

# The International Journal of Engineering Education

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### Part I—Special Issue on Women in Engineering

Guest Editors: Jeff Jawitz and Jennifer Case

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| <b>Heather Stonyer</b>               | 392–399 | Making Engineering Students—Making Women: The Discursive Context of Engineering Education |

*Using a contemporary feminist framework, professional engineering education is located in the intersection of three discourses—the scientific discourse, the managerial discourse and the liberal education discourse. Within each of these discourses, ways of understanding engineering are articulated. This articulation occurs through practices, values, pedagogy and available knowledge(s) of engineering education. Centred in these discourses are particular normalised ways of understanding the engineer—these are the engineering identities of the scientist, servant and citizen. These are successful identities available to women (albeit with some restrictions). A number of practices, contexts and interactions, which create identities for women 'outside' engineering—the almost guys, helpmate and power-puff girls—are also identified. While advocacy can 'learn' from both the strategic compliance, at times, and the relative ease of some women's 'fit' into 'normal' engineering identities, in the women's experiences there remains a prevalent theme of 'not belonging' in the engineering community 'as of right'. It is argued that for full and effective participation in the engineering community we need to begin to explore how this asymmetrical relationship between men and women continues to be reiterated through the context of engineering education, particularly in engineering knowledge(s). In view of this, feminist advocacy needs to forge new partnerships with men in engineering, to ensure together that they achieve their intended goal of equity and equality for women in engineering.*

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| <b>Berna Zengin-Arslan</b> | 400–408 | Women in Engineering Education in Turkey: Understanding the Gendered Distribution |
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*The average percentage of female students in engineering departments in Turkey of 25% in 1998, allows us to argue that women are capable of representing themselves in this field to some extent. However, a detailed examination reveals that the distribution of female students in engineering departments is not even: they are more greatly represented in some departments than others. It can be argued therefore that women in Turkey have a reasonable opportunity of being represented in the field of engineering, which has been a male dominated area; nevertheless they exist in this realm with respect to their gender roles. In other words, areas that can be described as 'masculine' engineering departments and 'feminine' engineering departments have been formed and the decisions of female and male students in their choices of departments have been affected by this configuration. In this article, I firstly provide the data revealing this uneven distribution of women in different engineering departments of the universities in Turkey. Then I start investigating possible causes of this gendered distribution with an emphasis on the discursively constructed 'masculine' and 'feminine' images of engineering departments. This assessment is an outcome of the interviews that I have conducted with 15 women engineers from February 2000 to April 2000 in Turkey. Their experiences during their educational period with institutional structures and individuals such as professors and the other students, and their discourses on 'engineering' and their own departments are emphasized.*

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| <b>Alison Phipps</b> | 409–414 | Engineering Women: The 'Gendering' of Professional Identities |
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*This paper presents some of the findings of a research project conducted in the year 2000 in the UK, investigating the under-representation of women in the engineering profession. Many of the conclusions revolve around the imagery and cultural stereotyping that affects the educational decisions made by girls and young women, and suggests that professions and curricular areas are 'gendered' in a way that tacitly limits their career choices. Suggestions are made for initiatives that might combat this problem, suggesting in particular that images of female engineers should be prioritised in the context of industry public relations.*

#### *Experience of Industry*

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| <b>Pam Roberts and Mary Ayre</b> | 415–421 | Did she Jump or was she Pushed? A Study of Women's Retention in the Engineering Workforce |
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*Women now constitute 15% of students in Australian undergraduate engineering courses, but they represent only 5% of the professional engineering workforce. If engineering industry is to enjoy the benefits of diversity, it is important to retain, as well as recruit, women into the profession. The Careers Review of Engineering Women (CREW) project was undertaken in 2000 to investigate the issues surrounding women's retention, satisfaction, and progression in the professional engineering workforce. All Australian-resident female members of the Institution of Engineers, Australia were surveyed, together with a matched sample of male engineers. The survey found that similar proportions of female and male engineering graduates joined the profession. Differences were found in the nature of the engineering work undertaken by women and men, with more women describing their work as engineering-technical, and more men describing their work as engineering-managerial. Women were more dissatisfied with workplace culture and conditions, they received lower pay and benefits, and were far more likely to experience sexual harassment and discrimination than their male counterparts. The data indicate that women over 30 are leaving the profession, particularly if they are combining career and family responsibilities. This paper examines the implications of these and other results from the CREW study, set in the context of the literature, and suggests strategies to improve workplace retention and satisfaction.*

*This paper reports on research that explored the experiences of a woman engineer working in one of the most male dominated British industrial sectors—the construction industry. The paper relates the experiences of its principal subject through reflective journal accounts that she provided over a 12-week period. The diarist experienced serious sexual discrimination and harassment. It is suggested that, if her experiences are typical, then support strategies must be put into place to help women at the outset of their careers. The introduction of sexual harassment policies and procedures, training for staff, mentoring programmes and insight courses are potentially effective ways of helping women engineers prepare for the difficult workplace environment that they could confront.*

*What are people doing about it?*

**Minna Salminen-Karlsson**

430–437 Gender-inclusive Computer Engineering Education: Two Attempts at Curriculum Change

