

Reflection of a female engineering student role-model on engaging school students in the Qld Western-Downs

Steven Goh^a & Eden Adams^b
University of Southern Queensland^a, Australian Air Force^b
Corresponding Author Email: steven.goh@usq.edu.au

Structured Abstract

BACKGROUND

The engineering profession in Australia has failed to attract young women for the last decade or so despite all the efforts that have gone into promoting engineering as a preferred career choice for girls. This is especially so in the regional context. It is a missed opportunity for the profession to flourish as a heterogeneous team. Many traditional initiatives and programs have failed to make much impact or at best incremental improvement into attracting and retaining more women in the profession. The reasons why girls and young women in most parts of the world show little interest in engineering haven't changed, despite all the efforts to address them. The issue here is with the perceptions of engineering in the community and the confidence of female students to pursue a career in engineering. This paper reflects on two school outreach road-shows across the high schools within the Qld Western-Downs catchment to engage students and to inspire them to consider a career in engineering by changing the traditional image, stereotypes, and perceptions of the engineering profession. This is achieved by having suitable role models (in this case a young female engineer and engineering student) to present and inspire, run fun activities and problem solving workshops. This road-show concept is based on the Power of Engineering's events framework (Briody et al 2012).

PURPOSE

The case study aims to provide an insight and better understand the challenges of non-traditional role models in a regional context based on their individual experiences in a traditionally male-dominated industry of which stereotyping and social conditioning are perceived as more systemic in regional settings.

DESIGN/METHOD

The two school outreach road-shows took the engineering student role-model to a number of regional towns including Roma, Charleville, Mitchell, and St. George. These outreach activities in regional schools seek to increase the equitable participation of female and in particular female indigenous students in tertiary education and to consider a career in engineering. The research is framed by Grounded Theory. The data for the research is collected via a semi-structured interview with the engineering student role-model who went on this road-show, followed by a thematic analysis to establish the findings. The data analysis presented in this paper is at the preliminary stages.

RESULTS

Anticipated outcomes will hope to inform engineering outreach officers regarding the challenges within the regional context and hence better equip and train student ambassadors to effectively engage students in the regions.

CONCLUSIONS

What conclusions

KEYWORDS

Women in Engineering; Girls in Engineering; Disadvantaged students; Perceptions of Engineering; Engineering Careers.

Introduction

Engineering has remained one of the most male dominated professions around the world with male bias in undergraduate engineering student cohorts still evidenced (UN 2010). In contrast more girls are completing year 12 than boys, and more girls are undertaking tertiary studies than boys (Kaspura 2011). Engineers Australia suggests that women make up only 16% of commencing undergraduate students in engineering, and 9.5% of those with tertiary qualifications in engineering or related occupations (Engineers Australia 2008a). Of these statistics, over half of the 9.5% are under 30 years of age and just 15% of women engineers over 40 remain in the engineering profession. While women's involvement in engineering has increased somewhat over the past three decades, beginning from an extraordinarily low base, female participation remains very low compared to overall female workforce participation rates (Engineers Australia 2008b). This gender imbalance presents a missed opportunity if we are serious about addressing the engineering skills shortage. This is especially so in the regional context. Systematic intervention into the education system and graduate supply is required.

Perceptions, cultural and workplace flexibility issues have caused the exodus of women from the profession. Though addressing systemic workplace and cultural issues in the engineering profession is of urgency, the profession needs to consider strategies to improve the pipeline supplying female engineering graduates. Hence the K-12 sector is critical to successful participation.

While the business case for gender diversity at all levels is compelling, progress has been slow. The ILM report, *Ambition and Gender at work* (2011), suggests women's managerial career aspirations lag behind men's at every stage of their working lives and that they have less clarity over traditional career direction than men. From this research, there is still a fundamental perception and confidence issue about what women think they will be able to do. Up to 40% of first year undergraduate students first consider university in primary schools, and another 23% at lower secondary schools; with 79% (of those surveyed) decided to study an area of interest (Hare 2010). The finding, as part of a large-scale survey of 55,000 students in 55 institutions, has given universities quantitative evidence for the first time that young students are highly receptive to the notion of attending university. Prof Trevor Gale, director of the National Centre for Student Equity in Higher Education, said "For some children it is a given that they will attend university. They never consider otherwise. It's part of who they are" (Hare 2010).

