

What Brings Women to the Table? **Female and Male Students' Perceptions of Ways** **of Thinking in Engineering Study and Practice**

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Women represent only one-fifth of engineering Bachelor's degree recipients in the U.S. This gender gap has stubbornly held for the past several years. Our study uses survey and interview data to examine the experience and perspectives of 40 first-year women and men intending to study engineering at a public, research extensive university.

Implications of Findings

Findings from this study present a complex picture suggesting why women as a group may be less likely to be attracted to engineering study in the first place. Gender identity development literature provides evidence of the cultural association of physical science and scientific ways of thinking—reason, fact, objectivity—with males and masculinity. At the same time, feelings, values, and subjectivity are associated with females and femininity (14). Using this framework, “male” ways of thinking seem to loom large in the minds of first-year students as they think about what engineering is and what it takes to be a successful engineer.

When participants were allowed to brainstorm the kinds of skills they thought necessary for engineering, women were much less likely than men to cite active-experiential ways of knowing. This suggests that women generally have not had as much exposure as men to hands-on, engineering problem solving prior to their entry into higher education.

Our study supports the claim that more first-year students and women in particular would choose engineering if they had a broader, more accurate understanding of the field. K-12 outreach and recruitment strategies should emphasize the importance of creativity, design, and communication (as well as math and science) in the study of engineering. Ensuring hands-on science, technology, and math opportunities for pre-college women may help them to better envision the active-experiential nature of engineering study and practice.

What We Found

Our findings provide a complex picture of gender differences in the experiences and ways of thinking that beginning undergraduates associate with engineering. The team found that, generally, differences between the ways women and men described engineering in terms of the value of engineering were not significant. All the data that we examined reflect that regardless of gender, the

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vast majority of first-year students view technical knowledge and skills including math, science, and similar abilities and ways of thinking as foundational to success in engineering. However, of particular interest are small but suggestive differences in how women and men perceived engineering to be intrinsically valuable.

The data set from the open-ended survey question (“five terms,” described below) suggested that men take a broader view than women of ways of thinking required in engineering. Furthermore, men are somewhat more likely than women to mention math-science-logical ways of thinking and somewhat less likely to mention creative-innovative ways of thinking. Also, men were more likely than women to mention active-experiential ways of thinking. However, while women were more likely than men to offer at least one term describing the intrinsic values of engineering, the terms were more often negative (e.g., stressful, boring) than positive. None of these differences were statistically significant but call for further inquiry.

Results from the structured interview data suggest that many students see links between the different ways of thinking, i.e., that math and science are foundations for creativity, and that both math-science-logical thinking and creative-innovative thinking are foundations for active-experiential thinking. On the other hand, some students see math-science-logical thinking in opposition to creativity. Further, there might be gender differences in how students view the practical nature of engineering as a field. Men were more likely to discuss and be attracted to the hands-on possibilities (tinkering, building, trying out ideas in the real world), while women were more likely to discuss and be attracted to linking theory and practice (designing and creating). Yet, the dominant understanding of all students was that math and science abilities are of the highest importance, and the majority of students’ first-year, preparatory education was centered on building these skills.

Method and Background

In addition to providing a basis for our findings, use of the survey and interview data demonstrate the unique strengths of mixed-methods research through the integration of quantitative and qualitative data. This research is part of the Academic Pathways Study (APS), a multi-institutional, longitudinal study of engineering student learning and development that is part of the NSF-funded Center for the Advancement of Engineering Education. To explore the intersection of gender and first-year students’ expectations of what it means to study and practice engineering, the team considered three APS data sets (referenced above):

1. A survey question asking students to rate a set of skills and abilities in terms of their importance for becoming a successful engineer;
2. An open-ended survey question asking students to list five terms they would use to describe engineering; and
3. Structured interview questions asking students to reflect in their own words on engineering as a field of study and as a profession.