



Literature Overview: The Application of Title IX to Science and Engineering



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Title IX of the Educational Amendments of 1972 is a law prohibiting discrimination based on sex in educational programs that receive Federal funds. It states: “No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance.”

It was passed less than ten years after the Civil Rights Act of 1964 when there was a climate for correcting patterns of excluding women and minorities from advanced education, a wide range of jobs, and professional jobs. Higher education in America was not open to everyone from the beginning. For the first two centuries in higher education, women and minorities were not admitted. Our society has moved toward greater equity through its laws and practice. Title IX is a legal milestone along that path.

As late as the 1960's, women were still impeded from applying to graduate school in certain fields of science or to leading schools which were all male (Rossiter, 1955; Rossiter, 2000). There were quotas to limit the number of women in medical schools and law schools. However, the country was increasingly worried about its capacity to compete with the Soviet Union, especially after the launch of the Sputnik satellite in 1957. Suddenly there was high interest and pressure to educate all children in science and mathematics in order to produce a stronger workforce. The worry about our competitiveness and our national preparation led to the passage of The Equal Opportunities for Women and Minorities in Science and Technology Act of 1981. The Act mandated that the National Science Foundation (NSF) start counting and reporting on the science and technology workforce every other year, and start investing in educational initiatives that would bring more women and minorities into science and engineering (S&E). NSF's early statistical indicators showed that most faculties in S&E were still composed almost entirely of white males, and the composition of students in S&E still showed few women and minorities (Rossiter, 1955; Rossiter, 2000).

As a new law in 1972, Title IX was not widely understood and accepted. It took decades of Title IX coordinators in state and school district offices to interpret how it should be applied, just as the Civil Rights Act of 1964 took many cases and experiences to result in changes that people could see. For thirty years, the focus of change was on girls' equal access to sports and on sexual harassment in schools. In fact, public perception is that the law was just about sports. How did the narrow interpretation happen? Possibly because it was clear that women did not have sports facilities, coaches, teams, equipment, uniforms, and scholarships. Many families with daughters had the painful experience of finding out that “girls are not allowed” to participate. Since the law's enactment, girls' and women's participation in sports is a great civil rights success story (National Collegiate Athletic Association, 2005), having tremendous positive benefits for American society. Some (Musil, 2007) think it boosted the entry of women into higher education. The participation of women in sports has increased more than 10 fold. More women have stayed fit, learned leadership, teamwork, and competition; excelled in athletic performance; broken world records; won medals in the Olympics; formed national professional teams; served as role models for youth;

and yielded a healthier society. In 2004, girls' rate of participation in high school sports was up to 40%, and girls got a 43% share of \$14 million in scholarships ("College Athletic Scholarships," 2008).

Women's participation in legal and medical education is at parity. Women are graduating from medical school at a rate approaching parity (47%) (Association of Medical Colleges, 2006). Women are earning more than half of law degrees now (American Bar Association Commission on Women in the Profession, 2005). In some fields of science, there are more women graduating than men. However, progress in the nation's most critical areas – computer science and engineering – is very slow. The numbers of women and minorities enrolling are low and the advancement to faculty positions is lower. Public arguments that were used to deny women basic education, the vote, and access to sports are similar to those still used against sending women into technical fields – they don't want it, they can't, and they belong elsewhere (Sommers, 2008). The S&E workforce crisis and the continuing low advancement of women prompted several scientist-advocates to revisit the text of Title IX to determine possible applicability to S&E education.

Since the 1980's, many programs were put in place to reach out to groups that were excluded from S&E. Many of the experimental programs were designed around the idea of an "intervention" that would improve the interest, skills, performance, and enrollment of underrepresented students in science, mathematics, engineering, and technology. The interventions expressed what is called a "deficiency" model, that is, students need to change in order to be successful. More recently, programs focus on changing courses, admissions practices, and the social environment of schools that implicitly favor narrow student interests and learning styles. The investment in intervention activities and research on learning and educational experience are wholly consistent with compliance with Title IX. Most of these programs were not initiated expressly because of Title IX. Federal funding programs were initiated in response to the Equal Opportunities Act of 1981. As long as there is evidence for unequal access and opportunity, the investment is warranted. Laws mandating the investment are in place. However, many advocates and practitioners do not cite the laws as a foundation.

