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Using technology supported inquiry learning to engage first year students in large classes

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Using technology-supported inquiry-learning with a large first year cohort

This paper describes a study that explored the promotion of learner engagement among first year students through a technology-facilitated inquiry learning approach. Students were given a series of authentic inquiry tasks supported by a raft of learning scaffolds. The technology-facilitated system supported timely feedback and support and administrative efficiencies for the tutors and teacher. This paper describes the Web-based system and reports aspects of an inquiry exploring the factors seen to influence students' levels of engagement and achievement. Recommendations are drawn from the study for further instantiations of the approach with appropriate revisions and changes.

Introduction

First year students in university courses often experience a number of difficulties that can limit their potential to succeed and achieve (McInnis, James & Hartley, 2000). First year students need to be able to assume responsibility for their own learning, to undertake independent research and inquiry and to communicate and argue their ideas in a succinct fashion (Calder & Hanley, 2004). Students entering university courses are often lacking in these skills and need to quickly develop a number of difficult capabilities to achieve success.

Often first year students find their initial studies stressful as they are exposed to new ways of learning. Many in their first year of university learning find difficulty with approaches that place high levels of responsibility onto the learner. In large classes, it is often difficult to provide courses that recognise and cater for the diverse needs of the student cohort. Such strategies can work if there is sufficient scaffolding and support but in large classes, it is often difficult to provide sufficient support to address the many needs of these new students (Calder & Hanley, 2004). Contemporary technologies have been shown in many cases to provide the forms of support that students in their first year of university study might need. Technology can provide strong systems for managing learning settings while offering students choices and opportunities to undertake learning suited to their own needs and wishes.

Web-based settings

Technology is widely used in university teaching in the form of Web-based instruction, often as a supplement to, live instruction (Romiszowski, 2005). Use of the Web in such settings provides many affordances for the teacher and students in the form of communication channels, information sources and management tools. Technology provides a number of options for course delivery and appeared well suited as a strategy in this project for supporting the inquiry-based learning approach we were planning. A Web-based approach enables the teacher to plan a student-centred learning environment and to pre-empt many problems which might arise for learners (Collis & Moonen, 2001). Web-based blended approaches facilitate timely communication between students and teachers and provide the means for both parties to connect when the need arises. The use of technology holds particular promise for the creation of learning settings that can interest and motivate learners and support their engagement while at the same time providing the necessary forms and levels of support for independent learning (Oliver, 2001; Goodyear, 2005).

Engaging learners

The capacity of a learning setting to engage learners is often seen as an indicator of the depth and scope of the learning that will occur (Trigwell, Prosser & Waterhouse, 1999). Typical university settings that involve lectures and presentations will frequently fail to engage learners (Biggs, 1999). Often conventional approaches encourage learners to focus on the content and information presented in a superficial fashion, in what is commonly known as

surface level learning. The alternative to surface level learning is *deep learning*. This is characterised by learners seeking to understand and comprehend content and information in ways that enable it to be applied and transferred beyond the classroom setting (Biggs, 1999).

Conventional learning approaches in higher education are often unsuccessful in developing and promoting higher-order learning outcomes (Laurillard, 2002). The problem often lies in the roles assumed by the learners being passive more than active participants in the learning process, receiving rather than seeking information. Jonassen (2000) argues that meaningful learning can only occur in the context of problem-solving and inquiry, activities that require students to become cognitively engaged. Kearsley & Shneiderman (1999) argue that engaged learning occurs in settings which involve active cognitive processes such as creating, problem solving, reasoning, decision making and evaluation.

Inquiry-based learning

There are many ways to design learning settings that generate the learner engagement required for successful learning. Collis & Moonen (2001) describe a model for teaching and learning called *the contributing student*. This model describes learning setting which provide engagement through collaborative activities that lead to the development of products in the form of actual learning materials. Herrington, Oliver & Reeves (2003) describe authentic learning as a means for creating meaningful contexts for learning in higher education. Their model of learning describes characteristics that they argue underpin meaningful learning based on the collaborative solution to authentic tasks that are complex and open-ended. Inherent in these models of learning is a deliberate strategy that encourages and requires learners to engage in higher-order thinking and cognition.

A number of writers have demonstrated and described the use of problems and inquiry as contexts for engaged learning (Jonassen, 2000). Inquiry-based learning describes the use of a form of problem or task that serves as a catalyst for student engagement and participation (Fogarty, 1997; Kingsland, 1996). Learning comes from the information processing that occurs as students work to explore the problem setting and to seek a solution. The novelty of working with the problem enables students to acquire new knowledge, as well as to further consolidate their existing skillset and understanding (Schiller, Ostwald & Chen, 1994).

