NSF's Program for Gender Equity in Science, Technology, Engineering, and Mathematics:

A Brief Retrospective
1993 - 2001

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Contents

“For the United States to remain competitive in a global technological society, it must take serious steps to encourage [women and minorities] to enter [science, mathematics, engineering, and technology] fields. . . . It is time for our nation to examine and reaffirm its policies of equal opportunity and access for all.”

—Report of the Committee on Equal Opportunities in Science and Engineering to the United States Congress (CEOSE 2000, p. 41).

Executive Overview

To promote gender equity in science, technology, engineering, and mathematics (STEM), the National Science Foundation's Program for Gender Equity (PGE) has supported more than 250 curricular innovations, professional development efforts, and informal learning opportunities for women and girls. With over $84 million in awards since Fiscal Year (FY) 1991, PGE is the largest public or private funder of efforts expressly dedicated to improving outcomes for girls and women in STEM disciplines. This document summarizes some of the program's meritorious awards and accomplishments during its first decade of administration.

In academe, women account for more than half (56 percent) of undergraduate enrollment at all institutions and 70 percent of the graduate students in psychology (increased from 52 percent in 1980) but only 19 percent of the graduate students in engineering and 28 percent of the graduate students in physical sciences and computer sciences. In the labor force, women constitute just 23 percent of the population employed in science and engineering and the unemployment rates of women are higher than those of men in each major science and engineering occupation and within most major age groupings (NSF, 2000). PGE is among the largest Federal programs working to ensure that "the other half" of the Nation's human capital is encouraged, retained, and employed in the science and engineering enterprise.

Historically, PGE's mission has been realized by supporting *experimental* projects, *model* projects, and *information dissemination* projects that—

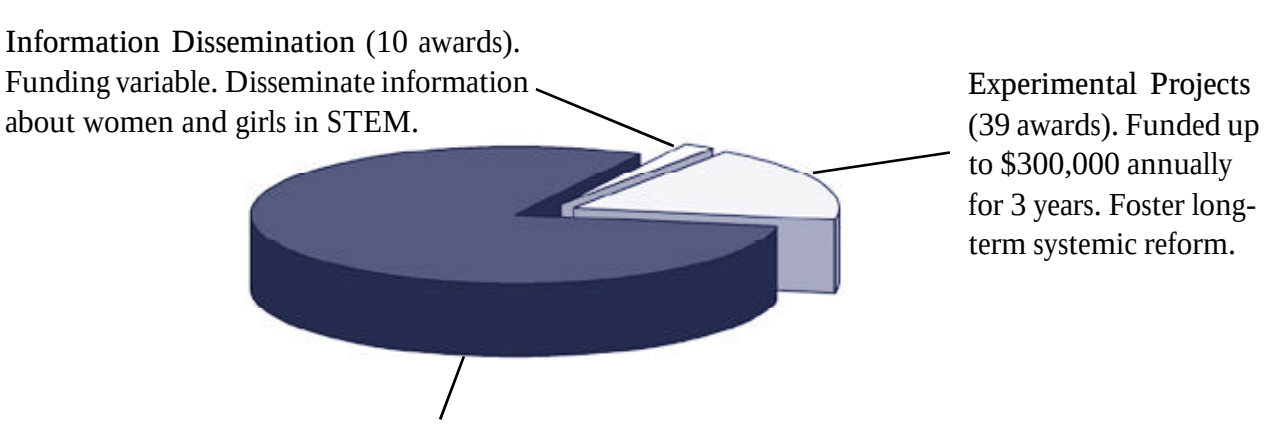
- Increase awareness of the interests, needs, and capabilities of girls and women;
- Promote instructional materials and teaching methods for increasing interest, retention, and achievement of girls and women; and
- Increase the availability of student enrichment resources, including mentoring.

According to figures provided by the Foundation Center (1999), as cited in a study on the national impact of PGE prepared by the Urban Institute (2001, p. 25): "Funding for girls' and women's programs totaled slightly over 5 percent of [private] foundation donations in 1997; however, the vast majority of this funding did not target [STEM] education."

Among Federal agencies, a few similar programs exist, but they are much smaller (for example, NASA's Women at NASA website). Even within NSF's Directorate for Education and Human Resources, PGE uniquely funds education research and projects targeting student groups from kindergarten though graduate school.[1]

[1] NSF has other programs that address the underrepresentation of minorities, persons with disabilities, and the advancement of women in the professoriate. The latter program, called ADVANCE, funds institutional efforts to increase the numbers of women in higher ranks of faculty, among other initiatives. An earlier, now discontinued program called Professional Opportunities for Women in Research and Education (POWRE) gave awards to outstanding female individuals, not education projects.

Distribution of PGE funds by project type, 1993 - 1996



Source: Urban Institute, 2001, p. 11.

As summarized by the Urban Institute (2001, p. 9), projects funded by PGE specifically address several critical areas of concern regarding gender parity, including—

- The disproportionately high number of girls who lose interest in science during middle and high school;
- The low number of girls who enroll in advance high school science and mathematics courses to prepare for college;
- The disproportionately low number of women with STEM undergraduate majors—particularly those in physical sciences, computer sciences, and engineering;
- The low rate of women completing STEM graduate degrees; and
- The slow rate of women's advancement to senior ranks and leadership positions in academic, industry, business, and government STEM careers.

The Importance of PGE Support for Gender Equity in STEM

Comparative funding of PGE and selected other, non-NSF Federal education programs addressing parity for women and other underrepresented groups, as identified by the Urban Institute Impact Study (2001).

Federal Agency	Program	FY 1999 Funding
National Science Foundation	Program for Gender Equity	$9.75 million
Department of Education	Minority Science and Engineering Improvement Program	$7.5 million
Department of Defense	Science and Technologies Academies Reinforcing Basic Aviation	$5 million
Department of Education	Women's Educational Equity Act	$3 million
National Aeronautics and Space Administration	Science, Engineering, Math and Aerospace Academy	$2 million
Department of Defense	Space Exploration and Science and Engineering Apprentice programs	$1.4 million
Department of Energy	Los Alamos Laboratory Underrepresented Minority and Female Program	$350,000

Source: Urban Institute (2001).

