

Prototyping a wholly online IT unit

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One of the objectives of prototyping is to assess the reactions of users to a proposed system. Reactions are gathered through feedback which then influences the way a final system is designed. This paper reports on a face-to-face undergraduate unit that was converted to online mode (the prototype) in an attempt to provide feedback about an innovative problem-based learning approach for a new unit. The feedback from students through three online surveys was positive overall. The student feedback and the lessons learned by teaching staff through interaction with the prototype suggested how the design and development of the new unit should proceed.

Keywords: prototyping, IT curriculum, online learning, problem based learning

Introduction

In 2006 a new wholly online core unit, *IT Practice*, was introduced to third-year students studying information technology (IT) at Deakin University. The objectives of the unit are to give students exposure to professional IT practices and prepare them for the workplace.

The framework for *IT Practice* was developed during 2004. The framework has an underlying problem-based learning pedagogy (PBL) using a simulated organisation as a case study. The approach proposed in the framework is innovative. Before developing the final unit, a prototype was built to establish the feasibility of the approach and to allow the eventual users of the system to test it out. Prototyping is an activity that is used in the IT industry to enable users to take an active role in designing a new system. The prototype was a project management unit that was about to be phased out with the introduction of the new unit. Some of the 'content' of the project management unit would be used in *IT Practice*. The project management unit was thus converted to online mode and aspects of PBL were included in the implementation. Pragmatic choices were made about what could and should be set up in the prototype in the time available. Feedback was gathered from two groups of stakeholders – students and teaching staff.

Background

A new Bachelor of Information Technology degree was introduced at Deakin University in 2004. All of the new units were phased in over a three-year period, and in 2006 all final-year units were offered for the first time. *IT Practice* is one of the core third-year units. The learning objectives of the unit are that students will have knowledge of technical practices within the IT industry; have an understanding of the ethical behaviours and social responsibility required of IT professionals; they will have put into practice knowledge acquired over their previous IT studies; and they will have extended their critical thinking and communication skills. A number of different student cohorts study the unit – students from two campuses; students studying in off-campus mode; and international students studying locally as well as from institutions located overseas.

IT Practice has been mandated to be delivered wholly online. Wholly online means that there are no face-to-face classes and all teaching normally takes place via the Deakin online learning environment, known as Deakin Studies Online (DSO), supported via WebCT Vista.

Problem-based learning (PBL) was deemed to be an appropriate underlying pedagogy for teaching the unit. The goal of PBL is to provide practice in solving ill-structured problems with new knowledge being

learned in the process of solving the problem. As they work through solutions in small groups, students improve problem-solving skills, teamwork, communication and leadership skills.

The characteristics of PBL are as follows:

- ‘real-life’ problems to engage the student in the learning process
- course material crosses traditional course material
- students collaborate in small groups
- the teacher’s role is as a facilitator of learning, not as an imparter of knowledge
- resources are available to assist in solving the problem but information on how to develop the solution is not provided.

PBL also has characteristics corresponding to those of the computing industry: i.e. computing is problem driven; life-long learning is required because of the continually changing nature of the industry; the project group is the main mode of operation; and it overlaps the boundaries of other disciplines (Ellis et al., 1998). PBL approaches have been used for teaching computing and information technology in Australia (see for example Duke et al., 1997; Greening et al., 1997) but the implementation in online computing or information technology education appears to be limited. There are added problems with conducting PBL online – ‘problems arise when the PBL method is applied in virtual learning environments where participants are distributed and weak communication channels make group interactions difficult’ (Miao et al., 2000, p. 232). According to Lee and Kim (2005), ‘it is important to provide a powerful artifact-mediated and society aware virtual learning environment for geographically distributed people to conduct PBL effectively’ (Lee & Kim, 2005, p. 291).

