



# What's gender got to do with it?

## Gender inclusive Engineering Education

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# Are there really so few women in engineering?

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- Australia completions 17.4% peak in 2003, down to 16.6% in 2008 (less than 2001) and domestic proportion decreasing.
- USA completions in 2007-8 were 18.1%, lowest since 1996
- Canada completions peaked at 21.8% in 2003, decreased each year since then to 18.9% in 2007
- UK completions 15.5% in 2005-6, slowly increasing



# How does this compare to other fields of professional education?

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- **Higher education bachelor completions or commencements in Australia 2008:**
  - Engineering 16.6% women (1441 women, 7220 men)
  - Architecture 43.1% women (1352 women, 1782 men)
  - Medicine (comm) 53.6% women (1942 women, 1684 men)
  - Veterinary (comm) 77.1% women (384 women, 114 men)
  - Law 57% women in 1999



# What about the workforce?

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- 2006 engineering professional workforce statistics:
  - Australia – 11.2% of employed engineers were female (ABS)
  - USA – 11.1%
  - Canada – 12.2%
  - UK – 8.7%
  - Germany – 15.4%
  - Romania – 25.2%



# Three key issues for Eng education – attraction, success and retention

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- Attraction – getting more women in to study engineering
- Success – having those students succeed
- Retention – keeping the women in the degree and graduating
- (of course these issues apply to the workforce as well)



# Attraction – key factors

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- Supportive teachers and family environment
- Strong role models
- Ability in maths and science
- Wanting to help society; “human issues”
- Experience of engineering-related activities and Career Days/Open Days (but teachers need to consider who they nominate to attend events)



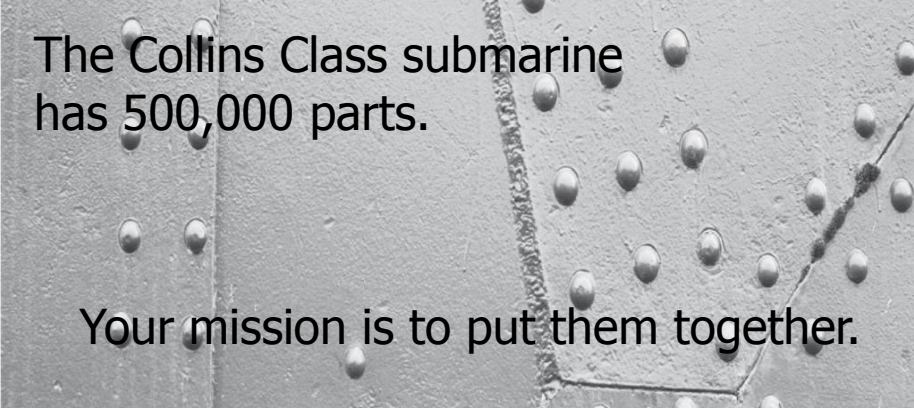
# What can universities do to attract more women to engineering?

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- Women in Engineering programs
- Scholarships for WIE
- Gender inclusive marketing
- Role models – more female lecturing staff
- These issues are NOT the responsibility of the very few female engineering faculty members.



# Gender inclusive marketing



The Collins Class submarine  
has 500,000 parts.

Your mission is to put them together.

**NOT this!**



Engineering builds the future.

Your job is to make it sustainable.

**A bit better**



# Success & Retention

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- What can universities do?
  - Support networks for female students (WIE programs, but beware spotlighting)
  - Increased industrial experience for students
  - Role models and mentoring
  - Better teaching and review of **curriculum**



What does curriculum mean to you?

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# What does gender have to do with engineering curriculum?

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- ... students and others have observed that engineering curricula (and physical science texts) tend to be crafted with over-use of masculine stereotypes and examples, such as automobiles, rockets and weapons. (King 2008: 72)



# What we know about women in engineering, construction & science

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- different prior knowledge and experiences with technology and science
- many women are interested in social context and value of technology
- preferences for collaborative learning environments (evidence from some studies but others dispute)



# Gender Inclusive curriculum

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- An inclusive curriculum is a curriculum (both content and pedagogy) which has been consciously designed not only to recognise and respond to the differences between individual students, but also to *use* these differences to enrich the learning experience of *all* students.
- A curriculum that builds a sense of men and women working together

How can I make my courses more  
inclusive?