In the absence of inspiration, directions and role models, this perception and confidence issue becomes endemic at the primary and secondary education levels, where growing minds form and adjust their expectations for future career paths, and they become self-limiting. Even if they persist through this doubt and progress to graduation at the tertiary level, female engineers may be acculturated with this self-limiting mentality. This can be intervened by changing the discourse describing the engineering profession, having engaging engineering activities, and having role models to inspire high school girls about a career in engineering. There have been many initiatives from the engineering profession and engineering faculties in addressing the supply of quality engineering graduates (King 2008). There have been a number of ALTC projects within the engineering and related disciplines (ALTC n.a.) as well as current and forthcoming ANET reports (ANET n.a.). Southwell & Morgan (2009) provides a comprehensive literature review of the leadership topic for the K-12 as well as the tertiary sectors, where Goh (2011) argued for leadership in engineering education from K-12 to university as key to improving diversity in the engineering profession. Frid (2010) aimed to enhance the primary teacher education students' capacities as

mathematics teachers to cater for the diverse achievements and learning needs of primary school students.

Other literature have suggested Women-in-Engineering conferences, equity and outreach programs exclusively catering for female students may increase the career aspirations of girls (Fahey & Missingham 2009; Holland 2007; Cater-Steel & McDonald 2011). However, these programs would only seek to partly address some very fundamental problems in the lack of recognition of the engineering profession within the community and the perceived masculine-oriented workplace culture (Mills et al 2007; Roberts & Ayre 2002; Darby et al 2003).

Other research alluded to the need to address the perceptions of engineering profession as a career option in female students (Oware et al. 2007; Jolly 2007; Hebbani et al 2010; English et al. 2011; Darby et al. 2003). In addition, Lyons & Quinn (2011) suggested that even though students who enjoyed science education at primary and middle school did not select science in year 11, reinforcing the need to change perceptions rather than just improving engagement in the classroom. Other major overseas research has been undertaken to address the question of perceptions (Marshall et al. 2007; Intel 2011; EngineeringUK 2011; NAE 2008), however, there are limited literature within the regional context except for those that revolved around low socioeconomic (SES) demographics (James 2001). While this research is nothing ground breaking or reliable, it seeks to understand the complexity of this fundamental problem that needs addressing in regional Australia.

Design and Methods

Research in perceptions and self-efficacies are often accompanied by inevitable biases, prejudices, and stereotypical perspectives, hence a theoretical framework established by Grounded Theory was used (Strauss & Corbin 1990). Though this research is far from empirical reality, it hopes to bring some insights for practitioner as to the main influencers affecting female students from regional context.

The engineering student role-model, who is a final year engineering female students went on two school outreach road-trip on behalf of the engineering faculty as part of a broader drive to increase rural tertiary participation. The two school outreach road-shows took the engineering student role-model to a number of regional towns including Roma, Charleville, Mitchell, and St. George. These outreach activities in regional schools seek to increase the equitable participation of female and in particular female indigenous students in tertiary education and to consider a career in engineering by:

- Providing remote-regional students access to school engagement programs that are normally available to schools in major towns and cities;
- Breaking down barriers and misconceptions about tertiary education and engineering studies;
- Inspiring non-traditional students to consider a career in engineering; and
- Actively addressing the gender imbalance in the engineering profession.

The data for the research is collected via a semi-structured interview with the engineering student role-model who went on this road-show allowing 2 weeks to reflect on the experience, followed by a thematic analysis to establish the findings (Aronson 1994).

Results and Findings

The results and findings were somewhat predictable. It was noted that in most cases, the findings are consistent with prior research (James 2001). The main reasons for lower tertiary participations mostly revolve around low socioeconomic factors and locational factors. Locational factors can be divided into accessibility to education infrastructure and rural/urban context. The role-model interviewed commented that even though she tried very hard to

remain positive, she was somewhat disappointed by the uninspired and unmotivated nature of the cohorts that she was attempting to inspire.

The role-model reflected that most female students in these locations other than Roma, did not see much sense in going to university and often have the perceptions that you have to be good at maths and science to do engineering, especially “hard” maths. Some students commented that a university qualification is not necessary for the job they are seeking, and that ideally they want to start earning money once they finish high school. Some commented that they did not have the results to go to university, but some students actually aspire to go but thought that financially it was inhibitive and that their family would not support them doing so. Peer groups were mentioned as important but were not a major influencer for deciding to go to university. Though distance education and online learning have been part of the Australian educational system for more than 15 years, it was surprising that most students still attribute “going” to university means one have to move away from their immediate community to major capital cities. This indicates a lack of understanding of the possibilities and accessibilities of tertiary education in the 21st century. With the roll-out of the NBN, this accessibility will be enhanced even more so, enabling more technologies that can be utilised through fast broadband.

It was interesting to note the role-model’s excitement when she spoke of the students at Roma. “The students were different there, somehow”, she said. Though, it has a fairly high percentage of low SES cohort, and perceived as having low access to tertiary education (by distance), the students were inspired and motivated to achieve an OP (Qld tertiary entrance score) for attending university. Some indicated they are already thinking about moving to the “big-smoke”. Some students commented that they will remain around the community because there is “plenty” of work opportunity around but wishes to study part-time to get a qualification via distance, and for some an engineering qualification!

