

Report from ASME International Engineering Education Conference

“Describing Mechanical Engineering: Devising a Strategy for Recruiting Underrepresented Students” March, 2009

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Participants of Plenary Session 2 were asked to complete two surveys during the breakout sessions. The first breakout session and corresponding survey focused on how departments describe mechanical engineering to their students. The second session focused on the best practices that departments currently utilize to recruit and retain potential female and underrepresented student. The responses of the surveys were examined for the emergence of frequent themes, which are described below.

Breakout Session #1: Describing Mechanical Engineering

The first breakout session asked participants to describe how their department described mechanical engineering (ME). In addition, the participants were asked how they would revise the departmental definitions given the topic of discussion during the session and the definitions provided by *Changing the Conversation* and ASME. The individual responses for this first survey are available in Appendix 1.

Current definitions of ME. Regarding how they currently describe ME in their department, some of the respondents discuss their departmental definitions of mechanical engineering as a **traditional** focus: energy, machines and manufacturing, mechanical systems, and application of science to industry.

Another theme that emerged in the descriptions is the idea that ME is a **broad and versatile** discipline. This notion of ME being broad and “needed in a variety of industries” was evident in 11 (52%) of the descriptions provided. Two individuals said that their departments describe as ME as the “liberal arts of engineering.” Other descriptions said the following: “broad and diverse,” “found in a large variety of private and public sector organizations,” “one of the broadest fields of engineering to study,” and “needed in a variety of industries.” Other definitions focused on different aspects of the role of mechanical engineering including **designing/building, problem solving, and creativity.**

A total of 6 (29%) of the individuals discussed **improving quality of life or serving mankind** in their definitions. For example, one person said, “MEs use technology to improve lives and livelihoods.” Another said, “Mechanical engineers improve [the] human condition.” One other individual stated that their department changed their definition in order to use language specifically from *Changing the Conversation*.

Considered revisions to definitions of ME. Most of the considered revisions focused on changing the definition of mechanical engineering to focus on the themes from *Changing the Conversation*. The primary consideration in the revised definitions concerned how ME can **improve society** and **make a world of difference**. These two themes clearly emerged in 11 of the 19 responses to this question. For example, the following phrases were used: “make a difference on our everyday lives,” “make the world a better, healthier, and safer place,” and “improve human condition.”

In addition to these messages, some respondents mentioned that they would change the type of problems that were focused on in their departmental descriptions. Rather than focusing on the traditional definition of ME, they would focus on how ME can be used to address the “**global challenges** facing our world today.” For example, issues that the respondents listed included green technology, biomechanics, health, clean water, medical imaging, access to transportation, and poverty. One individual mentioned that his/her definition would have “no gears; no machineries.”

Finally, included in the revised definitions by some respondents, an effort would be made to change the **image** of ME as being “cool” or more attractive to certain demographics. For example, one individual said that he/she would include “pictures of young (including women) engineers doing cool stuff.”

A definition that includes all of the three themes is as follows: “Mechanical engineers make a world of difference. Just imagine what the world would be like without clean water, access to transportation, medical imaging, and cell phones. The things that make a difference in your world come from the creative imagination of mechanical engineers.”

Breakout Session #2: Sharing of Best Practices

The second breakout session asked participants to share best practices in their departments relating to the recruitment and retention of female and underrepresented students. A total of 25 participants completed the second survey administered during this session. The individual responses to the questions on the second survey are available in Appendix 2.

Special efforts for recruitment. Respondents listed a variety of ways in which they attempted to recruit female and other underrepresented undergraduates to their departments. A primary method included **outreach** with area schools or organization. Most often, the relationship included high schools, although one participant targeted students in grades 4 through 6. These relationships with schools included activities such as the following:

- Inviting high school students to visit the department
- Special events targeted at engineering awareness
- Using women or minorities as ambassadors (including faculty, graduate, and undergraduate students)
- Other outreach such as summer programs or links with organizations such as Girl Scouts

A frequent theme in the responses included the use of **women as role models** in their recruitment efforts. Several mentioned that they ensure that there are sufficient numbers of female faculty members to serve as role models in the department.

Several respondents also noted that their **recruitment materials** have been designed to target minorities or females. For example, one individual stated that the materials have been designed using the slogans from the National Academy of Engineering. Others mentioned that recruitment materials highlights activities that are likely to be of interest to females, such as humanitarian engineering programs.