Creation of the prototype

The conceptual model

The pedagogical approach for *IT Practice* uses a PBL framework with an emphasis on experiential and authentic learning to gain insight into organisational practice and professional issues. The justification for the pedagogical framework has been described elsewhere (Goold, 2004).

The framework or the conceptual model consists of a number of elements. One element is the creation of a fictitious organisation, United Enterprises (UE) that simulates an organisation in the real world. UE consists of two components: resources and employees (staff). The resources are essentially any artefact that the company creates or stores as organisational knowledge. For IT students the emphasis is on documentation about users and customers; information systems documentation and software; and other information about organisational procedures, standards and related functions such as training. The UE employees have roles to play within the organisation. These roles are acted out by teaching staff (tutors). Typical positions in UE are project manager, legal advisor, help desk operator, quality assurance manager and business section managers. Students work in virtual teams, as members of the IT department to solve problems for UE. They communicate with other UE employees when they need assistance. The UE employees provide this assistance by giving support (scaffolding) for students to solve the tasks. The teaching staff administer the unit and its delivery, and create the resources within UE and the appropriate PBL assessment.

All of the problems are applied in the United Enterprises context. They are scenario based to simulate real life as much as possible. The problems are open-ended requiring investigation, analysis and critical thinking. Collaboration and communication are key elements in the model. This type of environment provides authentic learning and encourages active student engagement – ‘environments where experiential knowledge is learned through dialogue and interaction day-to-day’ (Vat, 2004, p. 138).

Converting the conceptual model into a prototype

Several possible environments were considered as suitable for the implementation of UE and the conceptual model. The first option was to situate UE within DSO. A second option was to create UE resources on CD-ROM and to use WebCT to link to the resources and provide the communication and

collaboration tools. Neither option was considered to be suitable. Students see DSO as a learning environment where unit materials are made available for downloading and where communication takes place with teaching staff. UE needed to be an authentic workplace that modelled the real world. Consequently the third option, which was subsequently adopted, was to create UE as a website that simulated an organisational intranet. This website would not only be a repository of static resources but would also be an environment where virtual teams could collaborate and communicate and where communication among all UE staff could be easily facilitated.

The open source content management system Drupal (<http://drupal.org>) was chosen for creating the website. While it provided adequate content management tools, the communication facilities within it were excellent and particularly suitable for the tasks to be carried out within the organisation. These included the facility for learners to participate in groups through discussion boards as well as the ability to post items in a blog-like fashion that could then be commented on by others. Features such as email notification and the facility for individuals to subscribe to groups are available. According to Farmer (2004) the ability for learners to subscribe to communication within a learning environment is related to the perceived success of that environment.

Drupal also offered a simplistic modular based configuration which, given the timeframe and scope of the task, was of significant value to the unit team. This configuration allowed for the simple installation of features and provided the unit team with a range of opportunities to flexibly design and further develop the system while it was in operation. For example, extra pages of information could be created quickly and incorrect registrations could be quickly erased.

Overall, while there are more suitable tools for the development of a fully authentic virtual website, Drupal was chosen due to the nature of the tasks to be completed and the ease of use of the software. While a more authentic website system would offer greater levels of authentication, control and administration, it would be unlikely to offer the same degree of flexibility and functionality in terms of communication. Further, given the relative lack of expertise of the unit team in the coding and development of complex content management systems, it was important to have a system that could be administered with relative ease.

Converting to online

The format for the old project management unit followed a traditional on campus mode of delivery. There were two lectures per week; a tutorial class, where concepts and tools discussed in the lectures were applied; and a practical class where exercises using Microsoft Project and Excel were completed. Assessment was a formal exam at the end of semester (50%) and three assignments (50%). There were thus restrictions on what could be done regarding curriculum in the prototype. Students were still required to use project management tools and techniques and assessment could not be varied. Rational selections were made about content for the prototype and the types of PBL tasks, so that the focus of the unit would not be compromised.