“Is this caused by the coal-seam gas companies coming into the Roma in the last few years?” wondered the role-model as we progress through the interview. She agreed that this is a possibility, in that Roma in the last few years saw significant infrastructure investments in new shopping complexes, new roads, new housing developments, and new airport being developed. It ceased to be rural. Though Roma is still relatively small in population, its context is much more transient and urban (and yes, you can get a decent cappuccino in Roma and fast broadband). The role-model also commented that these types of “interventions” and school visits by universities were quite common in Roma schools. In a way, the interventions were sustained over time.

In contrast, Mitchell, St George, and Charleville did not have the major investments in social infrastructure in recent times, the lack of transient workforce with “engineering” related qualifications (who fly in and fly out), and lack of sustained interventions.

Even though the research is based on one sample and findings were in most cases, consistent with prior studies. It was noted that social infrastructure seems to be a significant influencer for students to aspire for tertiary education. Though this has not been historically or empirically proven, it is worth examining further in a wider study. The other factors of significance relate to the composition of local or transient workforce. In some ways, they are the role models, and its significance can be supported by literature in female attraction to STEM careers. And lastly, an obvious observation, a sustained effort in effective interventions (student attraction for tertiary education) is required.

The next stages of research are to triangulate the observations presented in this paper with surveyed data from the students who participated in the outreach workshops. Future plans include regional settings in other states, and potentially a larger sample size with regards to school ambassadors who are interviewed.

Conclusions

The engineering profession within Australia has failed to attract young women for the last decade despite all the effort that have gone into promoting engineering as a preferred career choice for girls. It is a missed opportunity for the profession to flourish as a heterogeneous team. Many traditional initiatives and programs have failed to make much impact or at best incremental improvement into attracting and retaining more women, especially so in rural and regional contexts. The reasons why girls and young women in most parts of the world show little interest in engineering haven't changed, despite all the efforts to address them.

The preliminary evidence gathered in this research is based on a sample of one. Hence, authors acknowledge the limitation in reliability and validity of the findings. However, our finding suggests that the factors that potentially discourage tertiary education participation have not changed. There are socioeconomic factors and locational factors (accessibility and rural context). But, our research has also indicated that these factors can be negated. It requires that:

- Significant investments in social infrastructure to change the community from rural to urban context (this needs to be investigated further);
- A local or transient workforce that are STEM related acting as role-models; and
- Sustained interventions on student attraction for tertiary education over time.

It is hope that this paper can generate more interest in understanding and addressing the lack of female participation in engineering in rural and regional settings, and encouraging more research to be undertaken out “bush”! Beware of the flies though if you do!

References

- ALTC (n.a.). Australian Learning and Teaching Council: Grants and Projects, <http://www.altc.edu.au/projects>
- ANET (n.a.). Australian National Engineering Taskforce, <http://www.anet.org.au/>
- Aronson, J. (1994) A Pragmatic View of Thematic Analysis. *The Qualitative Report*, Volume 2, Number 1; Retrieved Sept 1, 2014, from <http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html>
- Briody, F., Goh, S. & Dawes, L. (2012). *Power of Engineering: Changing the perceptions of year 9 and 10 female school students towards an engineering career*. Proceedings of the 23rd Annual Conference for the Australasian Association for Engineering Education, Melbourne, 3-5 Dec 2012.
- Cater-Steel, A. & McDonald, J. (2011). *Supporting women in engineering, science and technology: The GoWest Project*. In Hudbson & Chandra (Eds) STEM in Education Conference. QUT, Brisbane, 24-27 Nov 2010.
- Darby, L., Hall, S., Dowling, K. & Kentish, B. (2003). *Perceptions of engineering from female secondary college students in regional Victoria*. Proceedings of the 2003 AaeE conference, Melbourne, 29 Sept – 1 Oct.
- Engineers Australia (2008a). *The Engineering Profession: A Statistical Overview*. 5th Edition. Engineers Australia.
- Engineers Australia (2008b). *Valuing the difference: an update on the progress of women in engineering profession*. April 2008. Engineers Australia.
- EngineeringUK (2011). *2011 Engineering and engineers brand monitor: understanding perceptions of engineering, engineers, manufacturing and technicians*. EngineeringUK.
- English, L., Hudson, P.B. & Dawes, L.A. (2011) *Middle school students' perceptions of engineering*. In Hudbson & Chandra (Eds) STEM in Education Conference. QUT, Brisbane, 24-27 Nov 2010.
- Frid, S. (2010). *Developing primary teacher education students' professional capacities for children's diverse mathematics achievement and learning needs*. Final report to the Australian Learning and Teaching Council.