Technology supports for inquiry-based learning

It was in this context that a project was conceived to design and implement an inquiry-based learning approach in place of a conventional content-based approach within a large undergraduate class. A Web-based tool was conceived that could support an inquiry-based learning setting. The conceptual design underpinning the development of the tool revolved around the provision of the following elements:

- Meaningful contexts for student learning;
- Scaffolds to support independent learning;
- Opportunities for teacher support and feedback; and
- Strong administrative efficiencies.

A design-based research methodology (Reeves, Herrington & Oliver, 2005) was used to guide the application and evaluation of the tool. A project and inquiry was undertaken to explore the following research questions:

1. What level of engagement can a Web-supported inquiry-based learning approach provide first year undergraduate students?
2. What factors influence students' levels of engagement and achievement in a Web-supported inquiry-based learning approach?

3. In what ways can a technology-facilitated approach create efficiencies for tutor support and feedback.

Research Method

The Web-support tool

The Web-based support tool was developed to provide a high degree of learner scaffolding for a problem-solving process and the administration of the approach. The tool was designed to provide a seamless interface for the teacher, the tutors and students to view the various problem specifications, to access relevant resources, to upload their solutions and to receive the feedback on their submissions (Figure 1).

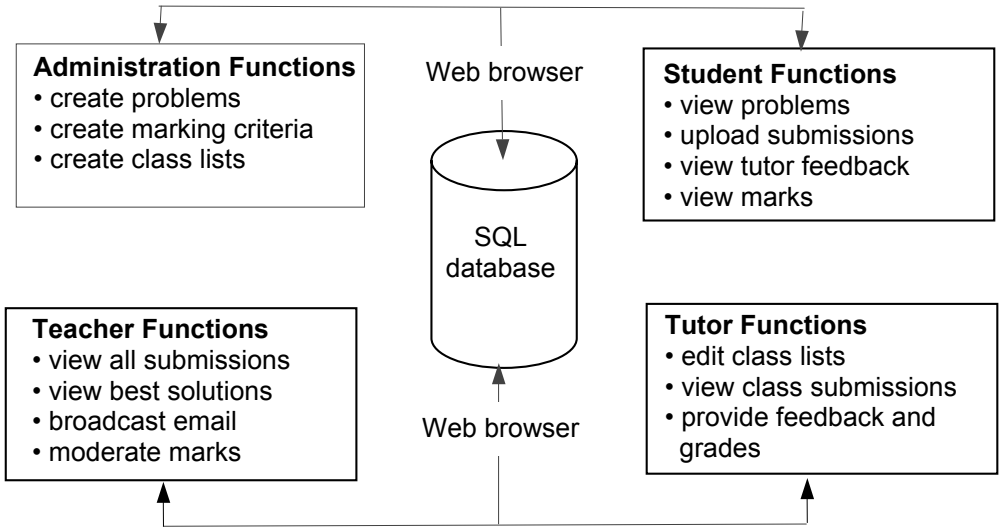

Figure 1: The functional elements of the Web-based tool

The online tool was designed with a high degree of flexibility to enable its reuse in different settings, among cohorts of varying sizes and with varying options for problem specifications, marking options and scoring of submissions. The use of a Web interface provided the flexibility to enable the tool to be accessed through conventional courseware management systems (CMS) via a single link to the supporting Web server where the tool was stored.

The Learning Environment

The study was undertaken in an Australian University in a first year foundation course of a communications degree. The course aimed to develop students' skills and abilities in visual design, particularly in regard to their use of ICT-based productivity tools. In order to promote learner engagement and motivation, an inquiry-based learning approach was developed which saw the course content and information contextualised through a series of weekly problems which students were required to solve. With its visual design focus, the course lent itself to an approach where the intended knowledge and skills were acquired through application to meaningful tasks and problems.

The problems were designed to provide meaningful contexts for the application of the knowledge underpinning the course and to deliver a range of open and different solutions to discourage students from copying or colluding. Two hundred and sixty three students completed the course that ran across a 12 week semester.

The Web Interface

The online tool that was developed used a visual interface to enable tutors to quickly view their students and to access their submissions (Figure 2).