Into Fiscal Year 2002 and beyond, PGE continues to support and develop projects in several areas critical to the program's mission. Thematically, these efforts include—

- Program evaluation, assessment tools, and best practices in all STEM disciplines, but particularly those with lower a representation of women and girls, such as engineering and physics;
- Dissemination of information, education and career counseling, and tutorials on gender issues in science and engineering for students, administrators, parents, and faculty;
- Education technology and research, including gender differences in learning mathematics and exam performance, the "digital divide," and girls' interest in information technology;
- Addressing the university climate, including support programs for female students, mentoring, undergraduate research opportunities, and distance education and tele-learning opportunities;
- Improved collaboration between institutions, including better articulation between institution types; and
- Professional development for education professionals.

Undeniably, much progress has been achieved, with some of this change catalyzed by PGE support. Equally certain, however, is that much more remains to be done regarding gender equity in all academic fields, but particularly in STEM. Improving the opportunities for women and girls will remain the primary focus of PGE as this unique program looks toward the future.

"While the accomplishments [of PGE] are excellent in relationship to the investment, the CoV believes that it is imperative to the national agenda that more women participate in programs that improve [STEM] education and career opportunities. The CoV believes that NSF needs to maintain a leadership role in this important agendum."

—PGE Committee of Visitors (CoV)
Report to NSF (2000, p. 11)

Background

Program History and Budget

In 1981, the Equal Opportunities for Women and Minorities in Science and Technology Act acknowledged it was the policy of the United States to encourage the participation of all groups in science and engineering. The Act mandated that NSF report statistics on these underrepresented groups and initiate programs fostering more proportionate representation. NSF accepted this mission, in part, with the creation of the Program for Women and Girls (PWG) in Fiscal Year 1993. In FY 1999, the program was renamed the Program for Gender Equity in Science, Mathematics, Engineering, and Technology (PGE) to clarify that women were not the only participants and principal investigators involved in the program's research and education initiatives. NSF also responded to the recognized disparity in the opportunities for women by sponsoring national activities such as the 1992 *National Conference on Diversity in the Scientific and Technological Workforce* and the 1995 conference, *Women and Science: Celebrating Achievements, Charting Challenges*.

In 1998, the U.S. House of Representatives passed H.R. 3007, the Commission on the Advancement of Women in Science, Engineering, and Technology Development Act. This Act called for the appointment of a commission of seven representatives from business and four from educational institutions. As stated, "the Commission will be mandated to identify the problems associated with the recruitment, retention and advancement of women, minorities, and persons with disabilities in science and engineering." (NSF, 1999, p.2).

> "By addressing the barriers that face women and minority scientists and engineers, Congress has taken action to help to ensure that our labor force is ready for the information age, and that our high-tech economy continues to flourish in the 21st century."
>
> —Rep. Constance A. Morella (R- MD),
> Chairwoman, Technology Subcommittee,
> on the passage of H.R. 3007.

The initial (FY 1993) PWG program budget was approximately $7 million, which was used to fund about a dozen projects over the program's first three years.

By FY 1996, the program had funded more than 35 projects, directly or indirectly involving more than 2.6 million participants (HRD, 1996). Early PGE/PWG awards focused on three thematic areas: *model projects*, *experimental projects*, and *information dissemination* grants. Networking and exchange of information is further developed through national conferences and an annual meeting of PGE grantees. Though the program has accomplished much in its short existence, national statistics reveal that much more remains to be done.

Women's Participation in Education, Research, and the Workforce

- "In 1996, women accounted for more than half (56 percent) of undergraduate enrollment at all institutions." (NSF, 2000, p. 9). "In 1980, 30 percent of full-time first-year science and engineering graduate students were female, compared to 41 percent in 1997." (NSF, 2000, p. 26).
- "The number of bachelor's degrees in science and engineering awarded to women has increased each year since 1966 (with the single exception of 1988), reaching 181,333 in 1996." (NSF, 2000, p. 19).
- "Women are more likely to complete a bachelor's degree within 5 years … [50 percent compared to 41 percent of men]." (NSF, 2000, p.14).
- "In 1997, 55 percent of the graduate students in all fields were women (Syverson and Begley, 1999) as were 40 percent of the graduate students in science and engineering." (NSF, 2000, p.25).
- "In 1966, women earned 5,469 or 13 percent of the science and engineering master's degrees awarded … By 1996, they earned 37,453 or 39 percent." (NSF, 2000, p. 35).
- "… Women earned the highest percentage of doctoral degrees in psychology (67 percent) … they earned the lowest percentage of their doctoral degrees in engineering (12 percent) in 1997." (NSF, 2000, p. 39).
- "Among all employed scientists and engineers, women were less likely than men to be employed in business or industry—46 versus 63 percent—and more likely to be employed in educational institutions—27 percent versus 15 percent of men." (NSF, 2000, p. 57).
- "Women were 19 percent of the total undergraduate enrollment in engineering programs in 1997 … the numbers of women enrolled in undergraduate engineering programs increased every year from 1989 to 1997, while the number of men declined every year between 1990 and 1996, with the exception of 1992." (NSF, 2000, p. 13)
- "In 1997, women accounted for 70 percent of the graduate students in psychology (increased from 52 percent in 1980) but only 19 percent of the graduate students in engineering and 28 percent of the graduate students in physical sciences and computer sciences." (NSF, 2000, p. 27).

Representative Awards

Model Projects—According to an analysis of 140 PGE awards made from FY 1991 to FY 1997 conducted by the Urban Institute, a typical PGE model project, which represents 18 percent of the program's funds and 59 percent of its awarded projects, received a one-year grant of $100,000. Model projects delivered STEM content primarily to middle school or college students, who participated in hands-on activities in small groups and received information about science- or mathematics-related careers. Teachers, faculty, and scientists participated in project activities.

Experimental Projects—According to the same analysis, a typical experimental project, which represents 80 percent of the program's funds and 33 percent of its awarded projects, received a three-year grant of $800,000 to deliver services primarily to middle and high school students. Activities were held weekly during the school year and often included a summer camp component. K-12 teachers and school administrators received professional development related to achieving gender equity in the classroom. University faculty served as role models and mentors to students, with an overarching goal of institutional change.

