# PROBLEM BASED LEARNING FOR ON-CAMPUS AND DISTANCE EDUCATION STUDENTS IN ENGINEERING AND SURVEYING

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## ABSTRACT

*Our University has one of the most diverse student intakes of any Australian university. It offers a suit of integrated programs to both On-Campus and Distance Education students in Engineering and Surveying. The programs cover 2, 3 and 4 year courses in 9 majors. The student profile includes a large intake of mature age students, particularly studying via distance education, international students as well as traditional school leavers.*

*In 2000, the Faculty embarked on a major review and restructure of its programs leading up to its reaccreditation cycle. The review process established that some major changes were required to develop new graduate attributes relating to teamwork, problem solving and life-long learning patterns as required by Engineers Australia. Proposed changes to the programs included the removal of some traditionally taught, content based courses such as physics and statistics. Their place was to betaken by a newly developed strand of 4 integrated courses which used a Problem Based Learning (PBL) methodology.*

*The first offer of the new foundational course took place in Semester 1 2002. It has since been recognised through a number of national and international awards.*

*As far as is known, the offering of this type of course to engineering students at a distance from the campus, working in virtual teams, has never been done before in the world. This course is now delivered to about 400 students annually. Student feedback indicates that the course successfully inculcates new attributes in an engineering graduate such as the ability to work in a team, to communicate, to self-learn, and to solve technical problems. All these attributes have been identified as desirable by professional and industry bodies around the world.*

*This paper gives an overview of the implementation strategy as well as results from a longitudinal study of students progressing through the strand.*

## INTRODUCTION

The University of Southern Queensland (USQ) is a regional university located in south-eastern Queensland, Australia. The main campus is in the city of Toowoomba which lies approximately 130 km west of Brisbane, the capital of the state of Queensland. The university incorporates five faculties – Arts, Education, Business, Science and Engineering and Surveying - and has a total enrolment of over 26,000 students.

The university has an international reputation for providing distance education with approximately 76% of the total number of students studying via distance education. The university also offers online education as well as the traditional face to face courses and programs.

USQ gives opportunities for tertiary education to a broad range of people by providing many alternate entry paths. This has lead to a very diverse student population. In Australia, student demographics have changed dramatically in the last 10 years. Now only 41 percent of university students are the traditional school leavers while 37 percent of students have attendance patterns other than internal full time modes(1,2). This contrasts with USQ where less than 30 percent of students enter university directly from school and only 24 percent are internal full time students(3). (**Figure 1**).

The Faculty of Engineering and Surveying (FoES) is unusual in that it offers 9 majors (agricultural, civil, computing/software, environmental, electrical/electronic, mechanical, mechatronic, surveying (spatial science), GIS) with no departmental subdivisions. Staff have discipline

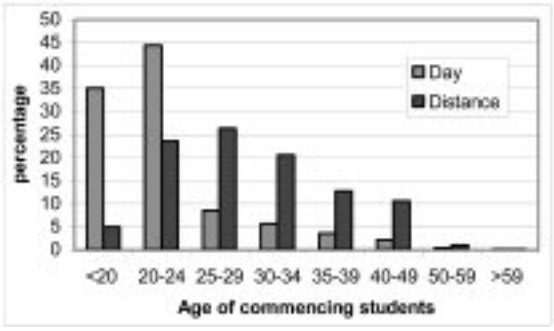


**Figure 1: Commencing student age profiles for USQ engineering programs**

specific knowledge and teach in their discipline areas at higher levels of the course, but the foundational years are taught by all staff, often in multidisciplinary teams.

The faculty has approximately 2,500 students with 76 percent studying via distance education. The diverse background of students in the faculty includes people with trade backgrounds or other tertiary qualifications and many mature age students. This means that a high proportion of students lack the traditionally expected background of maths and physics as prerequisite entry. At the same time some of the students with previous qualifications have gone well beyond the minimum entrance expectations. With all courses offered by distance education, many of our students are already working in the engineering and surveying disciplines. This student population brings a great range of prior knowledge, skills and experience as well as cultural and age differences. In the past, this student diversity has been seen as a disadvantage, but the faculty review suggested that the diversity represented an untapped potential advantage.

The challenge of managing the student diversity is complicated by the different expectations of students in the 3 levels of faculty programs. We offer Associate Degree (2 year full time), Bachelor of Technology (3 year), Bachelor of Engineering and Bachelor of Spatial Science (4 year) programs across all majors previous listed and a number of 5 year double degree programs (e.g. engineering/ business, engineering/ science). Economic constraints have led to the development of a large number of common courses for all programs and majors in foundational years, particularly in first year.

## PROGRAM REQUIREMENTS

Engineering educators are becoming increasingly focused on graduate attributes, driven by the needs of employers for immediately productive professionals and of professional registration bodies for globally comparable graduates. In Australia the professional accreditation body (Engineers Australia) has focused heavily on the development of graduate attributes required in engineering professions. They now nominate a range of attributes and require universities to demonstrate how these attributes are incorporated into the curriculum. This focus on graduate attributes is also supported by other accreditation bodies around the world(4,5,6,7) In short, the main focus of higher education now is on outcomes and not the process.

University policy in Australia at the national level is also concentrating on generic attributes of graduates for quality control reasons. Universities now explicitly list their required graduate attributes including such things as teamwork, communication skills and problem solving(8). Students and employers both appear to support this change. A recent survey of Australian engineering graduates rated ‘contributing positively to team-based projects’ as the most important work skill to be acquired, while ‘technical knowledge’ rated only 29th out of 38 nominated success factors. Thoben and Schwesig(9) expand these attributes, listing working globally in a multicultural environment; working in interdisciplinary, multi-skill teams; sharing of work tasks on a global and around the clock basis; working with digital communication tools; and working in a virtual environment as requirements of engineers and a responsibility of engineering educators. Meeting these requirements presents a large challenge indeed given the current economic climate in higher education and the resistance to educational cultural change in the conservative world of engineering academics.

In this paper we describe how the nature of the challenge was defined by review and then implemented in a revised curriculum as part of the re-accreditation process.

In 2000 the faculty prepared for their regular re-accreditation process by examining the

curriculum to establish how well these graduate attributes and the traditional discipline-specific knowledge were delivered to students. A comprehensive review by the faculty of its courses, curriculum and quality control was able to establish the need for new courses to meet a range of teamwork, communication and life-long learning requirements.

In addition to the requirements of accreditation and our student diversity, the faculty also had other objectives for the accreditation process These included developing an 'engineering mindset' in our students; the effective integration and communication between our distance education students; interaction between programs and majors so students can have a better understanding of the breadth and depth of the engineering professions and staff professional development in educational strategies and theories.

We accepted the argument of Spender and Stewart(10) who proposed that if educational organisations are to survive, they must move from a didactic to a more student-centred approach to learning. This call has been reinforced by current Australian government policies with incentives for universities to improve teaching and leaning within their organisation. Staff promotion pathways are increasingly dualistic, with greater emphasis now being placed on the quantification of 'teaching performance' in ways that mirror the traditional measures of research performance. The concept of a 'good teacher' is being more clearly articulated in university circles. Helping staff to move from the didactic teacher, the 'sage on the stage' to the facilitator, the 'guide on the side' is now an integral part of staff development in the faculty(11).

## IMPLEMENTATION STRATEGY

The Faculty concluded in 2000 that the new requirements for engineering graduates could be met through the introduction of Problem Based Learning (PBL) courses. It found that the didactic teaching of a number of foundational courses was not meeting the needs of our students. The courses could not challenge the better students while helping those who lacked prior subject knowledge. Consultations with industry employers, past graduates and academic specialists indicated that these courses contained little if any knowledge that was essential for a professional engineer. As a result the Faculty substantially changed the content and teaching methodology of one eighth of the 4 year degree program.

| Course | Student cohort – all majors | Team Size |
|---|---|---|
| Research Project | Bachelor of Engineering, Bachelor of Spatial Sciences | 1 (individual) |
| Engineering Problem Solving 4 | Bachelor of Engineering | 3 to 4 students |
| Engineering Problem Solving 3 | Bachelor of Engineering | 3 to 5 students |
| Engineering Problem Solving 2 | Bachelor of Engineering, Bachelor of Spatial Sciences, Bachelor of Technology, Associate Degree | 5 to 7 students |
| Engineering Problem Solving 1 | Bachelor of Engineering, Bachelor of Spatial Sciences, Bachelor of Technology, Associate Degree | 6 to 8 students |

**Table 1: PBL strand of courses**

Four content based courses were removed and replaced by a strand of 4 new courses to be delivered using PBL, with our existing final year research project as a capstone course for our 4 year programs. The new courses were designed to cumulatively develop attributes of teamwork and communication as well as the ability to identify and acquire required content knowledge within contextual engineering problems. They had secondary objectives of introducing students to engineering at an early stage of the program and inspiring them to continue with their studies. The habit and skills of life-long learning were also an objective of the strand.

