ENCOURAGING ACTIVE LEARNING WITH MORE INTERACTIVE WWW DESIGNS

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Abstract

When faced with the challenge of developing an undergraduate mining subject – Process Simulation and Control - in flexible mode to allow students on location at various remote mine sites to study the subject simultaneously with their campus-based colleagues, the development team was keen to focus on providing a quality learning experience as opposed to just delivering content remotely. The challenge lay in how to harness the new technologies in ways that would support and improve learning, not just replace a traditional form of delivery (lecturing) with its digital equivalent (lecture notes online). This paper uses Oliver, Omari and Ring's (1998) WWW use framework to outline and categorise the uses of the WWW in this subject in terms of fostering learning.

Keywords

online learning design, technology for learning, collaborative learning

Introduction

In 2000, The University of Queensland's Department of Mining, Minerals and Materials Engineering launched the Undergraduate Site Learning Program (USLP), which is a new teaching and learning initiative focused on providing a structured learning environment for senior undergraduate students who are selected for placement at mine sites more than 1000km from the main University campus in Brisbane.

The emphasis of the USLP is on integrating work practice and flexible learning. Students complete useful tasks for the minesite while concurrently fulfilling university course requirements via access to flexible learning resources. This paper describes the first course to be developed and delivered entirely in flexible mode - *Process Simulation and Control*. Only a few students were studying this course remotely from the mine sites and the majority of students taking this subject were campus-based. *Process Simulation and Control* introduces students to mathematical modeling techniques and then teaches them to apply these to practical tasks. Students are taught the theory and practice of basic automatic process control, and are given exercises modeled on tasks typically undertaken by a process control engineer in a minerals processing plant.

In designing this course, we wanted to use the new technologies in ways that would support and improve learning, not just replace a traditional transmission form of delivery with its digital equivalent. Oliver, Omari and Ring (1998) provide a framework for considering the various forms of educational applications the world-wide web supports to foster learning. Their web use

framework is categorised by four main web applications for teaching and learning: a) Information access, b) Interactive learning, c) Networked communication and d) Information construction. This paper considers the extent to which each of these categories of WWW use is evident in *Process Simulation and Control* and the pedagogical decision making that shaped the final design.

Information Access

It has long been argued in the literature that predominantly transmission focussed approaches are less likely to lead to positive learning outcomes and deep learning (Laurillard, 1993; Oliver, 1998; Biggs, 1999), and ironically the advent of the WWW has unfortunately provided the technological means of fostering just such an approach (Brown, 1997; Wardrop, 2000). A scan of online offerings from the higher education sector will reveal uses of the web predominantly for delivery of content and information.

The WWW as a medium of delivery of complex and lengthy textual material can be especially counter productive (Carr-Chellman & Duchastel, 2000) particularly when students are studying at remote locations where issues of bandwith, cost of connection and download speed can negatively impact on their access to this information. Students also tend to print out any content that is provided online, and this can result in content being delivered in a confusing disarray of single disconnected sheets. Simply publishing lecture notes online or a great deal of printed material online, does nothing to enhance the pedagogy (Oliver, 1998). Oliver et al. (1998) and Salmon (2000) argue that while access to content is necessary it is not a complete component of learning and that more interactive uses of the WWW will contribute to improved learning outcomes. The WWW needs to be used in much more interactive ways if it is to serve as a useful tool for learning.

The WWW was used minimally in *Process Simulation and Control* in terms of information access. It did however provide links to useful resources together with access to case study material related to a minerals processing engineering problem. This material was presented online so that it could be supported by the network features of the site and would dovetail with the online group work components. Students were able to access all of the relevant resource material related to the case study from the website which they used to collaboratively solve the engineering problem.

Interactive Learning

The design of this subject places the learner at the core of the teaching and learning experience, and like Sims (1999) and Biggs (1999), emphasises the importance of learner activity and interaction as essential mechanisms to support learning. They argue that students are less likely to learn in deep ways by passively receiving information transmitted to them no matter how technologically rich the delivery mechanism might be. Deep learning is more likely to occur when students are required to actively engage with that information - to structure it and build links from it to their exisiting knowledge framework - to undergo conceptual change.