Recent Supreme Court decisions (University of Michigan, 2003) about targeted admissions have fueled a backlash, and a hesitancy to continue them. However, the decisions do not preclude targeted programs. They require more careful and sophisticated consideration as to how under-represented students can be recruited (Malcom, Chubin & Jesse, 2004).

The purpose of this paper is to enable readers who care about diversity in science and engineering to understand the issues surrounding Title IX and to understand the possible uses of the legislation in supporting their activities.

Title IX as a Tool for the S&E Talent Crisis

Since the Equal Opportunities Act of 1981 there were many national policy reports and conferences on the problem of the talent crisis and the under-representation of women and minorities in S&E. They tended to repeat the issues, the statistics, and recommendations for change, and yet in critical fields, the numbers of female and minority students are barely rising, and, the lack of diversity of faculty has stalled and stayed the same for decades. In 2000 there was a workshop on the chemical workforce at the National Academy of Sciences. Debra Rolison, a research chemist at the Naval Research Laboratory and an independent advocate for women, gave a talk. She noted the lack of progress in chemistry. She noted that discrimination lawsuits by individuals had not worked, and they inevitably damaged individual careers. The numbers of female graduates in chemistry was increasing, and yet women were not showing comparable

progress in gaining faculty positions. The number of female Ph.D.'s in chemistry was up to 33% in 1999, and yet the fraction of women in top research departments in chemistry was only at 10%. The title of her talk was: "Title IX for Women in Academic Chemistry: Isn't a Millennium of Affirmative Action for White Men Sufficient?" (Rolison, 2000a). Later in the year, she published her "uppity talk" as an editorial in Chemical and Engineering News (Rolison, 2000b).

Two years later, Senator Ron Wyden (D-OR), Chair of the Senate Subcommittee on Science, Technology, and Space, convened a hearing on stronger enforcement of Title IX with respect to math, science and engineering education and called for a 10-year retrospective report on NSF programs to promote the participation of women, minorities, and persons with disabilities in S&E. He also called on the National Academy of Sciences to report on how universities support their S&E faculty with respect to Title IX compliance reviews. With co-sponsor Senator Barbara Boxer (D-CA), he requested a Government Accountability Office (GAO) audit of Title IX enforcement among agencies funding science and engineering (Wyden, 2002).

Soon after, *Science* magazine recounted how "a 30-year-old federal education law caused participation in sports by women to skyrocket" and "a panel of scientists and women activists told the U.S. Senate that Title IX could also help the next generation of women scientists and engineers in academia" (Mervis, 2002, p. 356).

Both Rolison and Wyden came out with strong statements again. Rolison echoed Wyden at the October 2002 U.S. Senate Hearing. She cited the evidence of discrimination against women in the 1999 MIT study of faculty in science (Massachusetts Institute of Technology, 1999). She called the lack of diversity in research universities a national disgrace. In asking what would motivate reform, Rolison suggested we look at the reward structure that is Federal funding for research, and proposed that Federal agencies consider withholding funds from institutions that showed no progress in recruiting female students and faculty (Rolison, 2003). Wyden published an article in Computing Research News which promoted the idea in public discussion (Wyden, 2003).

The GAO audit report was issued in 2004. It reviewed the status of women's participation in S&E and promising practices. It recommended that NASA, Energy, and NSF take more action in conducting compliance reviews. The Department of Education was found to be conducting reviews. One appendix summarizes the billions of dollars in Federal funding to universities from NSF, NASA, Energy, and Education that are subject to Title IX accountability (U.S. Government Accountability Office, 2004).

Soon after, the National Women's Law Center and the Women's Prerogative launched a nation-wide public education and letter-writing campaign called "Left Out, Left Behind" in response to Donna Nelson's study of diversity in science and engineering faculties (Nelson & Rogers, 2005). A website supports look-ups of the diversity statistics for individual universities and letter writing to specific university departments and to Federal officials (National Women's Law Center & Women's Prerogative, 2004).