The four courses in the strand were named Engineering Problem Solving 1, 2, 3 and 4 and were integrated into our suite of programs as shown in **table 1**.

The curriculum and course objectives for these four courses were completed and formal specifications written so that the strand functioned as an integrated unit(12,13).

As students progress through their program the problem complexity and technical difficulty of each problem solving course increases as does the need for student independence and application of research. Teamwork skills are developed in the early courses where the teams themselves provide peer support to the students. Many students find it a revelation that they have significant knowledge and skills from their life experience which help their teams overall task. The appreciation of their peers' skills and the friendships formed through working together are common outcomes of these courses. As student confidence in their ability to learn and research skills grow, the team support is reduced until the student is ready to demonstrate professional level engineering work in his or her final year research project.

The first problem solving course focuses on 'setting the scene'. It introduces students to PBL and has a greater emphasis on teamwork, conflict resolution, problem solving skills, application and sharing of prior knowledge, self learning and reflection, communication skills (both individually and as a team), task allocation and finding and applying appropriate resources.

Students are allocated to a team of the appropriate size, as indicated by **table 1** and assigned a staff member who acts as team facilitator. Resources provided for the teams in these courses include:

- A course web page where problems are released and specific resources are provided or indicated to help address the problem or improve the team operation. They include a Frequently Asked Question (FAQ) section, regular tips and hints from the Examiner and extra resources particular to each problem.
- Communication facilities through a commercial courseware environment (WebCt). This provides email, discussion boards and chat facilities for each team and facilities for electronic submission of final project reports, weekly team reports and individual portfolios. It is also used to gain student feedback through electronic surveys.

| | Project 1 | Project 2 | Project 3 | Project 4 |
|---|---|---|---|---|
| % marks for project report * | 50% | 60% | 70% | 80% |
| % marks for team reflection** | 50% | 40% | 30% | 20% |

* reports also require sections on project planning and research methodology

** reflection includes plan and strategies for improvement in team performance

**Table 2: Sliding scale of marks for team reflection**

- A course resource book that contains general information on all aspects of the course from setting up email accounts and maintaining a computer file structure through to technical information for each of the problems. However the technical information is taken not from traditional engineering or technical texts, but other sources so that students are forced to understand it in the context of their own problem before they can apply it.
- Other people: students are encouraged to seek resources from outside the course e.g. work colleagues, team members etc.

Assessment of the courses varies according to the learning objectives and course specifications. In the first course, there is no examination. Individual marks are determined from the team result of the project report and individual peer and self assessment forms. The four reports account for 75% of the total marks available with the other 25% coming from an individual reflective portfolio. In addition the weighting on 'technical' aspects and a team reflection of the processes changes throughout the course as shown in **table 2**. The team's project report must cover aspects of project planning and management and research methodology. Communication skills are enhanced by a requirement to use different presentation formats including a formal technical report, a technical memo, an informal report and a PowerPoint presentation (with appropriate speakers notes). This is designed to increase the students' communication skills by identifying the audience and writing appropriately.

## ACHIEVEMENTS AND CHALLENGES

The strand of PBL based engineering courses have been progressively introduced since 2001. When the foundational course was first offered it was to our knowledge the first offering of an engineering PBL course to truly distance students working in virtual teams and communicating solely by electronic means, such as discussion boards, email and chat sessions.

There are only a limited number of references on team work organized for distance education students and all these still rely at least in part on face-to face meetings at specified times during the course(14,15,16,17). The cohort of students at USQ studies truly at a distance and there is little or no possibility of face-to-face meetings during the semester. USQ has the fourth largest international education program in the Australian higher education sector, and is the largest off-shore distance education international education program - recruiting from around 50 countries. Its success and support of distance education students has attracted large numbers of students not only from remote locations both nationally and internationally, but allows students who for work, family or personal reasons cannot be present on campus during normal hours. The implementation of team based work was organised with these students in mind. Course delivery for the on-campus cohort is then a comparatively simple exercise as a variation on the external offering.

The work of the staff of the problem solving strand has been recognised with several national and international awards. The strand has won the USQ award for the Design and Delivery of Teaching Materials for two successive courses and the Australasian Association of Engineering Education award for excellence for Curriculum Team Project. The delivery team for the foundational course were finalists in the prestigious Australian Awards for University Teaching (AAUT) in 2005. These awards have recognised the innovative nature of the courses, particularly for distance students, the development of resources for staff and students and the corresponding staff professional development.

Faculty staff are routinely rotated through the problem solving courses and must attend annual staff training sessions on delivering courses in this new engineering educational paradigm. This has resulted in nearly 50% of the faculty academic staff being exposed to cooperative learning techniques(11). It has significantly contributed to changing the culture of teaching within the faculty and even within the university. Staff responsible for training and implementation of the problem solving course have given university wide seminars and workshops on the techniques and strategies employed in the courses.

A perhaps smaller but still significant achievement is that of ‘reflective practice’ now being undertaken by students and in future by staff in the delivery teams. Part of the individual assessment for students requires a reflective portfolio. Students must learn to reflect on the learning that has (or has not) occurred during the course and present reasons, outcomes and implications of their reflections in the portfolio. Reflection is a novel experience for engineering students, and it is necessary to provide guidance on the process and requirements in the initial course. They are guided by a number of activities and a reflective writing guide that are available on the course web page. Where students undertake the reflective exercise properly during the semester the results have been very positive(18,19).

The development of the PBL strand within an engineering course offered to students at a distance from the campus was a novel, even world-first process. A longitudinal study was developed to document the students reception of these courses and their progress in acquiring the required attributes. The survey is ongoing, but results to date indicate that a large portion of the student cohort agrees that their learning, retention of knowledge and appreciation of problem solving and prior knowledge has increased through these courses. Key findings to 2004 include:

- 54% of students thought that the PBL courses had increased their ability to learn, with only 14% unsure of this effect.
- 52% of respondents either agreed or strongly agreed that their confidence in their ability to independently learn new concepts was increased, 22% were undecided.
- 70% of respondents either agreed or

strongly agreed with the proposition that the course had enhanced problem solving skills and made effective use of prior knowledge. Only 15% were unsure of the effect.

- 83% of respondents thought that the courses had enhanced their appreciation of the prior knowledge and skills of their fellow team members. Only 8% had no opinion on this issue and 10% disagreed.

The student portfolios have qualitatively affirmed the results of this survey. Students tend to dislike the extra work required for the course and the need to depend on others in a team situation. Many do however realise how teamwork is now an essential part of the engineering profession and comment on how their skills in this area have been improved. Those with more experience in the university system are also likely to state that their learning experience has been significantly deeper through this course then it has in other traditionally taught courses.

## CONCLUSIONS

The move to PBL was a huge undertaking by the Faculty of Engineering and Surveying at the University of Southern Queensland. It represented a significant cultural change for both students and staff, which has not been made without difficulty. Initially both parties found the change difficult but as problems were overcome, many of the inherent benefits of PBL became more apparent.

Now a large portion of the student cohort agrees that their learning, retention of knowledge and appreciation of problem solving and prior knowledge has increased as in the data below. A longitudinal study of the students is continuing with each offer of the course to document changing student attitudes, their perceptions of their learning progress and confidence in their ability to learn.

It would seem that the strand of Problem based learning engineering courses is achieving its objectives of inculcating teamwork, communication, and life long learning attributes while enabling our students to acquire specific technical knowledge as required for specific projects.

