Gender Equality in STEM: Empowering Women Through Leadership and Engineering Education Strategies

Stella A Quinones, Patricia A Nava and Ben Flores

The University of Texas at El Paso

STEM GENDER EQUALITY CONGRESS

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Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

• **WHY** do we want to increase the number of women in engineering? **WHY** does it matter?

• **WHAT** path led us to where we are now?

• **WHO** is UTEP?

• **HOW** will we increase the number of women pursuing engineering degrees?
Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

• **WHY** do we want to increase the number of women in engineering? **WHY** does it matter?
Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

- **Contribution to Family Income (Texas)**
  - 1970: 66% (Females), 34% (Males)
  - 2010: 42% (Females), 58% (Males)

- **Total Workforce (US)**
  - 2009: 48% (Females), 52% (Males)

- **STEM Jobs (US)**
  - 2009: 24% (Females), 76% (Males)

- **Engineering Jobs (US)**
  - 2011: 13% (Females), 87% (Males)

Sources:
- ASEE Engineering by the Numbers
- Economic Issues for Women in Texas
- US Dept of Commerce
- US Census
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Engineering Enrollment by Gender (US, 2015)

- Bachelor’s:
  - Female: 21.4%
  - Male: 78.6%
- Master’s:
  - Female: 24.1%
  - Male: 75.9%
- Doctoral:
  - Female: 26.2%
  - Male: 73.8%

Engineering Degrees Awarded by Gender (US, 2015)

- Bachelor’s:
  - Female: 26.2%
  - Male: 73.8%
- Master’s:
  - Female: 19.9%
  - Male: 80.1%
- Doctoral:
  - Female: 23.3%
  - Male: 76.7%

More likely to be employed in STEM Fields

ASEE Engineering by the Numbers
Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

- 2 million job openings in STEM by 2022
- Less pay disparity in STEM jobs compared to other jobs
- Investing in women’s success → cultivate leaders of tomorrow and more innovation and more successful companies
- Currently only 6% of all females graduates earn their degree in a STEM discipline

Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

• **WHO** is UTEP?
Where is The University of Texas At El Paso?

5% of UTEP Students (~1,100) are from Mexico
Who is The University of Texas At El Paso?

- El Paso Population: 679,036, 80% Hispanic
- UTEP Population: 23,000, 84% local, 80% Hispanic, 5% Mexico
- University President: Diana Natalicio
- Architecture: Bhutanese
- College of Engineering Faculty: 103, 14% Female (44% UTEP Faculty Female)
- College of Engineering Students: 2,929 UG, 20% Female
Who is The University of Texas At El Paso?

Ranked among the Top Ten research universities in the U.S. - Washington Monthly Magazine
Engineering graduate programs ranked among the top 5 in the U.S. for Hispanics (10th consecutive year)
UTEP ranks 1st in the number of Hispanic graduates in Mathematics and Statistics, Engineering, and Education – Hispanic Business Magazine
UTEP ranks 3rd among all U.S. colleges and universities in the total number of bachelor’s degrees awarded to Hispanics in all academic disciplines – Hispanic Business Magazine

“to ensure that whatever their backgrounds, all young people in our region will have the opportunity to attain their full potential”

“balance a quest for excellence with a strengthened commitment for access”

Diana Natalicio
UTEP President
College of Engineering: Female Enrollment

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Fall 2006</th>
<th>Fall 2007</th>
<th>Fall 2008</th>
<th>Fall 2009</th>
<th>Fall 2010</th>
<th>Fall 2011</th>
<th>Fall 2012</th>
<th>Fall 2013</th>
<th>Fall 2014</th>
<th>Fall 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Enrollment</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>17%</td>
<td>21%</td>
<td>18%</td>
<td>19%</td>
<td>18%</td>
<td>22%</td>
<td>23%</td>
</tr>
</tbody>
</table>
Degrees Awarded to Women in Engineering
UTEP

% Degrees awarded to Women in Engineering
2006 - 2016

Highest % of female graduates:
Civil Engineering (28%)
Industrial Engineering (40%)
Metallurgical and Matls Eng (39%)

Lowest % of female graduates:
Computer Science (20%)
Electrical Engineering (17%)
Mechanical Engineering (17%)

Only departments that follow an upward trend during 2013 - 2016 are Comp Sci, Industrial Engineering and Mechanical Engineering

CIERP Data May 2017
Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

• **WHAT** path led us to where we are now?
## The University of Texas at El Paso: Numbers and Culture