A final theme that emerged from several of the respondents included the use of targeted **scholarships** for females or minorities.

Special efforts for retention. The most frequent effort that was listed by the respondents included the use of appropriate **organizations** at the college-level to help retain students. These organizations included SWE, NSBE, and SHPE. Several respondents mentioned that they encouraged their students to participate in these organizations.

In addition, departments and colleges offered **special programs** to their female and minority students. These programs included the following:

- Mentorship programs with other female students or mentors from industry
- Female socials or luncheons
- Special resources for females (such as lounges)
- Networking activities

Other efforts mentioned less frequently included the following:

- Targeted scholarships
- Tutoring
- Showcasing female faculty in first-year seminars
- Humanitarian projects
- Special advising or support
- Encouraging welcoming departmental climate
- Grouping females in specific course sections

Anticipated changes to efforts. The most frequently planned change to recruitment and retention efforts focused on changes to **marketing materials** used by the departments. The respondents suggested changing their websites, recruitment presentations, brochures, catalogs, wall displays and videos to reflect issues brought up by the session and *Changing the Conversation*. This planned change was evident in 10 of the 23 responses for this question.

Others specifically noticed that they planned to change the **language** used in these materials to focus on describing ME in a new manner, using themes from *Changing the Conversation* such as “making a difference.”

Several respondents discussed changing their **curriculum** in such a way that projects would focus on topics more likely to be of interest to women and minorities. For example, one

individual stated that they would “change a lot of student projects to reflect ‘the grand challenges.’” Another person suggested “reshaping the introduction to engineering course to address female preferences.” Another individual said that their department would “emphasize grand challenge projects in appropriate coursework.”

Other changes suggested by the respondents included the following:

- Increase personal involvement with female faculty during the application process
- Build stronger relationships with area schools
- Participation in climate survey
- Recruit more female faculty

Interest in ME Climate Study. Participants were asked two questions on the survey asking whether they would be interested in having the ME Department Climate Study Survey. Of the 24 individuals who responded to this question, 10 (42%) said they would be interested in participating, 11 (46%) said they were not sure, and 3 (13%) said no.

When asked how much they would be able to contribute to the costs of the project, those individuals who were interested in the study responded in the following manner: 6 said they would be able to contribute less than \$500, 2 said they would contribute between \$500 and \$1000, 1 said they would contribute over \$1500, and 1 said they would be unable to contribute.

Appendix 1: Survey Responses for Breakout Session 1

1. How do you describe mechanical engineering in your department?

- Traditional focus: energy as one stem and machines/manufacturing as other stem; give examples of each.
- ME is the profession that works with energy and mechanisms to produce products and services to improve the quality of life; M E is the liberal arts of engineering, works with energy and materials to create devices and processes to improve the quality of life.
- Mechanical engineers are problem solvers; conceive, design, operate and renew products and processes of significance to human kind (thermal/fluid, structural aspects); design and develop everything you think of as a machine specialize in areas such as manufacturing, robotics, auto transportation.
- Some boring text even I haven't read.
- Mechanical engineers design and build things, systems, in many fields.
- M E's design and build things.
- Our slogan is "Mechanical engineering is the liberal arts of engineering"; I don't know who came up with it and I dislike it; it will be changed.
- Versatility; broadness; thermal management.
- Broadest engineering discipline; creative problem-solving; serves mankind.
- Broad and diverse; multidisciplinary; much more than just "mechanical systems"; not just for "gear-heads".
- Analyze, design, and build mechanical systems and devices; virtually every company hires ME's; broadest of engineering disciplines (encompasses electrical, civil, etc.); visual pictures of products/devices; M E's do basically everything; identify everything you touch today - ME's have role in; engineering is about creativity
- ME's use technology to improve lives and livelihoods; you'd be hard pressed to find a product that an ME wasn't involved in designing or making.
- Forces and energy; mechanical systems and energy systems; design and making of things.
- The mechanical engineer needs to be extremely versatile and can be found in a large variety of private and public sector organizations; he or she may be involved in product design.
- Application of science and technology essential to industry, (?), (?), and society; it is one of the broadest fields of engineering to study and contributes (?) of ME influence society everyday; ME's are responsible for automobiles, airplanes, satellites, robots, power plants, machine (?)
- Mechanical engineers improve human condition by creating new products and developing new processes that enhance mobility, safety, sustainability, and economic productivity.
- As a broad discipline; lists all job areas industry sectors
- The curriculum in Mechanical Engineering focuses on the analysis, design, manufacturing, and maintenance of Mechanical components and systems; emphasis is placed on the fundamental concepts of engineering science and design needed in a

variety of industries including automotive, aerospace, biotechnology, material and chemical processing, microsystems and sensors, nanotechnology, machinery and robotics, pharmaceutical, energy production and distribution, heating and refrigeration, food production and processing, entertainment, pulp and paper, and many others.