Early in 2005, Larry Summers, an economist and the President of Harvard, joined a Conference on Diversifying the Science & Engineering Workforce, sponsored by the National Bureau of Economics at Harvard. Speaking only briefly he made the statement that there are fewer women in science and engineering because women were not interested and because innate differences limited their success in science. His comments launched a "perfect storm" of over 800 pages in the media -- general, scientific, and public policy (for example, Glazer, 2005). Senator Ron Wyden, during confirmation hearings for the

Secretary of Education by the Senate, disputed Summers' comments and yet again raised the issue of using Title IX to change the status of women, since the Department of Education is one of the agencies responsible for enforcing Title IX (Wyden, 2005).

Within the year, Harvard President Summers formed two Task Forces, one on Women Faculty and one on Women in Science and Engineering. They were asked to identify issues for immediate action and to recommend structures and initiatives that will ensure continuing commitment to enhancing faculty diversity. They surveyed Harvard policies and practices, practices at comparable institutions, and research. The resulting reports are good resources for identifying potential policies and practices that have been tried or could be tried to promote the recruitment, retention, and advancement of female faculty in math, science and engineering (Harvard University, 2005). The reports were completed in three months, possibly because many of the policies had already been identified in the past, but were not put in place before.

Anniversary Reflections and Advocacy

The same year, a comprehensive history of Title IX was published that documents the dramatic impact of the law on girls' participation in sports, and the many derivative benefits to society of this "social revolution" (Blumenthal, 2005). The author posed Ron Wyden of Oregon is the natural successor of Edith Green, who was also the Senator from Oregon and the Chair of the Senate Science and Technology Subcommittee, and who got both the Equal Pay Act and Title IX into law. *Let me play* shows how Title IX was primarily and narrowly applied to equal access to sports for thirty years.

Advocacy organizations recognized the 35-year anniversary of Title IX with special publications, although in many, the narrative still concentrated on pre-college education and progress in sports and reducing sexual harassment (American Association of University Women, 2007; National Coalition for Women and Girls, 2008; National Organization for Women Foundation, 2007).

Recently, the Society of Women Engineers made Title IX awareness a priority for 2008, naming a SWE Title IX Lead who is a lawyer, issuing a position statement, providing briefing materials specifically on Title IX, and submitting testimony to Congressional hearings (Society of Women Engineers, 2006; Pieronek & Shanahan, 2008). The National Women's Law Center and the American Association of University Women continue to track with the issue intensively.

Application to Sports Versus Academics

Catherine Pieronek published an analysis of potential differences between the application of Title IX to sports and the application to academic programs (Pieronek, 2005). Written by a lawyer who is also a university administrator, it provides the best guidance as to what both complainants and universities might expect in the application to S&E. Looking at litigation through the 1990s, she observes that the focus was almost entirely on athletics and on sexual harassment. With athletics, where the genders are segregated, it was easy to assess unequal allocations of resources such as scholarships, teams, and facilities. In the academic context, the university must show that it provides an environment that affords men and women the same opportunity to participate (Pieronek, 2005). Men and women compete against each other for admission to universities and to S&E departments. Discrimination can result from policies, procedures, and practices that covertly and possibly unintentionally favor one sex over another. Remediation is not a simple shift of assets; it is much more complex (Pieronek, 2005). It may entail changing the attitudes of faculty and changing the "climate" as experienced by faculty and students. Points of discouragement and discrimination can be hidden in recruitment practices, admissions evaluations, peer student feedback, unappealing course sequences and teaching style, and perception of the profession as a welcoming and

successful direction. At the same time, there are prevailing views that women are not interested, and that lack of interest is the main reason they are absent (Sommers, 2008; Schmidt, 2006). A complaint of discrimination or unfairness under Title IX must be brought by an individual. The circumstances are individual, and a complaint or suit can have adverse consequences for that individual. With sports, the suit could be about sports options, teams, and facilities that are clearly gender-specific. Also, participation in sports is less likely to be about an individual's commitment to a profession.