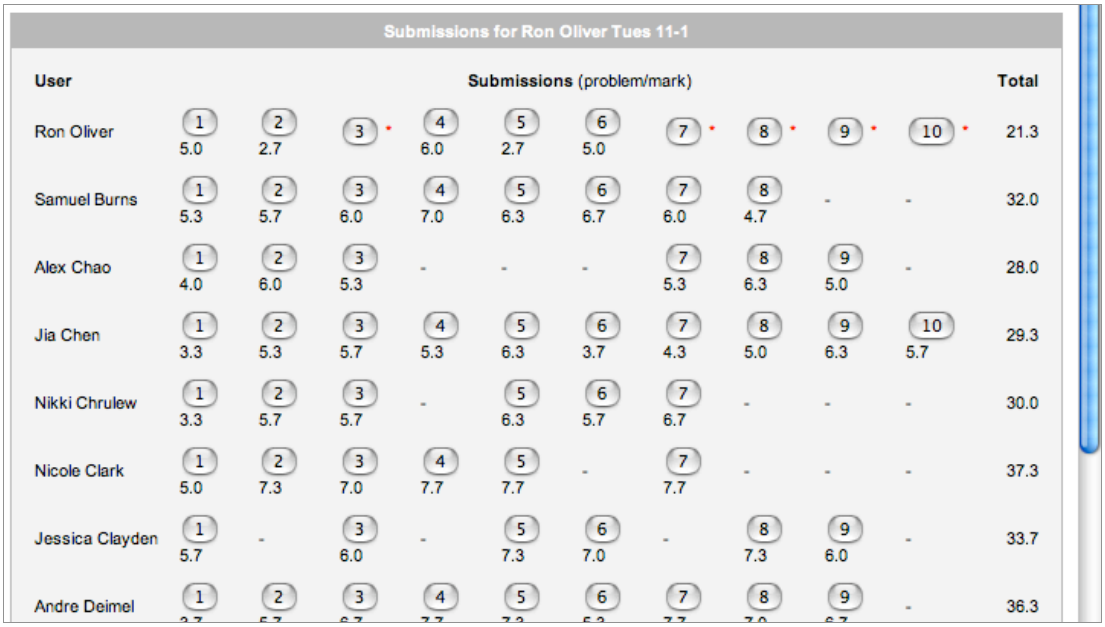

Figure 2: Tutor page for accessing student submissions in the Web-based tool

When tutors clicked to choose a particular piece of work for a student, the interface enabled the teacher to download the students' work and provided an efficient input screen for providing students with feedback. The system automatically calculated the marks and made any necessary deductions for work submitted late (Figure 3).

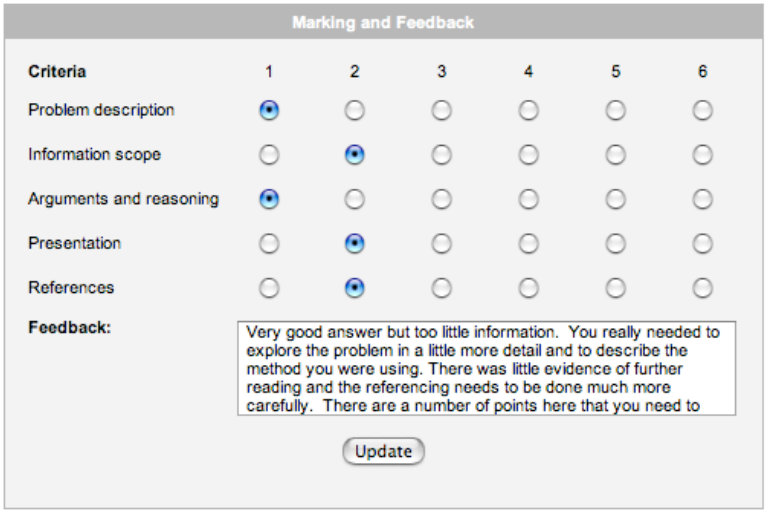

Figure 3: Tutor marking screen in the Web-based tool

Students also had a relatively simple interface, a single screen that enabled them to upload their work and to view the feedback from the tutor (Figure 4).

