Science, Technology, Engineering and Mathematics (STEM)

Harvard Chief's Comments on Women Assailed
The Washington Post, January 19, 2005

The Math Myth: The Real Truth about Women's Brains and the Science Gender Gap
TIME, February 27, 2005

American Science in Decline
The Washington Times, July 18, 2005

For Women in Sciences, Slow Progress in Academia
The New York Times, April 15, 2005

In January of 2005, Harvard president Lawrence Summers suggested that "intrinsic aptitude" might help to explain why few women reach the highest ranks of science, technology, engineering and mathematics (STEM) careers in academia.

While the ensuing media storm brought needed attention to the under-representation of women in STEM, fascination with perceived differences in men's and women's brains unfortunately diverted attention from what evidence shows to be the all too real culprits: socialization and discrimination while girls are still in school.

Progress in STEM Since Title IX

Girls' participation rates in STEM courses have unquestionably increased since the passage of Title IX. Before then, many educators accepted the stereotype that girls could not achieve in STEM subjects and should not pursue STEM-related careers. Accordingly, they frequently steered high school girls away from higher-level math and science classes, and excluded them from extracurricular activities such as science and math clubs. Not surprisingly, girls' achievement in STEM lagged behind that of boys through much of the last century.

The 1969–70 National Assessment of Educational Progress (NAEP) assessments in science found that while grade-school and middle-school boys outscored girls by an average of only 5 points; in high school the gap increased to 17 points. Similarly, the 1973 NAEP math assessments showed girls narrowly outscoring boys at the fourth- and eighth-grade levels, but by high school, girls had fallen significantly behind.[77] In contrast, on the 2005 NAEP math and science assessments for grades 4, 8 and 12, the largest gap between boys' and girls' scores was a mere four points.[78] By that year, high school girls were achieving better grades in math than boys, and the gender gap on the mathematics section on the Scholastic Aptitude Test (SAT) was closing, despite documented bias in this test.[79]

With most states now requiring two or more years of math and science for high school graduation, more girls than boys are taking chemistry and biology. In 2000, the most recent year for which statistics are available, 65.7% of girls took chemistry in high school, versus only 58.0% of boys. Girls also outnumbered the boys in math courses through precalculus, but boys still slightly outnumbered girls in calculus courses (11.1% of high school girls and 12.2% of boys took calculus in 2000).[80]

Another indicator of girls' progress in the STEM fields is the increase in girls taking the Advanced Placement (AP) tests in calculus and physics. In the last 10 years, the number of girls taking the AP Calculus AB exam has increased nearly 60% and the number of girls taking the AP Physics B exam more than doubled during the same period.[81] Girls now comprise 48% of AP test takers in calculus AB, 47% in chemistry and 58% in biology.[82] And, in 2007, half of the 40 finalists in the Intel Science Talent Search were girls.[83]

Women at the university level also have had a growing presence in the STEM fields since Title IX was enacted. In 1970, women earned 17.5% of bachelor's degrees in natural sciences and engineering, and by 2004 their share had risen to 38.4%, and women now receive more than 50% of degrees in biological and agricultural sciences. In the same timeframe, women's share of doctorate degrees in these fields more than quadrupled from 6.7% to 30.5%.[84]

Overall, women now comprise nearly 60% of all undergraduate college students, and nearly half of all master's, doctoral, law and medical students.[85] And although their share of STEM degrees earned lags behind men's share, the overall number of women in STEM fields has steadily increased over the past 35 years, while the number of men earning STEM degrees has remained constant over the same period of time.[86]

Substantial Gaps Remain

Despite this progress, women remain under-represented in engineering and the physical sciences, earning only 20% of all bachelor's degrees granted in engineering and physics. And, while women earn 45.9% of bachelor's degrees in mathematics, their share has been decreasing since 1994.[87] Within the physical sciences, women earned 51.1% of all bachelor's degrees in chemistry, but they received only 21.8% of all bachelor's degrees in physics. Women earned only 25.1% of all computer sciences degrees and 20.5% of all bachelor's degrees in engineering.[88]

In addition, girls are still stigmatized, and stereotypes of their lack of ability in STEM persist. Although the obstacles presented by the academic culture are becoming more subtle than the overt discrimination of the past, girls continue to be discouraged in K-12 mathematics and science courses; undergraduate women transfer out of STEM fields before graduating because of unsupportive classroom environments characterized by lack of role models, a limited peer group and outdated pedagogy; and women scientists and engineers earn less and advance more slowly than men in both academia and the private sector. And while some of these differences could result from personal choices, the culture of STEM fields too often creates circumstances that isolate and exclude girls and women, dissuading them from pursuing these careers.[89]

The barriers to girls' and women's progress in STEM begin in K-12 education, starting with the messages received in the schools themselves. In a 2006 Girls Inc. survey conducted by Harris Interactive, 44% of girls and 38% of boys agreed with the statement, "the smartest girls in my school are not popular," and 17% of girls and 14% of boys thought it was true that "teachers think it is not important for girls to be good at math." One ninth grade girl noted, "Even today, society values beauty in girls over intelligence and talent."[90]