The prototype was set up with three topics:

- 1 People and Project Management
- 2 Tools and Techniques
- 3 Planning and Managing IT Projects

Throughout the semester students worked in online groups of six or seven. The three topics were assessed by assignment work in line with the previous version of the course. For Topics 1 and 3 students used the United Enterprises website. Topic 2 addressed the core functions of scope, time, cost and quality. Resources and activities for each of these core functions were set up in a structured way. Neither UE nor the PBL approach was used for Topic 2, although students still worked in groups to complete the tasks.

The PBL tasks: Topic 1 and Topic 3

Topic 1 People and Project Management consisted of a 'get-to-know-you' activity, resources related to HR management and teamwork and a group assignment. In the assignment students were asked to select an appropriate project team for a project (scenario) for United Enterprises. Biographies for eight

Information Technology Services staff were available on the UE intranet. Information about one of the UE staff members is shown in Figure 1. Group discussion about suitable members for the project team took place in DSO.



Figure 1: One of the ITS Staff in UE

Topic 3 Planning and Managing IT Projects involved the creation of a project plan for a Staff Portal project. All details about the project were available in the UE website. The interface showing the introduction to the Topic 3 assignment is shown in Figure 2. Students had to subscribe to their groups within UE and they worked within UE, using discussion forums and submitting work. Two people at UE were available to answer questions about the project – Bill, the manager of the Project Office and Pat, the Project Manager.



Figure 2: Information about the UE project

Evaluation of the prototype

The evaluation of the prototype occurred in two ways:

- reactions of students through feedback given by online surveys
- observations and lessons learned from the teaching staff.

Student evaluations

At the completion of the assessment for each of the topics an online survey was administered (in Weeks 4, 9 and 13 of the 13-week semester). The surveys were voluntary and anonymous. Students were asked to evaluate the learning materials and to provide information about the resources they had used. They were also asked to provide details about the amount of work they had done on each topic and to provide information about working in groups both face-to-face and online. Most questions required a *Likert* response, though a few questions were open ended requiring further comment. Students also provided demographic information about their gender, age, their course major and whether or not they were an international student.

Table 1 shows the surveys that were conducted and the types of tasks that were assessed for the topics. The total number of students who were enrolled at the date of each survey and the total number who responded are also shown.

Table 1: Survey and participation data

No	No. of questions	Task type	Students enrolled	Completed surveys	Response rate
1	22	PBL UE (static)	146	64	44%
2	39	No PBL used	141	52	37%
3	37	PBL UE (dynamic)	138	50	36%

The surveys conducted for Topics 1 and 3 were specifically designed to evaluate the PBL framework and to provide feedback about United Enterprises. The survey used for Topic 2 was not related to evaluation of the prototype. This survey was used primarily to gauge student perceptions of virtual team work and their experiences of online learning. The results of this survey have been reported elsewhere (Goold, Augar & Farmer, 2006).

Feedback from staff

The Unit Chair and three tutors were involved in teaching the prototype unit. An educational developer created the United Enterprises website and provided ongoing technical support throughout the semester. Tutors were given instruction (training) about the new approach and a 'Tutors Only' discussion forum was used to communicate and discuss teaching issues during the semester.

In Topics 1 and 2 the tutors were responsible for the group discussion forums in DSO. Each group consisted of six or seven students, and tutors provided some assistance with tasks and acted as mentors for the group. In Topic 3 two of the tutors had designated roles (Pat and Bill) within UE. Students worked within the UE environment and they asked for help from Pat and Bill.

During the semester the tutors reported on what they observed as students interacted with UE. They also made recommendations about future improvements for the UE website.

