

FEMINISM, WOMEN'S STUDIES AND ENGINEERING: OPPORTUNITIES AND OBSTACLES

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"I would rather be a cyborg than a goddess," ends Donna Haraway's influential *Cyborg Manifesto*.¹ Cyborgs are cybernetic organisms, and represent hybrids of machine and organisms, nature and culture, social reality and fiction. In the feminist studies of science and technology, cyborgs have come to symbolize the promise of our technological culture; they remind us of the progressive possibilities we can imagine when science and technology shapes and is shaped by feminist politics.

These new progressive visions of feminism and science and technology grow increasingly important and critical as technology moves to the center-stage of our cultural dreams and nightmares. The need for collaboration and dialogue between feminists and scientists and engineers becomes all the more immediate and pressing given the growing chasm between these disciplines. A quick survey of women majors at the University of Washington makes this point. In the College of Engineering, women represent 11 out of 66 majors in aeronautics, 12 out of 49 in ceramics, 51 out of 555 in chemical, 50 out of 217 in civil, 63 out of 419 in electrical, 23 out of 68 in industrial, 39 out of 289 in mechanical, 5 out of 36 in metallurgy, and 18 out of 31 in technical communication. In contrast, Women's Studies, a relatively small department in comparison has more women majors than any of the engineering departments (85). However, of these a relatively small percentage are science/engineering majors. These numbers suggest two issues. First, the segregation of parts of the academy - women are underrepresented in engineering disciplines and men in Women's Studies. Second, if we look a little deeper, we will find that an unfortunate reality of academia to-day is that engineering and science disciplines rarely deal with issues of women or gender and the discipline of Women's Studies rarely with issues of science and engineering in their curricula or research. Why is this? And what can we do about it?

During this panel we will briefly sketch out a project for feminism and engineering. We will explore what the frameworks coming out of the feminist studies of science and technology and feminist theory in general offer our understanding of feminism and engineering. In what ways can these frameworks enrich disciplines in engineering, and the sciences? Conversely what do the disciplines in engineering and the sciences offer feminists and scholars in Women's Studies? In Anne Fausto-

Sterling's words, how do build "two-way streets" between the sciences and engineering and Women's Studies? What would this mean for the programs we run, the classes we teach and the students we mentor? Finally, we will offer a few examples of collaborative projects that suggest possible ways of bridging the growing chasm between these disciplines.

Women in Science and Engineering Programs, organizations such as WEPAN and AWIS are extraordinarily important for women scientists and engineers. They offer concrete mechanisms and opportunities to mentor and be mentored, network with others across universities and countries, and share strategies for successful careers. These support structures and networks are very important to practicing scientists and engineers especially in many disciplines in engineering where women often still find themselves "tokenized." Although these programs are enormously important and successful, we wish to argue that frameworks coming out of Women's Studies and in particular from the feminist studies of science can enhance the effectiveness and scope of such programs. While there are many ways in which the new scholarship on women can contribute to women in engineering programming, we want to suggest two.

First, over the last ten years, there has been a growing controversy in Women's Studies about the categories "woman" and "gender." Feminist scholars have argued that "woman" has most often stood in for the experiences and bodies of white, western, heterosexual women and that these experiences have been universalized to include women all over the world. There has been a growing recognition in feminist scholarship that sex and gender as social and analytic categories are inextricably inter connected with other social categories such as class, race, ethnicity, sexuality, disability etc. Women's Studies has developed a rich theoretical frame to understand and locate such intersections and has much to offer those of us who work with women in science and engineering. Collaborations with scholars in Women's Studies can allow us to design our projects with greater scope and to be inclusive of differences among girls and women as a central mission. Other than not leading to stereotypes of girls or women, such strategies also allow us to build alliances with other programs on campus so that difference is not fragmented into sub-categories but dealt with holistically and in its complexity.

Second, we want to draw on a central development in the feminist studies of science and technology. Central to the development of the feminist studies of science and technology is the recognition of "gender" as an important analytic category in the study of science and technology. What feminist scholars argue is that it is inadequate to only study "women" in science and engineering. In addition, they argued that we have to understand how the "culture" of science and engineering function. Because, once a part of the culture of engineering, women are expected to and sometimes participate in that culture just as enthusiastically as do some men. There is nothing innate or "essential" to women's bodies or minds that would make them resist scientific culture any more than men (Although there are certainly factors in women's socialization that might render them more marginal). By shifting the focus from "women and the pursuit of science" to that of "men and women in the pursuit of

science," Evelyn Fox Keller argues that we are forced to "preserve all three terms (men, women, and science) but simultaneously acknowledge the socially constituted character of each term." Just as "gender represents a cultural transformation of sex", so too does "science represent a cultural transformation of nature." In order to truly understand women's under-representation in science and engineering, we must understand the relationship between men, women and science.³

An example that illustrates this move is an NSF funded faculty-graduate student action project at the University of Arizona. During this project, women graduate students and faculty (men and women) carried on a conversation anonymously through two facilitators. As part of this, two student groups and two faculty groups independently named the unwritten rules of graduate education. Getting faculty and students to name the rules that govern their professional lives and identities was a fascinating exercise. The "rules" illustrate how gender norms and roles are "operationalized" in specific settings within graduate education and provide a rich interpretation of the culture of science and engineering. The faculty list more closely resembles the goals of graduate education more than rules - they stress the learning of the social and intellectual climate of one's field, learning to formulate and carry out research projects, learning to communicate about one's work. Students interpreted their set of rules as the means and mechanisms by which they could attain the faculty's list of goals.