<table>
<thead>
<tr>
<th>Department</th>
<th>T/TT</th>
<th></th>
<th>Non T/TT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Comp Sci</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Civil Eng</td>
<td>19</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Elect/Comp Eng</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mech Eng</td>
<td>13</td>
<td>0</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Metal, Matls, Biomed Eng</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ind, Manuf, Sys Eng</td>
<td>6</td>
<td>1</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Eng Educ and Leadership</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>74</strong></td>
<td><strong>11</strong></td>
<td><strong>15</strong></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td><strong>PERCENT</strong></td>
<td><strong>87%</strong></td>
<td><strong>13%</strong></td>
<td><strong>83%</strong></td>
<td><strong>17%</strong></td>
</tr>
</tbody>
</table>

College of Engineering Faculty Webpages
### The University of Texas at El Paso: Numbers and Culture

<table>
<thead>
<tr>
<th>Rank</th>
<th>Total in rank, (as % of total faculty)</th>
<th># of Men, (as % of rank)</th>
<th># of Women, (as % of rank)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/TT</td>
<td>85 (83%)</td>
<td>74 (87%)</td>
<td>11 (13%)</td>
</tr>
<tr>
<td>Non-Tenure-Track</td>
<td>18 (17%)</td>
<td>15 (83%)</td>
<td>3 (17%)</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>103</strong></td>
<td><strong>89 (86%)</strong></td>
<td><strong>14 (14%)</strong></td>
</tr>
</tbody>
</table>
Driving Force for Change: University Structure and Leadership

- 1988: Female President (Diana Natalicio)
- 1997 – 2012: 8 out of 12 Female Tenure Track Faculty left before tenure (67%)
- 2004: NSF ADVANCE
- 2006: 1st Female Chair
- 2011: 1st Female Associate Dean
- 2014: 2nd Female Associate Dean
- 2017: 13% Female T/TT Faculty (11 out of 85)
- 1996: Women’s Advisory Council to President
- 2012: WIN Engineering Mentoring
- **2016: STEM Accelerator Media Event**
- 2016: Professional Development: Start of Conversation
- 2017: Dean’s Search
Gender Equality in STEM: Empowering Women Through Engineering Education Strategies

• **HOW** will we increase the number of women pursuing engineering degrees?
“Expanding the number of underrepresented students in Texas who earn STEM degrees.”

TEXAS REGIONAL STEM DEGREE ACCELERATOR

- SUPPORTS FIVE PROJECTS/TEAMS IN TEXAS
- FACULTY PROFESSIONAL DEVELOPMENT AND COLLABORATIONS AMONG COMMUNITY COLLEGES, K-12 AND WORKFORCE
- 100,000 STUDENTS EARN STEM DEGREES/CERTIFICATES
The University of Texas at El Paso: 2016-17 Interventions

Faculty Development Workshop

WIN DAY ONE: DESIGN A NEW EXPERIENCE

1. CHOOSE YOUR DOMAIN
   We will design an experience for this class/equation.
   - Win Day 1
   - Goal Driven Design: Project Based
   - Design: Align Goals to Activities
   - Design: Intrinsic Motivation
   - Products and Assessments
   - Inclusion Training

2. CREATE A ROUGH SKETCH
   
24 Faculty Participants

Faculty Partners

1 Computer Science
2 Civil Engineering
1 Industrial Engineering
1 Mechanical Engineering

Inclusion Training

- Potential and Math Proficiency
- Leaky Pipeline
- Sexism
- Stereotype Threat

Sharing + Mentoring

1 Faculty Partners
Faculty Development Workshop

Day 1
• Win Day One
• Goal-Driven Design of Project-Based Experiences
• Designing for Intrinsic Motivation

Day 2
• Develop Your Course Idea: Aligning Goals with Activities, Products, and Assessments
Inclusion Workshop
“social cognitive processes leading to prejudice and stereotyping”

Topics
• Lost potential in STEM – Women 50% Bachelor degrees/20% Engineering degrees in the US
• Leaky pipeline statistics – girls discouraged in middle school
• Cognitive Skills – no difference in math skills
• Sexism – “women succeed because are lucky or due to hard work rather than ability”
• Stereotype Threat – additional stress on women to perform well in a male dominated environment
• Solutions: Ex. Role models, teams, sense of belonging, etc...
Thinking about how we teach Engineering...