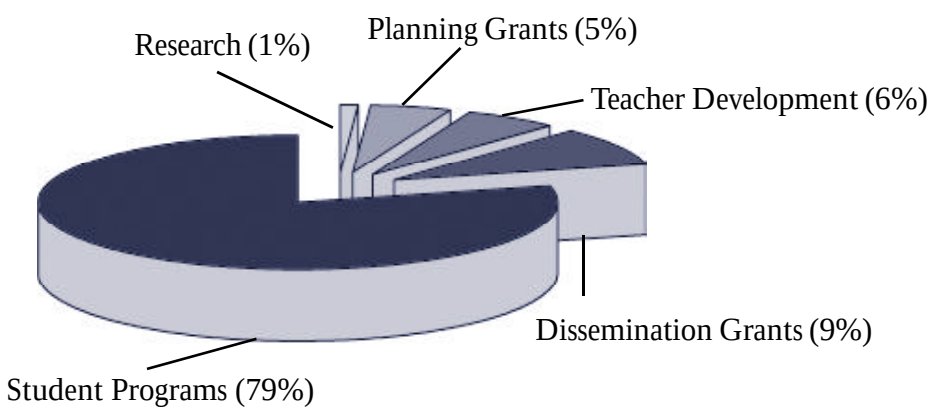
Information Dissemination Projects—According to the Urban Institute study, information dissemination projects represented 2 percent of the program's funding and 8 percent of its projects and were more variable in duration and amount.

By FY 1997, PGE products gaining national impact and utility included—

- Products including videotapes, web sites, teacher training materials, faculty handbooks, and teacher workshops. These activities and materials spread the awareness of the program far beyond the individually funded projects. Some support projects were receiving national dissemination through community organizations such as Girl Scouts of America, public radio, and television.
- Networks of women scientists, mathematicians, and engineers formed to serve as mentors, speakers, and advisors for many of the projects. Many networks have continued to exist and expand their outreach after the conclusion of the funded project. Individuals have continued to serve as role models for young women.
- NSF's PGE activities in FY 1997 alone averaged one or two press items per week, indirectly affecting the attitudes of parents, teachers, counselors, and the general public via increased knowledge regarding women-in-science issues.

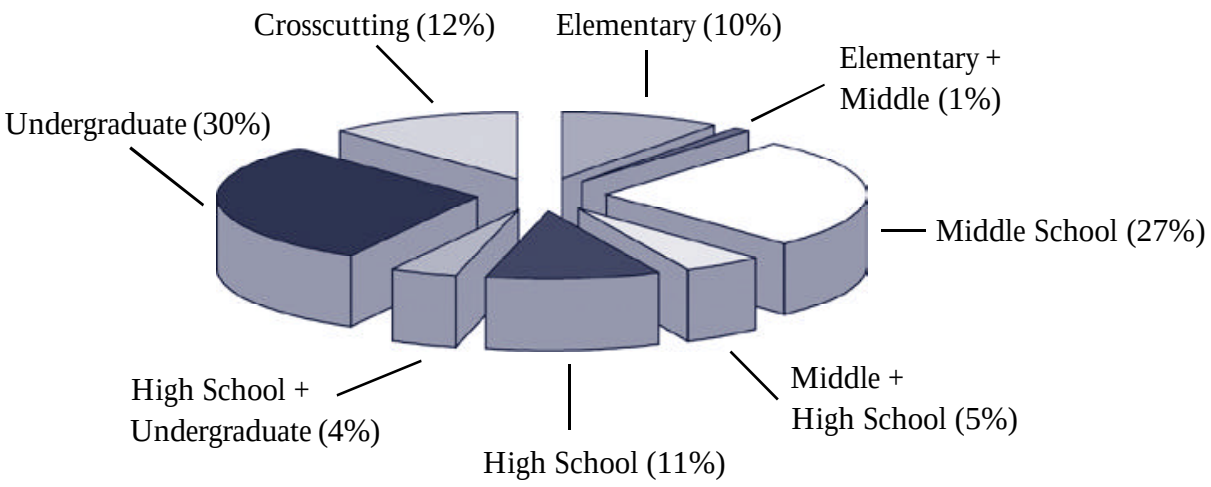
Today, large collaborative projects have taken over the kinds of initiatives once called experimental or implementation and development projects—multiyear efforts intended to encourage systemic change and obligating the largest portion of the program's approximately $9.7 million budget. Similarly, small experimental projects have carried on the work of model projects—one-year activities designed to create national exemplars. Information dissemination awards have remained integral to uniting this widespread community. Specialized planning grants round out the PGE portfolio. Notably, PGE projects also have a high representation of African American, Hispanic, and Native American students (often 75 to 100 percent), thereby also having an impact on underrepresented racial and ethnic groups (HRD, 1997).

Distribution of Program Funds by Award Instrument



Source: NSF Division of Human Resource Development.

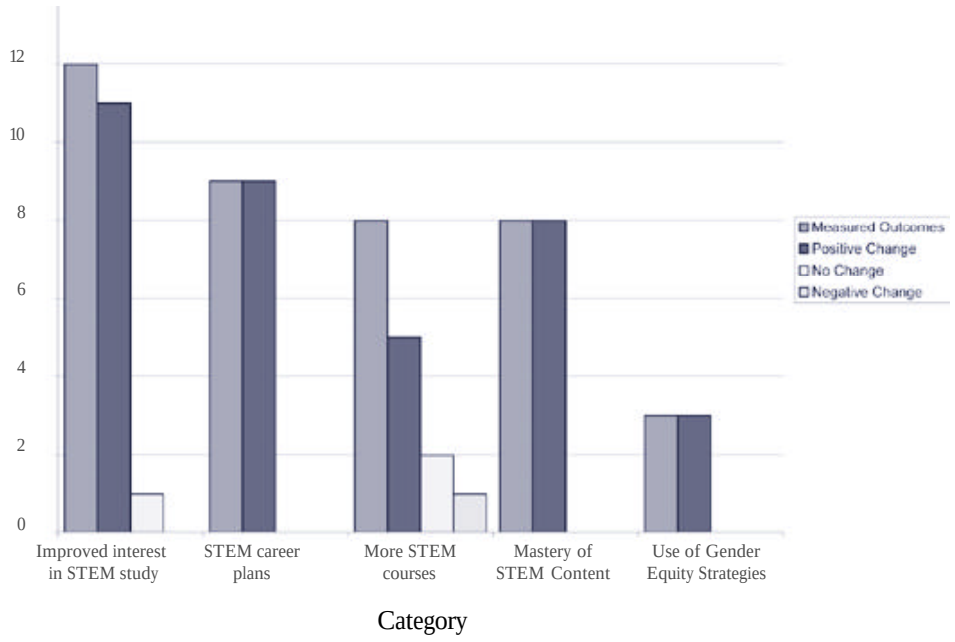
Distribution of Program Funds by Age Level



