

SUPPORTING EXPLORATIVE LEARNING BY PROVIDING COLLABORATIVE ONLINE PROBLEM SOLVING (COPS) ENVIRONMENTS

Sylvia Laretta Edwards, Jason Watson

Faculty of Information Technology

Robyn Nash

Faculty of Health

Ann Farrell

Faculty of Education

Queensland University of Technology, AUSTRALIA

s.edwards@qut.edu.a, ja.watson@qut.edu.au, r.nash@qut.edu.au, a.farrell@qut.edu.au

Abstract

Research confirms that people learn more effectively by active enquiry rather than passive reception and through experimentation and collaboration. Collaborative problem solving comprises a set of skills that are considered necessary for success in today's world (O'Neil et al. 2003). Importantly, the development of such skills requires a learning/teaching approach that combines both problem centred learning and collaborative/co-operative learning (Nelson 1999). The COPS project seeks to go beyond current Online Learning and Teaching (OLT) resources to provide a framework and system to create and deploy environments where teams of undergraduate learners at Queensland University of Technology can collaborate, engage, grapple and seek to make sense of authentic problems within an online environment. It will do so by creating problem centred 'learning designs' that can be integrated with face to face teaching to bridge the gap between the classroom and real world experience. This paper introduces the teaching and learning philosophy behind COPS and explains our approach to developing this new online tool.

Keywords

e-learning, pedagogy, collaborative, problem solving.

Introduction

In 2003, Queensland University of Technology (QUT) conducted a Review of Online Teaching (2003 Review Of The University's Online Teaching Activities) which identified the need to develop strategies to move QUT's Online Learning and Teaching system (OLT) to an integrated interactive online learning environment (beyond its current role of content delivery) and integrating on-campus pedagogies, and face-to-face teaching, with the online environment. In addition the review recommended the development of an "online bank of learning resources and objects" to establish quality assurance and to facilitate sharing within the institution. In 2005 QUT awarded a Large Teaching and Learning Grant to the Faculties of Information Technology (FIT), Health, and Education to develop a system to support explorative learning by providing Collaborative Online Problem Solving environments (COPS - Collaborative Online Problem Solving Learning Environment).

The goal of COPS is to further improve student learning by integrating face-to-face teaching methods with collaborative problem centred online learning environments that use valid

pedagogical models. COPS will allow students to explore problem scenarios, practice, and learn through experimentation and reflection. To do this, it will provide a system of dynamic branching where student experience will be dependant upon decisions that they make (similar to a “choose your own adventure” scenario). COPS should increase students’ confidence and learning capabilities in both the short and long term and make them feel as though they have a personal stake in the proceedings. It will also enable the Faculties of IT, Health and Education to develop a clearer understanding of students’ teamwork and problem solving skills and the learning/teaching strategies that are the most effective in assisting students to improve their skill bases.

We are approaching the development of COPS at the meta level: creating an authoring tool suitable for multi domains, where lecturers can use this tool to develop their own COPS learning designs throughout the university, and explore how learning designs can be reused. In addition, where possible, we will build new functionality as reusable components. Hence, components that support new features such as role playing, dynamic branching, and authoring will be open for reuse in future OLT projects. This paper further explains the teaching and learning philosophy behind COPS and our approach to developing this new online tool.

Background

"I hear and I forget. I see and I remember. I do and I understand."
(Lao Tsu, Chinese Philosopher, 6th Century B.C)

Research confirms that people learn more effectively by active enquiry rather than passive reception and through experimentation and collaboration (Bruner 1973). Learning through observation (listening, watching or reading) is not as effective as actually performing an action and reflecting upon its consequences (Wankat, 1993). If we can allow students to construct their own knowledge through an action-reflection cycle rather than obtain knowledge directly from a teacher this will undoubtedly lead to a deeper development of knowledge and skills.

