

# **CULTURE SHOCK IN ENGINEERING EDUCATION**

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## **Abstract**

This paper outlines the evolution of a new core unit into a first year engineering curriculum. This unit was born in response to both societal and professional/industry pressure for a cultural change in engineering education; a change which is intended to extend through the profession.

Professional Studies 1 offers the foundations for this cultural change. It is designed to help students identify and develop skills that will be further developed through the undergraduate program. It covers a wide range of core components surrounding professionalism. Formal lectures provide the knowledge base for this unit. Lecture content is supported by tutorial and practical sessions. A reflective journal with weekly entries is maintained through the semester and assessed. A team project selected by the students was designed to crystallise concepts and demonstrate learning.

The approach to teaching and learning in the unit supports current research findings and trends in delivery and assessment. Pedagogically, the unit is sound. Professional Studies 1 developed the character of an earthquake and shock- waves were felt through the semester and at a unit evaluation meeting. The reality involving coordination, timetabling, delivery, learning and assessment have become clear and huge chasms are developing in all other units in the engineering curriculum.

In summary, much of the unit comprises humanities content in what is otherwise a purely scientific and technical engineering degree. The reality and implications associated with cultural change in engineering education is finally filtering through to Engineering Course Coordinators and Faculty management. The reality has caught up with the rhetoric. To develop personal and professional values, attitudes and behaviours takes time. Faculty management and students are still in 'culture shock'.

## Introduction

The need to work together as one large global community is becoming essential for our continued existence on this planet. The last two decades have seen atrocities in war as well as catastrophic weather and geological events. More locally, those who are fortunate enough to secure work are working harder and longer hours; and many are becoming angrier and sick.

In response to this our nations provide aid in the form of food, human resources and money to those communities experiencing these tragedies. Many are beginning to seek 'alternative' answers to happiness. However, the way in which we respond to stress and trauma is individual; and the culture in which we were raised or live, significantly influences how we 'make sense' of our world.

If we are to maintain any quality of life for our children and future generations; we have a responsibility to raise 'cultural awareness'.

Engineering is a creative enterprise, considered to be both a science and an art. A science, in that it involves the application of scientific and mathematical principles to solving a wide range of practical human problems. An art, in that the problem solving process requires ingenuity, imagination and creativity. Engineers are involved with developing alternative resources and achieving greater energy efficiency for whole communities; so it is imperative we graduate engineers who have awareness and understanding of themselves and their role as professionals both locally and globally.

The 1996 Australian Review of Engineering Education was established by The Institution of Engineers, Australia (IEAust), the Australian Council of Engineering Deans and the Academy of Technological Sciences and Engineering. "Changing the Culture" (Review 1996), recognised the "need for a culture change in engineering education, ultimately to extend throughout the profession producing graduates able to lead the engineering profession in its involvement with the great social, economic, environmental and cultural challenges of our time.

The Review Report Summary states "*Courses should promote environmental, economic and global awareness, problem solving ability, engagement with information technology, self-directed learning and life long learning, communication, management and teamwork skills, built on a sound base of mathematics and engineering technology*" (p4).

This vision and professional leadership demonstrated by peak engineering bodies including The Institution of Engineers, Australia is essential to engender credibility to the argument, whilst convincing students (and some lecturers) that these issues are being taken seriously at the highest decision making levels.

Hacker's [(1981) (in Robinson and McIlwee (1991))] definition of a "culture of engineering" is that it -

*Stresses the importance of technology over personal relationships, of formal abstract knowledge...over inexact humanistic knowledge, and ultimately of male over female traits (p.404)*

Culture needs to be understood in terms of values, norms and power relations.

Recognising a 'culture of engineering', the IEAust developed a set of generic skills. Graduates from an accredited engineering course must demonstrate the following attributes:

- Ability to apply knowledge of basic science & engineering fundamentals
- Ability to communicate effectively, not only with engineers but also with the community at large
- In depth technical competence in at least one engineering discipline
- Ability to undertake problem identification, formulation and solution
- Ability to utilise a system approach to design and operational performance
- Ability to function effectively as an individual and in multi disciplinary and multicultural teams with the capacity to be a leader or manager as well as an effective team member
- Understanding of the social, cultural, global, business and environmental responsibilities of the professional engineer, and the need for and principles of sustainable development
- Understanding of and a commitment to professional and ethical responsibilities and
- A capacity to undertake lifelong learning

The IEAust also recommend an academic course structure and content to enable graduates to acquire the generic attributes listed above and achieve the course objectives. Typically a four year professional engineering course will have the following elements:

- Maths, Physics etc etc
- Engineering design etc (technical skills) *AND importantly*
- *Integrated exposure to professional engineering practice (including management and professional ethics). This element should comprise 10% of total course content.*

Professional Studies 1 is based on this philosophy and framework.

