

**article:1496****Teams that Work: Campus Culture, Engineer Identity, and Social Interactions**

CONTEXT: Public Engineering School is a well-recognized, stand-alone campus devoted to educating engineers. At the time of the study in the early to mid-1990s, women comprised 20-25% of undergraduates and 11% of faculty, more than national levels. Its commitment to reform in engineering education and to women's full inclusion, and its full support of my research project, suggested it would be a model program from which other campuses could learn. However, since the vast majority of studies about engineering and engineering education either ignored gender completely or assumed a gender-difference approach, I wondered to what extent these could explain the variety among men's experiences, and the variety among women's. Two major works suggested approaches. McIlwee and Robinson (*Women in Engineering: Gender, Power, and Workplace Culture*) used survey and interview data, and provided insights into women's difficulties, finding that there was a pecking order among (men) engineers and that some sites of practice were more equitable than others, suggesting women's experiences might be contextual. Holland and Eisenhart (*Educated in Romance*) used longitudinal interview data to document the way peer group culture impinged on highly motivated women who entered college intent on completing challenging math and science disciplines, but who subsequently just got by in college or left. But without direct study via participant observation, these studies left open to question what happened in everyday social interactions, and if they were independent of campus culture. Design teams seemed precisely the sort of social space where out-of-classroom, peer-group activities might be influenced by a wider campus set of practices, a place where producing women as people who did not belong in engineering might occur (the opposite of teamwork's intended effect). Thus, in this large cultural study, the research purpose was to investigate how students became engineers while working collaboratively as members of design teams completing real-world projects for government and industry clients, especially tracking enculturation processes for learning engineering expertise, engineer identity, gender (forms of masculinity and femininity made evident through campus practices), and power.

CONCEPTUAL FRAMEWORK: This article focuses on teamwork practices. Earlier teamwork research centered on gender-proportion theory, which depended on Bales' 1950s work involving laboratory experiments with two people who were willing subjects engaged in simple, quick tasks that barely mattered to their futures. But, this seemed not to mimic engineering design well, since design is part and parcel of a larger engineering campus culture and connected to career futures. That is, gender-proportion research overlooked context, and seemed too simple to have enough explanatory power in a complex learning setting. I crafted a conceptual framework around the central issues expected to be at play: identity, gender, power, and engineering knowledge or expertise. Situated learning theory suggested that knowledge and identity are bound together by communities of practice and must be learned by newcomers, for instance, that "being a tailor," a kind of person, is about knowing how to make clothes, a kind of knowledge made evident in everyday activities and productions. However, engineering seemed likely to involve more than Lave and Wenger's simpler trajectory suggested, which

required understanding how scholars conceptualize gender (the forms of masculinity and femininity deemed acceptable in certain cultures or societies), power (whose version of reality sticks), and engineering expertise (what do engineers know).

**RESEARCH QUESTIONS:** For this article, and in response to prior research suggesting that proportion matters most to women's experiences on teams, I wondered: Why is gender proportion an inadequate explanation of the situation? To answer that question, I wondered: How does teamwork proceed? What contributions do different people make to the team? What does this tell us about the simultaneous and mutual shaping of engineer identity and expertise? That is, how does the complex process of learning to be an engineer operate, how does it co-generate identity, expertise, gender, and power, and how does campus culture matter in teamwork? How does culture become evident in the behaviors of individuals, especially in their interactions with others?

**METHODOLOGY:** The study followed the research practice of cultural anthropology: become a person accepted in the community; engage in the community's everyday activities; gather field notes about what people do, say, and produce; and talk to people about what is going on and how they explain events. Over the course of four years, I engaged in three semesters of reconnaissance when I collected no data, but became acclimated to each of three design-class settings, then performed four semesters of active fieldwork – participating as a design-team colleague on seven student teams at the first-, second-, and fourth-year levels, getting to know 33 students well and interviewing them formally twice, attending all in- and out-of-class meetings, and interviewing their 11 professors. Interpretation of events was an ongoing process that began in the field and informed subsequent data collection (for instance questions asked at interviews depended on analysis of earlier field notes), continued off-site after primary field work was completed, and was bolstered by periods of secondary field work and peer review (giving papers at conferences, discussing findings at colloquia, having findings reviewed by insiders). In the main, data analysis tracked patterns of sameness, difference, and affiliation in the data, but the goal was to be able not only describe what happened, but also explain how things came to be the way they were (a process approach), and why they were this way (in this case an analysis of relations of power – whose sense of the world “stuck”). Reading and re-reading data ruled out competing explanations.

**MAJOR FINDINGS:** During undergraduate studies, students learned there were different ways to identity with, and be identified as, engineers. These student engineer identities encoded not only a status hierarchy of academic-science expertise ahead of design-engineering expertise (which campus practices established and supported), but also of men ahead of women, and of over-bearing men ahead of men not willing to exploit others (gender status hierarchies which campus practices also supported, in very complex ways, as explained in an article published in 1999 in *The Journal of Women and Minorities in Science and Engineering*). In fact, campus culture situated women only among those thought of as social achievers, not those known for their engineering, and only one respectable term existed for women. Summaries of 11 senior students (from two teams with the same proportion of men to women) illustrate that behaviors during, and contributions to, teamwork became not only demonstrations of one's place in the cultural identity terrain along with attendant power and status, but also cultural productions of the identity terrain. That is, by acting according to “type,” such as a hard-core over-achiever

taking credit for a woman's work on the team, which a lower-status nerd did not challenge though he found it unfair, things stayed the same. Equitable teamwork emerged in some teams due to the absence of men willing to use their status to exploit others and minimize their contribution to the team.

**RECOMMENDATIONS:** Because campus culture was actively produced through everyday social interactions, it was not inevitable, but have been otherwise. The research suggests ethical teamwork practices will come from transforming engineering culture, undoing taken for granted pecking orders in engineering - women's subordination to men, some forms of masculinity ahead of others, and especially academic-science forms of engineering practice above design engineering understanding enough of the book-learned ideas, then mucking about and figuring things out. But to do so requires leveling the prestige-producing machinery of a typical engineering education system. In fact, to undo the power of over-bearing students means to distribute more power to other students, that is, to recognize other forms of practice and empower those who now hold their tongues. **SUPPORT:** The research was supported in small part by funding from an American Educational Research Association/Spencer Foundation Fellowship, which underwrote developing the research proposal and performing fieldwork during the first-year design course, and by Wayne State University's University Grant Programs in 2002 and 2004, which allowed expanding the original conceptual framework and organizing the original ethnographies into a book manuscript.

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