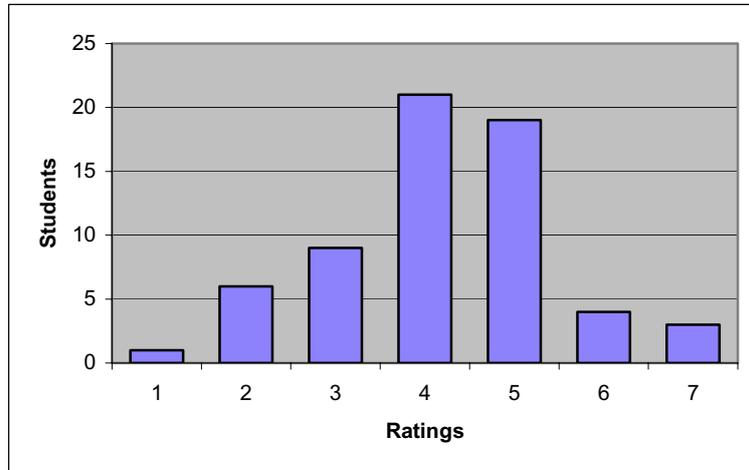
Results and discussion

Extensive feedback was provided by the three surveys. Students responded to questions about the topic materials and resources, their experiences of learning and working in online groups and their opinion of United Enterprises.

The surveys for Topic 1 and Topic 3 included two questions about United Enterprises:

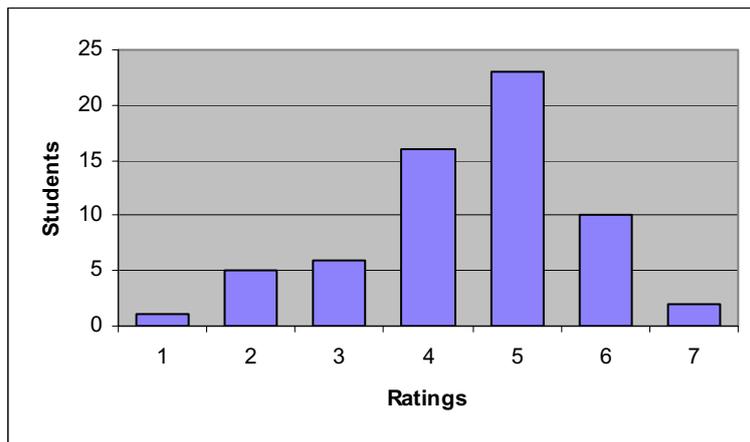
- 1 How do you rate United Enterprises as a learning resource? (Rating of 1 = 'Poor' to 7 = 'Excellent')
- 2 In your opinion how accurately does United Enterprises reflect a 'real-life' workplace? (Rating of 1 = 'Nothing Like It' to 7 = 'Very Similar').

For Topic 1 the responses to these two questions were positive, as shown in Figures 3 and 4. The majority of students rated UE as a ‘good’ learning resource that emulated the real world (Means of 4.2 and 4.8).



Note. Ratings from 1 = ‘Poor’ to 7 = ‘Excellent’

Figure 3: UE as learning resource (Topic 1)

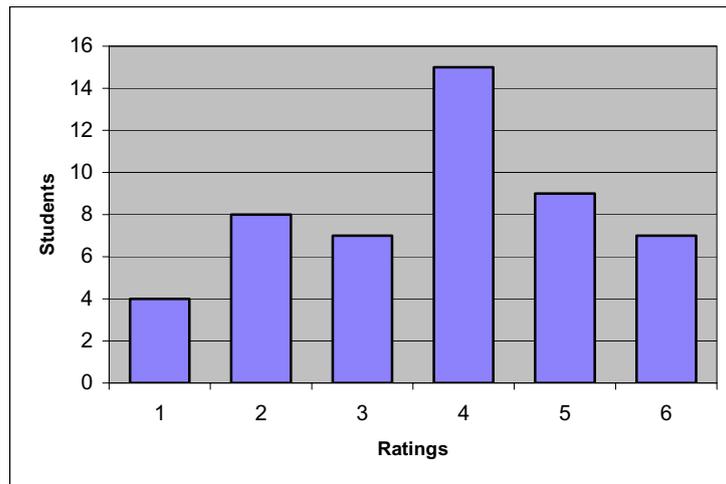


Note. Ratings from 1 = ‘Nothing like it’ to 7 = ‘Very similar’