The pervasiveness of the Internet and learning institutions need to address the issue of how mass access in a cost effective way has led to the Internet becoming an important medium for education and learning. Whilst e-learning promises reduced costs and increased effectiveness, accessibility and flexibility there have been problems in its implementation. In many cases there has been a focus on technology and content as opposed to learning effectiveness (Yam 2004). Key issues that have been identified include online learners’ perception of not feeling engaged, finding the content boring, feeling isolated, not understanding the context, having insufficient control, and students not feeling motivated (Rosenberg 2001). In fact drop-out rates in e-learning have been quoted to be as high as 35% (Svetcov, 2000). This lack of student engagement is not surprising as many learning organisations are guilty of deploying “shovelware” (placing material such as PowerPoint slides or traditional paper based documents online with minimal changes) (Yam 2004)(Vrasidas 2004).

Jonassen, Howland, Moore, & Marra (2003) argue that five factors exist in order for learning to be “meaningful”:

- Active learning; i.e. observing or manipulating the environment
- Constructive learning; i.e. creating meaning from experience
- Intentional learning; i.e. goal directed
- Authentic learning; i.e. keeping the learning in context
- Cooperative learning; i.e. being able to collaborate with other learners

It is the recognition of these factors that have led to an impressive shift of focus in online learning from *learning content* to *learning experience*. For example, Harper (2003) is investigating how contemporary theories of learning can be applied in an online environment. Traditionally e-Learning has focussed on cognitive models of learning that are consistent with more structurally based approaches to learning content. Contemporary theories such as constructivism are not readily accommodated in a traditional learning management system where structure is a requisite part of the learning design. Constructivist approaches are more readily facilitated in a collaborative

environment where learners can validate their perspectives through social negotiations and interaction with an authentic task. Importantly, Jonassen states that a constructivist approach is particularly appropriate as much of what needs to be learned today involves advanced knowledge in ill-structured domains (Jonassen 1991).

Laurillard (2002) describes how the complex process of learning can be considered as a conversation and introduces a framework that identifies the activities necessary in the learning process. This framework (Figure 1) is intended to be applicable to any academic learning situation and employs the following four strategies: 1) it must operate as an iterative dialogue; 2) which must be discursive, adaptive, interactive and reflective; 3) and which must operate at the level of descriptions of the topic; 4) and at the level of actions within related tasks.

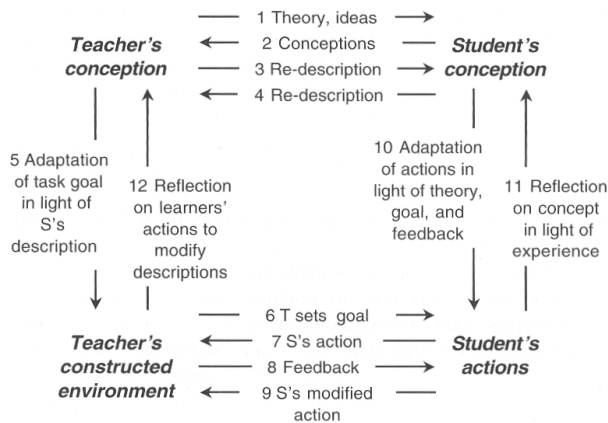


Figure 1: Laurillard's Conversational Framework (Laurillard 2002, pp.87)

The iterative approach in Figure 1 is based upon an extended version of Kolb's model of experiential learning: a continuous cycle of conceptualisation, experimentation, experience and reflection (Kolb 1984). Both these models [Laurillard's and Kolb's] define learning as a cycle and endorse the need for student reflection within that cycle. They also emphasise the need for an 'environment' or 'problem' with which learners can experiment and receive feedback; an environment where learners are active, grappling, and seeking to make sense, experiencing, forming assumptions, testing, and creating meaning from their experience. Problem

centred learning is a well known strategy for assisting deeper, critical active learning strategies and thus fostering the development of higher quality learning outcomes (Ramsden 1992).