*This study looks at two Swedish attempts at increasing the percentage of women in computer engineering education by changing the curriculum. One of the reforms concentrated on teaching methods and the other on creating a single-sex introductory class for women with a non-science background. The incentives for the reforms, the impact of the different institutional contexts, the role of the leaders as well as the needs and role expectations among the academic staff engaged in the reforms are discussed. The study reflects on the multi-faceted problems in changing a curriculum for the benefit of marginalised groups.*

**Peter J. Shull and Michael Weiner**

438–446 Thinking Inside the Box: Self-Efficacy of Women in Engineering

*We describe an initiative to investigate how institutional practices implementing information technology can promote retention of women in engineering through enhancing their self-perceptions and motivations. The initiative uses the self-efficacy theory to implement teaching techniques designed to promote educational attributes: greater motivation, effort, and persistence. The particular method we chose was to design and teach a course to educate women in the area of computer problem diagnosis and repair. Continued demonstration and reinforcement of the proficiency attained by the women throughout the course in computer technology distinguished them among colleagues and established an environment conducive to enhancing students' feelings of self-efficacy and associated control beliefs.*

**Annette Williams, Pat Turrell and Ros Wall**

447–451 Let's TWIST: Creating a Conducive Learning Environment for Women

*This paper describes the innovative staff development training offered by the Let's TWIST project, a European funded project aimed at widening participation of women studying, training and working in engineering, construction and technology. The training targets lecturers of engineering, construction and technology subjects in further and higher education across the UK and in Portugal. The training programme examines and shares the necessary components for creating a conducive learning environment for women. It examines the learning styles of women, curriculum content, recruitment and marketing and pedagogical practice that enhances self-esteem and confidence. The training material draws on the experience of female students nationally, and utilises the wide range and depth of the experiences of women lecturers from the project, in order to mainstream good practice. This article explores the impact the staff development training has had on the lecturers.*

**Ria Hermanussen and Cornelia Booy**

452–457 Equal Opportunity in Higher Technical Education: Past, Present and Future

*This article is a retrospective of 15 years of equal opportunity policy projects in higher technical education, and a consideration of the future thereof in the Netherlands. During this time the focus moved from a purely information exercise directed at girls to looking at the educational home for the cause. The latter initially concerned the didactical design of the courses, but now it also involves scrutinizing content followed by redesign of existing and design of new courses. Higher technical education is clearly on a new track that has tremendous potential. Nonetheless, a consistently integrated and expert approach is required.*

**Maria Udén**

458–464 The Impact of Women on Engineering: A Study of Female Engineering Students' Thesis Topics

*With a focus on technological practice, this paper detects and discusses changes that arose—or did not arise—as Swedish women entered engineering across a broader front. For this analysis, quantitative and qualitative data are related. A specifically new empirical source for the purpose of gender and technology studies is explored and described, namely M.Sc. theses by women engineering students. The conclusion is that the technology displayed in the women's theses does not differ from engineering science in general.*

## **Part II—Engineering Education Assessment and Research**

**Ivan S. Gibson**

465–471 Assessment in Engineering Education—A European Perspective

*The contents of this paper concentrate mainly on a review of papers presented at an International Seminar on Assessment held at Delft University of Technology, The Netherlands in 1999, and which was organised under the umbrella activities of the European Society for Engineering Education (SEFI). The fact that the Seminar was held shows that there is a real and widespread concern about assessment amongst engineering educators across Europe. Several themes emerge from this review and these are complemented using more recent published material. The overall message is that the education of engineers is changing rapidly from the traditional chalk-and-talk approach to one that emphasises understanding as well as acquisition of knowledge. There is an appreciable increase in project/problem-based activities. The major forcing terms for the change in paradigm are: pedagogical demands from teacher trainers, Governmental demands for more relevance, a drop in student demand for engineering programmes, the requirements of professional accreditation bodies, and the impact of individuals and small groups scattered across Europe who are experimenting in widely differing teaching environments.*

**Jeff Jawitz, Suellen Shay and Rob Moore**

472–478 Management and Assessment of Final Year Projects in Engineering

*The authors report on the first phase of a major study into the management and assessment of final year projects in engineering in the Faculty of Engineering and the Built Environment at the University of Cape Town. The results of a survey of assessment practice in final year projects across five departments are presented. The survey revealed a range of approaches and attitudes to the design, management and assessment of the final year project and the use of a variety of assessment methods. The authors make some preliminary comments on the implications of the lack of consensus in assessment practice on the key issues of the validity of the assessment system as well as the student perceptions of fairness.*

*The early formative years in engineering education are crucial in engendering a professional attitude and weaning students from a high school temperament. Junior students face a range of diverse subjects, involving various faculties, with seemingly minimal connections between them. For effective problem-solving, it is necessary to have an integrated cognitive structure for flexible retrieval and application of acquired tools. Students often fail to see the relation between the early courses and their chosen professional discipline. To encourage integration, we started the practice of collaborating with other course instructors of concurrent courses, to set a single joint project to count for both courses. The project, often with variations for each group, is carried out in small groups. The presentation of analyses and results provides opportunities to improve verbal and writing skills. We found that the exercise fosters a better understanding of relation between courses and an appreciation of the structure of the discipline during the formative stages of education. This article highlights the problems of fragmentation in engineering curricula, the remedial measures we tested and the results of our efforts.*