The WebCT site for *Process Simulation and Control* focuses primarily on increasing opportunities for interaction and self-assessment rather than delivering content. In this site, students were provided with a number of downloadable process control loop simulators that were designed to encourage students to apply their understanding of ‘practical control’ to realistic scenarios by manipulating variables and checking outcomes. The WebCT quiz tool was also used in a variety of ways to provide students with interactive exercises that allowed them to gauge their growing understanding of concepts and which also provided the course coordinator with data about student progress. In addition, a set of ‘test yourself’ review questions was included on the site which also provided detailed, immediate feedback for students to check their understanding. Each topic had ten review questions for self-assessment purposes.

There is much focus on active learning in this subject, and in a flexible learning environment, it is particularly important for teachers and course designers to ensure that adequate feedback

mechanisms are in place for learners to gauge their progress during the course (Boud, 1995), and to provide access to help where required.

Networked Communication

Biggs (1999) argues that when students are given opportunities to engage in dialogue about their growing understanding of new material and to receive feedback that can extend this understanding, they are more likely to engage in higher levels of cognitive activity and thus achieve deeper levels of learning. The WWW supports many different forms of communication that can be used to provide opportunity for this collaborative form of learning. Many communicative activities were designed in *Process Simulation and Control* to encourage students to negotiate meaning and engage in purposeful and collaborative discussion and activity. These included the development of email study groups where students formed groups and each group had its own discussion list forum to encourage interaction and collaboration within a manageable, supportive setting. An additional general bulletin board forum was created to keep the site dynamic by allowing new information and communication to be added during the course.

The Networked Communication facilities of the subject enabled the activities and tasks flagged in other resources to be drawn together. Students had the opportunity to test their understanding of mathematical model theory via the learning guide, the practical control exercises and the review questions on the WebCT site. The course coordinator was able to monitor students' progress by reviewing their responses to tutorial questions and discussion topics posted on the bulletin board, and track their attempts at the review questions. The remote USLP students were encouraged to use the bulletin board to contact their classmates on-campus and describe some of their experiences at the mine site. Their classmates were encouraged to reply, and a dialogue was created. Thus the networked communication features of the package played an important role in creating a convergent learning environment across two very different physical settings.

Information Construction

The WWW can be used to support the construction of information and knowledge, where documents can be created and modified after interaction and collaboration. In *Process Simulation and Control* students were provided with a case study where they were required to solve a minerals processing engineering problem. They were encouraged to take on the role of consultant engineer applying the concepts covered in the course to a real problem likely to be encountered in the workplace. The case study material is on the WebCT site, and provides background information, flowsheets, data sets and other information for students to tackle the simulation and control problems. This material is presented in the same way that a real consultant would expect to receive material needed for a study, in a variety of separate documents and notes. Just as in the workplace, students are encouraged to work with others to solve the problem and to make recommendations about optimising processes. The communication facilities of the WebCT site encourage students to work together in this way. A large portion of the assessment for the subject is based on submissions relating to the case study.

In addition to the case study activity students were also provided with opportunities to collaborate and construct information in the following ways:

- The development of a set of Frequently Asked Questions (FAQs) which was added to over the semester. Students with questions were encouraged to post them to the bulletin board and other students were encouraged to answer them. The 'best' student answer was then uploaded to become an 'official FAQ and answer'.

- A dynamic glossary built over the duration of the course, with students being encouraged to add definitions in a similar process as the FAQs.

- A ‘bug fix’ facility where students were encouraged to identify and pose solutions for any bugs that appeared in the simulation software.

- Short answer questions on the major topics were presented in private bulletin board fora for students to work in groups and answer. Groups shared their findings in the public forum.

- Groups collaborated to answer review questions.

Conclusion

The WebCT site is the dynamic learning hub of the course, and the WWW is used for communication, interaction, information exchange and knowledge construction. Students in this subject do not work as isolated remote individuals steadily working their way through the materials, but as groups of learners connected through time and space via the use of the communication facilities of the WWW. The communication tools are used in this subject to provide extended access to fellow learners and to teachers, and they have the potential to connect with relevant people outside of the immediate learning environment.

In contrast to a content focussed online delivery approach, this approach is learner-centred with an emphasis on educational design that values learner interaction, interactive learning, problem solving and networked small group work with a focus on realistic contexts. The subject offers students an opportunity to solve real process control problems in ways that mirror the work of professionals in the mining environment: through a course design which emphasises interactive learning and networked communication over information access.

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