

Developing professional practice skills through reflection on experience

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***Abstract:** The Bachelor of Engineering program at Central Queensland University, has evolved through a number of innovations over 15 years into the unique dual award program of the Bachelor of Engineering (Co-op)/Diploma of Professional Practice. This program is unique in that it includes co-operative education, Project Based Learning (PBL) (in on campus and external modes) and an explicit development of professional practice skills through the Diploma of Professional Practice.*

This development started in 1994 with the introduction of co-operative education, giving the students two placements of six months each during their study. To help prepare students to be junior professionals at the end of their second year of study, a PBL philosophy, with a partially inverted curriculum was introduced in 1998. Recognition that learning from the workplacements would need to be made explicit was addressed by the introduction of the Diploma of Professional Practice in 2004. All the courses in the Diploma are based on reflective practice, and are aimed at developing professional practice skills that are an outcome of the work placements

The combined program is designed around the triple themes of intellectual, social and professional development. The result is that students are able to articulate their learning, and recognise their strengths and weaknesses in these areas at any stage in their program of study.

Program History

Central Queensland University (CQU), in Australia, introduced Co-operative Education into its Bachelor of Engineering program in 1994. The initial introduction was made without any other substantial curriculum changes. The only real pedagogical change was the introduction of distance education to deliver two courses whilst students were on their work placements. The co-operative education component consisted of two nominal six months work placements, one at the beginning of third year and the other in the second half of fourth year.

As could be expected, the introduction of Co-operative Education as discussed in Jorgensen & Howard (2005) achieved only part of the aim of better preparing students for the engineering work place of the 21st century. The faculty at the time of approving the program, recognised that a complete review of the program would be required to develop the professional of the future. Engineering graduates, to be properly prepared for the workplace still required generic skills, such as problem solving, creativity, communication and teamwork.

Faculty Review

A number of the issues relating to the old program are identified in Jorgensen & Howard (2005). A summary of those issues is:

- Program overloaded with technical content (as technology changed, material was simply added to the program, with very little being removed)
- Students were overloaded with excessive class contact hours (29 hours per week in first year)

- High student attrition rates (up to 50% attrition from first year)
- Repeat teaching (surface learning resulted in material being forgotten as soon as the course was passed, and consequently material had to be re-taught when it was next needed)
- Students were not properly learning or integrating material

During the review process it became clear that the traditional CQU (and generally Australian) engineering curricula no longer adequately prepared graduates for professional life. The curricula were still heavily analytical, even though technology had automated many analytical tasks. Self-learning and sustained learning was not strongly encouraged, even though it was an obvious strategy for coping with rapid technological advances.

The Faculty identified the international best practices in engineering education. This process highlighted fundamental problems with the traditional program structures. These included:

- the promotion of rote or surface learning by excessive course workloads and a reliance on closed book examinations
- the development of a fragmented knowledge base in traditional course units; students find it extremely difficult to integrate knowledge in a design environment, and have poor problem solving skills
- very poor understanding of professional attitudes and values amongst students.

Problem-centred or project-based curricula were identified as providing the best solution. They provide an environment which reflects the professional workplace and a meaningful context in which the fundamentals of technology and design can be studied. The bulk of the international education literature had for at least twenty years, agreed that project-based learning had the following advantages:

- it takes account of the way in which students learn, the learning style is active, deep and contextual
- enormous improvements in student motivation have occurred elsewhere; first year attrition rates can be as low as a few percent
- it develops a high level of generic and self learning skills
- it supports the integrated view that most engineers have of their profession
- project-based learning produces highly valued engineers in the industrial setting

The outcome of the review proposed significant curriculum and pedagogical changes. While the review was driven by a desire to produce the best program, it was also a necessary response to significant social changes. These included a shift away from mathematics and sciences in high school education, the move to mass education and the automation of many analytical tasks in the engineering workplace. On a national level it had become clear that engineering curricula must evolve to remain relevant (JGFE 1997).

The outcome of the faculty review conducted in 1995/6 was the development in 1997 of a Project Based Learning philosophy to complement and enhance the co-operative education model already in place. The PBL/Co-operative education Bachelor of Engineering program commenced operation in 1998.

Professional Practice - Philosophy and implementation

Since the inception of the BEng(Co-op) program by the faculty graduates had demonstrated good professional practice skills. These had resulted from professional practice skills training, delivered by the faculty, and the opportunity to work in industry where they can use and develop these skills. Upon their return to the academic environment, they were encouraged through reporting requirements for their work placement, to reflect upon how those issues had impacted their placement. These learning opportunities however were not formally recognised by the university (except in the assessment of the work placement report) and was not credited towards their degree. This lack of recognition and credit was the motivation for the development of a Professional Practice program. This program replaces and extends material that was provided in the Work Placement courses of the Engineering Co-op Program.

The Diploma of Professional Practice, integrated with the PBL Bachelor of Engineering (Co-operative Education), aims to explicitly equip graduates with the knowledge, skills and attributes needed in professional practice and for professional leadership. As outlined in JGFEPS (2004) the combined program is designed around the triple themes of intellectual, social and professional development.

A feature of the professional practice program is its incorporation with the periods of work placement in a professional environment that provides the opportunity to learn and put into practice, professional practice skills. The existing work placements were highly regarded by employers, and this program now provides students with the training and education to maximise the learning occurring in the professional environment. The program is structured with internal courses delivered before and after work placement periods to provide necessary preparation and review of skills, which will be put into practice in the work place. They also require reflection on the learning.