Source: NSF Division of Human Resource Development.

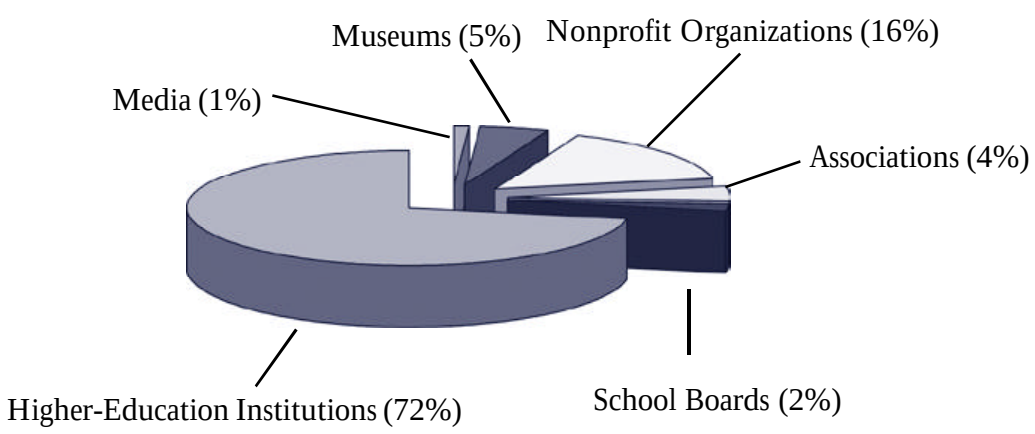
Participant Response to PGE Project Activities

Number of completed sample projects (*n*=30)



Source: Urban Institute (2001).

PGE Awards by Sponsor Type, 1993 - 2001



Source: NSF Division of Human Resource Development.

Annual Distribution of Program Funds

The Real Impact

Good intentions, statistics, and budget analyses can only tell part of the story for a program of this type. For its beneficiaries, the real impact of PGE can only be measured in terms of realized potential and the changes being made in specific programs and in individual lives touched by research in gender equity issues.

FYI

For the interested reader, project abstracts and detailed award information for the PGE projects summarized on the following pages can be searched at: http://www.fastlane.nsf.gov/a6/A6AwardSearch.htm using the award number indicated in parentheses.

Products with National Significance

An FY 1995 PGE award to the University of Washington (#9553430) helped to establish a mentor-training program with the intent of enhancing the retention of females pursuing undergraduate and graduate degrees in engineering. Building upon the university's Women in Engineering program, the learner-centered project has not only succeeded in its home institution but has been disseminated nationally.

Identified and itemized for a recent sample year (FY 2000).

Award Track[2]	Amount	No. of Actions	Percent of Budget
Large Collaborative Projects	$ 2,430,493	9	26.3
Continuing Grant Increments	$ 5,711,560	21	61.9
Planning Grants	$ 46,900	2	0.5
Information Dissemination Activity	0	0	0
Small Experimental Projects	$ 975,889	10	10.6
Supplements	$ 28,119		0.3
Misc.	$ 34,814		0.3
Total	$ 9,249,670	42	(100)

Source: NSF's Division of Human Resource Development, 2000.

[2] Based on the type and quality of proposals received and available program funding, not all award tracks may be funded in any given fiscal year (see, for example, Information Dissemination Activity for these data).

Similarly, Oakland's Chabot Observatory and Science Center (#9555807) has developed an environmental curriculum from its Female Involvement in Real Science and Technology (FIRST) project. FIRST is a remarkable collaboration between local learning institutions, professional associations, and non-formal science centers, directly benefiting 5th to 8th grade girls in some 45 schools and 1,200 teachers as well as area parents, counselors, and caregivers. The project also published a guide to establishing after-school science clubs.

At the University of Utah, principal investigator (PI) Marjorie Chan (#9625566) produced an award-winning video featuring "Women in the World of Earth Sciences" to inspire 10- to 18-year-old girls contemplating geosciences as a career. A PGE award to the National Council for Research on Women (NCRW, #9732530) helped to produce a summary of research in *Balancing the Equation*, a publication bringing current topics in gender equity to NCRW's network of 77 U.S. research centers and more than 1,500 organizations worldwide. A PGE information dissemination award to the Institute for Women in Science (#9710975) brought an increased awareness of gender equity options in trade, technical, and academic areas to teachers and school counselors. Equipped with this knowledge, these academic leaders can in turn inform other faculty, industry personnel, and students.

More recently, researchers at the University of Missouri - Columbia (#0120642) composed a team with experience in undergraduate engineering programs and in assessment and evaluation to develop standardized, exportable, and comparable assessment instruments and models for Women In Engineering (WIE) programs nationwide. A base of five institutions will pilot, revise, and test a set of assessment instruments they determine to be useful to most programs. There are about 50 WIE programs nationwide. WIE directors will benefit by having ready-made assessment tools that will allow them to collect data on programs, evaluate these programs, and make decisions on how to revise programs and/or redistribute limited resources to maximize overall program effectiveness. The resulting assessments will provide substantiated evidence for administrators, advisory boards, and potential funding agencies. Finally, programs will have the opportunity to take advantage of powerful benchmarking data, a logical step in the national movement to recruit and retain women in engineering.

