

THE NEW ZEALAND EXPERIENCE WE'VE COME A LONG WAY

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Introduction

Professional Engineering courses in New Zealand, as in other parts of the world, have always been male dominated. The early nineteen eighties saw a sudden rise in participation from approximately 2% in 1980 to 8% in 1983. These figures are measured as a percentage of the intake at First Professional Level (now known as Second Year). This figure has risen only gradually since then and has hovered between 12- 13% for the last 4 years.

In 1991, the engineering degree course at Auckland University was changed to a four year course with achievement - based selection procedures taking place at first year level (usually direct from high school) with some availability of direct entry at higher years. The percentage of female students in first year courses rose from 12% in 1991 to an all-time high in 1992 of 19.4%. A dramatic 62% increase! The result of our three year old Women in Science and Engineering program?

New Zealanders - Who are We?

It is probably useful at this point to put New Zealand and New Zealanders in perspective. New Zealand is composed of two main islands, totalling 1000 miles in length, approximately 1000 miles south east of Australia with a population of 3.4 million people and 50 million sheep. It was settled in the second half of the nineteenth century by free settlers of mainly British background. For many years it has had an agricultural based economy with considerable innovation in the fields such as refrigerated shipping, farm machinery and aerial topdressing. New Zealand was the first country in the world to give women the vote in 1893 and the voice of New Zealand women must have been heard in the early establishment of a system of free post-natal care for all mothers and their babies early this century.

The current population contains approximately 10% Maori, who are the indigenous people of New Zealand, and 3% Pacific Islanders with a wide variety of other ethnic groups including a rising Asian component.

In recent years New Zealanders have earned a reputation for innovation and lateral thinking in the use of their geothermal resources, natural gas and oil resources, yachting technology, to name a few.

Women are playing an increasingly strong role in New Zealand, particularly in education and health areas. Not unexpectedly, they have been almost entirely invisible in the areas of engineering and technological innovation.

Background to Participation in Engineering

It has been proposed that the increased participation of women in science and engineering areas could be said to follow the increase in participation by women in all fields of tertiary education, but participation in engineering has not risen to the same degree as that in medicine (currently 45%) or architecture (currently 26%), both of which require a high entry standard in mathematics and science related subjects.

During the eighties, an increasing awareness in educational, institutional and government circles to equality of educational and employment opportunities led to a variety of mainly low-key initiatives.

At both the Auckland and Canterbury Engineering Schools, a Women in Engineering committee of staff and students was formed who provided speakers for high schools, ran special displays on Open Days and produced a "Women in Engineering" brochure.

Several women engineers were working as secondary school teachers at that time and they provided information and encouragement, particularly in single sex schools.

In the mid eighties a Government sponsored initiative - the "girls can do anything" programme focussed community attention. This programme provided schools with publicity material, posters and brochures and commanded much media attention for a short period of time. A change of government and policy saw the programme disbanded.

About this time, following a visit to this country of a team from the EQUALS group of the Lawrence Hall of Science, Berkeley, an EQUALS group was formed in Auckland. They saw their role, as teachers working together, to encourage, by the interchange of resources and conducting inservice courses, teaching methods in mathematics and science that were "girl friendly". Another group was formed in Wellington under the name "Women in Science Education". Major curriculum reviews were also recognising that mathematics and science as currently taught were not meeting the needs or motivating young women and some ethnic minority groups.

These were some of the factors responsible for the gradual rise in community awareness and participation by women in engineering. To maintain this impetus, the University of Auckland in 1989 sponsored a full time appointee to encourage participation by women in engineering and the physical sciences by initiating programmes, preparing resources or any other means considered appropriate. This was the first, and at present only, position of its kind in New Zealand.

The Current Female Engineering Undergraduates

In 1989 when this work started, information gathered from records, by questionnaire and interview showed that the current pool of female undergraduates :

- * has a proportionately higher number of students from single sex schools than co-educational high schools
- * has a wide variety of schools represented including provincial (country) schools.
- * has an only marginally higher grade average than their male counterparts
- * did not choose an engineering course till late in their high school years

- * chose engineering to "use my maths and science" and for its professional status with clear job opportunities rather than a long held desire to be an engineer
- * has 32% with a close relative who is an engineer (not always university trained)
- * realise they had very little idea what the course contained or what the final job would be like.
- * received very little help from careers counsellors but support and encouragement from individual subject teachers and family

Reading of the early Women in Engineering programs in the United States and programs in Britain and Sweden, showed that our young women had many influences and impressions in common with female engineering students the world over.

