# Responding To Changing Demands In Engineering Education – PBL For Distance And On-campus Students

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**Abstract**
In 2002 the Faculty of Engineering and Surveying at the University of Southern Queensland (USQ) Australia introduced the first of four problem based learning courses into its programs. This was in response to changing requirements of both the university and professional accreditation bodies to address the graduate attributes of teamwork, problem solving, communication, and independent and life long learning skills within the faculty's programs.
This case study describes the methodology and implementation of the first of these courses and gives results from a longitudinal study that assesses student perceptions and results.

**Background**
The University of Southern Queensland (USQ) is a regional university and has acquired international recognition as a leader in providing flexible study options for students. It offers on-campus, off-campus (external), and on-line modes of delivery.

The Faculty of Engineering and Surveying has approximately 2700 students in 3 undergraduate programs across 9 majors. The majority of students study externally with only 24% of all students enrolled in the on-campus mode. 29% of the total student population are international students studying either offshore (22.5%) or on campus (6.5%). Programs offered by the faculty are Associate Degree (2 years), Bachelor of Technology (3 years) and Bachelor of Engineering or Surveying (4 years). All programs are fully articulated and fully accredited by the appropriate professional body.

USQ has a unique student profile. It has large numbers of mature age students who combine study at a distance with full time work. Students have a diverse educational background often without the normal prerequisite subjects required for engineering studies but with a range of both professional and life skills. USQ also has large numbers of international students. The introduction of PBL courses was seen as one method of using this diversity of educational, age and cultural backgrounds to advantage particularly in the core courses that all students, regardless of their program or major, must undertake.

In addition to the diverse student profile and multiple entry pathways to tertiary education, engineering educators must now respond to the demand of employers and professional accreditation bodies that are focusing on the demonstration of 'graduate attributes'.

In 2002 the faculty introduced the first of 4 problem based learning courses. The first course is described here. It is a core course to all commencing students in the faculty, regardless of program or major.

**Methodology**
The faculty has 2 distinct cohorts of students - day and external (distance) students. The academic in charge of the course forms teams of 8 students and each team has a mixture of students from each program and major. Each team is allocated a USQ facilitator and each facilitator would normally have 4 to 6 teams to facilitate. Teams have 4 projects to complete over the course of the semester (13 teaching weeks) and leadership within the team rotates with each project.

On campus students have 7 common hours on the timetable to enable students to organise their own team meetings without timetable clashes. Teams have weekly 'workshops' of one-hour duration with their facilitator allowing general concepts such as teamwork, conflict resolution, problem solving and running effective meetings etc to be discussed in a large group setting. Individual teams must then set their own meeting times and agendas. A weekly report detailing team progress and problems is presented to the facilitator in the weekly meeting with the 'project team leaders'.

External (distance) student teams are virtual teams with members from across Australia and the world. These teams cannot meet fact to face. They correspond, problem solve, allocate tasks and collate a final report on each of the 4 projects via electronic communication e.g. email, chat rooms and discussion boards. Weekly reports and interaction with their facilitator are conducted via email.

A course mail box was established and all student queries, especially those of a 'technical' nature are submitted to it. Monitoring student questions allowed a FAQ link on the course home page to be regularly updated with common questions and consistent responses. All teams were therefore receiving the same guidance and information.

Students are assessed on four team projects and the team project mark is modified to an individual mark based on peer and self-assessment reports. This constitutes 75% of the total mark for the course with the final 25% from an individual reflective portfolio.

**Issues**
Significant barriers are staff and student attitude, appropriate and adequate resources (both physical and financial), effective facilitation (particularly for external teams) and monitoring individual student learning and participation.

Staff and student attitudes are gradually changing with time. Early problems with the course are being corrected and this in turn is increasing student satisfaction. Staff training programs are being developed.

Students had significant difficulties with the reflective writing tasks, and similarly staff had difficulty in guiding and assessing these tasks. A Reflective Writing Guide for students and a parallel guide for staff were developed along with assessment rubrics. With the improvement of reflective writing from the students, staff began to realise the benefit of these tasks. In future offerings, staff will be required to undertake their own reflective writing tasks.

Communication technology is also a significant problem for some distance students, particularly those in remote areas where Internet connections are unreliable and slow.

**Benefits**
Outcomes for students include increased confidence in their ability to learn and apply technical knowledge; social aspects – mixing of students from across the faculty and the ability of external student to meet and work with other students; recognition of prior knowledge and experience; and peer and self assisted learning.

**Evidence of Success**
Analysis of portfolios revealed approximately 92% of students viewed the course favourably despite difficulties in communication via email and low motivation and participation of some team members. A longitudinal study shows 31% of students disagreed with the statement that the course "increased my ability to learn"; 25% *disagreed* with "confidence in my ability to learn increased"; 43% of students believed that the retention of knowledge was as good or better than traditional lecture based courses, with nearly one quarter of the students (23%) having no opinion on this option.

"*This course had challenged my ideas of learning, and through the application of problem based learning [the course] has taught me what no other subject has before… As such I feel confident in my basic knowledge of all the areas covered in this course, and I am confident in my ability to learn what I don't already understand*" – quote from a student portfolio.

**Reflections**
Staff training and attitudes are critical to the success of the course. There is often a direct relationship between teams that have teamwork difficulties, very critical reflective portfolios and facilitators who are not supportive of the methodology.

External students often choose this delivery for its flexibility. Teamwork and the reliance on others removes some flexibility of the students to study when it is convenient for them. On the positive side, it can help students set up and maintain a study schedule that carries over to other independent courses of study.

**Previous Publications**
**Brodie, L.M.** & Porter, M.A. (2004) *Experience in Engineering Problem Solving for On-campus and Distance Education Students,* Australasian Association of Engineering Educators Conference, University of Southern Queensland, Toowoomba, Australia, September 2004 p318-323

**Brodie, L.M.** (2004) *Reflective Writing By Distance Education Students In An Engineering Problem Based Learning Course.* 5th Asia Pacific Conference on Problem Based Learning - Pursuit of Excellence in Education, Petaling Jaya, Malaysia, 15-17 March, 2004

**Brodie, L.M.** & Porter, M.A. (2004) *Design, Implementation and Evaluation: an entry level Engineering Problem Solving course for oncampus and distance education students,* 5th Asia Pacific Conference on Problem Based Learning - Pursuit of Excellence in Education, Petaling Jaya, Malaysia, 15-17 March, 2004

**Brodie, L.M.** & Porter, M.A. (2001) *Delivering Problem Based Learning courses to engineers in on-campus and distance education modes,* 3rd Asia Pacific Conference on Problem Based Learning, Yeppoon, 9-12 Dec.

Porter, M.A. & **Brodie, L.M**. (2001) *Challenging tradition: Incorporating PBL in Engineering courses at USQ,* 3rd Asia Pacific Conference on Problem Based Learning, Yeppoon, 9-12 Dec.