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# ENHANCING PROFESSIONAL SKILLS IN DATABASE DESIGN THROUGH PBL

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**Key words**: problem/project based learning, active learning, tutors, collaborative learning, database.

## ABSTRACT

*The PBL approach was introduced in INSA, an engineering school in 2003. The implications of adopting the approach is illustrated through the example of a database design course. This module, which has been taught three times with slight modifications, is presented and details given on its objectives, content, organization and assessment.*

*During each module, a number of measures were implemented to assess the impact of the method: question directed feed-back sessions, a final anonymous questionnaire and a written report from tutors. The conclusions drawn are validated by teachers and students in a final discussion.*

*PBL results in an improvement of the students' work, both quantitatively and qualitatively. Students feel the method supports in-depth learning, develops autonomy and team work. The results show that the PBL approach improved both the knowledge acquired and professional skills developed.*

## CONTEXT

Over the last few years, teachers at the Institut National des Sciences Appliquées of Toulouse have been examining problems observed to differing degrees depending on year of study or specialization: lack of autonomy and motivation, passivity, cramming for exams, absenteeism especially from lectures. Students were critical of the academic character of the activities proposed (lectures, seminars, practicals), questioning whether they really prepared them for their engineering careers in industry.

To tackle this situation, INSA engaged in Project Based Learning (PBL) with the help of the Université Catholique de Louvain which has been working in this way since 2000(1). This active learning method based on a socioconstructivist approach focalizes on contextualized collaborative learning(2,3).

We present the new PBL module on Database systems implemented three times in 2004 and 2005 with classes of 35 to 53 students over 12 weeks.

## PBL

Project/Problem Based Learning is a student centred approach in which the student assumes increasing responsibility for his learning. The key aspects are(2,3):

- learning through solving a problem;
- learning through group work;
- learning with the guidance of a tutor.

The task of teacher, as project designer and tutor, is to create the necessary conditions to help students learn to learn and be able to monitor and assess their progress(5).

As it is a learning and not an application project, the subject is given to students at the beginning of the module, with no prior teaching. It is designed so that the students assess what they already know and identify what they need to learn to solve the problem. A booklet is given to each student containing a precise definition of the objectives of the course and how they will be assessed. It is important for the students to know exactly what is expected of them, individually and as a group. The project will affect motivation, especially if it is seen to be relevant by the students.

## ORGANISATION

### Objectives

The main objective is the acquisition of knowledge and skills in the discipline, in this case data bases, to which are added methodological objectives related to group work and interpersonal objectives (listening, interacting).

### Subject

The subject can be summed up as: 'You must design and develop a data base to manage appointments at a medical centre'. From the beginning, each group is placed in a real context, in the professional situation of a service company with specifications written in natural language. The subject proposed is said to be semi-open(6), the objective is defined but the students must find the method to achieve it, to understand and apply it. They will thus discover design and validation methods and the tools required to implement a relational data base. The subject expressly gives space for initiative and leads the groups to prospect, study and constructively criticize the methods and concepts they will study.

The openness of the subject is reinforced by the specifications which are in natural language, and therefore ambiguous and incomplete. The students will confront their understanding of the problem and ask the tutor as 'client' to give them the missing elements or to clarify the ambiguities they have identified.

As the subject is perceived by the students as vast and complex, collaboration is seen as vital, thereby reinforcing its efficiency in the learning tasks(3).

Defining the subject in this way provokes both positive interdependence and individual responsibility which are key factors in effective group work(7).

### Groups

To progress, the students work as a group most of the time and must cooperate, confront their individual understanding, put together their ideas and help each other. The group is a lever to enforce individual responsibility.

Given the length of the module (40h) and the type of learning objectives, we chose to make groups of 6 (or 7) students, a smaller group could work without real organization, a larger one could be difficult to organize.

The groups were composed by the teacher who was careful to ensure a good distribution of students (male/female, French/foreign students . . .) The students who had already had some experience of the subject in other establishments formed a separate group to avoid distorting group interaction and the learning process if they were working with 'novices'.

The tutor checks that in each group there is a chairperson and secretary at each session. The tutor always addresses the chairperson first when enquiring about group work. He insists that each member assumes both these roles at some time during the project.

### Sessions

Different types of sessions are clearly defined and organized in the student time-table:

- **group sessions with tutor and group sessions without tutor**. Students work in their group, confront points of view and carry out the work required. The tutor, when present, observes and intervenes (more details will be given later). During the sessions with tutor, two tutors work with 24 students, i.e. 6 groups;
- **question-based lectures**: Instead of lectures presenting notions *before* students work with them, lectures are given *after* student have investigated and started to apply them. At various stages in the course, lectures are organized on the basis of student questions, arising from group discussions. The teacher, in replying to these questions, brings his own knowledge of the field, defines or gives details on notions and methods and puts the studied concepts into perspective; hence the term 'question-based lectures'.

- **practical work**: Students have access to equipment and material (here, computers to access data base servers);
- **individual work sessions**: The student, alone, or with the group, as he wishes, organizes his activities according to his needs (reading, research, exercises . . .) All the sessions, including individual work, are placed on the timetable, generally in blocks of three hours: group work, lecture, practical, depending on the project schedule.

**Teacher's roles**

During this PBL module, the teachers have three functions which are independent of the planning of the sessions:

- **tutor**: he focuses on the group, its work methods, the participation of group members, their understanding of the concepts or methods. The tutor, contrary to students' expectations, does not answer their questions directly, but guides them towards finding the solution themselves. He questions the group and individual members, asking them to justify their approach both from the point of view of the scientific discipline and work methodology. His role is not to transmit knowledge but to encourage the group in its questioning, promote dialogue and guide them in the management of their project.
- **client**: placed in a virtually real situation, students need to meet the client to clarify the ambiguities of the specifications to complete their task satisfactorily. To reinforce the realistic context, the students are required to make appointments with the client and delegate one member of the group who meets the client in a place other than the classroom. The students therefore practise collaborative preparation and giving feedback on the answers obtained.
- **expert**: when a group is not able to arrive at a decision or the solution of the problem, when the tutor feels they are on a wrong path or he must validate a step in the project, the teacher officially assumes the role of expert in the field. He may then answer questions that have blocked them, develop a technical point or question a student or the group to check on knowledge acquisition.

We would like to insist here that a teacher, no matter his age or teaching experience, needs to follow a training course before working with PBL. This opinion is shared by all the teachers who have taken part in a PBL module at INSA over the last three years. We would go as far as saying that regular training is required, not just a one-off course. At INSA, we have set up discussion sessions for tutors to share their experiences. We also organise mutual observations: colleagues observe each other functioning as tutors, to give each other feedback.

**Documentary resources**

Students enjoy a large degree of autonomy and need access to sufficient documentary resources. We opted for making a general, complete data base textbook available for each group. Each student also has the duplicated course documents used on the course before it was PBL and access to internet.

**Detailed objectives**

The detailed objectives set out in the booklet are:

- to know the societal procedures for the creation and use of data bases;
- to know and apply the design principles of a data base;
- to know and apply the design principles of a relational data base, from validation to implementation, using the tool DB2;
- to assess the result in relation to the initial needs, to propose improvements;
- to acquire methods for group work;
- to be critical with regard to one's own behaviour and that of the group;
- to analyze and criticize the adopted approach to the project work.

Each of these objectives is subject to one or several formative and/or certificative assessments.

| Phase | Learning objectives | Deliverables |
|---|---|---|
| Pre-Project | - to understand the order<br>- to discover the process for a simple case | Oral presentation |
| Modeling | - to master the design tools<br>- to model the base<br>- to produce the relational scheme | Modeling & Concept maps |
| Validation | - to understand the validation tools<br>- to validate the design | Validation |
| Realization | - to implement the data base | Base |
| Queries | - to understand the underlying theory<br>- to write SQLqueries | Exercise & Queries |
| Synthesis | - to present the work.<br>- to meet a professional | Oral presentation & Report |

**Table 1: Simplified schedule**

## Schedule

A simplified schedule is given in **table 1**. Each phase of the project leads the group to discover, understand, learn and apply specific concepts and methods.

## Content assessment

The mode of assessment at the end of each step depends on various contextual criteria: nature of the objectives, stage in the project, efficiency, cost. It may take the form of an oral presentation, assessment grid, exercise, intermediate or final report.