How to Increase Enrolment

If the objective was to raise the participation of women in engineering then our method of approach was seen to be twofold.

Firstly, the awareness must be raised, of girls at secondary and primary school, their parents and teachers to the opportunities that a career in engineering can offer those with an aptitude and interest in mathematics and science.

Secondly the image of Engineering as a profession and course of study must be seen to value, not only technical skills and knowledge but also good communication skills, concern for people and the environment.

To meet the first of these, a variety of affirmative action and intervention programmes used overseas in the last decade have been investigated. In particular, experiences at Purdue University, the British Women into Engineering project and Australian initiatives, all provided excellent models.

Target groups were identified as

- Senior High School - when specialist subject choices had been made
- Junior High School - before choosing specialist subjects
- Teachers, counsellors
- Parents and the community
- Minority groups

Senior High School Level

At Senior High School level (Year 11 and 12) students have specifically chosen mathematics, chemistry, physics and other specialist subjects, studying five or six subjects at this advanced level. The "pool" of students eligible to enter engineering is therefore limited. In New Zealand at Year 12 in 1990 31% of girls chose Mathematics with Calculus and 13% chose Physics. The ratio of girls : boys in Year 12 physics was 1: 3.

For each of the last three years we have organised a one day seminar "Enginuity Day" at the Auckland Engineering School for girls in their last two years of high school, who are

studying at least two of Mathematics, Chemistry and Physics. Engineering school staff and as many female students as possible take part in a day which includes a largely hands-on introduction to at least two engineering disciplines and a visit in small groups to a woman engineer at her office and where appropriate on site. Schools send volunteers and at present the day is restricted to 100 school students with keen competition within some schools for places. For the last two years, one third of the Year 12 participants have pursued a course in professional engineering. Ideally, the length of time and number of participants at this seminar would be extended.

At this level we also run a "girls only" Careers in the Mathematical Sciences Day which caters for over 300 girls from approximately 60 schools.

Engineering School undergraduates have been encouraged and provided with support for visits back to their high school - these have been very popular especially with schools in the "country" areas.

Visits to individual schools and 1:1 interviewing of potential students is felt to be an important part of the information and support service.

Nationwide, an increasing number of residential Science summer schools have been held, with participation by girls usually over 50%. These have been a response to the recognition that although retention to the fifth year of high school has doubled in the last five years, the percentage of the pool continuing with the study of physical sciences has dropped.

Junior High School Level

Junior High School is considered to be the time many of our students start to opt out of maths and physical science subjects. The influences of peer and family group pressures, lack of confidence in their own ability and stereotyping of career opportunities are all well documented contributing factors. Mathematics and science are compulsory for the first two years of high school and then students choose 5 or 6 subjects to continue with.

Major reviews of teaching methods, curriculum and assessment methods are underway and are almost in place. The issues of under participation by girls, Maori and Polynesian students are being addressed but the wheels of change move slowly and it will be some time before the results are seen in our classrooms.

A New Zealand initiative, the SOS (Skills and Opportunities in Science) for Girls group was formed in late 1989. The aim was to organise two day seminars which would provide a vehicle for interesting the 12-15 year age group in scientific and technological careers. These seminars use a wide range of role models to facilitate job-related problem solving activities and have included civil, mechanical and electrical engineers. Participants are volunteers (some at teacher's suggestion), costs are kept free or minimal, and there is no individual competition involved. The enthusiastic reception from teachers, educators, parents and the girls to the concept saw the production of a workpack and video, so that teachers could organise these seminars in their local community with assistance from the SOS group. The seminars are now running in both islands with local teams of teachers acting as advisers. The emphasis of the seminars has been

- to create a conference like 'special' atmosphere - off campus and out of uniform
- to show that studying mathematics and science can lead to careers that value
 - team work
 - good communication skills
 - creative thinking
- to show successful women with a variety of academic and skill levels

Several evaluations have been conducted - mostly qualitative, seeking impressions, changes of attitude - covering a range from same day, six months to 2 years later. Same or next day impressions are very vivid and have elicited comments such as *"I didn't know architecture was anything to do with science!"*

"I thought engineering was about cars, and then Kim told us about her job and it was really good" "I'm not going to be an engineer but I will take science because there's more chance of getting a job and it'll give me more variety of jobs won't it?"