The new program separates the professional development components previously combined with the BEng(Co-op) work placement courses and presents them in an explicit program. This explicit program provides students with due recognition of their professional practice skills. This program is now integrated with the BEng(Co-op) program to form a dual award program known as Bachelor of Engineering (Co-op)/Diploma of Professional Practice (BEng(Co-op)/DipProfPrac(Eng)). With the introduction of this dual award, the BEng(Co-op) is no longer offered as a stand alone program.

Dual Award Structure

In 2004, the dual award was introduced at CQU. Students already enrolled in the co-operative education program were offered the opportunity to transfer to the dual award. Consequently the first graduates from the program graduated in mid 2007. Since 2004, only the dual award option of the co-operative education program has been offered. The dual award structure is shown in Table 1 below.

Table 1 Dual Award Structure

Year	Term 1	Term 2
1	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points)	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points)
2	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points)	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points) Professional Practice Preparation 1 (6 credit points)
3	Work Placement External Course (6 credit points)	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points) Professional Practice Review 1 (6 credit points)
4	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points) Professional Practice Preparation 2 (6 credit points)	Work Placement External Course (6 credit points)
5	PBL course (12 credit points) LBL course (6 credit points) LBL course (6 credit points) Professional Practice Review 2 (6 credit points)	Graduation

The Courses

Professional Practice Preparation 1 (PPP1) is designed to prepare the second year students for their first work placement. These students have 2 years of technical study, but need to be “work ready”. The faculty recognized that if the students are in the workplace for only six – eight months, then they need to be of value to the employer from the start. In the same way that the technical study had been specifically chosen to ensure that they were capable of performing worthwhile engineering work, the professional practice course was designed to ensure that they were not lost in a professional environment. The course covers:

- Resume and letter writing skills
- Responding to selection criteria
- Interview techniques
- The transition from study to work
- Employment contracts and conditions
- Identifying the industry and types of employer they hope to be involved with as an engineering practitioner
- How to evaluate their own work in terms of the Engineers Australia National Competencies
- Critical engineering workplace issues including ethics, codes of conduct and OHS.

Additionally the students attend the presentations given by the third year students who have just returned from their work placement. These presentations allow the students to hear what the actual placements were like. What the students gained from the experience? What were the conditions? What were the issues?

Professional Practice Review 1 (PPR1) is designed to have the students reflect on their first placement. They must describe their company, their department and their employment conditions. They must also give a description of the work that they did, what projects they were involved in and how the work was achieved. They are asked to reflect on their competence in the position. They must then reflect upon what was achieved by the work, and identify what contribution they made to the company, and the significance and value of the experience to themselves, as well as any specific learnings. They must do a self evaluation of their personal growth in the areas of intellectual, social and professional growth. This is not just identifying their growth, but articulating the change in themselves that demonstrates that the growth has occurred. Finally they must articulate and analyse the workplace issues that they had to deal with.

As part of demonstrating that they are addressing professional growth, they are asked to write a career episode report. This is a document that will form part of their engineering practice portfolio for application to become a Chartered Professional Engineer (CPEng).

Professional Practice Preparation 2 (PPP2) is taken by the fourth year students, preparing them for their second work placement, and follows on from PPP1. It has the students investigate:

- Their skills and attributes
- Professional responsibility
- Career exploration
- Career management
- Further interview skills
- Further review of Engineers Australia National Competencies for CPEng

Once again the students attend the presentations by the fifth year students returning from their second work placement.

Professional Practice Review 2 (PPR2) follows the same format as PPR1. The students reflect on their work placement and present their reflections to the class. This sharing of reflections allows the students to compare their experiences and identify common issues and share solutions that they have developed to those issues. Additionally they are asked to reflect on their career planning process, and to evaluate their ability to function in their chosen career.

Work Placement courses consist of a formal course structure to match the work experience period. Each work experience consists of a nominal 26 weeks duration. Assessment limited to weekly activity and reflection journals and self-established job objectives.

This program is similar to one currently offered at the University of Technology, Sydney (UTS), called a Diploma of Engineering Practice. (University of Technology, Sydney, 2005). This means there are now two engineering faculties in Australia offering a dual awards incorporating co-operative education and professional practice. This is evidence that there is an increasing perception amongst industry and educators that the professional practice skills require explicit development and recognition.

Graduates of this dual award program will have demonstrated the knowledge, skills and attitudes needed for professional engineering practice and leadership. This encompasses academic knowledge and skills with engineering discipline theory, technical expertise, personal development and professional formation. In particular this program enables specific and measurable development of professional engineering practice skills, employment readiness, social awareness and lifelong learning attributes (JGFEPS 2004b)

Conclusion

While it is well recognised that co-operative education is capable of informing and enhancing the development of a graduate's generic skills, without the explicit reflection on the experience, learning can be limited. CQU, by incorporating and integrating project based learning enables integration of the professional and technical knowledge and skills. By then further incorporating and integrating explicit professional practice skills development, they encourage and enable a significant integration, broadening, deepening, retention and internalisation of professional, generic and technical knowledge, skills and attitudes. This is through identifiable preparation for, application in, and considered reflection of, learning experiences.

CQU, through the development of an integrated Bachelor of Engineering program, incorporating project based learning, co-operative education and explicit development of professional practice skills, has created a program that they believe to be unique in the world. The uniqueness incorporates both the delivery and the interpretation and combination of these learning paradigms. It has taken fourteen years of development within the university to reach this stage with parallel developments nationally and internationally informing and shaping its structure.

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