Only the final presentation and report (group mark) and the individual final examination (individual mark) are certificative. The two marks have the same weight, emphasizing the fact that, although the result of the group work is important, learning is always an individual action.

For all the assessments, formative or certificative, the mode and criteria are described in detail in the project booklet and therefore known in advance.

Most of the assessments are formative, with the purpose of helping the students position themselves with regard to what they have learnt or accomplished. Several modes have been chosen:

- individual assessment forms, filled in by each member of the group, which are then the basis of group discussion. The aim here is that the explanations exchanged during the discussion will promote individual understanding;
- a concept map is a good tool to express acquired knowledge and spark productive confrontations;
- exercises with their corrections on the website reassure students on their understanding;
- the intermediary presentation allows each group to position itself with regard to the other groups, to note differences, negative and positive points, even to take example from them;
- interventions by the tutor, during the session, through questions addressed to an individual or the group, bring out strong or weak points and guide the group in the process;
- the teacher, in the question-based lectures, redefines the learning frame.

## Assessment of group work

We have chosen a formative assessment of the objectives of the group work methodology and behaviour.

Group work is assessed in the same way twice: at the end of the pre-project (after the intermediary presentation) and at the end of the project. The students fill in an assessment grid individually and the tutor then leads a discussion on the different opinions.

The objective of these assessments is for each group to identify and explain how it is working and to recognize ways in which it can improve and become more efficient. The tutor's role in this case must be non-directive and neutral. Normally, he has already observed the group, detected problem areas and his objective here is to encourage the students to become aware of them. He will act as a mirror for the group so that the

discussion will turn to the tricky areas for which solutions may be found.

The assessment of individual behaviour is done at the end of the project through a self assessment form and individual interview. Here, the role of the tutor is to help the student observe himself.

These assessments are new to students but after the initial surprise, they are quickly accepted and tend to establish a relation of confidence between tutor and students. The remarks made, whether in groups or individually, have always been honest.

**Presentations**

The presentations are an important moment for students who show the results of their work, at an intermediate or final stage, the former being a trial run for the latter.

The first is assessed for its content rather than form which is strictly defined (10 mins per group, 6 transparencies, 2 A5 pages) to avoid unnecessary effort on visual/audio effects and focus on what is essential. The objectives are:

- to analyse critically the project process;
- to present the work done;
- to assess what has been learnt;
- to self-assess group work.

Each group gives its presentation in front of the others, one of which plays the role of assessor and gives feedback at the end of the presentation. It is a question of collaborative, formative, peer assessment with the tutor giving complementary remarks and observations. The presentation is given by three members of the group, drawn just before the start. This is unusual but strengthens positive independence and individual responsibility.

The final presentation is run on the same lines but is longer and the mark is given by the tutor only.

These presentations reinforce group cohesion. They also allow each student to know where he stands either by the presentations or the remarks of the tutor. Class cohesion is also strengthened thanks to the transparency and evident objectivity. The discussions which follow are generally interesting and rich. The students' questions/answers to each other are objective and relevant.

**Individual assessment**

Although the individual assessment was similar to the exam set previously, it is difficult to make objective comparisons. We can, however, say that the quality of the explanations and justifications in students' papers was far better than that of previous exams following the classical teaching method. Students appeared to really want to show what they had learnt through PBL.

**GLOBAL POINT OF VIEW**

The PBL module lasted twelve weeks, the atmosphere was pleasant and no particular problem arose. Student investment was high and all but the two who rejected the method, participated fully.

The difficulties which arose in the first experience were mainly of an operational and logistical nature.

PBL requires rooms equipped for group work: appropriate tables, boards or paperboards for each group, possibly cupboards for group materials. In our case, the rooms were used at other times for classical classes and there was therefore the added burden of reorganizing the space each time.

**EVALUATIONS**

The evaluations of the module and the pedagogical method took different forms:

- at the first assessment of group work, through an informal discussion, the tutor received the general impressions of the students;
- at the final individual examination, an anonymous questionnaire, with 43 questions, was filled in by each student and the results treated by computer;
- the tutors provided a written report of their observations;

- a general session presenting the various elements was organized with the students and INSA colleagues.

**Student evaluation**

The results obtained from the three PBL modules gave virtually the same results. We present here the results of the first one.

The students' evaluation was globally very positive since they replied favourably to the final two questions: 'On the whole, I appreciated the PBL sessions' 85% and 'This experience should be continued' 89%.

The other answers to the questionnaire are given below.

PBL makes it possible to go further than the simple application of concepts (87%), supports in-depth learning (72%) develops autonomy (94%), critical thinking (86%), self-evaluation (67 %) and group work (94%). Group work plays a positive role on participation (81%), distribution of work (72%), efficiency even without a tutor (81%).

During the question-based lectures, students feel more active (74%), more attentive than in traditional lectures (63%).

The drafting of the report allows to clarify ideas (64%), and synthesize knowledge (74%).

Only the questions about the sufficiency of the documentary resources (49% dissatisfied) and the regularity of individual work outside the sessions (47%) are negative.

**Teacher evaluation**

The teachers' evaluation was very positive as they were very satisfied with the module, even if they did note an increase in the workload and requirements for all (students and teachers).

The relationship with students is more open and friendly, PBL offering opportunities for regular, constructive discussion. They were impressed by the work done by the students, both its quantity and quality. Their pleasure was clearly stated : 'it's exciting!'

The ratio of one tutor for two groups is comfortable and it is possible to pass to one for three.

The difficulties pointed out by the tutors were:

- playing the different roles during the sessions, because of lack of time;
- guiding without directing too much;
- managing rejection by students;
- filling in the documents concerning group work.

The project designer also pointed to the large amount of preparation time before the first module.

The question-based lectures are interactive as the students have some difficulty understanding the subject or the method and ask numerous questions. This lecture requires that the teacher masters the subject well to answer the students' questions satisfactorily. As they have invested a great deal in the project and assimilated the concepts, their questions are of a higher level than before PBL.

The greatest difficulty observed by the tutors concerning the groups was time management.

**Evaluation with a professional**

The field of engineering, especially in IT, has two specific characteristics. Firstly, work is organized around projects carried out by structured teams, with specific roles for the different members. Each individual generally works on several projects at the same time, assuming different roles in each one.

Se√condly, the technical and technological know√ledge is incomplete at the beginning of the project, meaning that those involved must learn, as the project progresses, the required knowledge and methods.

We organized at the end of this module a session with a professional. In accordance with PBL principles, each group prepared questions for the engineer who was a former INSA student. The main gist of the numerous questions of the students was 'how do engineers work in industry?', 'does PBL prepare us for the future?'

The reply to the second question was that what brings PBL close to the world of work is project work, group work, time constraints, learning as one goes along. What makes PBL different is the objective. In PBL, it is learning whereas, in industry, it is profit making. Cost management and consequently rigorous time management is essential.

The engineer, through the answers given to the students, clearly validated our approach which aims at a better acquisition of professional skills.

## CONCLUSION

The results of this first experience in PBL at INSA was extremely positive. The objectives regarding responsibilisation and motivation were on the whole achieved. This was confirmed for by a subsequent study(8).

PBL raises the demand level for students and tutors. Both are involved much more actively and this in turn leads to improved quality of work and teacher-student relations. It also affects how participants feel: pleasure or disappointment.

This pedagogical method places the students in a situation requiring social interaction, helping them to integrate into their scientific studies intra- and inter-personal practices that they will implement throughout their career.

With the exception of the question of costs, the context of PBL is very close to that of industry. Through the project, the nature of the subject, collaborative work and the need to acquire new knowledge, it gives students the opportunity to improve their professional skills.

