suitability of Society and Environment for wholly online delivery, with 42% of respondents answering ‘yes’ to the question ‘Do you think the material covered in Society and Environment lends itself well to online delivery?’; 27% answering ‘no’ and 31% answering ‘not sure/undecided’. Responses included:

- Online units don’t work well with environmental studies – we don’t learn anything practical to use in the field (Bronwyn, 18-20 years).
- Considering I felt I learnt the difficulties and advantages of social interaction in enviro [sic] issues, I believe it worked well, plus a lot of the learning came from the trial-and-error nature of the tasks. I felt it was a good subject to put online, as the need to work in a new and exciting social environment contributed to the learning of the social issues involved in environmental protection (Ben, 18-20 years).

Effectiveness of Wholly Online Group Work in an Environmental Science Unit

Although the unit Society and Environment is more about social science than biological or ecological science, there is a need to reflect on the way in which science is taught given the declining interest in science at primary, secondary and tertiary levels (Dearn 2003). Dearn (2003) argues that “we need to teach science more like the way science is practised, that is, as an exciting field of intellectual inquiry rather than a process of memorising and recalling large quantities of information” (p.1). Student feedback through online discussions, unit evaluations and the questionnaire distributed in this study, as well as staff evaluations of the unit all suggest that online delivery of Society and Environment does not provide students with a rich and rewarding experience in the same way that face-to-face classes and field work can. This finding is consistent with Wiesenberg and Stacey’s (2005) review of the literature on online learning which highlights the dramatic increase in the number of subjects and courses being offered online but an “apparent lack of a concomitant improvement in quality, effectiveness, and benefits of online learning from both the learners’… and the academy’s perspective” (p.386).

A large proportion of respondents expressed the view that a blended learning approach (see Stacey, Barty and Smith 2005) would be preferred over wholly online learning. For example, one respondent said:

I support online work for many reasons, but I think it would have been better had we been given a more gradual introduction to the wholly online idea, and still had at least 1, one hour lecture per week just to help on the content levels and the social interaction (Susan, 21-26 years).

Effectiveness of Wholly Online Group Work in an Environmental Science Unit

This study also aimed to learn more about the role of group-work in a wholly online learning environment. Owing to the new delivery format of the unit Society and Environment, group work was seen to be essential. Twenty percent of the assessment for the unit was therefore based on a student’s ability to work effectively as a member of an online team.

While many respondents commented on the benefits of online group work, many more highlighted the disadvantages. Forty-six percent of respondents (n = 48) said ‘yes’ to the question ‘Do you think there are benefits to be gained from online group work as opposed to face-to-face (that is, in class) group work?’ and 90% said ‘yes’ to ‘Do you think there are disadvantages associated with online group work?’ Furthermore, respondents were more likely to say they enjoy the traditional style of group work...
at university (that is, in class) when compared with online group work (Figure 3).

Some of the benefits of online group work were reflected in the following responses:

The group learns to nut out problems without the aid of teaching staff. Some people take leadership roles (Jane, 27-32 years). Can reduce the need to meet for trivial purposes such as assigning tasks. It also forces you to think carefully about your writing and communication, as written communication can be misinterpreted if not worded properly (Ben, 18-20 years). You can look up what was said weeks ago (John, 21-26 years). It can be documented how much individuals contribute to group projects (Susan, 21-26 years).

In contrast, the disadvantages of online group work are highlighted by these comments:

Some people fail to contribute as they do not have to answer to you in person (Kerry, 27-32 years). Groups are always hard, but when online groups are formed, it often leaves individuals doing more work than some (Rob, 18-20 years).

Many students struggled with the online group work component of the unit. Some were frustrated by the lack of effort put in by other group members, while others felt that it was easier to meet up in the library or café to work on assignments. Even though many found the group work to be a difficult process, the online group discussions throughout the semester did suggest that a learning environment had been created in which students helped each other construct new knowledge. Social constructivist theory helps to explain this process where collaboration helps students to move past their ‘zone of proximal development’ (Stacey 1998). The following response emphasises this:

[Yes, my group worked well together because there were] More ideas/methods etc for writing up assessment tasks, varied backgrounds of people = varied ways/ideas/education levels (Jack, 21-26 years).

However, the benefit of online communication for students who are often remote from one another and the campus (Stacey 1999) does not apply to Society and Environment students who are on-campus students and see each other regularly in other units.

No significant differences were found between male and female respondents in preferences for online collaborative work. For example, 48% of male respondents said ‘yes’ to the question ‘Do you think there are benefits to be gained from wholly online study?’, while 46% of female respondents gave the same response ($\chi^2 = 0.00$, df $= 1$, $P = 1.00$). Similarly, no significant differences were found between respondents of different ages, with 15% of 18-20 year-old respondents either agreeing or strongly agreeing with the statement ‘I enjoyed the group work component of this unit’ compared with 29% of respondents over the age of 20 years ($\chi^2 = 0.57$, df $= 1$, $P = 0.45$).

Overall, most respondents expressed the view that the online group work would have been more enjoyable and effective had it been partly conducted in a classroom setting. As the following response suggests:

You can’t be sure other members are getting the information you are posting, it can enhance face-face group work only! (Mary, 21-26 years).

Conclusion

This inquiry investigated the effectiveness of wholly online delivery of a core unit in an undergraduate, on-campus, tertiary environmental science course; and wholly online group work. The findings suggest that, although there are some benefits associated with wholly online learning, the students taking the unit under investigation would have preferred a more blended approach (that is, a combination of face-to-face and online teaching and learning).

Benefits associated with the online delivery of the unit centred around the flexible nature, both temporal and spatial, of the tasks; as well as an enhancement of online communication skills among students. However, these benefits were outweighed by the disadvantages associated with the wholly online learning experience. The findings suggest that the particular group of environmental science students surveyed in this study find the university experience most rewarding when they are interacting with staff and each other in a face-to-face environment; and have the opportunity to participate in hands-on, practical tasks either in class or in the field. As such, further research is required on the motivations and learning preferences of students who specifically seek out courses of study involving a significant amount of work outside of the university classroom. This may provide further insight into the future role of online learning in environmental science.

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