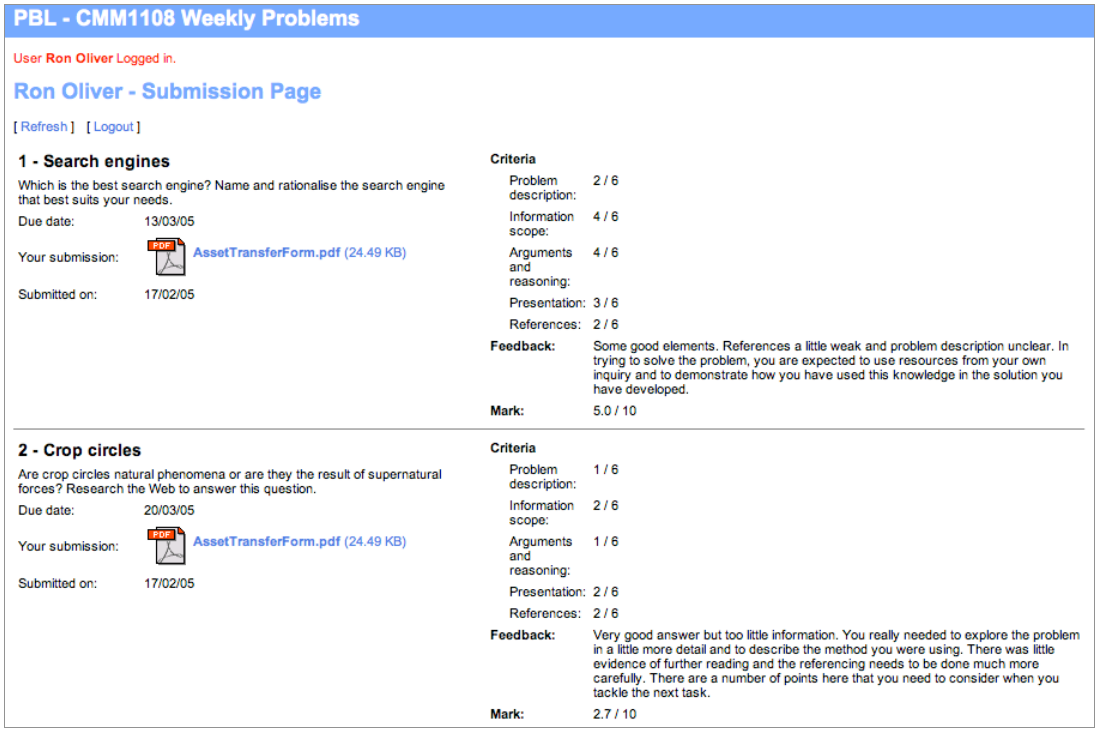

Figure 4: Student page in the Web-based tool

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Data Collection

Data to support an analysis of the research questions was gathered from a variety of sources. At the end of the course students were presented with an online questionnaire which consisted of multi-choice questions and short answer questions. Completion of the questionnaire was a voluntary activity and 135 responses were received representing a 51% return rate. The questionnaire required students to describe the levels of interest and engagement that the problem solving activities engendered, and it explored students' preferences in terms of problem type, frequency of submission and depth of treatment. Tutors also completed an online questionnaire to gauge their responses and reactions and feedback was obtained from the full complement of 9 tutors.

Discussion And Results

Learner Interest and Motivation

A potential measure of the level of learner engagement supported by the approach was the number of problems students attempted. The minimum number that could be completed for

full marks was five problems but if they wished, students could complete up to the maximum ten. The mark they would receive was the aggregate of their top five marks. Learner-centred approaches have been shown in previous studies to provide strong motivations for learning and if this was the case in this study, we could expect to see students attempting more than the required number of problems. Twenty three percent of the class attempted one extra problem and a further twelve percent completed two extra problems. Seventeen percent of the class attempted fewer than the required five problems.

The number of students who attempted more than the required number of problems was not substantial. Whereas it was thought that the inquiry-based approach might create a simulating context that would encourage and motivate students to devote more time to the study of this unit, the results do not suggest that this was a feature of the course. There were 18% of the students who attempted seven or more problems and it is probable that this number would have responded equally to any other form of delivery that sought to promote engagement.

As a further exploration of the capacity of such an environment to motivate and encourage learner participation, the relative workloads of the students studying in this unit were compared to workloads in other units they were studying. Thirty four percent of the students judged the workload to be lighter than in other units. Their responses indicated that there were a number of circumstances and features leading to a reduced load. Interestingly a number commented on the small size of the problems set and the perception that these appeared less important than the larger tasks that formed the assignments in their other units.

There were approximately 30% of the students in the course who responded that they spent more time studying in this unit than they spent in other units in the course. Their responses suggested that the reason for this was not so much a matter of them being motivated to spend more time because of the interest and relevance of the problems, but more so because of other factors such as their lack of IT skills, the number of assessment items and the difficulties they faced solving the problems.