In a study looking at high school STEM classes in 2002, researchers observed the presence of serious discriminatory conduct directed at girls, which appeared to account for the further observation that the more advanced computer science classes only had one or two girls enrolled. For example, in one Computer Science 2 class girls were constantly taunted about their bodies, their appearance and their competence, and the male teacher did nothing to stop the harassment. In the same programming class, a girl asked her teacher why he always used football examples for their assignments. Rather than varying his examples, he told her that she could choose whatever topic she wanted for her assignment. This response elicited demeaning remarks and laughs from the boys in the class, such as "do it on sewing." Again, the teacher did nothing to intervene. Not surprisingly, none of the high school girls enrolled in Computer Science 2 went on to enroll in Computer Science 3.[91] *The Chronicle of Higher Education* cites an anecdote of a girl who was one of two girls in her high-school programming courses, where the boys in the classes repeatedly told her that she was not good at programming and out of place. "One of guys I grew up with and was in all of the classes with told me that, scientifically, girls were not programmed to do math like guys could," she said. "And I believed him."[92] According to psychologists, girls and women are more likely than boys and men to internalize criticism and biased comments like this one.[93]

Another area of concern that affects women before they even enter the university classroom is bias within the Scholastic Aptitude Test (SAT), an exam designed to predict the performance of a student in his/her first year in college. MIT found that a woman with the same SAT score as a man was likely to get better grades. After adjusting its admissions process to compensate for the SAT's "under-prediction," MIT has found that its women students earn higher grade point averages in more than half of the majors, including math, science and computer science, even though their average SAT math score is 20-25 points lower than that of male students.[94]

As discussed in the Employment chapter of this report, even for the girls who are not discouraged in high school, and pursue STEM courses at the university level, gains in women's attainment of bachelor's and doctoral degrees in STEM disciplines still have not translated into workplace parity—particularly in academia. Women represent fewer than one in five faculty members employed in computer science, mathematics, engineering and the physical sciences. In engineering in particular, women account for just over one in ten faculty members.[95]

Title IX Enforcement is Lacking

In 2004, a Government Accountability Office report requested by Senators Ron Wyden (D-OR) and Barbara Boxer (D-CA) revealed that many federal agencies failed to conduct compliance reviews. These reviews are part of the most basic oversight requirements mandated by Title IX in order to assure that funding agencies evaluate whether programs and activities comply with Title IX. The report, entitled *Gender Issues: Women's Participation in the Sciences Has Increased, but Agencies Need to Do More to Ensure Compliance with Title IX*, looked

at Title IX compliance practices at three federal agencies that support significant basic research in the STEM disciplines: the National Science Foundation (NSF), Department of Energy (DOE) and National Aeronautics and Space Administration (NASA).[96] The report pointed out that these agencies, along with the Department of Education, have not fulfilled their statutory obligations to ensure that grant recipients comply with Title IX.

The report further noted that grant recipients cannot prove compliance with even the most basic of Title IX requirements, such as reporting compliance data and completing a self-assessment.[97] Many have failed to designate an employee to coordinate Title IX compliance efforts, establish a Title IX grievance procedure, and disseminate information regarding the institution's Title IX nondiscrimination policy. Moreover, because the responsibility for gathering compliance data rests with the individual granting agencies, there is no centralized way to determine whether a particular school has conducted the required self-assessment, and no cross-agency standard for what a self-assessment should look like. Instead, when granting funding, federal agencies tend to accept as proof of compliance the educational institution's own pro forma statement that merely attests to the fact that the educational institution complies with Title IX in all respects.[98]

The GAO report also points out that because students and faculty generally do not know that Title IX applies to anything other than athletics, relatively few academic Title IX complaints have been filed with the aforementioned federal agencies.[99] The report suggests that a comprehensive campaign to educate students and faculty about their rights could lead to greater exercise of those rights.[100] However, faculty and students who are aware of the law's reach fear retribution for filing complaints, even though, as recently held by the Supreme Court in *Jackson v. the Birmingham Board of Education*, Title IX provides a remedy for such retribution.[101]

In the wake of the GAO report, NSF and NASA began to conduct selective Title IX reviews of STEM departments at postsecondary institutions in 2006. While these reviews are a start and may uncover important information relevant to the institutions involved, more widespread and systematic reviews are needed to bring about change on the scale necessary to increase the percentage of women in STEM fields. In particular, such reviews should focus on the culture and climate of relevant STEM departments to determine whether women and men face different barriers to success.