- Within the last month, we lifted language from "changing the conversation" and modified our old catalog statement and website definitions using this language.
- Very traditional description; describe what mechanical engineers do, type of jobs for them, etc.

2. How would you revise the departmental definition of mechanical engineering?

- Should talk about how M E can better improve society: green technology, biomechanics, health, etc.
- Mechanical engineers conceive, design, operate, build, and renew products and processes of significance to human kind.
- Mechanical engineers make a world of difference; just imagine what the world would be like without clean water, access to transportation, medical imaging, and cell phones; the things that make a difference in your world come from the creative imagination of mechanical engineers.
- De-emphasize the "traditional" description of M E as the design of systems to convert energy from one form to another, etc.; focus on the engineering content behind systems, processes, and devices that make a difference on our everyday lives and that address some of the global challenges facing our world today.
- In terms of people, how M E impacts lives and can change the world; put pictures of young (including women) engineers doing cool stuff.
- Mechanical engineers change people's lives by turning ideas into products.
- Global; cultural; societal; impact technology.
- No gears; no machineries.
- Consider including tag-line descriptions as attention-grabbers.
- Make connections to "every day" experiences - e.g. show how engineering relates to medicine, safety, transportation, energy, etc.
- Add top messages to the classical message.
- I like the "world of difference" theme of NAE.
- Start with features images of impacts - graphical images to illustrate range of applications: environment, water, energy, health; follow by technology approach (?) with mechanical energy, mechanical and energy stem.
- Emphasis (?): engineers innovate, better lives and help shape the future; mechanical and aerospace engineers focus on design products that...
- Mechanical engineers are creative problem solvers that make the world a better, healthier, and safer place; are engaged in finding solutions to provide to sustainable energy and reduce (?), to reduce poverty, to provide security and safety, and to address transportation problems for a growing world population; needs to be more specific and geared to M E.
- M E's improve human condition by creating new products and processes that enhance human mobility, environment sustainability and economic prosperity.

- M E is cool!
- See above.
- I think it is a good idea to use "tested" message to revise the description.

Appendix 2: Survey Responses for Breakout Session 1

1. What special efforts does your department use to **recruit** potential female and other represented undergraduates?
 - Give some preference in engineering scholarships.
 - Special scholarships in the past; summer youth programs, women in engineering; invite students from a high school with predominately black students in Detroit - bus them to the Michigan Tech.
 - WISE (Women in Sciences and Engineering); use female and other underrepresented students as role models.
 - Participate in "Preview of Engineering Day" and participate in focused presentation on impact of engineering to the betterment of society.
 - Humanitarian engineering; strong SWE program
 - No special efforts except those towards Native American students; in that case, we have special program (dedicated staff) to help recruit and retain.
 - None, because we are not allowed to select students (European type of system); students are ranked by national-wide examinations and we are forced to accept those who got higher ranks; fortunately, in my university, we are getting the best among the best.
 - A Saturday morning "Lipstick and other Fashion Essentials" for 4 - 6th graders; they learn how to make their own lipstick and makeup, so it's mainly for women.
 - Some targeted scholarships; summer programs at college level.
 - Hold meetings of all females with 1st year females; female social, meet with all graduating women.
 - In our talks with high school seniors and juniors we use articulate spokespersons who are female or underrepresented in addition to others.
 - Engineering Awareness Days; target guidance counselors and explain to them about engineering.
 - College level women and minority ambassadors; visit high schoolers (math and science classes).
 - Recruiting material highlights service oriented projects, especially humanitarian efforts in Central America; successful female students highlighted in brochure.
 - NSBE; SWE; personal interaction for interested females; legacy students.
 - We send female faculty for recruitment; we are a minority school.
 - Relationships, relationships, relationships; we try to support "engineering community" among our students, but especially our women students; faculty know all students personally.
 - Hire female faculty and female graduate students; introduction to engineering course (with lab focusing on teamwork).
 - Ensure sufficient female faculty members to be role models for women students; select female graduates who are potential future faculty on meeting advanced degree requirements; female faculty outreach to women's sports teams to inform targeted women about M E; department head sends email to students with ³ 3.0 GPA to invite them to M E discipline.

