



International Journal of  
**Gender, Science and Technology**

<http://genderandset.open.ac.uk>

**A Review of 'Gender Inclusive Engineering Education'  
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**PUBLICATION DETAILS**

Date: 2010

Published by: Routledge

ISBN: 0-415-80588-0

**REVIEW**

The first few chapters of this book go over well trodden paths, summarising the extensive research on the under-representation of women in engineering in university education and in the workplace, but this is just the necessary scene setting for the more practical aim of the book – to influence university engineering departments to change their curricula. In the introduction the authors talk about 'the elephant in the classroom', the unspoken issue of gender in recent reports and books on engineering education. Equally, current concerns about technical skills shortages also ignore the issue of gender and the under-representation of women. The authors tellingly point out that in the 76 pages of a 2006 Australian government audit of skills shortages in science, engineering and technology there was not one single mention of 'women' or 'female', though they hasten to add that this omission was later acknowledged and redressed in a subsequent report by the Australian Council of Engineering Deans. In the introduction the authors also point out that in the many articles, reports and books on the under-representation of women in engineering, in both education and in the workplace, the issue of the engineering curriculum is rarely addressed.

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The rationale for this book is to address the under-representation of women in university engineering courses by specifically addressing the curricula of those courses. As someone who has been involved in these debates for nearly three decades, attending conferences, writing papers and being involved in projects such as Women in Technology at the Open University UK and the EU Curriculum-Women-Technology project and addressing many of these issues in general curriculum debates in a UK university, I was quite surprised at the recent research reported here.

Although the starting point here is the Australian context, care is taken to be broadly relevant. Chapter 2 summarises recent research on the numbers of women students in university engineering courses. International comparisons are difficult as the definitions used in the collection of data vary between countries, as do the dates and contexts of published statistics. This leads to a rather fragmented picture, made worse by the reported research yielding widely varying, and even contradictory, results. Nonetheless the familiar scene emerges of women constituting less than a quarter of engineering graduates in North America, Western Europe, Australia, Asia, Africa and the Middle East. Although some figures are given for other countries the concern of the authors is mainly for the English speaking world and in particular North America, Australia and the UK as they identify these as where the under-representation of women is most notable. They report that in Canada, USA and Australia the numbers of women in engineering had been steadily rising but have now either reached a plateau or gone down, whereas in the UK numbers have continued to rise but have always been noticeably lower. As this chapter is only short and aimed at scene setting it is understandable that it is only a snap shot and cannot give a comprehensive picture either among different engineering disciplines or over a longer time frame. This has been an issue of concern and research for decades now and it would have been interesting to see longer term comparisons.

Chapter 3 looks at the range of initiatives taken over the years to improve the numbers of women entering and succeeding in university engineering courses. A broad ranging and well structured overview of the theoretical contexts of these initiatives is given. The authors don't disagree with these initiatives, indeed they think they are essential. The premise of this book, however, is that these initiatives have not really addressed the problem and that although well intentioned the underlying, though usually unstated, theoretical premise of many initiatives is that women are themselves to 'blame' for their under-representation. This 'deficit model' targets women rather than institutions, curricula or the prevailing culture.

In chapter 4 the authors get to the real substance of their argument and the book livens up and becomes more radical. Earlier chapters outlined the whole premise of the book, that for engineering courses to be more attractive to women curricula need to change, and here the authors begin to expand on what they mean by this and make it clear that they are not talking about minor adjustments. 'Curriculum' doesn't just refer to course subject matter but to the whole learning environment including teaching methods, classroom structures and assessment strategies. In particular the authors argue that 'attention must be paid to the social composition of the class and the cultural background of the educator and students in the planning and practice of engineering education in order for it to qualify as inclusive' (p55). The authors give a very brief overview of learning theory, touching on Piaget and Vygotsky and then homing in on constructivism as they argue that this is currently the dominant learning paradigm. From a constructivist stance the context and relationships of learning are central and so all assumptions in the classroom, including those about gender, are obviously significant. The student constructs a concept of who is rightfully an