By Pieronek's reading, it is consistent with Title IX for a university to engage in targeted efforts to encourage women (Pieronek, 2005). The statute does not require nor prohibit quotas to achieve equitable opportunity (Pieronek, 2005). Under the current law, there may not be different admissions standards for a particular gender, male or female. The institution may offer different services separately or differently for female students (and for males) as long as they are comparable services. Her discussion of what educational practices are consistent with Title IX and which are not allowed is useful to those engaged in special outreach and retention efforts. Likewise, her discussion of Title IX implications regarding employment practices is a good introduction.

Compliance Reviews

There was little released to the press about Federal agency responses to the GAO audit report. Published accounts mostly highlight the idea of compliance reviews (Munro, 2006; "Federal Inquiry on Women in Science," 2006). NSF reported that its responsibility for compliance was transferred to the White House Office of Science and Technology Policy (OSTP) (Bhattacharjee, 2007).

A few participants in campus visits that were conducted have shared their experience. The aerospace-engineering and physics departments at the University of Michigan at Ann Arbor were visited by NASA. NASA representatives requested information on undergraduate recruitment and retention and the makeup of their faculties (Wilson & Birchard, 2006). According to Catherine Pieronek, NASA's appropriation bill includes language that requires two compliance reviews per year, and NASA conducted two (as of summer 2008). Review teams were asking for both qualitative and quantitative information, covering recruitment, outreach, admissions, enrollments, academic advising, classroom environment, policies regarding family leave, safety, and sexual harassment. They asked for information about practices and programs in place that are aimed at improving the status of women. Paige Smith reported that NASA visited the aerospace and engineering departments at the University of Maryland, College Park. As the Director of a Women in Engineering Program, Dr. Smith found herself a key resource in preparations for the review, and advised others in similar positions to anticipate the role (Smith & Pieronek, 2008).

Compliance with Title IX is an elusive reality. Universities applying for Federal funding provide pro forma assurances that they are in compliance through boilerplate language in grant agreements which is not specific to Title IX. Four Federal agencies that were scrutinized by the GAO (DOE, NASA, NSF, and Department of Education) do not require special tracking or reporting of information about Title IX compliance from grantee institutions, in relation to either single grants or generally in relation to the the institution as a whole, as a recipient of Federal funding. There are few Title IX complaints filed with the agencies directly. There are few Title IX complaints filed on campuses. In either case, there is a lack of awareness that Title IX covers academics and not just sports, and there are professional risks in filing a complaint with the Federal agency or with the university. (Professional risks of filing complaints of discrimination are described in several sources (Gornick, 1983/2009; American Association of University Women, 2004).) Federal agencies cite a lack of resources to develop their own compliance review

programs, and delegate their responsibility for reviews to the Department of Education or to OSTP. There are only a few reports of reviews actually conducted.

Metrics and Indicators

What are various measures proposed to track inequity? In 2005, Donna Nelson, a chemist at Oklahoma University, published a survey of faculty diversity in the nation's top fifty science and engineering departments. Her detailed charts showed that the numbers of students graduating through PhD in the universities by gender and race/ethnicity (the pool of available candidates), and the demographics of faculty, by rank, gender, and race/ethnicity. Another survey followed in 2005, including the top hundred departments (based on National Science Foundation rankings) (Nelson & Rogers, 2005). The idea of getting fresh, direct data on the composition of faculties came from the awareness that routine reporting by universities was not accurate (for example, per Rolison, 2000a). Debra Rolison convened a panel at the annual meetings of the American Association for the Advancement of Science (American Association for the Advancement of Science, 2006; "C&EN @ AAAS Day 3," 2006). One of the participants, Richard Zare of Stanford University published "Sex, Lies, and Title IX: Federal law banning sex discrimination in schools may do as much for academics as it has for athletics" (Zare, 2006).

The American Association of University Professors issued a major statistical report on gender diversity of faculty across all fields, not limited to S&E (American Association of University Professors, 2006). It provides data on four measures of gender equity for faculty at over 1,400 colleges and universities across the country. There are individual campus listings with the belief that discussion at the local level is more productive than a focus on the more abstract national picture. The four indicators compared in the report for men and women faculty are employment status (full- and part-time); tenure status for full-time faculty; promotion to full professor rank; and average salary for full-time faculty.

