

Globally responsible graduates - Turning rhetoric into reality.

Patricia Kelly Lecturer in Cross Cultural curriculum development
(p.kelly@qut.edu.au)

Deborah Messer Lecturer in engineering
(d.messer@qut.edu.au)

Queensland University of Technology
Brisbane
Australia

Abstract

Faculties of science and technology are under pressure to prepare graduates who can work effectively for diverse communities, locally and globally, based on the principles of sustainable development. These expectations have been made clear in Australian higher education statements, by professional bodies and in the Queensland University of Technology's (QUT) Teaching and Learning Plan. In practice this means academics working with students in person or on-line, to challenge their thinking and to encourage them to change. It also involves a paradigm shift for many students and academics. Principles of social and environmental responsibility and cross-cultural communication skills must move from being seen as optional "add-ons" to being fundamental aspects of education for all engineers and scientists. They must be part of formal content and assessment in order for students to take them seriously.

This paper is based on the second year of collaborative work in the subject, Technology and Society, to meet these challenges with first year Engineering students at QUT. The vast majority of these students are males, many of whom have entered university with set attitudes and expectations of the degree. They also come from increasingly diverse cultural and study backgrounds and we were concerned that their studies were not responding to this. So as Harari (1997) urges, we are working towards "an atmosphere where students break out of their mental and national ghettos", using a combination of group activities, written material, professional role models, ethical dilemmas and reciprocal feedback to value and build on students' responses.

It takes planning, courage and perseverance on the part of lecturers to change and to convince students that these changes will benefit them personally and professionally. Many teaching staff also need professional development in order to do this confidently and effectively as part of an integrated approach. We are approaching it as a collaborative professional research partnership (Grundy 1998) of the kind which current work and budget pressures within universities are making more difficult to establish and maintain. The paper therefore offers an opportunity to consider and assess the portability of this case study of curriculum change.

Introduction

"Global education implies preparing students for global citizenship. Few students and still too few academics, seem to have taken that challenge seriously" (Volet and Ang 1998, 6).

The rhetoric is clear on what is expected of engineering graduates in Australia and world-wide, and why. In November, 1997, the Institution of Engineers Australia (IEAust) approved a Policy on the Accreditation of Professional Engineering Courses. The document states that through the process of accreditation of university education, the IEAust will "ensure that graduates from an accredited course are adequately prepared to enter and to continue the practice of engineering". Graduates should also have "the ability to communicate effectively, not only with engineers but also with the community at large; and an understanding of the social, cultural, global, business and environmental responsibilities of the professional engineer, and the need for and principles of sustainable development".

IEAust's review of Continuing Professional Development (CPD) in Engineering affirmed this stance. After reviewing submissions from industry, universities, Government, IEAUST and its members and Overseas Engineering Institutions, the Review concluded that the issues driving the agenda for all constituencies are those related to internationalisation, commercial practices and social and cultural interaction. The Australian Science, Technology and Engineering Council's study based on extensive consultations, came to similar conclusions. Its preferred future for Australia is a country that is "creative, productive, inclusive, as well as ecologically sustainable". This requires "engineers and technologists trained to think in terms of the future".

However, according to Thom, (1997) information collated by the World Federation of Engineering Organisations (WFEO) indicated that "instruction in environment and sustainable development was totally inadequate, being of the order of 10 percent of time in 5-15 percent of courses." His work group formulated teaching and learning principles including "involvement of the head, heart and hands" and the "need for collaboration and cooperation" (ibid.) The expectations are clear, but there is less information about how to implement these attitudinal and skills changes in students and teachers who often see no need for change and resent the challenges involved.

Dealing with reality

We have been collaborating to try to implement these changes in a first year engineering elective unit, Technology and Society, in the Faculty of Built Environment and Engineering, since 1997. This has been a roller coaster of highs and lows. However, we hope that this summary of the main issues and how we dealt with them may prove useful to others interested in change.