## Background

The Unit, Professional Studies 1 is a core first year engineering unit comprising some 300 or more students. The student cohort is diverse, socially and culturally. It comprises the majority school-leavers 17/18 years of age, some 20% students from non-english speaking backgrounds and international students with women and mature students in the minority (approx 10%); many layers of culture.

Professional Studies 1 is a 12-credit point unit. The relationship between credit points, contact hours and time spent studying the unit varies across and within units depending on the individual's personal learning strengths, weaknesses and commitment. However, roughs guide for successful completion of a unit is sometimes expressed as a ratio of approximately 1:1 (that is 1 credit point – 1-hour contact and/or study or for every hour of lecture there should be 2 hours study/research).

In 1999 - 9 hours contact (lecture and tutorials) was required to put in place the foundations to successfully complete this unit. The remainder of first year engineering units is essentially scientific and/or technical in nature (Engineering Mechanics 1, Materials Physics 1 and Mathematics). These require some 3 to 4 hours contact. All could be successfully completed with very little interpersonal communication. Students come to University with individual perceptions. Those perceptions develop through first semester. From week 1 a vocal minority of students enrolled in the unit were negative and hostile towards the content and requirements for successful completion.

## Aims and Objectives

Our mission statement established the foundation for design of the unit - *BNB007 is designed to help you identify and develop the skills necessary to be effective responsible and ethical professionals in a rapidly changing world.*

Professional Studies 1 is an introductory unit. This unit seeks to:

- Introduce students to the concept of professionalism and professional practice
- Introduce students to a range of core components of professional practice – social understanding personal and interpersonal, written, oral and graphic communication skills and generic computing skills
- Provide students with opportunities to apply understanding to case study scenarios
- Develop early experiences with problem based learning
- Afford opportunities for students to meet with students in order professionally based courses.

Student learning was developed using a variety of teaching and learning (and assessment) methods; all of which culminated in a team project EXPO. The focus of this project changes annually to reflect an international or national theme. In 1999, the Project theme complimented the United National International Year of Older Persons, so students were required to create a product or service based on the theme

“Engineering in the Year of the Aged”. In 2000 the Project theme will be “Engineering in Rural Communities”.

Content was based on the premise that in order to be effective professionally; one needs to understand the self. Students had the privilege of professional experts and psychologists from a variety of specialised areas, sharing knowledge and experience. Most of this content was delivered in case study form. This provided students with opportunities to explore their habits and behaviours (learning style inventory, personality quiz, analyse study habits, manage conflict and difficult people, team-dynamics etc.).

## Culture Shock

Students were required to keep a journal and ‘reflect’ each week on their personal thoughts, feelings, values and attitudes towards the issues and topics raised in lectures through the week. These journals formed part of the assessment for the unit. Kelly (1999 p.5/6) wrote *“Reflective journals can be seen as a way of “making the present unfamiliar” by labelling it and thinking about it.”* Further *“If learning is ‘our ability to adapt and change with such readiness, we are seen to change’ (Revans, 1981:136 in Passfield) then students in BNB007 used their reflective journals to successfully engage in learning. Reflective journals are a powerful life-long learning tool...”*.

The team project was set in week 1 of the semester. This required students to form groups or teams. Students were to self-select/create teams. Each team was to comprise no more than 8 individuals including 1 student who spoke a language other than English AND at least 2 individuals from each of the engineering disciplines (ie groups must comprise at least 2 students each from civil, electrical and mechanical). This approach forced students to cross a number of cultures and find/develop a team with appropriate skills to develop their product or service.

Kelly (1999 p.4) wrote:

*“This is important because increasing student diversity, or large numbers of international students, does not automatically create genuine interaction between local and international students on Australian campuses. Volet and Ang (1998) challenged institutions and individuals to ‘design learning environments which foster students’ development of intercultural adaptability as one of the major aims of the internationalisation of higher education’. This implies that students ‘need to risk the emotional challenge of moving outside their zone of comfort’ (Volet and Tan-Quigley, 1995 in Volet and Ang op.cit:12).”*

Once the team was cohesive and functional – the focus of the project then launched the students out into the community where they were again required to use interpersonal skills to achieve learning objectives.