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# EFFECTIVE USE OF WebCT IN A PROBLEM-BASED LEARNING COURSE FOR A DUAL MODE DELIVERY

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## ABSTRACT

*As part of a radical curriculum change, the Faculty of Engineering and Surveying at the University of Southern Queensland (USQ) introduced a strand of four problem-based learning (PBL) courses in 2002(1). While the first of these courses concentrates on building team skills, the second in the strand, Engineering Problem Solving 2 (ENG2102), introduces statistical analysis, basic physics concepts and elements of GIS and mapping as part of the technical content. The annual enrolment in this course is about 250 including over 100 students studying this course externally. One of the important factors to be considered in the design and delivery of such course is to provide an effective e-learning system considering that a significant number of the students study through the distance mode.*

## INTRODUCTION

WebCT is an e-learning system that is being used by several institutions for web-based teaching and learning(2,3,4,5). WebCT (Vista 2) was first implemented at USQ in 2002. Our course was one of the earliest adopters of WebCT as a learning platform at USQ. With improvements to this delivery system over the years, the ENG2102 course is now fully delivered to on-campus and distance students by the WebCT Vista learning management system (LMS). A wide array of WebCT features, such as course material delivery, discussion groups, timed release of problems, self assessments, electronic assignment submission and marking, and student surveys are all used. We consider that WebCT has removed the tyranny of isolation for distance students and enabled them to form successful virtual groups that benefit from the team-based PBL approach. This paper discusses this success and documents student receptiveness to both the LMS and PBL in Engineering.

## HOW DID WE USE WebCT IN ENG2102?

The upgraded version of the Learning Management System (LMS) WebCT Vista 3.0 has several highly useful features that we used in the delivery of ENG2102. The particular features used in the last offer of this course in semester 2, 2005 are discussed in this section. A readily navigatable interface for the course homepage is referred to as the *StudyDesk* and is depicted in **figure 1**. The homepage evolves during the semester, as more icons are added progressively throughout the semester.

### Gaining Familiarity with the LMS and Allocating Students to Teams

Once each student registers on the LMS and completes and submits the introductory short quiz, we use a WebCT facility to allocate them to many small groups or teams. With a diversity of different study programs and sub-disciplines, we ensure that the seven member groups have representatives from each program and major. While we could have utilised the 'survey tool', we opted for the 'quiz tool' to collect student demographic data, and to begin their familiarisation with this LMS tool that is used throughout the course. We considered that this survey offered the opportunity to collect data to discover student's initial impressions and expectations of the course. Since students needed to be rapidly allocated to their individual groups in order to commence their course work, participation rates in the survey were very high and much interesting data was collected.

In a second part of their first assignment, the students were requested to reflect on their learning and team-working skills acquired in the pre-requisite course Engineering Problem Solving 1, and to outline their expectations of projected learning outcomes ENG2102. We chose to have students submit their assignments electronically as a word file

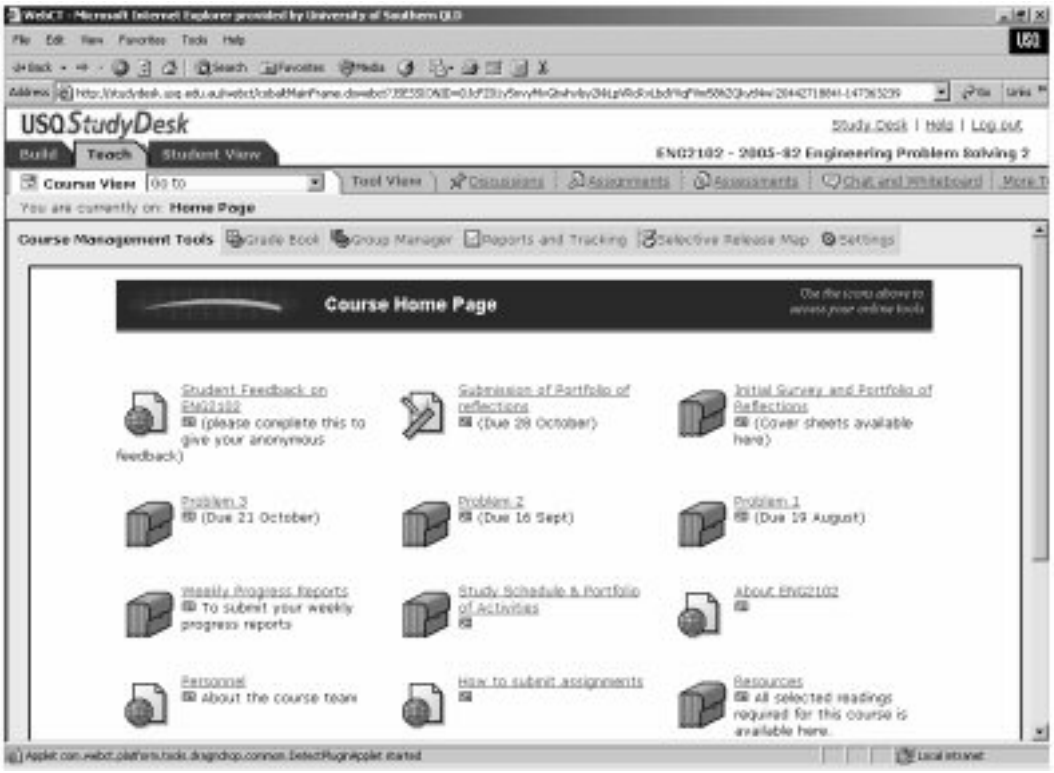



**Figure 1: Layout of course homepage using WebCT**

attachment, through the 'assignments' submission box, thereby using another tool available on WebCT. While this assignment provided much useful information to the team facilitator on the individual team members, it was importantly their first attempt to attach a file in WebCT. We quickly discovered that many students faced problems with attaching files, mainly due to their computer software/hardware limitations or failure to install the Java plug-in properly. Overcoming such issues was important to the students at this early stage of the course, as all future submissions were required to be done electronically using WebCT.

## Delivering the PBL Problem Scenario

While all course content is delivered via WebCT, a small printed course guide outlines important information such as the course specification and information contacts. together with a small resources book with a few selected readings are supplied to students. The PBL course problems are, however, solely delivered by WebCT. Three problems are successively given to the student teams, who focus on each problem for a period of four weeks. A series of 'organizer' icons shown in **figure 1** (terminology used in WebCT for folders) represent all three integrated problems, which are progressively time-released to students. Each problem involves a problem scenario devised by the staff facilitating team in one of the technical content areas. For example the first problem usually revolves around the use of control charts to monitor a production process illustrating basic statistical concepts.

Past course offers have taught us that a starting point for students' problem-solving efforts is essential, particularly for less-experienced school leavers. Therefore, in addition to the problem scenario and relevant data, links to published information or background information sources are provided through these organizers, in place of conventional lectures for students.

## Communication Between Distance and On-campus Team Members

WebCT Vista 3 provides a highly useful 'Discussions' tool for asynchronous interaction between the team members and their

facilitator. A dedicated discussion area for each team was created that was accessible only to their fellow team members. As each problem was released, a restricted discussion area was created for each group to discuss the particular problem and to conduct the team's collective efforts towards solving the problem. While each team had its own secure discussion area, a class-wide discussion area was created and monitored by a team of facilitators (known as 'technical facilitators') who were responsible for the students' progress on problem development. This allowed students and staff to communicate issues relating to a particular problem that needed class-wide discussion. It also functioned as a means of posting some guidance in solving the problem, where required. Such class-wide discussion ensures class equity for all teams and equal treatment by the technical facilitators, who also were responsible for monitoring the general progress of their teams as 'team facilitator'.

Distance students notably regard the flexibility provided by the 'discussions' tool as a highly useful feature, but they also frequently use the synchronous online 'chat' tool when teams need to allocate tasks and make collective decisions within tight timelines. The 'Chat and Whiteboard' tool available on WebCT was made available to every team, in case they preferred to use this, but many teams prefer to use other 'Chat' vendors' products.

**The Problem-solving Process**

The staff team creates and designs three inter-related problems for each semester's offer. A typical second problem involved the transport of hazardous waste through an urban area where students have to select the preferred route using a risk weighting process to take into account schools, shopping centres, traffic lights, roundabouts, etc. The related third problem revolved around buried detection loops for traffic control and their ability to reliably detect motorbikes in a turning lane. For each problem, students were required to research and master the necessary background theory and use it to recommend a satisfactory problem solution.