Research Findings with National Significance

PGE researchers at the Baylor College of Medicine (#9906394) have developed a SMART Graduate Records Exam prep course that produced significantly higher test scores among project participants. The results have the potential for national impact on the way testing is done at the college level. The Colorado School of Mines (#0080669) is using PGE funds to research the communication and behavior of engineering teams with the intent of understanding productivity in mixed-gender work environments.

Miami Dade Community College (#9554188) demonstrated significant results in pedagogy and comprehension with its project teaching mathematics through writing. Here, transactional writing is used to develop active learning skills while mentoring and career counseling helps to translate student understanding to increased retention in STEM fields. Ohio's Denison University (#9710136) used PGE support to investigate a team-based mentoring approach pairing tenured faculty and works with non-tenured economists as professional mentors as an alternative to continuous, one-on-one support in a field that has few female role models. At

North Carolina State University, PI Sarah Berenson (#9813902) has developed Girls on Track, a multi-institutional program directly impacting 200 middle-grade girls, 50 in-service Algebra I teachers, 15 guidance counselors, and 30 math education undergraduates. Additional contributors include IBM, the Mathematical Association of America, and many other corporations in nearby Research Triangle Park.

Deconstructing Stereotypes

Effective learning begins with the student's belief that she is unconditionally capable of succeeding. Too often, an inescapable condition—and obstacle—is the presence of unfounded stereotypes, which is why several PGE awards have served women and girls in finding their own voice in the learning process. In Nevada, the Carson City School District (#9908703) developed an experimental project to invite Hispanic girls into computer-aided design (CAD). Local businesses provided workforce training through internships paid by the project, as well as transportation and assistance with English skills as needed. The Alabama School of Fine Arts (#9619214) similarly created a welcoming environment for high school girls with an interest in studying mathematics and science. By educating teachers in more gender appropriate science experiences and building linkages to institutions across the state, the project developed comprehensive partnerships and garnered national recognition for turning out high-performing girls and boys, equally.

The Women in Science and Engineering (WISE) Institute at Penn State University (#9714759) produced "Computer Hardware Diagnosis and Repair," a series of workshops for students and teachers across six sites for two years. Participants were high school students, undergraduate students, and in-service/pre-service teachers and Lockheed Martin donated used computers. Additionally, teacher participants specializing in computer diagnosis and repair were able to take working computers back to their schools. The project found that women became confident and interested in computing and many became leaders of workshops for others, including other teachers. Apprehension about hardware was key in changing attitudes toward computing. This was significant human capital especially in rural areas and the project attracted a lot of media attention. PI Judi Wakhungu also made presentations in Africa, where the model will be implemented.

Montana State University-Bozeman (#9618855) conducted a project aimed at high school girls from rural schools and Indian reservations. The team learned that they had to bring the program to the reservations; that tribal girls would not travel out. Recently, girls who were members of the "Why Not Me Science Club" on the Crow Reservation won the national NSF-Bayer National Science Competition over 500 other teams. They developed house-building material using straw, which is in abundance in their community, and proved their adaptation was fire, water, and heat proof. They will use the $25,000 prize to build a community center to demonstrate the viability of the straw-bale material and a once-popular construction technique that had been long neglected. Toledo Public Broadcasting (#9453076) also received PGE funds to work with local school districts, Girl Scout Councils, and science centers to provide a girl-friendly curriculum for replication and broadcast by other stations, providing hands-on technology learning experiences to about 500 Girls Scout leaders and 1,250 Cadette Girl Scouts in the project's first year alone.

Institutional Impact

PGE awards are also making a difference on campus, contributing to systemic reform in the way women and girls are taught and inspired in their chosen majors. As just two examples, the Georgia Tech Research Corporation (#9453106) received one of the first awards from PGE to adapt and improve the courses used to prepare mathematics and science teachers, leading in turn to a change in classroom climate for boys and girls. Another FY 1994 award, to Rutgers University New Brunswick (#9450588), provided hands-on mathematics and science activities and engaging experiences in a single-gender learning environment. The project allowed participants to follow their own interests irrespective of competing or differing learning modes employed by other classmates.

Integration of Technology

At the University of Massachusetts - Amherst (#0120809 and others), an interdisciplinary team will design and study the impacts of an intelligent (computerized) tutor mathematics for high school students. Using environmental biology as the context for mathematical exercises, the tutor features gender-adaptive instruction, graphical manipulations to enhance spatial cognition, virtual mentors, and sections designed to improve performance (and narrow the gender gap) on the SAT-Math achievement test. The project integrates research and education by conducting the experiment in three different school systems with the participation of teachers and administrators. Also in Massachusetts, the Education Development Center (#9450042) and the Center for Children and Technology created an inviting, non-formal learning environment for K-12 students by providing telementoring linkages to successful women professionals in STEM careers. New York's Girls, Incorporated (#9908759) used PGE funds to enhance and improve the Internet-based learning component of its Girls Dig It Online web site, which fosters an interest in archaeological science in girls aged 12 to 14 in a safe on-line environment with science professionals and educators contributing content, feedback, and activities.

Leveraging National Cooperation

"Bridging the Gap" was the title of a FY 1994 award to North Carolina's Discovery Place, Inc. (#9450006), a philosophy that still represents the PGE mission. The project involved empowering Girl Scout facilitators to "plan, organize, and direct [science, engineering, and mathematics] at a grass-roots level" with the potential to impact more than 330 Girl Scout Councils and 2.6 million Girl Scouts nation-wide. The Connections Partnership at Northeastern University (#9813896) also teamed with the Girl Scouts to represent over 8,000 Boston-area K-12 girls with its gender-appropriate programs. Specific connections are made between middle- and high-school students and the undergraduate experience using both formal and informal educational experiences.

Building Partnerships

The Triad Alliance for Gender Equitable Teaching (#9813926) represents a partnership between the Science and Health Education Partnership of the University of California at San Francisco and the San Francisco Unified School District. Offering a multi-level professional development program in gender equity and science education reform, the project will address girls' self-esteem, assertiveness, and comprehension of STEM material with the eventual national dissemination of a how-to package detailing Alliance methods.