By the end of semester it seemed the majority of students deeply resented the unit in all its forms; the notion of a journal, content which challenged the individual, writing, researching, uncooperative team members, talking to strangers. Students had been forced out of their comfort zone.

Each week the content delivered was intended to develop understanding of what it meant to be professional. Guest lecturers, 'experts in their field', were invited to present to the class current ideas, case studies and philosophy on certain issues in industry; specifically professional ethics, environmental sustainability, economic and political context of engineering, cultural awareness, respect and understanding.

The unit required the collaboration and coordination of some 20 academic staff and the management of a further 10 guest lecturers. Each week there would be comment or complaint from these teaching colleagues and guest lecturers relating to the behaviour of the student cohort in class time. Staff struggled with student resistance and hostility the entire semester.

An evaluation of the unit in the last week of semester suggested student perception of the quality of this unit was very low.

The Team Project EXPO was held on the last weekend of the semester and advertised in the media. 4 Panels of assessors/judges were engaged. Each panel comprised a staff member involved in the delivery of the unit, a member from the professional body (IEAust) [a professional engineer] and a member from the aged community. An expert in cultural diversity education (and integral member of the teaching team) acted as a rover amongst the teams.

The EXPO was both successful and rewarding. The venue filled to capacity with interested parents, members of the public and representatives from aged care and communities. Staff was impressed with the quality of student projects and presentations. Students were overwhelmed with the attention. Student learning crystallised and understanding and confidence was evident. Two patents resulted from these projects. There was an obvious shift in student attitude towards the unit this weekend.

Kelly (1999 p.6) wrote *"In action learning paradigm terms, their (student) responses are much more significant. All students were pushed out of their zones of comfort "in conditions of ignorance, risk and confusion, where nobody knows what to do next"(Revans 1990 in Passfield 22)."*

At the end of semester a unit evaluation/planning/design meeting was held. The issue of contact hours and assessment was raised. Senior academic staff recommended a reduction in the number of contact hours and assessment to mirror the more technical unit contact hours. This proposal has been rejected; however the teaching team is exploring efficiency of time for the individual student.

## Conclusion

Essentially Professional Studies 1 comprises humanities concepts and learning in what is otherwise a purely scientific and technical engineering degree. This requires regular and consistent personal interaction and reflection in a variety of forums and with various audiences. It is simply not possible to nurture and develop professionals without providing the building blocks on which to nurture and develop the self or the individual. This takes time.

Engineering Faculty staff is beginning to seek assistance with redesigning of other units and laboratories.

Since the 1996 Review of Engineering Education the design and implementation of a more 'inclusive or responsive' engineering curriculum has been a priority for this Faculty. This requires specialist skills and understanding. This unit has evolved and developed through a collaborative partnership with the Academic Staff Development Unit (Ms Patricia Kelly) and consultants or as Kelly (1999) writes "*in action learning terms, 'learning with and from others involved in the same mess' (Passfield op Cit.).*"

Margot Cairnes is a leading Australian management consultant. Cairnes sums up business in the 21<sup>st</sup> century as moving from a bygone industrialised 'machine' era where everything was tangible, visible, measurable and controllable into an 'E' era where everything is intangible, invisible, difficult to measure and control, complex and messy and one where the relationship is everything. Margot believes "Technologically, we are very advanced but psychologically we are babes in the wood. We don't know ourselves or anyone else very well". The 21st century professional will need emotional maturity to survive and maintain any quality of life.

Margot assures me "You can't grow emotionally without at least some pain".

## REFERENCE LIST

Institution of Engineers Australia (1996) Changing the Culture: Engineering Education into the Future ACT: Institution of Engineers, Australia.

Institution of Engineers, Australia (1997), Manual for the Accreditation of Professional Engineering Courses. Institution of Engineers, Australia.

Kelly, Patricia (1999, December) Paths are made by walking: changing an engineering curriculum. Paper presented at 10<sup>th</sup> World Futures Studies Conference, Bacalod, Philippines - Futures of Diversity: Celebrating Life and Complexities in the Next 100 Years!

Roberts, P., & Lewis, S (1996) National Position Paper for Women in Engineering for the Review of Engineering Education. Melbourne: Swinburne University of Technology.

Robinson, J. Gregg and McIlwee, Judith S. (1991) 'Men, Women, and the Culture of Engineering' The Sociological Quarterly, 32, 3, pp. 403-421.

Taylor, E., & Yates, W. (1995, July ) Nurturing Diversity in Electrical Engineering. Paper presented at the conference Women Culture and Universities: A chilly Climate?, Sydney.

websites:

<http://olt.qut.edu.au/bee/bnb007>

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