**The Role of Online quizzes**

The WebCT 'Quiz' tool enables the teaching team to preserve the PBL-based learning approach and at the same time gently provide an indication of the preferred way to solve the set problem. On-line quizzes serve a dual purpose in that they both help to focus student's attention on pertinent technical content areas relevant to each successive problem, as well as provide some measure of their mastery of the underlying course content. Short quizzes for each problem of graded difficulty are highly effective in achieving both tasks. These quizzes were progressively released and made available only till the completion of the relevant problem. As they carry no summative marks for the course, the answers and feedback were made available on quiz completion. Students were strongly encouraged to complete and submit their quizzes, otherwise a small marks penalty was incurred.

**Assignment Submission and Marking**

Electronic assignment submission by groups has greatly assisted the assessment process. Student teams submit their relevant assignment as file attachments to the specific 'Assignment' drop box. Though the report is submitted by a team representative, other team members can check that their team report has been submitted successfully. Individual staff facilitators responsible for marking can mark their section of the report simultaneously, without waiting for the marker's task completion. The marks are then moderated by the examiner to ensure quality assessment outcomes. As each marker annotates the electronic assignment providing feedback to students, this process is normally completed within two weeks of student submission and returned electronically to the student's team or group.

**Self and Peer Assessment**

One of the major challenges in a team based PBL course is evaluating the individual student's performance. While a team consensus seems to work effectively in determining this(5), a further individual self

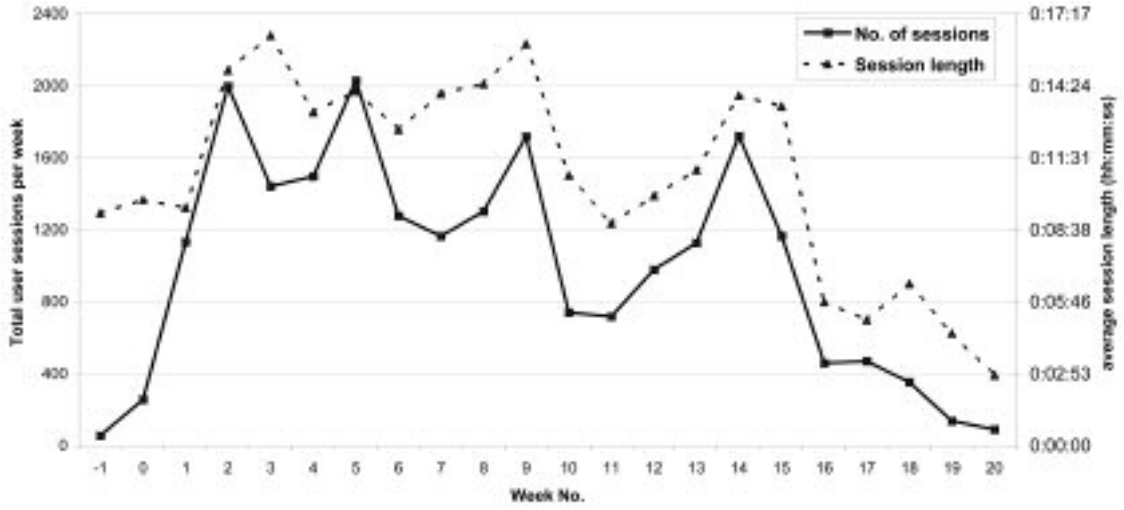



**Figure 2: Weekly usage over the entire semester**

and peer assessment is needed to cross-check its validity. This cross-checking process was employed for each problem and helped to ensure equity between team members.

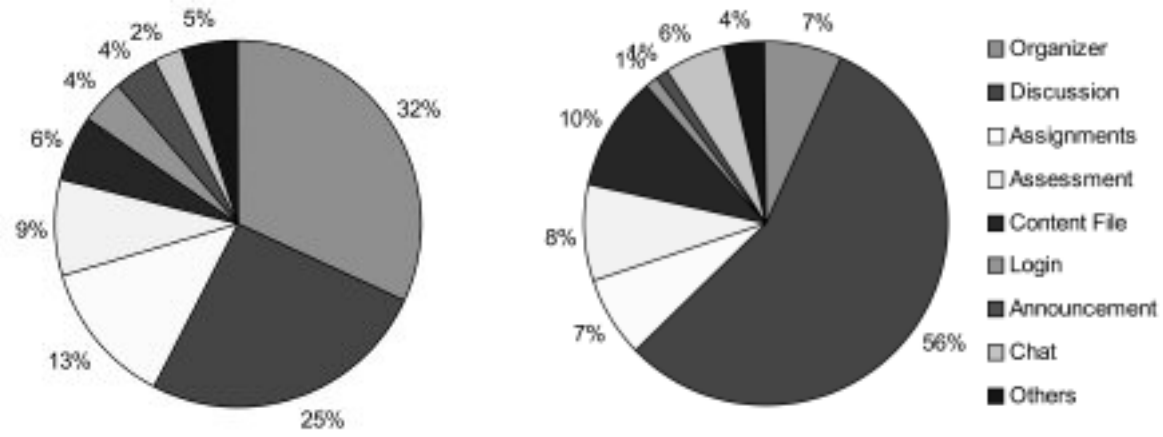
## HOW EFFECTIVE WERE THE TOOLS?

Several features of WebCT were used in the delivery of this course. How did the students use this system and was it effective? We evaluated the effectiveness of this system using the tracking feature of WebCT. **Figure 2** presents the weekly usage of the StudyDesk during the entire semester in terms of the total number of user sessions per week and the average session length. Overall usage has been very high throughout the semester (Week 1-15), with an average of about 1350 sessions per week. This approximates to 190 sessions per day, equating to the number of active students in this course. This means that, on the average, each student logs onto the StudyDesk once a day during the semester.

The initial peak in week 2 reflects the due date of their first assignment (initial survey and reflections), and finalization of team allocation. The other 3 peaks (Weeks 5, 9 and 14) are the weeks when the team problem reports were due. The lowest activity recorded in Weeks 10-11 is the two-week mid semester recess, where most on-campus students go home or external students are required to be on-campus for residential schools. The general downward trend in **figure 2** is attributed to greater student familiarity with the WebCT system. The average user session length followed a similar pattern, except in Weeks 15 and Week 18. These exceptions can be attributed to longer times spent by students submitting their individual reflections and completing other assignment requirements. The release of marks for problem 3 in Week 18 has resulted in the slightly longer session times.

Tool usage over the entire semester is given in **figure 3**, which compares the total number of sessions and the time used for each tool. The 'organizer' tool has been the one most widely used for nearly one third of the total sessions. This was used to deliver the problem scenario and relevant information. Other extensively used tools include the discussions, assessments and assignments tools. It should be noted that the chat tool has not proven very popular making up only, 2% of the total sessions. It is reassuring to note from **figure 3(b)** that although the discussion tool occupies only 25% of the sessions, most students have spent the majority of their time (56%) on discussions. The time usage of assignments, assessments and the organizer are of similar order. Though the number of chat sessions was relatively low, the time spent on chat rises to 6%, as one would expect.

Discussion group usage differs markedly between on-campus and distance student teams in the early part of the semester. Total interactions for the two contrasted teams are compared in **figure 4** against progressive stages of the course. The lower use of this




**(a) Based on number of sessions** **(b) Based on total session time**

**Figure 3: Tools usage over the entire semester**

communication channel by on-campus students is explained by their having alternative face-to-face communication opportunities. Distance students who are for the most part older and more mature rely strongly on discussion groups to work as a virtual team. This finding is in accord with studies on post-graduate students studying on-campus and at distance(6). A secondary trend is the tendency for declining discussion group traffic, as the student cohort progresses from problem 1 to problem 3; evidence of functioning teams. We also note that the on-campus teams have tended to use more online discussions towards the end of the semester, possibly a reflection of less time spent on face-to-face meetings due to other commitments such as preparation for examinations and assignment submissions in other courses.

A high proportion of both on-campus and distance students completed the quizzes even though they carry no summative marks for the course. As seen from **table 1**, all students who attempted the quizzes also submitted the self and peer assessment for the relevant problem. As they were made aware that failure to complete these items could incur a small penalty of their marks, all active students complied.

With regard to assignment submissions, all teams submitted their first assignment by the due date, while only one team submitted late in the 2nd and 3rd problems. We believe that the teams were well aware of the consequences of late submissions and the fact that all details were recorded on WebCT.