The studies commissioned as a result of Senator Ron Wyden's request in 2002 were completed in 2008 by the National Academy of Sciences. One surveyed departments and their policies, looking at hiring, tenure, and promotion practices. The second surveyed faculty at top research universities, looking at demographics, employment experience, and allocation of resources (National Research Council, 2008).

Since 2002, the National Science Foundation has required that every proposal address "broader impacts" of any proposed research or education activity. Researchers must include some plans to take their activities and findings to society, through educational outreach (at schools, museums, etc.), promoting teaching, expressly recruiting the participation of under-represented groups, or partnering with less advantaged institutions (National Science Foundation, 2007). The impact of the requirement, in the form of evidence for actual and effective results, has not been assessed across individual grants and Foundation-wide, in spite of the fact that every proposal is required to address it and every review is required to consider it in the evaluation of merit for funding.

NSF funded a workshop to discuss possible metrics by which grantee institutions and individual investigators could report out Broader Impacts (Cady & Fortenberry, 2008). The idea was that the metrics might also substantiate compliance with Title IX. The project found that colleges and universities are already required to file a report called "The Equal Employment Opportunity Higher Education Staff Information Report (EEO-6)" biennially in odd-numbered years with the Higher Education Reporting Committee (composed of three entities). It covers the composition of faculty and staff by job category and salary, disaggregated by gender. In addition, Federal contractors (including most colleges and universities) must supply Affirmative Action plans. Those two could be a first step in public reporting of status at

institutions. The project suggests that these established reports be expanded – at the institution's option -- to include:

1. Comparisons over time of the composition of various populations (by gender) within the university (for example, faculty profile over a time period)
2. Comparative measures of individual productivity at given points (for example, time to promotion between various positions, by gender)
3. The presence/absence of specific practices to improve access and climate for under-represented groups

This paper provides a practical guideline for those developing campus data.

Recent Milestones

A lot of information, and controversy, culminated in a pivotal report from the National Academies called *Beyond bias and barriers* (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2007). The prestigious Committee on Science, Engineering and Public Policy charged a group to recommend methods for achieving the goal of fully utilizing talent represented in women scientists and engineers. They looked at research, academic culture, and effective practices in education and faculty recruitment in order to make recommendations. The Chair of the group of 15 was Donna Shalala, President of the University of Miami, and they were supported by multiple grants and a project staff headed by Laurel Haak. They drew on contributions from many experts. The book is an outstanding and readable summary of research, profiles of particular key projects, and recommendations for action. It supersedes dozens of prior task force and commission reports in repeating and incorporating now-familiar action items. One of its key recommendations is that an inter-institutional organization be created to monitor compliance with Title IX (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2007).

The Science & Technology Committee's Subcommittee on Research and Science Education held a hearing on October 17, 2007, to discuss and endorse the report (U.S. House of Representatives Committee on Science and Technology, 2007). The day after the hearing, Representatives Eddie Bernice Johnson (D-TX) and Silvestre Reyes (D-TX), Co-Chairs of the House Diversity and Innovation Caucus, also sponsored a briefing on "The Leaky Science and Engineering Pipeline: How Can We Retain More Women in Academic and Industry?" Co-sponsors included the Society of Women Engineers, the American Association of University Women, the American Chemical Society, the Association of Women in Science, Girls Incorporated, National Center for Women and Information Technology, National Science Teachers Association and the National Women's Law Center. Johnson and Reyes then introduced H.R. 3524 Gender Bias Elimination Act of 2007, based on the recommendations made in *Beyond bias* (U.S. House of Representatives, 2007). In February of 2008, the House Diversity and Innovation Caucus – now representing 55 Members – held another meeting to hear from stakeholders on the issue. Over 60 organizations registered. The Gender Bias bill was reintroduced in the 111th Congress as H.R. 1144, the Fulfilling the Potential of Women in Academic Science and Engineering Act, in February, 2009 (Johnson, 2009).