engineering student and who is not – from the classroom atmosphere, style of lecturer, language used, examples given and materials used – and when these are all male gendered that will be part of the student's construct and can lead to a clash between the identity the student has constructed of themselves and the identity of a 'professional engineer' absorbed from the teaching materials and culture. 'Gender inclusive curriculum' refers to a curriculum that has been consciously designed to recognise and acknowledge the evidence that there may be differences between the 'cultural baggage' brought to the classroom by men and women. This cultural baggage can include prior knowledge, interests, approaches to learning and strengths in assessment tasks. As constructivist learning theory suggests that new knowledge has to be linked to the old, the 'baggage' brought by students is clearly relevant to their learning. It is important not to assume that students have certain backgrounds, experiences and interests but to accommodate student diversity in the classroom and to realise that all students are advantaged by such inclusivity. The holistic approach advocated here is not totally new (CuWaT, 1998) but this book does bring the ideas together in a useful way.

Having set out the case for curriculum change, in chapter 5 the authors outline strategies for designing and implementing inclusive curricula. The approach taken is not hard-line or prescriptive, listing 'think about' points, giving concrete suggestions and recognising that innovators have to work within an often restrictive institutional context. The authors argue that whilst educators may not be able to change every component of the curriculum, tackling any component of a course is worthwhile. Much of what is covered here will be quite familiar to university faculty, and will already be being addressed by many institutions, but it is interesting and useful to have it presented as a holistic package as it is here. Additionally, most of what is described could be usefully extended to any subject area. Much of this chapter is based on the personal experience of the authors and gives rather general suggestions, but these are backed up with concrete examples from their own courses. Accreditation requirements of the different engineering bodies round the world are outlined in an appendix and are synthesised into a generic set of 'attributes of engineering graduates'. In this chapter they take each of these attributes - body of knowledge, lifelong learning, problem solving, autonomy and team work, ethics, communication and global contexts - and list indicators expressing inclusivity along with educational strategies for addressing each indicator. Some very concrete and useful strategies are given with practical advice and examples, mainly in what would come under the heading of contextualisation.

Chapter 6 is again a very practical and useful one, aimed at engineering teaching staff and the challenges faced in the classroom. It recognises the reality of the teaching situation and that compromises often have to be made when trying to ensure inclusiveness in an environment that is still steeped in more traditional cultures. Eleven examples from a range of countries and contexts are given with discussion of the teaching approaches, how they are inclusive and how successful they have been. These are followed by additional suggestions under the seven attributes required of engineering graduates.

Recognising that progress can easily be lost when staff change, in chapter 7 the authors consider the policies and strategies needed to ensure that gender inclusivity is embedded into an institution. It was very interesting to read that since 1990 all Australian universities have had to develop and report annually on equity plans including access, retention and success for study fields with less than 40% female students – that is very radical when compared with countries such as the UK, though

it seems that progress in Australia has stalled recently due to funding cuts. The issue of embedding inclusivity in institutions considers institutional leadership, diversity policies, inclusive culture, faculty development, collaborations, women-in-engineering programmes and ongoing research and evaluation. These are all easier said than done, and this section gives the overall good intentions followed by three examples. What comes out of these is that gender inclusivity is a continuous process rather than something that can be dealt with once and for all.

This book is a useful reminder that the issue of the under-representation of women in engineering is still there and it is a fresh look at some of the questions and gives a strong argument for a more holistic approach. What is proposed is 'nothing less than a different way of doing engineering education' (p177), targeting the curriculum and whole learning environment rather than just 'targeting the women'. It is a useful contribution to the debate and includes many useful suggestions.

#### **REFERENCE**

CuWaT (1998) Changing the curriculum – Changing the balance? Unpublished report of the Curriculum-Women-Technology project sponsored by the European Union under the Leonardo da Vinci programme.