Laurillard's framework seeks to describe the dialogue that needs to take place for learning to occur. However, it does not refer to the dialogue between learners (where learners can profit from each others different perspectives and strengths). Learner collaboration, where learners with aligned goals help each other towards some common objective, can enhance a constructivist learning cycle by providing an additional channel for validation and feedback (Jonassen 1991). Consistent with sociocultural theory, collaborative learning emphasises the importance of social interaction in the learning process (Vygotsky 1978). Collaborative Learning can also help maintain an authentic context, allowing learners to understand the importance of working well together for the good of the whole. Industry uses cooperative incentive structures which create a situation where the only way a team or group members can attain their own personal goals is if the group is successful. Therefore, to meet their personal goals, group members must both help their groupmates to do whatever helps the group to succeed, and, perhaps even more importantly, to encourage their groupmates to exert maximum efforts (Slavin 1995). Collaborative problem solving comprises a set of skills that are considered necessary for success in today's world (O'Neil et al. 2003). Importantly, the development of such skills requires a learning/teaching approach that combines both problem centred learning and collaborative/co-operative learning (Nelson 1999).

Collaborative learning environments provide a means to create more engaging and dynamic instructional settings (Kagan 1994), and research has demonstrated the educational advantages that can be derived from such environments (Slavin 1995; Jonassen et al. 1995; Qin et al. 1995; Bruffe 1999). Collaborative problem solving emphasises co-operation in the context of a 'carefully constructed scenario' (Edens 2000; Major & Palmer 2001) and is underpinned by pedagogical values that include the creation of learner centred learning environments, student ownership of the learning experiences, analysis of learning content and exploration from multiple perspectives, and the importance of the social context for learning (Nelson 1999). There are, therefore, important educational imperatives to employ collaborative problem solving as a constructivist learning strategy for students.

Introducing the COPS Environment

Our project seeks to provide a framework and system to create and deploy environments where learners collaborate, engage, grapple and seek to make sense of authentic problems whilst online. We have tentatively titled this new environment COPS, which stands for Collaborative Online Problem Solving. COPS will enable teaching staff to create reusable problem centred ‘learning designs’ that can be integrated with face to face teaching to bridge the gap between the classroom and real world experience.

Project Aims

COPS specifically addresses the teaching and learning priorities of work integrated learning via relevant authentic problems, the generic capabilities of problem solving and teamwork, and fosters an environment which may benefit the transition of students from university to the workplace. Specifically the project aims are to:

- Provide learners with a meaningful context for pursuing a goal whilst using QUT’s OLT.
- Develop an online environment where teams of learners undertake roles and work to solve authentic problems that can only be solved by successful collaboration; emphasising communication and collaboration rather than individual activity.
- Encourage students to form a personal stake in the learning process through simulation, role playing and having fun.
- Provide opportunities for students to make mistakes in a non threatening environment.
- Develop a range of reusable COPS learning designs (templates) to provide an affordable consistent high quality learning experience based on engagement and active learning.
- Develop strategies to assist teachers in the design and evaluation of their ‘problem’ environments and to assist with integration with face-to-face teaching.

Proof of Concept

The project stems from an FIT (Faculty of Information Technology) proof of concept model developed to support collaborative and story / problem centred learning (Watson, Sahama, & Edwards, 2004). This proof of concept has formed the basis of our initial design work in the project, so we will now describe it for you so you can understand how COPS will work on its completion and insertion into QUT’s OLT. There are two workflows associated with this model. One is a problem scenario workflow and the other a pedagogical workflow.

Problem scenario workflow

The problem scenario workflow represents the problem which is imbedded into a COPS scenario (Figure 2). In the workflow figure below we see that this problem has one starting state, a series of intermediate states, and three possible endings to the problem. It may help if you think of this as “Choose your own adventure”, a device used in young adult literature, where a reader makes choices from two to four possible alternatives throughout their reading of the book, until eventually they reach the end of the “adventure”. This “adventures” end though can be different each time you read the book, depending upon the choices you make while reading.