An award to South Dakota's Youth and Family Services (#9906176) seeks to adapt the "Teaching SMART" methods of professional development and sustained educational reform—first developed by Girls, Incorporated—in six diverse urban and rural locations across the country. Teaching SMART is demonstrating a model for changing the way teachers teach science. Over 125 teachers each year are attending a training session and then, with regular personal follow-up by trained site specialists and working with peer coaches, practicing equitable, student-centered, hands-on, inquiry-based teaching methods. The project is finding ways to improve the model, for example, by facilitating networking between site specialists. Teaching SMART is focused on teachers, but the ultimate goal—student outcomes—are measured as well, to see whether student confidence, science content knowledge, problem-solving skills, and enjoyment of science are increased.

An award to Massachusetts' TERC, Inc., in collaboration with the University of California at Santa Barbara (#9714743) is infusing successful math reform workshops with a greater awareness of gender issues. The project directly impacts more than 13,000 mathematics teachers attending such workshops each year. Meanwhile, the "Jump to the Sun" project at Coastal Carolina University (#9553411, #9619217) investigated the factors affecting the awareness of STEM careers by women and girls and uses mentoring, relevant activities, and the extra-curricular involvement of families and caregivers to nurture interest in science and mathematics.

Regional Impact

At Rutgers University New Brunswick (#9553482, #9632274), the "Family Tools and Technology" project is an after-school program for girls, their teachers, and their parents to collaborate in problem solving activities that illustrate the real-world applications, importance of science, technology, and mathematics. The project presents career opportunities in technology as accessible and exciting options for girls and makes STEM materials more engaging and comprehensible for both girls and boys.

The Advocates for Women in Science, Engineering, and Mathematics (AWSEM) project (#9450030, #9714862) at the Oregon Graduate Institute for Science and Engineering has developed activities and career information for high-school girls interested in STEM and features mentoring, role models, and tutoring to enhance these interests at locations statewide.

Building upon past NSF support of a multi-generational model program, the "Sisters in Science" project at Temple University (#9619021) also had a broad impact beyond the classroom by involving parents, counselors, and community members in girls' STEM education. Among science and technology centers, the Miami Museum of Science (#0114669) received PGE funds for its project entitled GREAT—Girls Redesigning and Excelling in Advanced Technology. The project will raise the awareness and interest of girls (particularly those in underrepresented minorities) in information technology and advanced technology, inviting them to pursue advanced education or careers in these areas.

Reaching Specialized Populations

Girls and women from rural populations, underrepresented minorities, or those possessing disabilities have been called doubly disadvantaged in terms of access to and inclusion in mainstream educational practices. Recognizing this, several PGE awards have sought to address these specialized populations. West Virginia's Appalachia Educational Laboratory (#9815117) worked with several partners to investigate the attitudes of rural girls when selecting careers and college majors, with the intent of encouraging greater participation of girls from these communities. In the District of Columbia, George Washington University (#9714729) collaborated with Gallaudet University and several Historically Black Colleges and Universities to increase the STEM participation of girls with hearing impairments and those from minority groups. The project used mentoring, interpreters, and student research experiences to provide more equitable and accommodating classroom experiences.

California's Sweetwater Union High School District (#9813908) worked with business and community partners to make technology careers more attractive to its minority (primarily Latina) female student population. The holistic project incorporates professional development, student services and support, and articulation opportunities with various project partners.

New York's Educational Equity Concepts (EEC, #9632241, # 0114741) continues its project emphasizing STEM experiences for girls ages 6 to 11 who live in urban settlement houses. The EEC project will work with United Neighborhood Houses (UNH) and United Neighborhood Centers of America (UNCA) to nationally disseminate its effective practices and lessons learned.

A project at Arizona State University (#9619121) found effective strategies for guidance counselors in advising "talented, at-risk girls" and encouraging them to enter STEM fields. The program reached about 400 girls, including more than 100 Native Americans and 130 Mexican Americans across 40 high schools. Through seminars, 369 teachers and counselors advanced their skills in talent development. The project yielded two psychological tests, and eleven theses and dissertations. Fifty-two graduate students were trained in assessment, group counseling and individual counseling. The project has been effective in raising girls' understanding and application of mathematics and science, correlating these successes with the girls' enhanced self-esteem and interest in careers in STEM fields.

What We've Learned

General observations from the field of research in gender equity (excerpted below from NSF, 1999) include—

- Role models are important elements in a girl's development, and there are ways to make the most of a role model's impact.

  Interviewing role models ahead of time, before inviting them to participate, can help you keep them on target and at the right level for the girls in the program. It is particularly helpful to find stories of perseverance, and personal stories that focus not just on the science and engineering, but on the people who have been involved in the lives of the role models from girls to adults. Role models who are nearer in age to the girls in the program can have a particularly strong impact and can lead to close personal and perhaps professional relationships.

- Advance placement physics and computer science remain male-dominated. The National Center for Educational Statistics addresses this and related issues in their publication, *Men and Women on the Engineering Track.* More work must also be done in engineering to develop a better curriculum and to place more emphasis on girls at an earlier age.

  Research has shown that, in the last five years, some of the gender equity programs are paying off in areas such as trends in course taking. For example, girls are now taking calculus in the same numbers as boys.

- There is a need for good research on the relationships between socio-economic class, ethnicity, and gender equity issues.

  Some research of this type has shown that families of girls of color are not as stereotypical, in terms of occupation, as might be expected.

- There is a need to increase the willingness of engineering departments to accept women and minority faculty.

  Encourage local industry leaders to become involved in supporting the diversity aspects of your program. Industry has already learned to value a diverse work force. Identify faculty who have daughters and encourage both daughters and parents to become involved. Establish incentives for faculty to take diversity workshops.

- Research has identified some of what today's college students think about gender equity issues: There is an emerging backlash among men in the freshmen age group of eighteen to twenty; they are more concerned than their counterparts just five years ago about who would stay home with the children.