## Desirable enhancements of WebCT

While course improvements do not solely depend on enhancements to WebCT, we believe some enhancements in a few tools could be beneficial as part of an integrated LMS. This is particularly needed for distance students who essentially rely on WebCT to function as a virtual team. Finding themselves compelled to seek out alternative chat facilities beyond the designated LMS to communicate between widely dispersed team members, weakens the acceptance of WebCT.

The Chat facility available within WebCT Vista 3 was found to be less serviceable than the discussion group tool described above. Students report that it displays erratic behaviour and stability issues during use by dispersed team members. Invariably these difficulties were surmounted by using alternative Chat facilities provided by Yahoo or Microsoft, etc. This tool

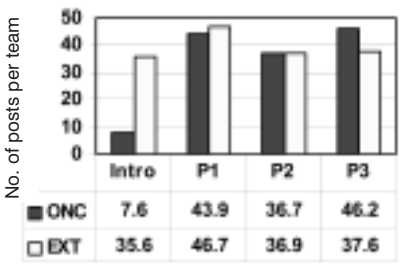



**Figure 4: Discussion usage**

| Problem | Quiz attempts | Peer Assessment |
|---|---|---|
| P1 | 208 | 201 |
| | 205 | |
| | 201 | |
| P2 | 201 | 187 |
| | 192 | |
| P3 | 193 | 191 |

**Note:**
Initial survey was submitted by 209 out of 215 enrolled students using the 'quiz' tool.

**Table 1: Assessment usage**

requires further enhancements before it will gain student acceptance and use.

We have not used WebCT Mail as we rapidly discovered that having large volumes of e-mail addressed to individual facilitators and the examiner was an unmanageable situation for a class cohort of approximately 250 students. A more practical solution proved to be a separate course mailbox that was accessible by all members of the teaching team. In this way, individual team facilitators could process the relevant email while the examiner could assist them where necessary and respond to more specific queries. While some improvement to the Mail tool is desirable, we prefer to use the course mailbox alternative.

## CONCLUDING REMARKS

We endorse the use of WebCT Vista for delivering team-based PBL problem solving courses to engineering students based on the following:

- Very high student participation rates with a wide range of WebCT tools such as discussion groups, quizzes, surveys, and electronic submission.
- Student acceptance has been widespread amongst student cohorts studying in both on-campus and distance modes.
- Enables distance students to hold virtual meetings and duplicate the on-campus PBL experience.

The suggested enhancements to this LMS would substantially improve the design and delivery of team based PBL courses.

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# SUPPORTING THE PROFESSIONAL DEVELOPMENT OF ENGINEERS USING WebCT

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## ABSTRACT

*This paper provides a good practice case study on how professional development of engineers may be facilitated by using virtual learning environments (VLEs) to support teaching. A VLE is just a tool so what really matters is what is taught and how. Curriculum design for professional development requires the matching of the needs of the institution for academic rigour with the requirement to address practical issues pertinent to industry. This may be facilitated by incorporating professional body requirements into module design, as in the Introduction to Project Management at Napier University's School of Engineering.*

*Whether students are nominally full-time and campus-based or part-time and workplace-based, they are increasingly short of time. They tend to focus on high-value activities, and it cannot be guaranteed that they will attend all scheduled classes and/or do the prescribed learning tasks. By designing in frequent, small, formally assessed activities, and using WebCT for their support and as a medium for discussion, it is argued that effective learning may be supported. In addition, the integration and formal assessment of learning skills within module activities can promote development of generic skills for life-long learning.*

## TARGET MARKET AND PROGRAMME STRUCTURE

The BEng Product Manufacture programme was designed for engineers currently working in industry who have a relevant HND and wish to raise their qualifications to ordinary degree level. Students study four core modules, as well as doing a project, and then choose two other modules, depending on whether they wish to specialise in electronics, automation or materials. The programme may be taken over a flexible period, minimum of one year, and teaching happens over all three trimesters in the academic session, with some student choice of the order of modules taken. There is no face to face contact and WebCT Campus Edition is the primary mode of delivery. In this first year of operation the student intake has been from UK and Ireland but the intention is to offer it internationally.

## MODULE DESIGN APPROACH

### Industrial Relevance

*Introduction to Project Management*, one of the core modules, represents a very important topic for engineers, as many will be required to work in multi-disciplinary teams on design and manufacture projects. This module aims to provide and/or augment the student's project management knowledge and skills, so making them more effective team members. A particular aim was to base the module on professional requirements so time was spent at the module development stage in consulting with industry, and the module itself includes the topics on the syllabus for the Association for Project Management's (APM) 'Introductory Certificate in Project Management'(1). While the module is not an APM course, the students are encouraged to think about how they may wish to develop themselves professionally, and activities relating to project management professional bodies and their role are included in the early study units. The University does not arrange external examinations but directs students to the relevant information, should they decide to take these independently and, as Napier is a corporate member of APM, students get a discount on exam fees. One of the APM publications is on the list of essential textbooks, and others are available to students through the University's library; these resources are referred to frequently within the study units.

Two project managers were used as 'visiting on-line lecturers', one from Napier, and one

from an external company, and between them they had a wide variety of project management experience covering defence, information technology and construction industry sectors. They set some exercises during one of the module units and were available for consultation through a 'Project Managers' Forum' discussion board topic.

**Use of Good Practice Guidelines**

In the forward to *BS8426: 2003 A code of practice for e support in e-learning systems* it is recognized that such systems can provide significant benefits in terms of access to learning and flexibility, but that there are issues to address regarding quality and effectiveness of support offered. The code of practice is intended to facilitate development of consistent, effective and transparent frameworks for support to enable learners to achieve their full potential and make e-learning a satisfying experience for all concerned. BS8428 considers e-support under four categories: process, concept, performance and dialogue. Within this module, discussion board topics were set up to reflect these categories and thus keep the interactions focused and organised.

The approach to module design and delivery was also informed by the *Rubric for Online Instruction*, developed by California State University(3) which suggests criteria for baseline, effective and exemplary courses relating to, e.g., the opportunities for interaction, the clarity of the learning objectives and the technical sophistication of the materials. This and the associated *Instruction Design Tips for Online Learning*(4) provide useful guidance for e-learning planning and evaluation.

**Module structure**

The module is taught over a 15-week trimester and comprises an introduction (Unit 0), undertaken prior to the start of the semester, 12 units of study, and the final exam. Unit 0 is an activity-based module introduction, dealing with learning skills and resources. It covers essentials such as WebCT usage and support procedures, the module study guide, and detailed information on the availability and use of study materials, giving students practical tasks to perform, such as posting discussion board messages. This introductory unit is considered crucial in setting expectations and tone, clarifying procedures, thus aiming to reduce or eliminate learner confusion and/or frustration. It draws together and gives some focus for information from other areas of the university, e.g. the library services generally and specifically in relation to distance learners, which may be a very important topic for those returning to education after a period away. It also helps to help create expectations of active, rather than passive learning.

The units follow a simple format and use a standard set of headings, guiding the student through the unit learning outcomes, study requirements (e.g. reading, computer work, workplace investigation), the learning activities arranged within a small number of topic headings, followed by a short summary. Units are typically four or five pages long, as they are mostly activity descriptors and 'pointers' to the content contained in the key textbooks or other resources such as the British Standard Guide to Project Management(5) and professional body publications.

In theory each university module comprises 150 hours learning, with a relatively small proportion of this time being devoted to presentation of materials in lectures and tutorials, and the rest being available for tutor and/or self-directed study. In practice, students on a conventional module often view the contact time as the module learning time, and do not use the remaining hours effectively, therefore limiting their level of achievement. McInnes states '. . . *students are now in a powerful position to shape the undergraduate experience to suit their own timetables, including work and lifestyle priorities. If universities are overly responsive to student work priorities and preferences they run the risk of exacerbating the growing problem of more general disengagement. We need to reconceptualise the student experience as a process of negotiated engagement*'(6). He goes on to say that engagement may be maximized in a number of ways including the setting of clear expectations and standards. Within this module a realistic expectation of the learning time is explicitly communicated,

and this is consistent with the 150 hours stated on the module descriptor.