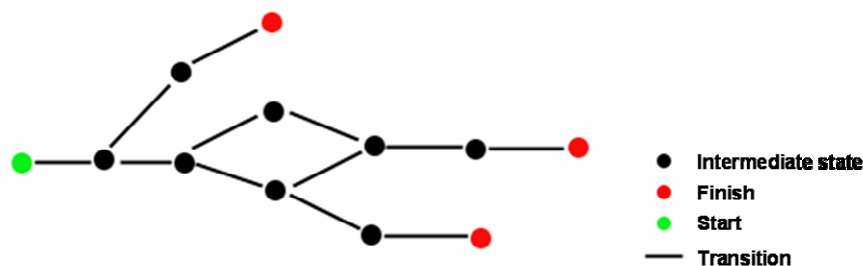


Figure 2: Problem scenario workflow

In the COPS case, a student team traverse the problem workflow by making a decision at each stage of the problem. This decision triggers a transition from one state of the problem to another. Decision point triggers can be activated based upon one or more actions from one or more role players, or from random events, or even from time outs (a specified period of elapsed time passes so the problem progresses to the next stage). Teaching staff can ‘force’ consequences on the team for non collaboration by setting a transition up so that it requires more than one role player to complete an action before the transition to the next stage can take place. The team is primed that they have to achieve a specific goal, and that they are expected to traverse the problem together until they reach an outcome that they believe achieves that goal. However, it should be noted that there may not be a single best outcome for problem resolution: for example, in some ethical situations there may be no black or white answer; it is the journey that is important.

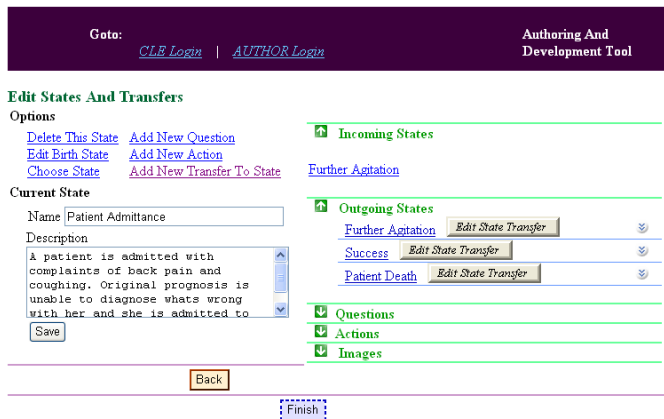


Figure 2: Proof of Concept problem authoring interface

At every intermediate state students are provided with a description of the requirements, and they can access numerous resources that facilitate investigation, decision making, outcome prediction and personal and team reflections. These resources are added by teaching staff and they may contain information specific to each role player and to each state of the problem workflow. This will increase the authenticity of the problem, and enforce collaboration using the ‘Jigsaw’

approach: where no individual student has all the information necessary to act appropriately (Aronson et al. 1978). In the proof of concept model, the problem workflow was set up and populated with content using the Problem Workflow Authoring Interface (Figure 2). This interface guides the teaching staff in their establishing of their problem scenario. It is intended that this will be further enhanced in the final version of COPS.

Pedagogical workflow

To support student learning COPS integrates Kolb’s pedagogical cycle with the problem workflow (Figure 3) using role play. This cycle is consistent with a constructivist approach and involves students experimenting, experiencing, forming assumptions, testing, and creating meaning from experience. Rudimentary elements which support students in each of the steps in Figure 3 have been created and can be seen displayed in the student interface (Figure 4); eg: the top tabs showing investigate, reflect, act, and side links to the journal, reflection, and collaborative areas.