  Women are increasingly intimidated in competitive situations: They are less likely to stand up for themselves than their counterparts were a decade ago. Girls still hide their abilities from the boys and both men and women tend to deny that there is any equity problem.

- In some ways, stereotypes of women have worsened over the last few years due to influences such as MTV and similar programming.

  Some see that America remains a white-male society, that something must be done to help girls step out of their constraints, and that we need to begin working with the boys to change attitudes that will affect future generations. Research shows that boys can change their ideas if they are exposed to role models.

Evaluation

Obviously, any advance indicator of change—whether for the better or not—requires careful and appropriate evaluation. Principal investigators have their own lessons learned in this regard, as excerpted below from the 1998 PGE awardees meeting and NSF (1999)—

- An effective evaluation requires an appropriate control group.

  For longitudinal evaluations in particular, self-control does not guarantee good results. It is important to also control the environmental conditions. For example, wait-list control may not be equivalent if you are selecting participants for maximum impact.

- It is wise to pre- and post-test on the attitudes and knowledge of children and on approaches to handling gender equity issues.

  One evaluation revealed that group leaders had a need for training in gender equity; this finding led to the development of three-day training sessions and follow-up activities. Concern is increasing for the need to conduct longer-term evaluations of programs, especially when it comes to compliance with behavioral objectives for projects within a school setting.

- For local or regional projects, on-site visits and ongoing development of personal relationships enhance the use of material.

  Thinking of the sites as entities that need to be nurtured and involving administrators at the sites are also ways to improve results.

- Teacher training is an important and ubiquitous activity of most projects.

  A typical evaluation plan includes three components: Pre-test and post-test with girls; Conduct interviews with participants and parents (program graduates can serve as interviewers); Use valid and reliable methods (instruments, questions) to assess impact.

Proven Strategies to Improve Outcomes for Girls and Women in STEM

- Mentoring/Role Modeling
- Extracurricular Activities
- Summer Camps
- Professional Development for Educators
- Activities for Parents

(*Excerpted from* Urban Institute, 2001, p. 21)

Dissemination

Common problems may inspire common solutions, but given the scope and size of the target audience, adequate dissemination of "solutions to the problem" are necessary to avoid repeating hard-won experience.

- Include dissemination activities in the project design and establish a relationship between dissemination and evaluation.

  Design aspects of self-perpetuation into the project or program, capitalizing on the enthusiasm of people who not only become involved but who establish a commitment to the project on an ongoing basis.

- On one hand, it is important always to have a product that results from the project; on the other, you must be realistic about your capacity to conduct the project and produce this legacy.

  The financial costs of dissemination must be addressed rationally, although emotional costs should be anticipated as well. For example, while it is great to end up with a successfully commercialized product, it can be very difficult to let go of your personal involvement.

- Address both internal and external audiences, considering factors such as educational level, when tailoring both message and medium.

  For example, a grade school administrator and a university administrator will respond quite differently and these differences can affect the success of your dissemination program.

- Several specific strategies are used frequently.

  Hire a professional marketing consultant. Find or develop expertise in packaging. Within your own institution, rely on communications and public affairs departments, students in communications and telecommunications classes, and leaders at the highest level possible. Use the "outside" audience to help develop messages and get the word out about your program or product. Use quotes or testimonials in promotional materials, conduct train-the-trainer sessions, and ask people how they found out about the program.

- Use the Internet to your advantage.

  List servers can be more effective than web sites because you are sending the message out to the audience rather than waiting for them to come to you. If you choose this approach, learn about and be sensitive to the listserv culture, and be sure to include appropriate subject lines to attract the attention you need.

- Many agree that they would rather impact the girls' lives, even if that means that valid research data would be lost.

Program Evaluation

In response to 1993's Government Performance and Results Act (GPRA), PGE as well as NSF and all Federal agencies has a mandate oriented toward outcomes-based performance. This means that Federal agencies and their programs must define their intended mission to the community, establish annual performance goals for that mission, measure actual performance against these goals, and publicly report these results. PGE directly responds to the GPRA goal of improved achievement in mathematics and science skills needed by all Americans. Although long-term impact is not implicit in most PGE awards—which are typically funded for three years or less—the program has nonetheless produced many model projects or proven practices employed or available for implementation nation wide. Approximately half of the projects funded by the program since FY 1994 are still active today.

With GPRA imperatives in mind, PGE has also hosted a number of third-party evaluations of program performance and to ensure that the program's direction remains of maximum benefit to its intended constituents (see below). The 1998 Urban Institute study focused extensively on the development of outcome indicators for PGE projects. Today, program staff are also developing a system of automated reporting templates for PIs with a particular emphasis on reporting outcomes of project activities.

1997 Committee of Visitors

On January 22-23, 1997, a Committee of Visitors (CoV) performed a review of approximately 25 percent of the program awards from FY 1993 to FY 1996. The CoV found that approximately 70 percent of the program's awards were to universities, correlating closely with the 60 to 70 percent of proposal submission from university sponsors "with the rest coming from a good mix of community colleges, informal education institutions, local education authorities, or other public education institutions, and organizations." (CoV, 1997, p. 3) and "the Committee was unanimous in praising the program staff for its excellent management of the award process." (CoV, 1997, p.4). The CoV also found particular administrative strengths of the program to include: outreach to a variety of institutions, quality of the review process, consistency in program officer's decisions with reviewers' comments and ratings, and on-going communication with projects.

The Urban Institute Study

In 1998, the Urban Institute of Washington, DC, initiated a study of PGE and its impact on the national community. In their study of 180 PGE projects funded between 1993 and 1996, including in-depth study of 40 projects—the Urban Institute Study focused on four key areas:

- *Contributions to the Knowledge Capital*—Fully half of the products evaluated had received the highest quality rating as contributions to the scholarly literature and each had been disseminated to at least 50 and as many as 700 people.
- *Contributions to Social Capital*— Impacts on the educational infrastructure included: improved pedagogical practices used to nurture and challenge females in STEM courses, the creation of new courses or modification of existing courses to provide more opportunities for achieving gender equity in STEM classrooms, the introduction of gender bias-free curricula, and the broadening of STEM research opportunities for students at the high school and university levels.
- *Contributions to Human Capital*—Forty PGE projects sampled directly served over 31,500 participants, including teachers, administrators, counselors, and students in kindergarten through graduate school; and
- *Project Evaluation Meta-Analysis and Assessment*—Eighty-six percent of the 22 projects so reviewed presented credible evidence about the effectiveness of project strategies.