### Assessment

The intention was to operate educationally sound and efficient assessment which would, at the same time, help prepare students for the appropriate professional body examination, should they wish to take it. Therefore it was felt that the use of a supervised, multiple choice, online examination would best facilitate this. That has required working with the University's Academic Registry to set up and evaluate new examination procedures, including the use of company staff as invigilators so the examination could be taken at the student's workplace.

While using a final examination on its own for summative assessment would be efficient from the academic's point of view, this would not necessarily promote early, consistent and effective engagement with the module materials, and this is necessary to prevent dropouts and optimise the outcome for the student. It was decided that the exam should account for 60% of the final mark, with the other 40% being awarded for unit activities done throughout the module. So, as most of the unit activities are formally assessed and count towards the final mark, students get a tangible reward for their efforts and effective learning is facilitated by a consistent level of engagement.

Some unit activities require short responses such as a discussion board posting, and this technique is used particularly when the intention is to facilitate students sharing information and learning from each other. Sometimes a Word or other type of file needs to be submitted through the 'assignments' tool on WebCT, and other activities may be web-based searches with the result being seen within a subsequent submission, e.g. finding out about academic referencing practice and then using this in an assignment. File naming instructions are explicitly given for each activity, which facilitates efficient data management and also the use of Turnitin(7) a software application for the detection of matching text and therefore a means to help deter and detect plagiarism.

Many of the unit activities require students to research project management methods used in their own organisations. This consideration of theory alongside practice reinforces relevance and also helps foster critical evaluation skills.

### Learning Skills

Learning resources and methods of dealing with information have changed, with students now having many more electronic sources to choose from via the Web. The module has sought to utilise this positively by incorporating professional body websites, electronic journals and web-based case studies into module activities, and making good use of University learning centre resources, including study skills support information. This easy and flexible access to a wealth of electronic resources illustrates 'affordances' of IT-based learning, i.e. the properties of IT that enable particular approaches to learning(8).

## MODULE DEVELOPMENT RESOURCES

### People

It is estimated that the time spent in total by the module leader to complete all tasks related to the production of the units was around 240 hours, with significant time being given by educational development advisors and the school administrator on top of this. Module delivery time, including dialogue, assessment and trouble-shooting, was also required in addition to development time.

School administrative staff have been very involved in the technical aspects of WebCT since the School of Engineering pioneered the 'WebCT minimum presence' in the University, i.e. creation of a WebCT site for each module and programme. Correspondingly, the programme administrator, with assistance from educational development advisors, has been central to development of the BEng Product Manufacture, performing such tasks as creating the WebCT template for all programme's modules, generating module guides, and converting Word documents into web format. She is therefore a key member of the programme team and has a particular role

in achieving appropriate standardisation across modules. Also, it is important to direct distance learners to the best place for advice and sometimes they need to talk to a well-informed administrator, or a member of the University's IT support staff, not to an academic.

**Teaching Materials**

Little time was available so rapid development was a priority. Using existing published materials was part of a time-saving strategy, as well as a decision made on principle, so effort was focused early on towards finding suitable textbooks, which were reasonably priced, and had supporting electronic resources. E-books were also investigated though these did not provide a solution in this particular case. American publishers supply books with extensive supporting electronic materials including, in some cases, WebCT sites, but British publishers, by and large, were found not to be good in this respect, so a combination of resources was assembled to give the right content and tone for the module, including one (US) book which included electronic quizzes, case studies and outline solutions to discussion questions, as well as project management software.

**EVALUATION**

The students' industrial base is very important, especially in relation to some of the activities as currently written, and the module would not therefore translate easily to a situation where learners were not in relevant employment. Levels of motivation are generally high among part-time students, and this has been evident here, with the vast majority of assessments delivered on time and to an appropriate standard. For staff, working with this type of student is very rewarding.

There have been a few technical problems, though these were resolved quickly. Where VLE system problems occur at the module start this adversely affects University image and reduces student confidence, and at the end has potential to cause difficulties with security of assessment data.

The assessment approach, particularly scalability, has been evaluated, with adjust-ments proposed to combine each unit's individual activities into the smallest number of separate files possible, thereby reducing file download times from the VLE. Fewer files would also make submissions to Turnitin more efficient, and in future direct access to this facility from WebCT Vista may also help(9).

Students were asked for their feedback during Week 5 of the module, again just before the examination, and finally once formal assessment was completed. The process was facilitated by WebCT surveys which were developed using Respondus(10), a software application which allows text files to be imported, formatted, previewed and then exported to single or multiple WebCT sites. This was much easier than creating the surveys directly in WebCT.

The questions explored issues such as the pace of teaching and learning, the methods of assessment, company support for their studies, perceptions of the social aspects of the learning process, the VLE tool and its use, and their attitudes to professional devel-opment. Although the small cohort size limits analysis possibilities, student responses indicated the following key points:

- Students felt that their theoretical knowledge of project management was enhanced and that this would complement their practical work in project teams. They and their companies thought that industrial relevance of learning material was either very important (majority) or important.
- The students now have a better understanding of how their organisations operate, especially in relation to project management procedures.
- Students have developed their general learning skills through engaging in module activities.
- Companies were mainly very supportive, providing time off to study, full funding (with one exception), and access to company staff for module activities.
- Students expressed an interest in gaining professional qualifications and two of the three joined APM during or shortly after the end of the module teaching.

- While they said that the pace was demanding, the students found the structure of the activities and assessments helpful in maintaining a consistent effort throughout the module and keeping on track.
- Two of the students said that they experienced a sense of community through online study but one felt that face to face contact was needed to properly develop social aspects, although the lack of that didn't adversely affect him. All students said they found the discussion tool helpful in feeling connected to others and learning from them.

In addition to module feedback, the University uses an independent evaluation expert to gauge student and staff responses to WebCT and this has found that '. . . *overall student feedback is positive. Students like the accessibility features of WebCT – when and where they want it. Students also described many examples of WebCT as an aid to learning*'(11). Although it is must be remembered that only a proportion of modules are on WebCT, the results are encouraging and indicate demand for the tool from students. This is more strongly reflected in the 2006 evaluation of the pilot of the new version of WebCT, Vista, where improved tools offer benefits to staff and students(12).

## CONCLUSIONS AND FURTHER WORK

Flexible learning is still seen by some managers as a means to free staff up for other activities by reducing their contact time with students. It is suggested that support requirements for development and delivery of high-quality online learning are not well understood and must be addressed in terms of guidance given to managers on e-learning timescales and resources.

More needs to be done on incorporation of existing good practice guidelines into module design and delivery. Work emerging from the Joint Information Systems Committee (JISC) and other projects will provide valuable information and perhaps institutions need to develop more effective ways to access and share external and internal knowledge. Learning from the good practice (and mistakes) of others will save time and money and facilitate better outcomes for managers, academics and students.

Often content creation diverts attention away from *teaching*, i.e. helping students to see the relevant points, practice sufficiently and reach an appropriate standard of proficiency. It is recommended that more use is made of existing published materials and that e-learning development is focused on pedagogy and appropriate use of IT tools to support researching, analysis, collaborating and testing of knowledge and skills.

Much needs to be done regarding focused and appropriate staff development for e-learning. Educational development specialists can keep academics abreast of the educational and technical developments in relation to online learning and perhaps it is particularly helpful when this is communicated through an online programme, such as Napier's *Introduction to Online Learning*, as this illustrates many of the issues from a student perspective as well as effectively showing the staff member where their own strengths and weaknesses lie(13). Development of these skills takes time and in all of this the issue of support and rewards for staff should not be forgotten(14). It is also suggested that better teamwork between academics, administrators, educational development specialists and IT service providers would use time and talents more effectively and produce a more satisfactory result, while helping promote good practices across the institution.

The experience of teaching this module this module is that VLE technology may be effectively used to create a framework for learning which promotes and rewards engagement and supports the professional development of engineers. In the next academic session the module will be migrated to WebCT Vista and further work will be done to refine the approach and update the materials, applying lessons learnt from the University's participation in the JISC project 'Transforming and Enhancing the Student Experience through Pedagogy' (TESEP)(15). As part of this, small-scale research work will be conducted to examine attitudes, competencies

and aspirations of student groups whose modules will be changing to a similar pattern of learning activities in the next session. It is hoped that this will help determine student views on the study frameworks, learner control, rewards for consistent performance, collaborative methods of working and use of technology to support learning.

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