- Fahey, E. & Missingham, D. (2009). *Educating and promoting women in engineering through an international conference for undergraduate and postgraduate engineering students*. 20th AaeE Conference, University of Adelaide, 6-9 Dec.
- Goh, S. (2011). *Leadership in engineering education from K-12 to university: Key to improving diversity in the engineering profession*. 15th International Conference for Women Engineers and Scientist, Adelaide, 19-22 July.
- ILM (2011). *Ambition and gender at work: Research findings*. Institute of Leadership and Management, UK. Retrieved Aug 1, 2012, from http://www.redhotcurry.com/pdfs/ILM/Ambition_and_Gender_at_Work.pdf
- Intel (2011) *Survey of Teens' perceptions of engineering*. July 2011. Intel.
- Hare, J (2010). "University dreams start in primary school". *The Australian*, Nov 24, 2010. Retrieved Aug 1, 2012, from <http://www.theaustralian.com.au/higher-education/university-dreams-start-in-primary-school/story-e6frcjx-1225959737265>
- Hebbani, A., Roan, A., Westwood, R. & White, C. (2010). *Female careers in science and engineering*. A report submitted to the University of Queensland, Dec 2010.
- Holland, B. (2007). *Remembering not to forget why there are so few women in engineering: the Women in Engineering program, UTS 1981-*, Proceedings of the 2007 AaeE Conference, Melbourne, Dec.
- James, R. (2001). Participation disadvantage in Australia high education: An analysis of some effects of geographical location and socioeconomic status, Chapter 42 in *Higher Education*, pp455-472, Kluwer Academic Publishers, Netherlands.
- Jolly, L. (2007). *Women, Men and the practice of Engineering*. Proceedings of the 2007 AaeE Conference, Melbourne, Dec.
- Kaspura, A (2011). "More students attracted to engineering but still not enough". *Engineers Australia*, Vol 83, No. 5, May 2011.
- King, R (2008). *Engineers for the future: addressing the supply and quality of Australian engineering graduates for the 21st century*. A scoping report for the Australian Learning and Teaching Council. Retrieved Aug 1, 2012, from http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=424B574D-BEB5-F665-89AE-6A23B49918C6&siteName=ieaust
- Lebihan, R. (2012). Engineering drive to alter the gender equation. *Australian Financial Review*, 28th May 2012.
- Lyons, T. & Quinn, F. (2011). Looking back: students' perceptions of the relative enjoyment of primary and secondary school science. In Hudbson & Chandra (Eds) *STEM in Education Conference*. QUT, Brisbane, 24-27 Nov 2010.
- Marshall, H. (2007). *Public attitudes to and perceptions of engineering and engineers 2007*. A report for the Royal Academy of Engineering and the Engineering and Technology Board, September 2007.
- Mills, J., Mehrtens, V., Smith, E. & Adams, V. (2007). *Would you choose an engineering degree course if given the choice again?* Proceedings of the 2007 AaeE conference, Melbourne, Dec.
- National Academy of Engineering (2008). *Changing the Conversation: messages for improving public understanding of engineering*. A report published by NAE funded by National Science Foundation.
- Oware, E., Capobianco, B. & Diefes-Dux, H.A. (2007). *Young children's perceptions of engineers before and after a summer engineering outreach course*. 37th FIE Conference, Milwaukee, 10-13 Oct.
- Robert, P. & Ayre, M. (2002). Did she jump or was she pushed? A Study of women retention in the engineering workforce. *Int Journal of Engineering Education*, Vol.18, No.4, 415-421.
- Southwell, D & Morgan, W (2009). *Leadership and the impact of academic staff development and leadership development on student learning outcomes in higher education: A review of the literature*, a report for the Australian Learning and Teaching Council. Retrieved Aug 1, 2012, from <http://www.altc.edu.au/resource-leadership-academic-staff-development-literature-review-qut-2009>

Strauss, A. & Corbin, J. (1990). Basics of qualitative research: Grounded theory procedures and techniques. Thousand Oaks, CA, US: Sage Publications, 270 pp.

United Nations (2010). The World's Women 2010: Trends and Statistics. Department of Economic and Social Affairs, United Nations, New York. Retrieved Oct 15, 2012 from http://unstats.un.org/unsd/demographic/products/Worldswomen/WW_full%20report_color.pdf

Acknowledgements

Acknowledgements are given to the hundreds of boys and girls in high schools around remote western Queensland who took part in the USQ engineering outreach program during a number of road-trips in 2013.

Copyright statement

Copyright © 2014 Goh & Adams: The authors assign to AAEE and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to AAEE to publish this document in full on the World Wide Web (prime sites and mirrors), on Memory Sticks, and in printed form within the AAEE 2014 conference proceedings. Any other usage is prohibited without the express permission of the authors.