Communication

There are several barriers to improving communication. Firstly, most of our teaching spaces discourage interactive teaching and learning. Older classrooms are designed on the "sage on the stage" model, with fixed chairs facing the front. Our newer lecture theatres are steeply raked to fit in the maximum number of students, making interaction incredibly difficult. Moreover students are either accustomed to sitting back rather than participating or else they may lack the confidence and skills to participate effectively.

Our student body is very diverse, in terms of age, ethnicity and experience. There are very few females and increasing numbers of international students, mainly from Asian countries. Even though students are judged on their communication skills through group work assessment and presentation skills, there is little time or attention given to help them gain these skills. Tokenism is not an answer, that is setting up group sessions in the hope that will somehow automatically develop skills. We observed very little interaction in such sessions. This is also true for cross-cultural communication. Recent research suggests that not only do Australian students seem reluctant to engage in cross-cultural interactions but that this attitude becomes more negative as they progress through their course (Nesbitt and Todd, 1993). The message is clear "Unless inter-cultural contact is engineered as part of formal study, social cohesion will not happen and all students will miss out on critical learning opportunities" (Volet and Ang, 1998 : 9).

We made a commitment to communication through "setting the scene" sessions which take about two hours. They have worked with up to sixty students but will have to change for the 100 students we expect in 1999. This approach has proved effective in beginning to break down barriers across gender and ethnicity. They consist of a quick "Find a Person Who..." introduction which is non-threatening but gets people out of their seats and out of their comfort zone. We follow with a more intensive small group activity combining introducing the idea of mind-mapping (concept mapping) with information about the group, including their ideas on what it means to be a globally portable graduate.

In 1998, we added a negotiated learning agreement as part of an approach introducing first years to the idea that they are already on the path to being world class, global professionals. We called it a draft "work contract", asked them to discuss it in pairs under the headings "positive, negative and interesting" and to add any suggestions for change.

As members of the BMB005 project team we agree to:

- 1. treat each other with mutual respect and courtesy*
- 2. work towards an ethical and professional standard in our professional and personal lives*
- 3. seek direction and guidance when we don't know something*
- 4. manage time effectively.*

We had thirty four positive responses, nine negative and eight interesting. Common positive responses included "creates friendly, comfortable environment", "sets guidelines", "treat each other with mutual respect". Negatives included "not enough girls doing BNB005, only male perspective", "we shouldn't need a contract".

Interesting included "when seeking help you are often looked down on" and "working towards ethical standard. To actually sit down now and get personal, moral ethics straight is something new, where usually people wouldn't think much about it in the beginning".

In Semester 2, 1998, this task marked the beginning of each student's journal or personal reflective diary. They will revisit the contract at the end of the semester and also use the journal to reflect on and map their learning journey. We used world class, "globally portable" engineers (Morris & Hudson, 1995) as a "sexy" phrase to interest students in the generic and transferable skills required in order to be confident and competent professionals both within and outside Australia. While there is an acceptance that students may need cross-cultural skills in order to work overseas, there is little recognition of their importance in creating and sustaining a culture of "productive diversity" (Kalantzis & Cope, 1997) within Australia. This is equally relevant for most countries.

Sustainability

In order to challenge students, we used the following quote. We showed it as an overhead transparency and asked them to discuss in pairs the question, "Who you think might have written this and when?"

"the continuation of traditional resource patterns and their unanticipated results (for example, global climate change) will lead to diminishing economic benefits and degradation of the other services that we derive from our living resources"...

Some suggested this century, a few thought it was the 1960s or the 1980s, one suggested Greenpeace and one suggested David Suzuki, to which another replied, "who's that?" It was clear that they thought such sentiments could only come from "greenies" and that they thought it was a bit dated. They were quite taken aback to find that the quote came from the 1998 document, *Teaming with Life*, put out by The US President's Committee of Advisors on Science and Technology, which has representatives from some of the largest universities and business corporations in that country. We had made the point that the people in positions of power, who they did consider worth listening to, were taking the environment seriously. They then discussed how it was relevant to them as engineers.