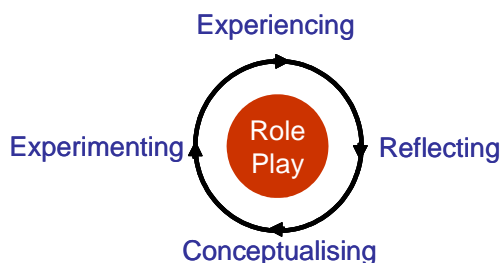


Figure 3: Our use of Kolb’s (1984) Pedagogical Cycle

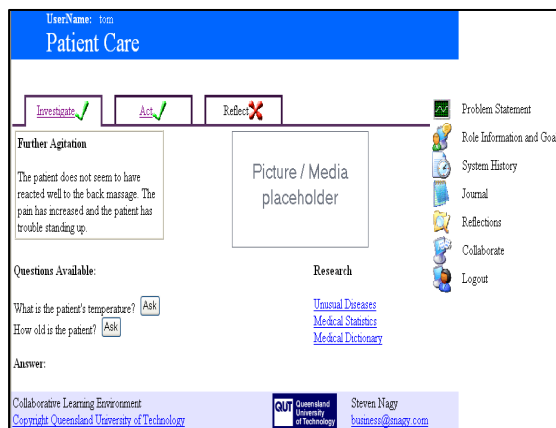


Figure 4: Proof of Concept Student interface

The student interface

The objective of the student interface (Figure 4) is to present the problem scenario to each role player with the relevant content for their role at that particular stage of the problem. In addition, the interface must explicitly drive the student through the pedagogical cycle in Figure 3. In this cycle the system separates the investigation phase, the decide/predict/action phases and the reflection phase. This approach is consistent with Kolb’s model of experiential learning. The proof of concept model is of low sophistication but will be improved by the creative process described in the implementation plan (included below). The investigation (researching or exploration) phase is currently supported by a description of the current state, a series of strategically placed questions (that the student may ask), and relevant pictures, media and research links. In the decide/predict/action phases, students are required to select from prescribed actions after first predicting the likely outcome and explaining their rationale. If the selected action triggers a change of state the content will update for every student in every role of the scenario. Students will be prompted to reflect on the result of their action, or change of state, in their reflective journal.

COPS Project Development

A broad outline of our implementation plan for each stage of the COPS project is described in Table 1. To date COPS has completed most of the creativity and specification phases. We move into the remaining phases from early in 2006.

<p>Creativity Phase: In this phase the coordinators of the units selected for the pilot phase, instructional designers from TALSS, and relevant experts will establish the pedagogical goals of the Online PBL system and establish how the system can support face to face teaching, engagement and deep learning.</p>
<p>Specification phase and then build phase: This phase will create a specification for the system (both the student interface and the authoring interface). Upon signoff of this specification TALSS will develop an alpha version of the Online Collaborative Problem Based Learning system and employ user testing to facilitate development to beta stage. The system will be integrated with OLT. Meanwhile, academic staff will develop an approach to embed Collaborative Online Problem Based Scenarios into host units. These learning designs will then be implemented within the beta system.</p>
<p>Pilot phase: A pilot phase will determine the efficacy of the beta online PBL system (student side and author side) and the learning designs implemented. Each host unit will embed a PBL learning design, hosted through OLT, into the curricula. Evaluation data will be collected.</p>
<p>Refinement phase: Data from the pilot scheme will be evaluated to determine the efficacy of the system and the learning designs employed. The system, and the learning designs, will be refined in the light of these findings. The final version of the system and the reusable templates will then be delivered</p>
<p>Dissemination phase: In the early stages of the Pilot we will commence our evaluation of data from student performance, both pre and post implementation. We will also consider results at the end of each stage from the student surveys and focus groups, and by comparison of SEU (Student Evaluation of the Unit questionnaires) for host units. We will perform usability analysis using tools such as Flashlight and for the staff involved implement other qualitative forms of analysis. The dissemination phase will include staff development sessions to facilitate other unit coordinators with using COPS.</p>