- We have girls day once a year (females from high schools are invited); SWE participates in Girl Scouts group badge.
- Celebration of women in engineering for top female applicants; pre-engineering program; engineering for kids.
- Recruitment is centralized from the Dean's office, recruiting to engineering.
- The department and faculty participate during visit days and open days by asking our minority undergraduate to attend and talk to prospective students and presenting their topics via posters.
- We have redesigned all of our recruiting materials; they (?) reflect much more the language of the NAE 4 slogans; we use female students a lot in our recruiting efforts; we host and participate in several outreach efforts, much as Engineering Exploration for Girl Scouts.
- Participate in college women in engineering program; participate in college interviews of high school high achievers for special enrichment programs; provide appropriate scholarships.

2. What special efforts does your department use to **retain** female and other underrepresented undergraduates?

- Strong SWE program - very active.
- Scholarships (small amounts) to sophomores, juniors, and seniors based on leadership activities minority (men and women), women; introduced design projects that help people in first year course in engineering fundamentals.
- Get them involved in various student organizations and competition teams.
- Organize (?) groups within ASME RAIAA sections.
- Humanitarian engineering; strong SWE program
- Special programs for Native Americans; many of those are focused on retention.
- Our efforts are focused on retaining students, whatever the group.
- A freshman mentorship program, where the senior women engineers meet informally once a month for coffee on an individual basis.
- SWE and NSBE at college level; special "BellSouth Minority Engineering Program" at college level to increase retention.
- Female social once per semester; Women in Engineering
- One of our female faculty members holds informal sessions with female undergraduates; we support "Women in Engineering" in our college.
- Active SWE organization; active NSBE/SHPE organizations.
- Tutoring; goal identification; support.
- Female faculty member (adjunct) conducts annual retreat for women engineering students.
- Not a problem other than making sure financial aid is sufficient.
- We gave an office to female students (with computers, sofa, etc.); we have special luncheon for females (including faculty).
- Network women only off-site activities (lunch, go to event).
- Advising; promoting them to serve on the Mechanical Engineering club.

- Interactive teaching; active counseling; mech club activities; summer internship opportunities; create an "ME family" environment.
- We provide individualized help to all female and underrepresented undergraduate students; each female is made a member of SWE; we have no problem retaining them.
- Support for SWE; support for receptions, meetings; undergraduate research opportunities; minority engineering programs.
- Within the college, we have activities such as finding women mentors from industry to each individual student.
- We do not have any difficulty retaining our female underrepresented undergraduates.
- Very little; strongly encourage participation in SWE; group them in sections if possible.
- Appoint females to student advisory board for the department; showcase female faculty member in freshmen introduction to engineering course.

3. What changes do you anticipate making to your recruitment and retention efforts of female and underrepresented students as a result of this session?

- Change the way in which we describe our M E program in promotional materials; institute a mentor program - upper class women to befriend and mentor younger women.
- Relook at advertising, web page, marketing materials; include examples that show how grand challenges that help human kind.
- Describe M E in a new light: "making a difference" etc.
- Redesign our Preview Engineering presentations.
- Website changes.
- Changes to website as per "Changing the Conversation"; involve women in mini baja (?) (move from gear head perception); research Hispanic trends/date' "Grand Challenge" projects for students.
- Changing the department website to have images which are more attractive to women.
- Improve web presentation/dialog
- Change recruiting materials.
- I'm looking for ideas.
- ?
- Change the language.
- Trying to engage more, younger students - middle and high school.
- We are looking for new ideas.
- More personal involvement by faculty sooner in the application pipeline.
- Reshape the introduction to engineering course to address female preferences resulting from the studies presented in this session.
- Brochures and short student videos targeting specific groups.
- Not sure
- Climate survey; images of engineering on walls, web; changing description of M E on website.
- Not sure: need to think about it.
- We try to have our female faculty to meet with perspective females during a breakfast session supported by the department.

- Recruitment: create more direct relationships with local and regional high schools; retention: change a lot of student projects to reflect "the grand challenges" and make them more interesting for female and minority students.
- Changed website and catalog (already done); recruit more female faculty; emphasize grand challenge projects in appropriate coursework.

4. Comments:

- People need to be more careful on language; too many times men are men and women are girls; even today, dean were referred to as "he" not "he or she"