

# ENGINEERING LINKS - WHEN ENGINEERS DON'T TEACH AND TEACHERS DON'T ENGINEER

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## INTRODUCTION

The Women in Engineering Unit in the Faculty of Engineering at UTS has been actively promoting engineering to young women since 1981 (1). In that time there has been a significant increase in the intake of women into UTS engineering courses, from 2% in 1981, 8% in 1991, 10 % in 1995, to 14% in 1999.

The Unit has four focus areas of activity:

- **Outreach to Schools and Community** - demonstrating to young women, young men and their teachers that engineering is an attractive profession for women.
- **UTS Engineering** - ensuring that our courses and environment are inclusive of female students; that issues important to women are recognised by students and staff, both women and men, and that these issues are effectively addressed in the total learning environment.
- **The Engineering Workplace** - providing access to role models in industry for female students by providing opportunities for them to meet and speak.
- **Professional Associations** - linking our students with other Women in Engineering groups and advocacy of women in engineering, challenging the current image of a male-centred workplace.

These activities will only be effective if men and women work in partnership, sharing the vision of engendering engineering rather than the exclusive responsibility of Women in Engineering.

While these activities began the swing to a more equitable intake of men and women, there was still a significant gap. To address this gap, the Engineering Links program at UTS was developed and trialled by the Women in Engineering Unit in 1998. Its main aim is to improve the understanding in the general community, especially girls and women, that engineering is an integral part of their everyday lives. In so doing, it is hoped that the intake of young women into the profession will increase. Recent changes in the curriculum in our faculty (11) focus on desirable attributes of our graduates. The outcome was a course more likely to engage the interest of young people, especially young women. The inclusion of attributes like professional formation with its associated communication skills in providing technical information to the community, has also opened the way for programs like Engineering Links.

Having had many years experience in the education of young women at high school level, I see that a major stumbling block to young women entering engineering is a lack of understanding amongst school students and teachers of the role of engineering in society. Unlike many other subject areas in the school curriculum, *engineers don't teach and teachers are not engineers*. Even more importantly, unless young women

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and their teachers have direct contact with an engineer through family or friends, they may never have even **articulated** the word 'engineering' until they are expected to make their career choices or guide students in their choice.

Students in the Engineering Links program encourage school students and teachers to articulate the word 'engineering' by working with them in their classrooms and community groups. Naming a concept and thus becoming familiar with it is the first step to development of understanding (15). By presenting engineering as an active and vital career option that supports gender equity it is hoped to increase the intake of young women into the profession, and that young men entering the profession are better equipped to recognise and respond appropriately to equity issues.

The Faculty of Engineering at UTS has supported the program by tapping into the learning and experience of its more advanced undergraduate engineering students. So far very few final-year school students have been involved so intake cannot be expected to change for a year or two. However, monitoring of current engineering students has begun so that changes in attitude in future years will be detectable and quantifiable.

## HISTORY OF ENGINEERING LINKS

In response to an Australian Review of Engineering Education (4), the Women in Engineering Unit received a grant for a Community Outreach Project. I was employed to fulfill the vision of this project. Highlights from the grant application included features like:

- A *Community Outreach Kit* ... to communicate engineering to high schools and diverse community groups.
- The focus of the kit will be UTS student projects and experiences.
- A training program for UTS Engineering students as outreach representatives including cultural awareness training, meetings with community/industry partners, communication and presentation skills.
- Interactive activities from student project work to present in Design and Technology and Science classes as well as at UTS Information evenings, Open days and Careers Markets.
- Increased educational and collaborative opportunities for partners, and stimulate awareness of the links between technology, community, industry building a more cohesive understanding of each others needs and how we can collaborate.
- Students would be given the opportunity to participate in the Outreach Training Program and form part of the UTS engineering student outreach team.

The **issues and needs** that underpin the outcome included:

- Engineers have a poor public image. They are seen to be the cause of current environmental problems, as people who build bridges, roads and skyscrapers. Poor communication with professionals other than engineers, the general public and school students who are potential engineers have contributed to this poor public image. *Engineers rarely become school teachers so opportunities to change this image are isolated and rare.*

- As it is a relatively new Australian university, UTS lacks a traditional image of excellence in the eyes of the parents and teachers of school students. Very few teachers or parents were educated at UTS (City campus) so they have no personal sense of loyalty to it. As a central city campus, the appearance of the building and the streets surrounding it are not appealing to many in this age of green thinkers. The campus appears to be fragmented by busy public roads. However, it is no more so than more traditional universities in Sydney.
- 'Engineering' is not part of the vocabulary of many school students and is often not considered as a career option (especially by young women) until after they have made their choices of senior subjects. Engineering is limited to students who elect maths, physics and engineering science in their senior years. This limits the intake at university level and precludes those who chose subject combinations like maths/biology, maths/design and technology, or maths/geography. Often these students are equally capable of becoming outstanding and creative engineers.
- There are already numerous resources available (2, 3, 5, 7-10, 12-14). However, these resources do not always meet the needs of teachers and school students because they all require development time by teachers to relate them to current curricula and to involve their students directly.

Problems in overcoming these issues is difficult because in schools:

- Little time is allowed for teachers to include in their lessons anything that does not relate directly to the curriculum.
- Little support is given for professional development of teachers.
- Teachers and their students often lack an understanding of the diversity of the fields of engineering. Although science, maths, design, and computer science graduates often become school teachers, engineers rarely do. This means that school students rarely have role models or mentors with first hand understanding of engineers and the engineering profession.