One evaluation asked girls to draw and/or describe an engineer before the course and then after - particularly noticeable were the number of 'after' drawings which drew two pictures, one of a man and one a woman - both neatly dressed and often with comments such as "happy", "confident", "tidy". It takes very little imagination to picture the "before" drawings.

Recent interviews carried out as part of a long term study showed very vivid, positive memories of the course, with raised attitudinal changes to maths and science. Although not all had continued with science, they all felt the course had raised their career expectations and motivation - *"I realised I had to decide what I wanted to do and go for it"*.

We are very aware that a one-off intervention programme like this will soon become a pleasant memory unless there is follow up. Suggestions are included in the workpack for classroom activities that can enable the girls to build on the confidence they have gained in "having a go" at science activities.

Emanating from the SOS seminars, a series of posters displaying women in Careers in Science and Technology have been funded and distributed to every secondary school in the country.

Teachers

Raising the awareness of teachers and encouraging them to support students with aptitudes in these areas is also seen as being of prime importance. Teachers have direct, everyday contact with the students and have a profound influence on a student's vision of her ability and potential. A variety of seminars have been organised, assistance given with professional development courses, and support given to the EQUALS and similar groups. A close liaison has developed with teachers and careers advisers at many of the "feeder" schools.

Parents and the Community

Parents will continue to wield an enormous influence on their daughters' choice of career. Any opportunity to increase their understanding of the issues involved must be taken. When time and personnel are limited it is tempting to adopt a "reactionary" stance, waiting for an invitation to speak, write an article, speak on radio. To target this group effectively, opportunities must be actively sought to speak, write and disseminate information as widely as possible.

Minority groups

In New Zealand, Maori and Polynesian students do not have a history of achievement in the "European" sciences or technologies, they have few role models and little experience or emphasis from home. The new science curriculum is addressing these issues and is including and valuing Maori scientific knowledge and concepts. Bi-lingual classes include the teaching of science in Maori up to third year high school level. Family and cultural perceptions of the role of young women must also be considered.

Retention

This has not been seen in the past as a major issue. With the recent rise in participation by women and the increasing diversity of academic and ethnic background, it is expected that support systems will need to be formalised. Currently in place are informal lunches and some peer-tutoring with 1:1 support from the Liaison Officer and other staff members.

The Engineering Culture

The difficulty in changing attitudes in girls, their parents and the community seems well stated by Beder⁴.

"engineering has attracted those who like to deal with things rather than people; dislike ambiguity; like certainty and order; have a narrow range of backgrounds ... introverts. If engineering were portrayed as it really is, an interdisciplinary subject that involves people, service to the community, negotiation and compromise, entrepreneurial skills and exciting challenges it would be a much more attractive option for women ... and a lot more men would be attracted too."

The recognition of the white, male, macho engineering culture is increasingly being acknowledged by the Professional Associations and the Schools of Engineering. A high profile with these bodies ensures that gender issues are not neglected as they seek to humanise engineering and raise the perceived status level and image of professional engineering. Progress in this complex area requires collaborative effort with the profession, educationalists and the media but we believe it will be a major factor in the increased participation of women.

Where to from here?

The last three years have seen major growth in awareness, and understanding of the opportunities available to our young women in professional engineering - the recent intake figures dramatically illustrate that.

With our "great leap forward" come many unanswered questions. Will our numbers plateau out as it seems they have in other countries? Is there a critical mass? How do you recognise when programs are no longer needed? How must the curriculum and teaching methods change? Should they change?

We recognise that there are many areas on many fronts that need more emphasis, but we in New Zealand do feel we have come a long way.

References

1. O'Neill, B. "Who wants to be an engineer?" New Scientist, 5 May 1990