Figure 4: UE as ‘real-life’ (Topic 1)

When asked what were the best things about UE students responded with statements such as ‘good team of people at UE’; ‘good insight into a PM company’ and ‘lots of information which we eventually needed while working on the assignment’. Typical responses to what were the worst things were ‘not enough information supplied about company’ and ‘lack of description about their employees’ backgrounds’. Improvements suggested were ‘to provide more detail about the organisation’ and ‘provide more interaction’.

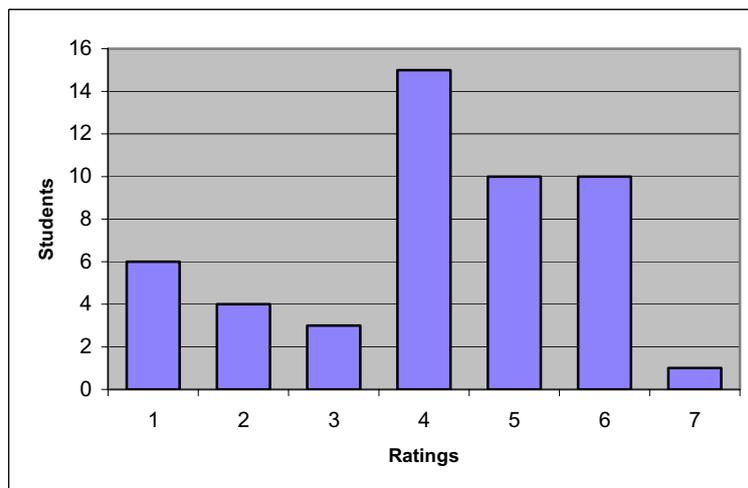
For Topic 3, the responses to the same two questions were still positive as shown in Figures 5 and 6 (Means of 3.8 and 4.1) but not as positive as the responses for Topic 1.



Note. Ratings from 1 = 'Poor' to 7 = 'Excellent'

Figure 5: UE as a learning resource (Topic 3)

One might expect that the level of satisfaction with a new approach might increase as students become more familiar with the environment and what they are expected to do (Dennan, 2000). This was not the case here. The addition of extra features in Topic 3 – the group collaborative workspaces and the interaction with UE employees – caused problems for students and detracted from their satisfaction with UE.



Note. Ratings from 1 = 'Nothing like it' to 7 = 'Very similar'

Figure 6: UE as 'real-life' (Topic 3)

Typical responses to what were the worst things were 'navigation was a problem', 'the ability for other students to subscribe to our group' (in reference to other students who subscribed themselves to other groups and were eavesdropping) and 'hard to keep track of posts in discussions'. The improvements suggested were 'to get the attachment manager working properly', 'have a discussion forum similar to DSO' and 'questions should be posted together, not under people's profiles'. On the whole the discussion forums and the method of uploading resources for others to view were considered difficult to use. The online environment is a socially unfamiliar place and any unfamiliar tool will only enhance the level of dissatisfaction with the environment (Miao et al., 2000).

External factors may have also contributed here. Topic 3 was released to students in Week 9, immediately after completion of Topic 2 where only DSO was used. The tutors reported that students had difficulty adjusting back to the UE environment. Students had not used the UE environment for some four weeks

and were given little time to explore the additional features that UE now had. The assignment for Topic 3 also competed with several other large assignments due in other units in the same week. It should also be noted that the surveys were independent of each other and there is the likelihood that different students responded to each of the surveys.