2000 Committee of Visitors

A second PGE Committee of Visitors was convened on May 3-4, 2000, reviewing the program along with the Program for Persons with Disabilities. Their scope was program management and activity from Fiscal Years 1997 to 1999. Their very positive report and specific recommendations for future directions are already influencing immediate redirections of the program.

Members of the 2000 CoV examined the review process of a random sample of 11 percent of the funded grants and a small sample of the declined proposals for the Program for Gender Equity from all of the proposals submitted in 1997, 1998, and 1999. Among its findings, the Committee observed, “The project staff appear to be highly active in supporting and guiding prospective PIs in the preparation of new proposals, advising on evaluation and dissemination strategies, and using working conferences to develop and refine products. They refer to this as their ‘enabling function.’ Given that this program often attracts first-time proposal writers who may be uncertain about the proposal process (including the importance of discussing possible projects direct with program staff), this is a function to encourage and enhance.” (CoV 2000, p. 5).

The Committee also found the program’s award processes and management to be exemplary with an impressive research framework being developed to gauge progress and evaluate impact. Considerable new knowledge and proven-good practices were seen as developed through this NSF investment with sufficient positive results to allow scaling up of PGE activities for wider implementation.

A Look to the Future

Today, PGE awards continue to reflect the program's mission on a national scale. Projects of greatest interest are those that—

- develop partnerships among stakeholders in education for women and girls (school districts, institutions of higher education, industry, professional associations, and consortia);
- advance the preparation and professional development of educators and faculty, especially with regard to ways in which to include and retain more females in the education pipeline;
- contribute research that deepens our knowledge of learning and education practice, especially as related to gender bias and stereotypes; and
- increase the technological and scientific literacy for all Americans by increasing the reach of STEM study to fully half of its population that has traditionally been excluded or discouraged.

At the same time, a national indication of "what works" in educational parity is being derived by PGE project activities. These efforts include—

- extracurricular STEM activities;
- mentoring and role modeling, including electronic mentoring;
- summer camp activities, including internships;
- professional development of educators and community leaders;
- parent activities;
- bridge programs; and
- revised curricula.

Among projects funded in FY 2001—

- A project at the City University of New York's Hunter College (#0120465) will produce web-based tutorials for STEM students and faculty at colleges and universities, and for anyone else interested in a summary of research about the role of gender in science careers. The tutorials will be developed using PowerPoint slides with voice-over narration. Science-based information about inadvertent bias in evaluations of men and women is available in technical sources but is not known to most students or educators. The tutorials will provide a suite of 15-minute tutorials that could be incorporated into lunch discussions, workshops, briefings, classroom discussions, web sites, and on-line courses aimed at anyone. Not everyone will read the source material, but the short, substantive "research bites" could reach many, many diverse audiences and individuals.

- At Virginia Polytechnic Institute and State University (#0120458), a broad interdisciplinary team is researching the pivotal transition points and factors in girls' lives that result in their positive or negative view of information technology as a viable career choice. The study considers the total environment—high school, community college, and university, both inside and outside the school—and what shapes girls' perceptions of technology as friendly or unfriendly to them. It will document longitudinally the impact of family, peers, school, and community on girls' perceptions of IT careers; examine the key transition points in girls' experiences with technology; and determine how the choice of a nontraditional career is associated with the development of self-authorship. The results will inform educators, policy makers, and administrators about those pivotal transition points in girls' lives that result in their positive or negative view of information technology as a viable career choice.

- Washington State University (#0120884) will address the low retention of tribal students in high school and low participation in STEM study, which limits career options for all, but particularly for girls. Key positions in tribal industries must be filled by non-tribal individuals because the Native American students tend to drop out. The WSU grant employs four key strategies to improve on persistence and success, especially of female students. The strategies were developed with the Colville Confederated Tribes, who are close collaborators. Washington State University, Lewis-Clark State College, and eight school districts in eastern Washington State (including five serving the Colville Confederated Tribes) are teaming. The focus is primarily in-service and pre-service teacher and faculty development. There are four major program components, including Innovations Workshops, which build on a prior NSF grant, and will give secondary school teachers and counselors increased gender and Native American culture awareness applied to STEM pedagogy and curricula. Also included is a university course called "Gender, Culture and Science" for STEM pre- and in-service teachers. A "Culture and Career Awareness" program will enlist a Tribal Advisory Council to advise how fundamental Native American beliefs about education can be infused into STEM curriculum, and develop career resources especially designed for tribal students. Finally, Summer Institutes for Secondary Faculty will develop a state-approved institute for in-service teachers emphasizing gender and culture in the STEM classroom. The latter is expected to be self-sustaining due to accreditation, and result in local leadership teams that can continue the Institutes.

- The University of Maryland (#0120786) will create an all-female learning environment within its science and engineering college, bringing the advantages of an all-female learning environment, epitomized by women's colleges, into more mainstream higher education. The program offers a hands-on introductory orientation program for freshmen and an enhanced team research experience for upper class students. The enhanced team experience consists of participation in all-female research teams led by female faculty, and mentoring by female faculty members and more advanced female students. The entire research team is taking part in training on mentorship, team functioning, and psychological constructs key to enhancing successful learning. The female faculty members' own research program is the setting for the student teamwork and mentoring. The two-level program is designed to address external (contextual) and internal (personal) barriers to the success and persistence of female students, at two important stages in their undergraduate experience, with sensitivity to the issues that research shows are critical at each juncture.

The overarching need—to better include the female half of the population in the Nation's science and engineering enterprise—remains today. The number of new proposals to PGE has continued to increase each year since the program's inception, indicating a widespread and growing national interest. With an appropriated budget of $9.7 million, PGE staff currently administer an average disbursement of 31 awards from more than 160 submitted proposals, with the latter figure increasing annually.

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