

INSIDE ENGINEERING FACULTIES: DEVELOPING A NEW LAYER OF ADVOCACY IN AUSTRALIA

Sue Lewis

National Centre for Women, Swinburne University of Technology,
Melbourne, Australia

Background

Recruitment, retention and educational development programs for teaching staff in engineering faculties are currently the three broad layers of 'women in engineering' programs within Australian universities. Many universities have 'women in engineering' (WIE) programs and they are funded and defined in very different ways by different engineering faculties. They are often marginal to central faculty concerns through their location, staff tenure, program decision making and funding levels.

With recruitment or outreach programs, the focus is women in schools and in the community. With retention and support programs the focus is the women within 'non-traditional' courses and training. These approaches have been described as 'women focused' and without them we would not have the increased numbers of women within engineering. Like other WIE programs, the National Centre for Women (see poster) reassessed its programs in the early 1990's and we shifted our emphasis from changing women's career aspirations and support once they had enrolled, to include working toward change at organisational and cultural levels in education and industry. Consequently, a third layer of educational development has been added to recruitment and retention initiatives in engineering faculties.

These educational development programs are challenging and focus on improving the teaching and learning within engineering faculties in response to including more women students. Programs can centre on staff development sessions or can be a longer term model of research and development where staff collaborate to investigate and change their local curriculum and teaching. Both reject the idea that you simply add women to a faculty and stir. Consequently, they represent a shift from changing women to changing engineering.

This paper will briefly outline two case studies of educational development programs within engineering faculties and consequently illustrate the models we are finding useful. I will also discuss the resistance that can be generated from this layer of advocacy. First to the culture of engineering faculties in Australia.

Gendered engineering faculties

Women comprise only 13.1% of university students in engineering faculties in Australia. The most rapid increase in female students was during the period from 1986 to 1990 where a 1% increase per year occurred¹. This increase has slowed since then to 0.6% in 1994. Whether this is a plateau in the 'graph' of female participation is yet to be revealed. At the moment however, the rate of increase in women studying engineering is slowing in Australia. These aggregate figures hide the large variations in women's enrolment patterns from campus to campus and from field of engineering to field of engineering. Chemical engineering has shown a 10% increase in female participation over the past six years to almost 32% whereas electrical and mechanical fields have increased more slowly to 9% and 7% respectively¹. Women academics in engineering faculties comprise only 4%.

Consequently, one of the central issues facing engineering faculties in Australia is the male student environment. Many women students experience a chilly learning environment through how they are treated in the classroom or the laboratory, the relationship with teaching staff, and the informal student exchanges. Not all male dominated engineering faculty environments exhibit characteristics that make them uncomfortable for women, but many do. There is also no predicability about the chilly nature of the learning environment; one year can exhibit a comfortable learning environment for young women and men and the next year can be macho and intolerable for the young women and anyone not part of the dominant male, anglo group².

WIE program managers in universities have been predominantly women without faculty teaching status, and employed to work in educational and promotional programs where their focus is 'safely' outside faculty corridors. Consequently, the teaching staff themselves and the curriculum and teaching practices within these engineering faculties have been largely unaffected and unchallenged by these programs. Many academic staff in engineering do not have educational qualifications.

Perhaps the central obstacles for WIE programs in universities are the pervasiveness of the culture of autonomy, individuality, competition, and the 'old' hierarchical models of management prevalent in engineering faculties. Added to this, research in universities is being maintained as a higher priority than teaching and educational development. The personality characteristics of scientists and engineers also show that males tend to be "emotionally reticent, disliking overt emotional expression in others and themselves....", they also tend to be authoritarian, conservative and controlled in their thinking"^{3,4}. The research questions, methods, criteria of success, and styles of teaching are male defined and consequently, the

knowledge itself reflects a bias towards a male cognitive style in its practices, theories, ways of teaching, and ways of managing and organising faculties. Engineers have created a profession where the separation of theory from social and environmental contexts is prevalent.

One of the most illustrative examples of how this culture of autonomy can affect the teaching and learning environment for students came from a project a few years ago where the teaching staff conducted a review of the first year program through surveying all staff and students⁵. They found:

- the curriculum, content sequencing and assessment of most first year subjects were decided independently of other subjects and with little collaboration between first and second years
- staff knew little of what was happening educationally outside their own subject
- the practical component of the subjects had diminished over the past ten years due to diminishing resources and this was having a detrimental educational effect
- there was very little continuity or uniformity in the description of the subject goals and objectives given to the students
- some content areas overlapped between subjects and resulted in confusion for students due to different terminology and symbols.

'Change is a process not an event'⁶

It is always challenging to work for change. It is particularly challenging to work for change within engineering faculties. Too many engineers see change as an event and not a long term process. The most successful programs are where a group of engineers have worked collaboratively over time - on curriculum and teaching projects rather than one or two session staff development programs. These former programs are the focus of this paper. Fullan's criteria for successful change are very relevant; the overlap of the individual participants needs with those of the central funding body, the support of hierarchy, and the opportunity for staff to interact with each other, share ideas and have access to support and assistance⁶. Some of the most useful elements from educational development programs inside engineering faculties are where:

- academic staff applied for and were selected for the project on the basis of their interest and commitment to a gender based review of their curriculum and teaching,
- programs started from the individual needs, interests and understandings of the participating academics,
- academic staff were provided with time release and/or research assistance
- data collection phase focused on the local faculty context

- mandatory support of the dean and heads of schools
- academic staff worked together in teams,
- commitment to formal and informal meetings and staff development sessions/programs extending over time,
- ongoing support and follow up from consultants throughout the year,
- external consultants participated in a formative evaluation of the program,
- documentation of the project contributed to the professional profile of the academic staff.