“creating a more inclusive environment and a culture that embraces high retention rates in female students, faculty champions and feedback leading to self efficacy and increased self-awareness”

“flattening out differences between male and female students”

“female students tend to underplay skills”

“Giving female students capacity and expertise improves self-confidence and ability to thrive and communicate in a male dominated field”

“if given a problem, the female students tend to try to solve it by themselves, whereas the male students talk to each other”
Faculty Partner – Amit Lopes
University 1st Year Seminar Course (30 students)

Faculty Quote: Felt a lot of fulfillment; that first year it is critical to remove their fears; help them to understand that failure is ok, the grade is important, but not more important than learning.

Student Quote
Very understanding in what a freshman in their first semester experiences, and tries to work with them while still challenging the students.

Faculty Philosophy
Focused on a very hands on, project-based type of learning, and giving them something to look at when they are learning a new concept. Teams are multidisciplinary.

Activities: Win Day One, Vectors, 3D Printing Toy, Quad Copter Design Project
Faculty Partner – Martine Ceberio
Introduction to Computer Science (50 Students)

**Faculty Quote**: I’m not going to teach you much; most of what we are going to teach you already know, I’m just here to show you that you know this already. I’m not here to tell them crazy things that make no sense to them.

**Student Quote**
All the concepts are put in place ... then the concepts are used to develop our problem-solving skills. The students get much more feedback on how they are doing and where they can or need to improve. ...this is the best way to learn in my opinion.

**Faculty Philosophy**
Emphasize problem solving using CS, by linking personal experiences to the jargon of CS, and try to convince students that CS is no different than what we do in real life, we just do it with a computer. Students choose own teams.

Problem solving of real and challenging scenarios; Teaches by competencies.
Faculty Partner – Barry Benedict
1st Year Statics Course/Mechanical Eng (90 Students)

**Faculty Quote:** is the first time students work in teams and students are not used to working on teams...need to prepare students as freshmen to work on teams.

**Faculty Philosophy:** Use a personalized system of instruction that is self paced and requires students to show mastery before going on to next level. Use CATME method to form teams - no fewer than 2 women per team.

Challenging since not all students working on the same thing. “Moving in the right direction, may die in the process.”
Faculty Partner – Ivonne Santiago
3rd Year Hydraulic and Hydrology (40 Students)

Faculty Quote: Special effort to connect to women.... asked them “how do you feel in your team?” “What have you encountered?” Provided them with videos or articles about women, and encouraged them not to take role as note taker or secretary. Be part of the engineering components, not just soft skills.

Faculty Philosophy
Use of technology to provide hands on learning of real life water scenarios, ex. drones to show natural river and water sheds, community projects, form diversity teams based on gender, work, military, parents etc...no all-female teams.

Faculty Projects: Six senior undergraduate civil engineering students are designing a water filtration system for a community of 500 in Haiti to provide safe drinking water that will be monitored remotely by Santiago at UTEP.

Solving real life community water problems; Female Student Mentoring; Flexible Communication Strategies
Faculty Quote: Some male students have some experience tinkering with engines or electronics with male mentors, so start at a level that is above most students so that both male and female students are on the same level, then provide the support required to make them feel “productively lost.”

Student Quote
The class is challenging but the material is very interesting. It has a good balance of theory in the lecture and hands-on applications in the lab. In this class I wasn't left wondering what the use of everything I learned was in real life, because the sensors we worked with were ones that are used in real life.

Faculty Philosophy
Give students a view of advanced concepts, create hands-on real life projects that are both challenging and motivational, and provide sufficient support students to help students succeed. Students choose own teams.

Win Day 1; Students work on 9 sensor projects using circuit components and hardware to analyze signals.
Recap...

- Engineering faculty developed new courses and interventions to address the stereotypes and challenges identified in the literature to create inclusion opportunities via hands-on learning experiences that help level the playing field in STEM fields.

- There is a difference in the focus and conversations taking place.

- Faculty plan to continue to design new projects and work on course development and sustainability (Ex. Virtual reality teaching tools, team formation, course assessment, challenging projects, etc.).

- Chairs are supporting work in most cases.

- Male faculty are noticing when female students are engaged and comfortable, and when they are new to the engineering environment.

- Faculty differ on philosophy of forming teams with women, but are having conversation and are noticing.
Leadership Matters

In House Candidates

Outside Candidates
Leadership Matters

From UTEP President Diana Natalicio -- “We are delighted to have a leader of Dr. Maldonado’s experience and stature join our team at UTEP, she is uniquely prepared to lead the students, staff and faculty of the college and their inclusive vision to advance engineering locally, nationally and globally.”

Maldonado Named Dean of UTEP’s College of Engineering
Questions?