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# Gender Inclusive Curriculum

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- Designing and implementing a gender inclusive curriculum requires consideration of all of the following curriculum components:
  - Assumptions about students
  - Aims and objectives
  - Assessment
  - Content
  - Teaching and learning methods
  - Teaching practices
  - Learning environment



# Gender Inclusive Curriculum

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- Making any of these components more gender inclusive will help
- Ideally, all of these components should be incorporated into the process
- Making any individual course more inclusive will help make a program more gender inclusive
- Again, ideally the program as a whole should be considered



# GIC – Assumptions about students

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- Think about:
  - Prior experiences of students
  - Whether all or any have “tinkering” experience
  - Access to computers and computer literacy
- Include introductory lab and computer sessions that are open to all, not seen as remedial



# GIC – Aims and Objectives

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- Think about:
  - How to integrate technical with societal needs
  - Developing student awareness of different cultural and gender perspectives, globalisation
- Include social, environmental and global aims and objectives as well as the technical and professional ones



# GIC – Assessment

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- Think about:
  - Some assessment modes favour some groups
  - Assessment techniques should match T & L
  - Context/language can favour some groups
- Provide a variety of assessment methods
- Allow choices
- Ensure relevance



# GIC – Content - 1

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- Think about:
  - Incorporating diverse interests
  - Use open-ended opportunities sometimes
  - Relating theory to real world
  - Using analogies that are gender or culture specific
  - Using application examples that only interest some students
  - How have the topics been decided?



## GIC – Content - 2

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- Include applications in different social and cultural contexts
- Give students investigative problems
- Include cross-disciplinary opportunities
- Use examples of general familiarity and interest rather than those that will be unfamiliar or of no interest to many in class
- Discuss ways in which technology has improved lives



# GIC – Teaching and learning methods

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- Think about:
  - Active learning strategies are generally more effective than passive
  - Use a variety of teaching methods to accommodate a range of learning styles
- PBL, mini-projects, peer-assisted, case studies, computer-based, collaborative, open-ended laboratory exercises



# GIC – Teaching practices

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- Think about:
  - Many studies of engineering students show that women may lack confidence at the start and that this persists and sometimes increases
  - How to give equal attention to all students
  - Group selection and operation
  - Language issues – technical terms, time to respond
  - Working to include all students and building recognition of difference among students



# GIC – Learning environment - 1

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- Think about:
  - Teacher-student gender and culture dynamics
  - Student-student dynamics
  - The atmosphere in the classroom – is it friendly and open?
  - Are you interested in the students?



## GIC – Learning environment - 2

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- Encourage all students to participate in class
- Ask students how to modify activities to include them
- NEVER tolerate racist or sexist remarks
- Ensure rules of behaviour are clear to all



# An exemplar of inclusive practice in engineering

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# Engineering materials - 1

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- Course structured around industry case studies, practical demonstrations of material failures in class
- Environmental and human factors considered, e.g.
  - Fracture of a marine oil pipe resulting in oil slick
  - Corrosion of steam pipes with potential for injuries
  - Tutorials that ask students to give judgements on legal issues regarding injury arising from material failures – whose responsibility?



# Engineering materials - 2

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- Assessment range and flexibility
  - Online quizzes, in-class quizzes, written assignments, practical reports
  - Students who do not achieve 50% in these must sit exam
  - Other students may choose whether to do the exam to replace quiz results but with a guarantee their mark will not reduce



# Engineering materials - 3

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- Why is this gender inclusive?
  - Content approach enables students to relate study to the social and environmental aspects of engineering, rather than just the theory
  - Use of failures as examples that most students will be familiar with
  - Flexibility and range of assessment gives students from diverse backgrounds the opportunity to choose how to best demonstrate their knowledge
- Student evaluations consistently excellent

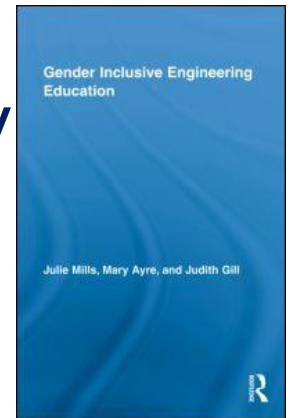
# Gender Inclusive resources - 1

- Project website:

<http://resource.unisa.edu.au/course/view.php?id=568>

- Book:

Gender Inclusive Engineering Education by  
Mills, Ayre & Gill (Routledge, 2010)





# Gender Inclusive resources - 2

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- *DiversityWeb*. <http://www.diversityweb.org/>
- *EngineeringExamples.org*  
<http://www.engineeringexamples.org>
- Busch-Vishniac, I.J. and Jarosz, J.P. (2007) 'Achieving greater diversity through curricular change', in R.J. Burke and M.C. Mattis (eds) *Women and Minorities in Science, Technology, Engineering and Mathematics*. Cheltenham: Edward Elgar.



# Relevant recent studies/reports

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CREW 2000 and 2007 – Career Review of Engineering Women, Engineers Australia ([WIE resources](#), Australia)

King 2008 – [Engineers for the future](#) (Australia)

FASTS 2009 – [Women in Science in Australia](#)

AAUW 2010 – [Why so few?](#) Women in STEM (USA)

Hewlett et al 2008 – [The Athena Factor](#) – Reversing the brain drain (USA)



# Thankyou

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## Questions?

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