Table 1: Broad outline of the development of COPS

At this stage we are considering the implementation issues of seven separate problem scenarios in seven units from four faculties at QUT. This will be culled down to three for actual piloting. COPS will be fully integrated with the existing online environment of each of the units identified for piloting. Units that we are considering include: EAB002 *Early Childhood Foundations 2: Families and Childhoods in Early Childhood*: an Education Faculty 1st year unit offered in Semester 2; ITB117 *IT Professional Studies 2*: a 1st year IT unit offered each semester; ITB267 *Data Warehousing for Decision Support*: a 2nd year IT unit offered each semester; JSB241 *Introduction to Investigations and Policing*: a 2nd year Law unit offered in Semester 1; NSB324 *Medical-Surgical Nursing*: a 2nd year Health unit offered each semester; PUN500 *System Safety For Health, Safety & Environment*: a masters level Health unit offered in Semester 2; and PUB251 *Contemporary Public Health*: a 2nd year Health unit offered in both semesters.

To facilitate the creation of each of these problem scenarios instructional designers have developed a template (writing framework) to aid teaching staff with describing and planning their problem scenario and to help assist them with considering how they may incorporate their

interesting idea into a reality in their classrooms. This template also helps teaching staff with describing the details of their problem scenario in a style suitable for the purposes of the COPS project system designers. Teachers are firstly asked to describe their proposed scenario within the case study to be completed by the student groups. They are then asked to define each of the group member/s' roles in the scenario. They are required to identify the issue/s, potential or otherwise, that need to be resolved by the group, or in the case of projects, the specific issues in relation to the tasks to be undertaken by each group member in their roles. They are expected to use this identification of issues to check how the tasks align with the outcomes and criteria they have already stated.

We have then asked each teacher to describe the possible workflow pattern/s for the scenario's project teams. To do this they must consider how the activity or tasks of each role will influence the workflow pattern and its sequencing in terms of the group trying to resolve the problem tasks. In other words, by the time the teacher has described all of these segments, we have a simple description of what our COPS designers are going to need to ensure they have designed the environment to cope with these types of problems. It has already proved interesting, and often each scenario has some unique characteristics. For instance, some of the units require a scenario activity that will be completed within 1 tutorial or workshop alone, other units require the system to be capable of running for the duration of a semester, and other units who fit anywhere along the semester time length continuum.

Conclusion

Institutions are implementing e-learning to increase accessibility, flexibility, effectiveness, and even for cost reduction purposes, but historically much of that the implementation has been disappointing (eg: "shovelware", high attrition, and poor learner engagement). There has recently been an impressive shift of thinking by the community of researchers; a recognition that we need to concentrate on pedagogy, not technology. However, there are still serious limitations in the support provided to help educationalist build pedagogically sound student experiences. In addition, the costs associated with developing highly interactive e-learning content is a major hurdle (Carr 2001). It is apparent that if we are going to achieve our ambition of making high quality pedagogically sound e-learning ubiquitous, we need to develop new authoring practices and new tools. These tools will need to focus on creating learning opportunities and be underpinned by sound pedagogy. The objective of COPS is to fill this gap and to facilitate the creation and delivery of online activities that engage learners in constructing knowledge through experimenting, experiencing, forming assumptions, testing, and creating meaning from experience as opposed to a more didactic view of learners as passive recipients of knowledge through teaching and learning activities (Jonassen 1991; Savery & Duffy 1995; Chen, Chung, Crane et al. 2001). We are currently emerging from the creativity and specification phase of our project (determining the look and feel of the system and which problem scenarios will be suitable from a teaching and learning viewpoint). During the presentation we will be able provide you with details of the problem scenarios we have selected to pilot and show you the look and feel of the system.

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Acknowledgements

The authors of this paper would like to acknowledge Dr. Tony Sahama, Steven Nagy and the team from TALSS including Amanda Schnitzerling, Meredith Godat, Martin Perrett and Aneesha Bakharia.

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Please cite as: Edwards, S.L., Watson, J., Nash, R. & Farrell, A.(2005). Supporting explorative learning by providing collaborative online problem solving (COPS) environments. *A paper presented to the OLT 2005 Conference, QUT, Brisbane*, 81-89. <https://olt.qut.edu.au/udf/olt2005/>