Implications for the U.S. Workforce

The exclusion of women and girls from STEM is not only unlawful discrimination, it has significant implications for our economy. Looking at a broad set of data trends, the NSF governing board observed a "troubling decline in the number of U.S. citizens who are training to become scientists and engineers," and warned that these trends "threaten the economic welfare and security of our country."[102] The United States outsources work to and imports scientists and doctoral candidates from many countries in order to meet the needs of American competitiveness and innovation, and some worry that America's military superiority and security will suffer as a result of this reliance on foreign talent."[103]

Fortunately, the United States has an untapped pool of potential workers. If women and members of other traditionally underrepresented groups, such as racial and ethnic minorities and individuals with disabilities, joined the STEM workforce in proportion to their representation in the overall labor force, the shortage of skilled laborers in STEM could be addressed.[104] In addition, women, and especially women who are also members of other groups traditionally underrepresented in STEM, bring new perspectives and modes of investigation to STEM fields and, consequently, grow America's capacity for innovation.[105]

Conclusion

The persistent discrimination against women and girls in STEM, coupled with widespread concerns about American competitiveness, demonstrate that enforcement of Title IX in these fields is critical. Title IX can and must be used to eliminate the barriers that still exist for girls and women pursuing STEM programs. Proper enforcement of the law will help to eliminate conduct or practices that disadvantage students or employees on the basis of their gender, and create conditions that allow women and girls the opportunity to succeed in STEM fields.

NCWGE RECOMMENDATIONS

Policymakers, enforcement agencies and educational institutions all have an important role to play in educating individuals and institutions about Title IX's role in STEM, and in enforcing the law and addressing the effects of past discrimination by actively recruiting girls and women into these vital fields. The following are some policy recommendations.

CONGRESS

- Congress should conduct oversight hearings and call for enhanced agency enforcement, while also providing the funding necessary to conduct comprehensive reviews of educational institutions.
- As part of the reauthorization of No Child Left Behind, Congress should require and fund gender equity training for K-12 teachers.
- Congress should provide incentives to increase participation of underrepresented groups, including allocating funding on the basis of demonstrated compliance with obligations under Title IX and other civil rights laws.
- Congress should continue NSF ADVANCE grant funding to create diverse programs that help to retain women in academic STEM careers, and disseminate information about successful programs. In addition, informal STEM education should be promoted through federally-funded after-school programs.

ADMINISTRATIVE AGENCIES

- Federal agencies should disseminate promising practices from programs that promote gender equity in STEM fields, such as NSF ADVANCE grants or similar programs under the framework of "Women in Science and Engineering," to encourage broader participation in these programs by the STEM academic community.
- OCR should provide technical assistance to schools to help them understand their obligations under Title IX.
- The Department of Education should launch a public education campaign for students, parents and STEM faculty to educate them about student and faculty rights under Title IX.
- Federal agencies should initiate regular, systematic compliance reviews that have general relevance across institutions and that are consistent across funding agencies. In addition, they should evaluate fund-granting criteria and results for bias.
- OCR should collect data from recipient institutions that show how the institutions are discharging their Title IX obligations, such as in the areas of equitable compensation.
- OCR should promptly and thoroughly investigate discrimination complaints, and publish the results of those investigations. When there is discrimination, OCR should seek the full range of remedies, including termination of federal funding where warranted.

EDUCATION PROGRAMS AND ACTIVITIES

At the K-12 Level

- Schools should notify students and parents about the broad scope of Title IX protections, and give them the name and contact information of the Title IX compliance officer at the school.
- School systems should require students to take increased numbers of STEM courses to graduate from high school.
- Schools should integrate more hands-on activities into curricula and promote participation in and support proven after-school programs that incorporate the latest research on girls' engagement and persistence in STEM.
- Educators should encourage parents to speak positively with their daughters about science, technology, engineering and mathematics careers.
- Schools should invite interesting women with exciting careers in STEM to talk to students about their professions and provide hands-on experience in some aspect of their work.
- Schools should offer professional development to teachers that increases their gender awareness and shows them gender-fair teaching methods that will encourage girls and eliminate hostile environments.

At the University Level

- Universities and colleges should self-assess Title IX compliance, cooperate with Title IX reviews by federal funding agencies, and examine institutional policies, procedures and practices for gender bias, and make this information accessible to the public. As part of this ongoing self-assessment, schools should collect data to track progress of students and faculty, create accountability mechanisms and encourage mentoring for all faculty and students at all stages of higher education with emphasis on multiple and diverse support systems.
- Schools should incorporate gender awareness into professional development for faculty and administrators to address the subconscious ways that they may treat women and men differently.
- Schools of education should require students pursuing education degrees to take specific courses about gender equity and gender awareness.
- Educational institutions should establish family-friendly policies, and create an environment in which taking advantage of those policies and balancing work and life demands do not penalize the employee.
- Universities and colleges should increase networking opportunities through professional societies and peer support systems, and support those activities with funding and the allotment of time for participation in them.
- Educational institutions should study the practices that help companies succeed in retaining women in STEM careers. Corporations that partner with universities on research and recruiting should also partner on issues of gender equity.