For example, faculty rules stress the following: Graduate education should be the major focus of your life; Personal and extracurricular activities are okay so long as they not interfere with reasonable progress; Become the "expert" in your field; Show initiative and independence. In order to attain the above goals, students pointed to rules in their lists that allowed them to meet the above expectations. These rules include: Students should be visible around the department; Work all the time with no break; Don't show fear, self doubt, insecurity; Be happy; Be busy; Don't cry in public.

Thus students respond to the sets of unwritten expectations of faculty by a set of behaviors that best present them as "serious" students. Students elaborated on how gender is important in the culture of science. They feel an additional burden to have to follow the rules to be seen seriously as scientists. Often, this takes the form of dissembling behaviors. While students participate in these rules in public, such as being happy, or not crying in public, students respond with their own set of rules in private behavior - they cry in their offices or the bathroom. The ideal scientist according to the rules is one who is single minded, dedicated, emotionless, happy, well connected, intellectually curious, the expert ready to follow in the footsteps of the mentor to reproduce the system. Women respond to this "ideal" by learning to play the part. It is not that the women themselves change, but they learn to separate their professional and personal lives.

The above project is one example of how the feminist studies of science can inform women in science programming. Rather than train graduate women to perform successfully in the culture of science, it instead asked men and women in science, faculty and students, to examine the world in which they live. By examining and

critiquing their own culture, by the end of the project, faculty and students began imagining and exploring alternate models for a culture of science, one that did not define science and scientists exclusively in terms that our culture has relegated to the "masculine." Instead, this re-invisioning allows us to draw on models that are diverse, flexible and informed by difference. Such an understanding of the culture of science can be immensely powerful for the transformation of institutions as well as those of individual students. Encouraging students and faculty to take interdisciplinary courses can be clarifying in understanding the enculturation of scientists.

To now consider the other half of the chasm, the world of Women's Studies. While we believe that the project of feminism and technology can be very useful and powerful for engineers and scientists, we want to state that is equally critical for students and scholars in Women's Studies. Women's Studies scholarship and curricula are often equally uninformed by science and engineering disciplines. This seems extremely unfortunate, even suicidal given the world we live in and the fact that historical and contemporary concerns about science, medicine and technology are relevant to feminist concerns about social justice, the environment, health, and institutional inequality and power. For example, medicine has grown increasingly specialized and technical. The rise of HMO's, the debates over health care policies, and the choice of alternate therapies make an understanding of human biology critical knowledge to make an informed choice. Given this context, we must not only train all students and ourselves to be scientifically and technologically literate, but to teach them to think critically about these phenomena.

How do we achieve this? How do we build two-way streets between Women's Studies and disciplines in the sciences and engineering? We would like to offer two examples, one at the national and one at the local level. At a local level, one important strategy is to develop a cohesive curriculum in women's studies programs and departments that includes a cluster of courses on science and engineering. Although Women's Studies undergraduate programs in the United States have done a great deal over the past twenty years to create interdisciplinary units across the humanities and social sciences, most Women's Studies programs and departments have not broken the interdisciplinary boundary when it comes to science, mathematics and engineering. At the same time, feminist scholars such as Haraway, Fausto-Sterling, and Fox-Keller have produced a large body of scholarship that engages critically feminism and science. At the University of Washington, for example, the Department of Women Studies thus far offers only three undergraduate courses on science: "Women and Science," "Psychobiology of Women," and "Gendered Technologies." Such courses offer the potential for further expansion of course offerings. One of the challenges that women's studies units face is developing outreach strategies to undergraduates and potential majors of the relevance of science to women's studies and vice versa.

Thus, one important programmatic goal is to institute a body of coursework that reflects the scholarship in the diverse fields of science and interdisciplinary

Women's Studies. In recent years, large funding agencies have begun to address the possibilities in curriculum development that encourage conversations between women's studies and the sciences. For example, in 1996, the American Association of Colleges and Universities's Program on the Status and Education of Women, sponsored a funded project "to incorporate the new scholarship about gender and science into undergraduate science, engineering, and mathematics courses and to make science a more central part of women's studies courses." At the national level, the Association of American Colleges and Universities received support from the National Science Foundation to coordinate a three year, ten campus project that brings together faculty members from science and engineering with faculty members from women studies (Women and Scientific Literacy: Building two-way streets). On each campus these joint teams will develop and implement new courses as well as revise already existing courses in each of the campuses. The resulting courses in science and engineering fields address issues for women in science by framing them in the holistic way defined above; the resulting course in women studies will make scientific literacy a component of the courses. Thus by incorporating feminist scholarship in science and engineering courses, and scientific and technological scholarship in Women's Studies courses, the ten campuses work to build "two-way streets".

In our zest to build two-way streets we must remember that feminist scholars of science and technology warn us that this must not be a blind adulation of science and technology. All scientific and technological innovations are not necessarily progressive. They are often used to support regressive and undemocratic practices. Scientific and technological innovations more often than not maintain the "status quo." This makes the need for collaborative research and courses crucial. The need to understand the technology behind a machine while at the same time understanding the social and political consequences seems critical for both our students and ourselves.

¹ Donna Haraway, "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century." In Siminas, Cyborgs, and Women: The Reinvention of Nature. Routledge, 1991. P. 181.

² Anne Fausto Sterling, "Building Two-Way Streets: The Case of Feminism and Science." NWSA Journal, Vol. 4, No. 3, Fall 1992, pp. 336-349.

³ Evelyn Fox Keller, "The Wo/Man Scientist: Issues of Sex and Gender in the Pursuit of Science." In The Outer Circle: Women in the Scientific Community. Harriet Zuckerman, Jonathan R. Cole and John T. Bruer eds. Yale University Press, 1991. P. 228

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