The two tutors involved with their roles as Pat and Bill really enjoyed their new way of interacting with students. There was no script provided as to how they should conduct themselves but they managed to 'pull off' the roles as UE employees. Indeed no student to our knowledge realised that Pat and Bill were really part of the teaching team. From a practical view having UE employees to answer questions means that different tutors can act out the same role. Indeed, real experts can take on the role from time to time. Pat and Bill were also able to communicate with each other. At one stage Pat asked Bill about calculations for hourly rates in determining costs for the project as it was obvious that students were unsure about how to proceed. This type of scaffolding support is an essential component of problem-based learning.

Discussion with all the teaching staff revealed that many students were frustrated when team members did not contribute or when they left work to the last minute. The response to a question about how much work they did compared with other group members indicated that most students thought they did far more work than the rest of their group (Mean = 4.2). Topic 3 allowed students to allocate different marks to individuals but not many groups availed themselves of the opportunity. Despite the advantages of group work for peer learning, group work tends to be an issue in both face-to-face classes and online.

The teaching team also spoke about the emphasis on 'the task' and the fact that the processes in achieving the tasks were not particularly emphasised or rewarded. Processes such as how well they worked in a team, how information was shared and how critically they analysed each other's work are examples here. A key element in PBL is the reflection that takes place. No real reflection (lessons learned) was taken into account with the assessment for either topic.

Adoption of practices in the final unit

IT Practice was implemented in 2006 as a wholly online unit using the PBL approach described above and United Enterprises as the case study. The feedback from both students and staff through interaction with the prototype in 2005 has been used to guide and develop the new unit. Careful consideration was given to the types of tasks, how they would be delivered in the learning environment and how they would be assessed in a group learning context. In PBL the emphasis is on learners being actively engaged with the learning materials to acquire 'meaningful' learning.

The new unit has five modules, each with a core PBL task to drive the learning and allow for assessment. The assessment for each module is 20% of the unit and there are no formal examinations. Each module has a number of activities that must be completed both individually and as a group, and the final deliverable is usually a team report that requires extensive group discussion and interaction. Assessment takes into account the team submission (product) as well as the contribution of individual members to the team submission. For most modules the assessment includes an element of peer and self assessment.

DSO is the initial entry point for each of the modules. Learning materials (introduction, readings, resources); group activities; and discussion forums facilitated by a tutor, are available here. Students are given a week to complete the DSO tasks. In DSO students are *learners*. The focus of the module, however, is the PBL task which takes place in UE. All information about the task is provided within the UE website and all communication and collaboration takes place within the UE intranet. Employees of UE can be contacted to answer questions. The final submission, usually a team report, is emailed to the UE employee who initiated the task. The task in UE takes about two weeks to complete. While completing the task students are essentially *IT professionals* working on team projects which focus on different aspects of IT practice.

Most of the United Enterprises website has been redesigned and redeveloped by the Knowledge Media Division at Deakin University. Some of the student concerns about the navigation and resourcing in the prototype have been addressed. Due to time constraints it was not possible to create the collaborative workspaces (team forums) within the UE website maintained by the University. These UE team forums

have been created using Drupal, the same open-source software used in creating the prototype. The UE team forums are currently hosted on a School server. Although this arrangement is not ideal, it has provided the teaching staff with more control over access and more flexibility in getting resources up quickly. To the students UE appears as a single website. Students need their login to access UE and a modified password to log in to their UE team forum. The UE team forums have been set up by the teaching team and students no longer subscribe to groups themselves. This reduces the possibility of students eavesdropping (spying) on other team forums.

Conclusions

The prototyping of an online unit to test out a pedagogical approach and a suitable learning context has been a success. It has allowed those responsible for setting up and delivering the final unit to try out an innovative approach and to study how users (students) are likely to react. The use of the prototype has allowed the design of the proposed system to be better defined and has allowed the development to proceed with a better set of requirements.

The teaching team of the new wholly online unit *IT Practice* was more confident that the proposed problem-based learning approach with the United Enterprises website would succeed. The feedback from the first offering of the new unit in 2006 suggests that we are on the right track.

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