Action research has been another common thread (sometimes unspoken) determining the investigative process within most of the programs. Essentially, action research is a form of self reflective enquiry which aims to improve practice through understanding and to involve others in all phases of an open process. Practitioners research their own practice. Action research leads to formulating recommendations and putting these into practice. It also represents a cyclical process of ongoing change without a pre determined end point⁷.

Making Connections

"Making Connections" has government university teaching funds and has developed, trialed and evaluated a project based component of design engineering in first year. One of the central rationales for this program was that further improvement in the participation of women in undergraduate engineering may only be achieved through changing the traditional practices within engineering education. This program has implemented the shift from content to context driven curriculum and assists student learning by starting with a familiar curriculum context and building the technical and professional skills components through connecting with the engineering concepts. The gender inclusive model for this project was characterised by:

- open ended problem based learning
- social and environmental curriculum contexts
- collaborative team approaches
- diversity of teaching and assessment approaches.

Students work on design projects in teams, as well as presenting and evaluating their projects in a simulated workplace situation. Students choose the subject of their projects and many semester classes are structured to guide students through the design process, and integrate the social and environmental contexts into their design. Students must work with a client group. Interdisciplinary and group work are emphasised rather than lectures and individual work.



Maximising Diversity

A cluster of projects at another University arose out of a sequence of staff development sessions conducted over six months. These sessions focussed on factors that create a warm classroom environment for both female students and students from other cultures, as well as inclusive curriculum and teaching issues. Again the focus for this program was a faculty concern over the plateau and possible decline in the number of women within the undergraduate engineering programs. The faculty wanted to improve their educational strategies to teach in gender and culturally inclusive ways.

The culmination of these sessions was the development of a cluster of educational development projects within the engineering faculty. Staff were offered central funds to collaboratively conduct projects that supported student diversity in learning. These projects are linked together with a common faculty reporting and publication timeline. Funded projects are very diverse and cover:

- training of laboratory tutors to be more gender and culturally sensitive,
- analysing the assessment data within the faculty in order reveal any patterns of achievement in different assessment tasks,
- interviewing female and male students about the faculty environment
- videoing mechanical practical exercises in order to understand and intervene in any gender and culture dynamics within the class,
- the development of a multimedia library resource to cater for students from less technical backgrounds.

These programs are providing a model for the development of projects in other WIE programs where educational development funds are being harnessed to encourage engineering academics to collaborate on long term change programs for women students.

Resistance

Reform programs in engineering faculties are particularly vulnerable to resistance since they can threaten the comfort zone of other staff members and some students. There are a number of resistance discourses operating in faculties and they can be described politely as politics and educational priorities but they can be avoidance, sabotage and attack. They can be directed at educational development staff or the faculty staff participating and owning the programs.

Avoidance statements are the most commonly encountered and centre on assigning all educational problems to the student deficit model - the poor quality of student intake (always decreasing from earlier times) or the poor motivation or preparedness of students. Other avoidance mechanisms involve defending current practices based on the longevity of their degree conferring ceremonies, drawing on one particularly successful woman to justify current teaching practices, or problem recognition equals problem resolution. Sabotage can extend to appointing an unqualified person to a 'women in engineering' position, or appointing the right person in a far too junior position with low salary. It can also take the form of cynicism where everything has been done before or is an assumed part of current educational practice. Attack is often saved for any written material by questioning its grammar, meaning or research validity or the attack targets the staff development session where the facilitator is assumed the enemy and asked the most aggressive question. The forms of resistance can be many and varied.

I remind myself of the following list regularly (generated from a workshop of women in engineering program managers); change is slow, work with the support of others, work with engineers who are open to change and accept that some will never change, encourage ownership, have all the data at your fingertips, be flexible and listen to other views, know where there is the slightest possibility of finding any funds, and use the policies and regulations to the maximum.

Acknowledgments

The following WIE program managers have contributed to the development of these ideas and projects - Marian Boman, Jane Copeland and Pam Roberts. These programs would not have occurred without the commitment of the faculty staff who are enthusiastic about change for women students in engineering.

- 1 Lewis, S. and R. Harris (1995). Gender and Engineering: Higher Education Data. Data Matters: November. National Centre for Women, Swinburne University of Technology.
- 2 Lewis, S. (1995). Chilly Courses for Women? Some Engineering and Science Experiences. Women, Culture and Universities: A Chilly Climate? Sydney, Univ Tech, Sydney.
- 3 Head, J. (1987). A Model to Link Personality Characteristics to a Preference for Science. Science for Girls? A. Kelly. Milton Keynes, U.K., Open University: 18-23.
- 4 Hacker, S. L. (1981). the Culture of Engineering: Women, Workplace and Machine. Women's Studies International Quarterly 4: 341 - 353.
- 5 Lewis, S, Chapman, B. and N. J. S. Arnott. (1992) The Swinburne Engineering Education Development Project- An overview. Conference Proceedings of Australasian Association for Engineering Education, Brisbane, University of Queensland.
- 6 Fullan, M. (1982). The Meaning of Educational Change. New York, Teachers College Press.
- 7 Carr, W. and S. Kemmis (1983). Becoming Critical: Knowing Through Action Research. Geelong, Australia, Deakin University Press.