Learner Engagement

In inquiry and activity-based learning settings, the nature of the problems is often suggested as a primary factor in their ability to encourage learner participation and engagement. The study sought to determine whether it was possible to see such patterns in the nature of the problems students chose to solve. The number of students attempting the individual problems commenced at a high 79% for the first problem and declined across the semester with only 30% of the students completing the final problem. The average mark for the first problem was significantly lower than the average mark received for the remaining nine problems. This was probably caused by students becoming familiar with the submission requirements and marking processes. The low mark for the first problem was a factor that led many students to complete six solutions so they could hopefully recover some of the lost marks by gaining a higher mark for their extra problem. There was a high degree of consistency in the marking of the solutions between classes and a relatively stable standard deviation between the various problems. In previous explorations (Oliver, 2005), students were observed to show a preference for particular types of problems. In this class, for example, students indicated more interest and enjoyment in attempting problems that involved practical design solutions over problems that involved a more theoretical and research-based outcomes.

An important element of the study was to explore the ways in which the problem-based setting was able to provide supports for student learning and engagement. To explore this aspect of the learning, students were asked to describe the ways in which they felt the setting

helped their learning. A number of patterns emerged in the responses that were given. In particular, supports for learning were perceived to stem from the ways in which the weekly problems scaffolded the learning, supported student-centred activities and promoted knowledge construction.

A number of the students described the way that the weekly tasks provided a supporting structure for their learning processes. There were consistent suggestions among the students describing the value of the problems as a context for the inquiry. Among other things the feedback suggested that the problems encouraged the students to focus on the various topics in ways they might normally not have and the problems encouraged them to explore the topics in depth and beyond the course notes.

Many students commented that the weekly tasks provided strong supports for independent learning and in doing so provided a range of other learning supports. For example, many commented that the process encouraged them to make choices in relation to which problems they would solve and the depth and quality of the response they would make. A number responded positively about being able to explore, research and inquire as a fundamental component of their learning.

In responses to questions about the ways in which the inquiry-based setting assisted their learning, many of the students recognised that the practicality of the problem solving process helped them to derive meaning from the information and content they worked with. Student responses indicated that the problem-solving aided their learning by providing the means to out theory into practice and reinforcing the theoretical elements in practical ways that aided retention and recall as well as understanding

Whilst there were many responses that showed the learning setting in a favourable light, a small number of the students commented that the inquiry-based approach provided some disincentives and discouragements to learning. Students listed among their concerns issues related to the depth of the problems, some found them very hard while others found some of the problems too easy. The question of providing problems with the scope to cater for the diverse needs of the group is an issue that would seem to merit further attention.

Tutor Responses

The inquiry-based learning setting created many assessment tasks for the tutors to mark and the system had been designed to facilitate marking and feedback. Tutor response to questions concerning the utility of the system and the efficiencies offered for marking were very positive. All tutors found the system easy to operate and appreciated the electronic form of assignment submission. The point and click marking system with the text box for descriptive feedback, was considered by the tutors as very supportive, particularly as the system calculated and kept electronic records of the marks and overall totals. The tutors felt they were able to provide useful feedback in a timely and efficient fashion and enjoyed the paperless environment. From the coordinator's perspective, who was able to monitor all aspects of the submission and marking, the electronic system facilitated moderation, consistency in marking and provided a very useful means to oversee the assessment process.

Summary And Conclusions

This paper has described a study that explored the utility and efficacy of the application of a Web-based tool to promote learner engagement among first year students in a large class setting. The Web-based tool was characterised by strong learning scaffolds, meaningful contexts, feedback and support and administrative efficiencies. The paper has described the

conceptual underpinnings of the tool and the forms of engagement that resulted from its use among first year undergraduate students. The paper has also reported the factors that were found to influence students' levels of engagement and achievement.

The outcomes from the research provide evidence that Web-supported inquiry-based learning environment can support learner engagement but there are factors which can limit student motivation and interest. There appears a need for the problems and contexts to be well articulated and to provide clarity of intent. At the same time the problems need to be relevant and sufficiently detailed to require learners to gather information extra to that supplied to support the problem solving process, but not overly demanding on the scope and extent of the extra information required.

The research has demonstrated the ability of the Web-based setting to provide strong supports and engaging learning activities for the first year students in an efficient and organised fashion. Tutor response indicated that the process provided administrative efficiencies and facilitated a sustainable system despite the large number of assessments to be marked and reviewed. The technology-facilitated system provided many advantages for administering the approach for all stakeholders, the students, tutors and coordinator. From the results obtained, it is possible to conclude that the approach used might provide the forms of encouragement and support needed to support student retention in large classes. This component was not explored directly in this study but would seem a logical question in future studies. Future instantiations of the setting will seek to refine the problem specifications and requirements to address many of the issues raised in the inquiry.

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Note: A more comprehensive and detailed report of this study has been submitted for publication in Higher Education and will be published in 2008.