Summary

There is no shortage of information about dimensions of the problem, nor shortage of ideas for correction. There are many barriers to the application of Title IX to science and engineering. First, there is disagreement that the under-representation of women is a problem, that is, some believe that women choose to avoid participation in certain fields and occupations by nature and that discrimination is not a root cause of under-representation. Second, statistics about men and women in S&E fields do not explain why

there are gender gaps, and the reasons for gender gaps are fiercely complex as they incorporate the whole spectrum from unconscious beliefs and behaviors (on the part of both men and women) to outright hostile discrimination. Multiple specific research studies must be considered to uncover credible findings that explain the numbers. Third, many promising practices are not well known, some that are known may not be based on evidence of effectiveness (which is costly), and, they compete for scarce resources. Finally, the legal application of Title IX to academics is more complex than its long application to sports and sexual harassment. All these factors impede rapid understanding, consensus, and action.

At the same time, it is an opportunity. Title IX has been in place for 35 years and has managed to transform and open access to sports for girls in the United States. It could be used to accelerate progress toward equal access to S&E education and to a wider range of professional occupations for women. The goals are consistent with national imperatives to develop talent and meet a global competitive crisis especially in engineering and computer science. Greater awareness of a legal mandate, in the U.S. Code since 1972, is an important step.

RECOMMENDATIONS FOR PRACTICE

1. All organizations whose mission is improved education should make their members aware of Title IX and its application to science, mathematics, and engineering education. This includes information campaigns, web sites, brochures, webinars, and campus-based marketing.
2. Universities should review their own compliance with Title IX: a designated Title IX coordinator, published grievance procedures to resolve complaints, and public notice to the campus community that it does not discriminate on the basis of sex.
3. Current directors of programs targeted at women should cite Title IX compliance as a legal foundation for investments in special outreach, recruitment and retention. They should tie their efforts to institutional diversity indicators as much as possible (such as increased numbers of female students and female faculty).
4. Offices and programs on campus responsible for diversity should identify benchmarks or indicators to measure progress, and introduce more rigorous and regular collection of data. Examples and recommendations for metrics are widely available now. (For example, there is a template in *Beyond bias and barriers*.) They should tie their efforts to Title IX compliance.
5. Institutions should consider a campus self-evaluation. Many “climate studies” have been conducted with the goal of creating a more equitable and appealing environment for groups subject to traditional discrimination. Survey tools are available (Assessing Women in Engineering, 2009).

RECOMMENDATIONS MADE IN BEYOND BIAS AND BARRIERS FOR NATIONAL ACTION

1. An inter-institutional monitoring organization is needed to set standards and review Title IX compliance in science and engineering education. It would serve a function similar to that performed by the National Collegiate Athletic Association (NCAA) for sports in education.
2. The optimal initiating organization is the American Council on Education (ACE), which is currently an umbrella organization with 100 national member organizations (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2007).

3. The monitoring organization should: set professional and equity standards, collect and disseminate education and workforce data, and provide professional development training for members that include a component on bias in evaluation. It should develop and disseminate a model “climate survey” instrument for institutional self-assessments of progress toward diversity (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2007).
4. Federal agencies funding science and engineering education should establish clear guidelines and measures for compliance with Title IX and all civil rights statutes.
5. Federal agencies funding science and engineering education should take a more proactive role in assessing compliance, beyond counting the number of complaints within an institution.
6. Federal agencies funding science and engineering education should develop sanctions for noncompliance. For example, the NCAA asks a member organization not in compliance to withdraw from competition. The parallel in higher education funding might be to bar an institution from competing for federal funds for a period (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2007).

RECOMMENDATIONS FOR FURTHER RESEARCH

1. What is a minimal set of indicators or metrics that are feasible and acceptable to colleges and universities to represent the status of women in science and engineering? Which metrics are commonly collected now by a majority of institutions and do they provide an adequate set for the purposes of Title IX compliance measurement?
2. What is the impact of legislation aimed at reducing discrimination in education, and what has been the pace of change in response to such legislation? What are critical success factors?
3. What are the most effective motivators to get organizations to address and reduce discrimination?
4. Has the National Science Foundation’s incorporation of a criterion called “Broader Impacts” had any impact on sex diversity in S&E at grantee institutions?

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