To address these problems, it is important for engineers to present **themselves** and their profession to school students (thus to the future general public and potential engineers) and also directly to the teachers of relevant subjects to build understanding of engineering. This must be done prior to the subject choices at Year 10 level. The Engineering Links program has been developed to do this. The Faculty of Engineering at UTS recognises the importance of such an approach and is now funding the program within its own budget.

## WHAT IS ENGINEERING LINKS AND HOW DOES IT WORK?

UTS Engineering is a five-year Engineering Internship program that integrates academic study with at least two semesters of engineering experiences in the workplace. This gives our students a portfolio of academic and workplace-based achievements. Our course provides students with the option, through a substantial elective component, of either deepening their understanding of their chosen area of specialisation or extending themselves into new areas. One such elective subject is Professional Service Project in which engineering students learn and demonstrate their learning through a variety of professional service opportunities that focus on demonstrating professional engineering in a community setting (6).

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Engineering Links is a professional service **project** for engineering students. It provides resources for teachers who need technological expertise and/or support including printed materials, web-based materials and a consultancy service in fields related to engineering. The resources are produced by engineering students who either volunteer to do so, or enrol in the Professional Service Project subject. Students are supervised by staff with expertise in primary, secondary and tertiary education strategies and needs. All teachers know *there is no better way to learn something than to teach it*. Students who register as volunteers are able to gain forward standing in the elective subject if they enrol later in their course. Links between the engineering students, teachers, school students and the university are negotiated and co-ordinated by the academic supervisor of the program to ensure appropriate learning is achieved.

Engineering Links provides opportunities for engineering students, school students and teachers:

- **Engineering students** link with teachers and develop the time management and consultative communication skills of practicing engineers.
- **School students** link with engineering students, experience hands-on engineering and learn about engineering and university life.
- **Teachers** link with engineering students and find help and resources to enhance their technology education programs.

The Engineering Links program is a **resource** for school teachers that:

- Relates directly to their curriculum so that they can immediately see its relevance and the links between their subject and engineering.
- Keeps abreast of changes in the curriculum.
- Requires very little preparation or reading time from teachers before they can use it.
- Allows motivated teachers to extend its use.
- Grabs the attention of school students by being presented and written by young adults more in touch with the interests of teenagers.
- Promotes engineering and the diverse range of activities of engineers.
- Makes 'engineering' part of the vocabulary of students and teachers.
- Promotes UTS as offering an exemplary and innovative engineering course.
- Promotes UTS engineering as a resource base for teachers.
- Involves UTS engineering students in interesting learning strategies.

The organisation of the program is very flexible and involves much negotiation. Students register as volunteers or enrol in the Engineering Links program as part of the elective subject Professional Service Project. Teachers apply for a particular event or consultancy. Links are then made between teachers and engineering students by the Co-ordinator who also links UTS staff volunteers with students where necessary. The 'event' is prepared and presented by the participants and is followed by a debrief, evaluation and reflection. Because the needs of teachers and the preferences of students do not always match there is opportunity for negotiation. Non-enrolled student volunteers can often fill these needs and so work their way towards eventual enrolment in the subject. Where students do not have the expertise to fulfil a

particular need they can be linked to a staff member who can work with them on the presentation.

The types of experiences possible in Engineering Links can be **people-based**, **print-based** and/or **computer-based**. Some experiences during 1999 included:

- Elizabeth (Mechanical Engineering final year student) was linked with Penni (Primary School teacher of Year 6) to work with the class who were designing a fun park. Concepts of friction, gravity, energy, structures and motion were introduced by Elizabeth. Reflective journals, practical design activities, design process and fun were all part of the class project.  
*Outcome* - these young students now use words like 'engineering' and 'friction' as part of their everyday vocabulary.
- Swantje (Mechanical Engineering mid course) was linked with Debbie (Senior High School physics teacher) to provide engineering challenges and activities for a Year 11 physics camp. Swantje did this by working with a team of 5 other student volunteers.  
*Outcome* - The Year 11 students found that physics can be fun and can be seen in many different everyday applications.
- Karen (Civil and Environmental Engineering final year) was linked with Stephen (Secondary Design and Technology teacher of Year 9) to act as mentor for small groups within his class who were designing an item for sustainable living.
- David co-ordinated a project management unit with a school enrichment group who decided to manufacture and market hand-made paper.
- Tony (senior student) and Emily (junior student) developed an energy kit to meet the needs of the Junior Science Syllabus in NSW. Tony was enrolled in the subject while Emily was a volunteer.
- Linton (mature-age student) and Steve (senior student) were linked to appropriate staff from the faculty to produce resources in new areas of the new Engineering Studies syllabus for NSW HSC teachers.
- Rodrigo (senior student) guided a Year 8 Design and Technology class that visited UTS Engineering and discovered the world of computer control.
- Ken (staff) developed a talk and demonstration about the civil engineering involved in the building the pyramids and trench warfare in WW1.
- Development of other resources including **excursions to UTS engineering** with accompanying worksheets and notes; **printed and web-based resources**; **discovery packages** for staff and student presenters at Women in Engineering events.

## CONCLUSION

The Engineering Links program meets the criteria outlined in the initial grant. The main features of the program are its flexibility and negotiation. The scope is endless. As the program is in the early stages of development there is opportunity for individual teachers and students to shape it.

The benefits to engineering students are demonstrated in the resources they have created, the reflections they have written and the confidence, excitement and communication skills they have gained through their involvement in the program.

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It also provides them with creative learning opportunities and relevant reward for public service, while allowing them to develop their communication skills in practical ways.

The benefits to all participants are the personal and professional relationships developed that allow each to know the other's world. Links are made between teachers, school students, engineering students and the university so that each can learn about the other and be enriched by the experience.

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