We used another quote as the first "reflection point" in the first year students' workbook. "Improving and protecting our environment is compatible with growing the nation's economy", (*Teaming with life op.cit.*). Here is part of a draft response from an (international) student, as he wrote it. It is a good example of the kind of critical thinking we hoped for.

Is this sentence saying that if we take care of our environment, land, water, plants and animals, it will financially improve the economy? If this is correct, society will greatly benefit with a healthy economy and a stable environment. On the other hand, I believe this paragraph suggests that society cares for the environment only when it can improve there financially (sic) situation. This issue has gotten my negative attention. The well being of the environment is constantly being placed aside when it comes to the development of the industrial and technological world.

.. But as an engineer are you willing to place your job on the line when you stand against the corporate business person and head engineer? It is the moral and ethical values of those above us that dictate the way in which we behave. Are you willing to lose a job that you have studied and worked towards for several years, just because you believe it is unsafe or harmful to the environment? This is my primary issue for this reflection. The ethic and moral values of those working above us must be reviewed and changed all at once. ...

We also contrasted two differing views towards the land: one from a 1925 film, the second from an Aboriginal elder from Kakadu in Northern Australia. These have been juxtaposed in a recent Australian video documentary history series *Rewind*, (1997).

Man has come to stay. His conquest has begun. ...Fences must be put up. Trees must be ringbarked, scrub must be burned and the earth yields to the dominion of man. (1925 narration)

This ground..and this earth like brother and mother. They cutting its body off us. They cutting our mother's belly. (1997 Bill Neidjie - Kakadu Man)

These differences across time, cultures and gender attitudes challenge Australian and international students alike. Indigenous rights are an issue in many of the countries from which our students come and using an Australian example is a non-threatening opportunity to identify and discuss issues of exploitation of land around the globe. Fruitful discussions of controversial issues only occur if we have achieved a safe and respectful environment in which students believe they can share opinions and information without being ignored or ridiculed.

Collaborate or perish

Our professional collaboration emerged out of our mutual commitment to equity issues and from meeting on various committees. By working together over time we came to fulfil the principles of a successful collaborative professional research partnership (Gore (1995:19 in Grundy 1998:42) although it was more by accident than design. It is worth outlining the principles of successful partnerships because work, time and budget pressures within universities make such partnerships an increasingly popular way of getting collegial support for teaching and research within institutions and with colleagues elsewhere.

- It is "democratic and non-hierarchical". We value our different expertise and negotiate our way around differences.
- It meets "the distinctive interests of all parties". I (PK) justify my time since it is both staff development and curriculum change in response to diversity. Deborah meets the need to respond to the IEAust's requirements for engineering graduates and to work for change within her faculty.
- We have developed "trust, communication and understanding of each partner's perspectives.
- Lack of recognition or reward for collaborative activities has not been a major issue for us because we were focussing on the issues and the process.

- We have been "jointly responsible and involved in all planning from the beginning". This will extend to the expanded planning committee for the new subject in 1999.

These principles are a good guide for work across universities as well as within. It would be worthwhile to apply them in a cross-cultural setting to see how the principles need to be expanded or clarified and what skills are needed on both sides to do this effectively. We have found it difficult to get commitment from other colleagues involved in the unit to integrate our approach with their content. All core lecturers involved in a unit need to participate from the outset, including in the introductory activities. This will change as we plan next year's unit. All lecturers involved will have to meet and this will be our opportunity to gain their support and to understand and influence their perspective on the subject. We need our male colleagues' support and involvement because gender still seems to be an issue for many engineering students. If communication skills are seen as a solely female domain, then they are still not really regarded as important.

Some professional development will be required for those involved in teaching the subject next year. This will probably be a negotiated workshop including issues such as responding to diversity and internationalisation in different content areas, an agreed clear and appropriate style of written materials, agreeing on a "vision" for the unit itself and how to assess it.

