Women in Engineering: Building Confidence and Interest

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Background
Women in Engineering Programs

ARIZONA STATE UNIVERSITY
1997 - 2007

THE OHIO STATE UNIVERSITY
2011 - 2015

American Association of University Women

American Society of Home Inspectors

APASE

FIRST

Background Personal

2015 - present
Career Path

- Not a straight line!
- Your future career may not exist ... yet.
- What do I want to do?
- What kinds of skills do I need?
- How do I get there?
Essential Skills for 21st Century Workforce

Learning and Innovation Skills
- Creativity and Innovation
- Critical Thinking and Problem Solving
- Communication and Collaboration

Life and Career Skills
- Flexibility and Adaptability
- Initiative / Self-Direction
- Social / Cross-Cultural
- Productivity / Accountability
- Leadership and Responsibility

What is Engineering Diversity?

Underrepresented Pops.

- Less than 25%
  - Perkins Legislation
  - Title IX

Example:
- African Americans / Hispanic / Latino Americans make up ~24% of the population / combined make up <10% of the engineering Ph.D.'s

Inclusion in Engineering

- Women
- African American
- Hispanic / Latino
- Native American
- Disability Community
- LGBTQIA

Why is it Important?
- Economic Imperative
- Cultural Shift
- Cultural Competency
- Innovative Solutions
Why Embed Diversity?

Diversity leads to better outcomes
Diversity trumps ability
Diversity and problem solving

“By seeing problems differently and by looking for solutions in different ways; teams, groups, and organizations can locate more potential innovations.”

“Diversity leads to superadditivity, but only if members value the diversity present in the team” (i.e., people are heard and are willing to hear)

Women are.....

Everywhere - 50.8% of US Population*

Where women aren't ....

- represent 19.9% of all engineering undergraduate students in US
- women earn 19.1% of undergraduate degrees awarded in engineering***
- 22.4% engineering Ph.D. produced***
- up to 11% of practicing engineers?

Total Bachelor's Degrees Awarded by Engineering Discipline, by Gender, 2010-2011

Confidence vs. Interest
What comes first?
#Likeagirl
Engineering Student Profiles & Retention

- **Student Profiles**
  - High ACT / SAT Scores
    - Avg. SAT composite 1850+
    - Avg. math 720
    - GPA 4.0+
    - Admissions not necessarily based on holistic review
    - More competitive profile than listed as published minimum requirements
    - Women, on average, higher ACT/SAT scores than men
    - Women, more involved in leadership activities and outside organizations

- **Questions:** Are these students successful?
  - Do these students make the best engineers?
  - What can help make students more competitive?

- **Retention Issues**
  - Approx. loss of 40% students within first two years
  - Who are we losing?
  - Where are they going?
  - Why are they going?
Female Eng. Majors Less Likely to Work as Engineers after Graduation

Occupations of Engineering Majors
One Year After College Graduation, by Gender

1Includes education, training, and library occupations (except teachers); arts, design, entertainment, sports, and media occupations; and miscellaneous other white collar occupations

2Includes drafters; food preparation and service occupations; farming, fishing, and forestry occupations; construction and extraction occupations; installation, maintenance, and repair occupations; production occupations; transportation and material moving occupations; military specific occupations; and miscellaneous other blue collar occupations.

Bold numbers indicate a significant gender difference.

Source: Author's analysis of U.S. Department of Education, National Center for Education Statistics, 2008-2009 Baccalaureate and Beyond Longitudinal Study data

National Longitudinal Study: University of Wisconsin-Milwaukee, NSF funded

- 30 universities recruited / 230 universities responded / 5,500 women

**Key Findings** for women not enter engineering after graduation:
- 33% because perceptions of engineering as inflexible or engineering workplace culture not supportive of women
- 30% no longer interested in engineering
- Using knowledge they learned in engineering in other fields
Case for Improving Climate

**Rankings:**
University Rankings based on freshman retention rate; 6 year graduation rate; stud/fac ratio; class size; faculty resources; % faculty full-time; alumni giving; PhDs/faculty; NAE members; research $; reputation

**Climate has DIRECT impact** on factors considered in ranking…

**Workforce Development:**
Industry is demanding engineering education adapt to dramatic changes in engineering practice and engineers be prepared to build their future through wide range of leadership roles to meet grand challenges

**Climate has DIRECT impact** on factors considered in workforce development…

**Research Funding:**
NSF, industry partners, and other agencies have demanded that research criteria not only contain intellectual merit but **broader impacts**, the benefit to society and how research contributes to the achievement of specific, desired societal outcomes

**Climate has a DIRECT impact** on factors considered in research and funding…

**Increasing diversity is a byproduct** and climate is central to the overall “state” of the college of engineering.
WEPAN – National Conversation on Climate

- Handouts

**Frame 1**

*Equip the Women*

Minimize differences in experience between women and men so that women can compete as equals.

*Focus is on the individual.*

**Frame 2**

*Create Equal Opportunity*

Focuses on eliminating structural and procedural barriers that are biased against women and impede advancement. Interventions tend to be legalistic and policy-based.

[Link: http://www.simmore]
Great activities to develop future engineers!
WiE FIRST LEGO League

WiE TECHie
and
TECHie Bytes
WiE FIRST LEGO League

Eagle Robotics
Project Teams and Stereotype Threat

* 75 students responded
* 80% team retention in the first year
* biggest hurdle: fear of making a mistake
Components – must haves for girls!

- Gender neutral – beware of programs that have gender bias towards one sex or other.
- Context is important!
- Never be afraid to challenge girls, technically
- Encourage MISTAKES! Lots of them!
- Use mistakes as LEARNING opportunity, rather than belittling experience
- Encourage men and boys to be advocates...
- Help women to gain coping mechanisms for challenges they will face – be realistic!

Why Eastern And Western Cultures Tackle Learning Differently September 02, 2013 4:45 AM ET NPR
Changing the Conversation

• Engineers make a world of difference
• Engineers are creative problem solvers
• Engineers help shape the future
• Engineering is essential to our health, happiness, and safety

NAE Update, Changing the Conversation Report (2013)
Prepare Her!

- FIRST Lego League
  - http://www3.usfirst.org/
- Project Lead the Way (PLTW)
  - https://www.pltw.org/
- Take STEM or CTE Courses
- AP Courses
- Take Physics!!!!!
- More Math Please!!!!

Fix Something!!

Hands-on

Get a job in High School!
Links to area STEM-related summer camps

- Techie Camp – TECH CORPS (Columbus)
  - http://hadron.techcorps.org/
- iD Tech Camps (OSU and Case Western)
  - www.internaldrive.com/locations/oh-summer-camps-ohio-computer-camps/
- Camp Invention (all over)
  - www.invent.org/camp/default.aspx
- Math Plus Academy Technology Camps (Powell / New Albany)
  - www.mathplusacademy.com/summercamps/
- Great Lakes Science Center Camps (Cleveland)
- Camp COSI (Columbus)
  - www.cosi.org/families/camp-cosi
- Young Women’s Summer Institute
  - https://osc.edu/education/yhsi
Engineering Grand Challenges

- Make Solar Energy Economical
- Provide Energy from Fusion
- Develop Carbon Sequestration Methods
- Manage the Nitrogen Cycle
- Provide Access to Clean Water
- Restore and Improve Urban Infrastructure
- Advance Health Informatics
- Engineer Better Medicines
- Reverse-Engineer the Brain
- Prevent Nuclear Terror
- Secure Cyberspace
- Enhance Virtual Reality
- Advance Personalized Learning
- Engineer the Tools of Scientific Discovery

THANK YOU!

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