Role models for change

In 1998, BNB005 - Technology & Society has been structured to include a four-session process during which they can benefit from the experiences of professionals who have worked overseas. The first 'guest' lecturers shared their experience/s in the workplace and discussed particular 'positive, negative and interesting events' from their work around the world. The students enjoyed the first session and found it valuable to their development as world class professionals. Useful things they gained from the session included "social aspects of engineering, because the degree doesn't prepare you for social and cultural aspects". Many students thought it would influence them in ways such as "team work", "supporting colleagues as well as respecting them", "developing communication skills", being aware of different cultures and their rules" and being "humble".

This concept of 'humility' or how to get on with workers on site was brought up by both our first guest lecturers, one a German Engineer studying for his PhD in Mechanical Engineering and a lecturer in Civil Engineering, who has worked in many Middle Eastern countries and in Russia. The other, an Australian engineer, has worked on projects in remote sites in New South Wales and Queensland, so their knowledge and experience impressed the students. They need role models they respect and by being exposed to diverse role models, they learn to respect. The most recent session introduced students to a real critical incident chosen by an electrical engineer who is also female and a Muslim. She outlined the incident and they discussed it and what they would do, before hearing what she actually did to resolve the situation. Her solution modelled both creativity and ethical practice.

The next step

From semester 1, 1999 the engineering curriculum at QUT is being restructured. This elective's content and methodology will be embedded into a Professional Studies subject which all first year students will study. We will offer one of four modules. It will cover ethics, cultural diversity (including gender issues), sustainability and historical perspectives in engineering. This fits well with student responses to a "global skills" exercise". We asked the students in the first lecture what they thought was meant by "globally portable, world class" professional. Their replies suggested three main categories:

- *the standard of their engineering skills comparing to the best in the world*
- *being able to work and adapt to work anywhere in the world*
- *good speaker/ communicator (1 student)*

We asked them again in the final lecture of the unit. This time we used a twelve point list "Global Skills Objectives" for graduates, developed in Canada (Whalley, 1997). We asked "which best practices were relevant to them; which best practices did students believe they used throughout the unit; which practices didn't they understand and which practices would they like to know more about?" The responses provided useful information for future directions. Some 25 students out of a class of approximately 50 students attended the last class. As this was after their formal assessment, we were gratified (and surprised) that this number attended, because some students had left earlier sessions after ascertaining the content was "not for assessment".

The skills they considered the most relevant are: "to be interculturally competent in their professional lives" (22) and "to apply critical thinking skills to problems with an international or intercultural dimension" (19). (15) respondents also indicated that it is necessary to "be able to identify the major economic and political trends which provide the context for international/intercultural relations in their field of study". Fewer students believe that they use critical thinking skills (10), develop and test alternative hypotheses to explain differences in how problems are defined analysed or communicated (10) and can identify ethical issues that may arise in their personal and professional lives (10); all within international/intercultural contexts. Some claimed to lack understanding of the demographic trends which provide the context for international/intercultural relations (6) and a few students believe that there are major limitations and problems in their personal and professional lives that arise from ethnocentrism (4).

The information gained from our on-going evaluations, provides us with a base on which to plan future curricula to help students to develop these qualities.

Conclusion

Working to change established approaches and attitudes in Higher Education is not easy. It is tiring to be a minority urging change, particularly because many of the changes intersect with strongly held attitudes about economics, gender and culture. However, professional associations have made it clear these issues are being taken seriously at the highest decision making levels in the "real" world for which our university claims we are preparing students. The vision of professional associations needs to be publicised, disseminated and implemented. Those of us involved in this

work need to support each other and share insights and experience. We have very little time to make the transition to a sustainable path and change is not happening fast enough.

“Educating Engineers and Architects without including the implications of their work on the natural environment, is like teaching new soldiers to fire rifles without warning them that bullets hurt” (Lowe, I. 1996).

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