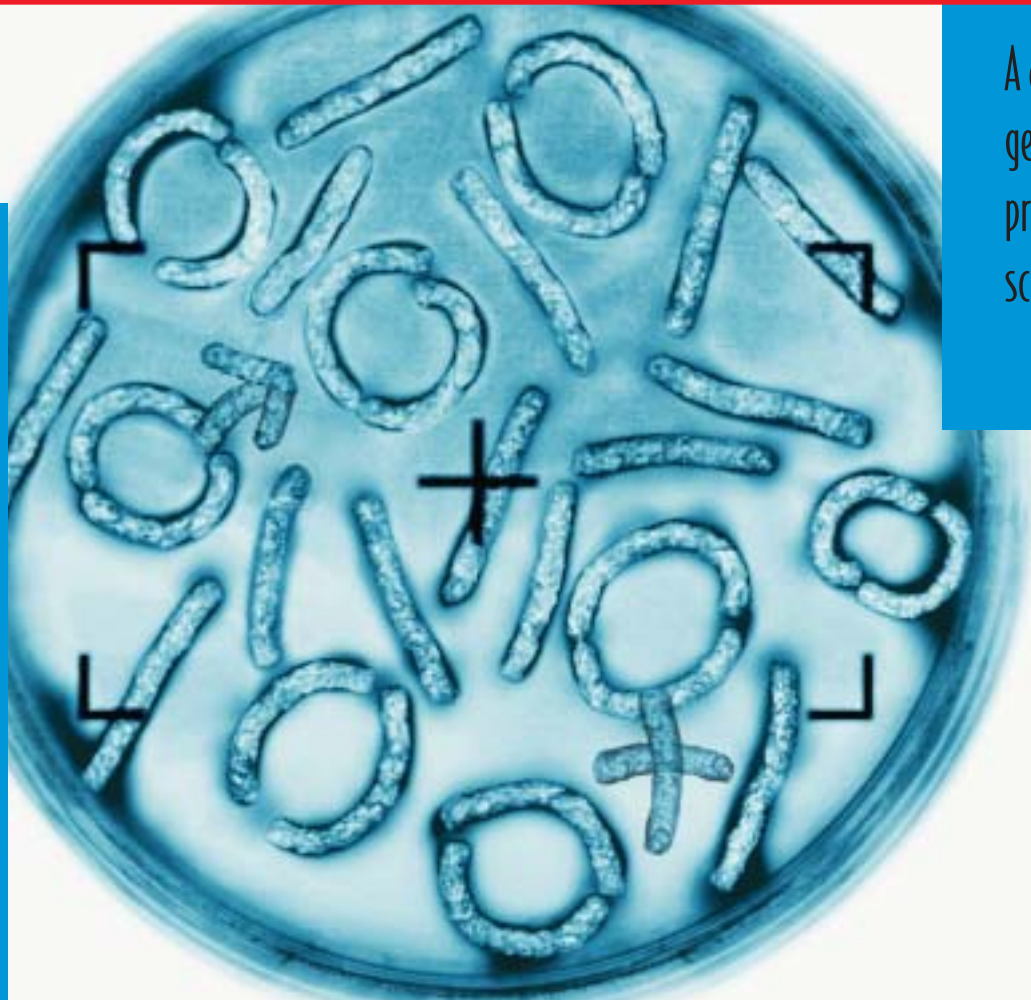


UNDER THE MICROSCOPE

A decade of
gender equity
projects in the
sciences



AAUW
EDUCATIONAL
FOUNDATION

Published by the American Association of University Women Educational Foundation
1111 Sixteenth St. N.W.
Washington, DC 20036
Phone: 202/728-7602
Fax: 202/463-7169
TDD: 202/785-7777
E-mail: foundation@aauw.org
Web: www.aauw.org

Copyright © 2004
American Association of University Women Educational Foundation
All rights reserved
Printed in the United States

First printing: March 2004
Editor: Susan K. Dyer
Graphic designer: Kenneth Krattenmaker

Library of Congress Control Number: 2004101327
ISBN: 1-879922-33-9

Table of Contents

Table of Figures	.ii
Foreword	.iii
Acknowledgments	.v
Introduction	.1
Disciplines	.4
Science	.4
Technology	.7
Engineering	.10
Mathematics	.12
Project Approaches	.14
Informal Learning	.14
Mentoring	.16
Professional Development	.17
Recommendations	.20
Appendix A: Methodology	.23
Appendix B: Selected Data Tables	.26
References	.29
AAUW Gender Equity Library	.31

Table of Figures

Disciplines

2.1	Subjects Covered in Science Projects . . . . .	.5
2.2	Science Project Types . . . . .	.5
2.3	Subjects Covered in Technology Projects . . . . .	.8
2.4	Technology Project Types . . . . .	.8
2.5	Engineering Project Types . . . . .	.11
2.6	Engineering Skill Development . . . . .	.11
2.7	Subjects Covered in Mathematics Projects . . . . .	.13
2.8	Mathematics Project Types . . . . .	.13

Project Approaches

3.1	Informal Learning Types . . . . .	.15
3.2	Mentoring Training . . . . .	.17
3.3	Professional Development Types . . . . .	.19

Appendix B: Selected Data Tables

Table 1	Gender of Participants . . . . .	.26
Table 2	School Levels . . . . .	.26
Table 3	Underrepresented Groups . . . . .	.26
Table 4	Locations . . . . .	.27
Table 5	Settings . . . . .	.27
Table 6	Involvement of Adults . . . . .	.27
Table 7	Project Goals . . . . .	.28

Foreword

In the past decade, increasing attention has been paid to the issue of gender equity in the science, technology, engineering, and mathematics (STEM) fields. Research publications, including the American Association of University Women Educational Foundation's *Tech Savvy* (2000) and *Women at Work* (2003), have documented the troubling shortage of girls and women preparing to work in these fields. In response to this "shrinking pipeline" of girls and women in STEM, a wide array of programs and strategies has been promoted and funded by governmental and nongovernmental organizations.

The AAUW Educational Foundation and the National Science Foundation are among the top supporters of gender equity projects in the STEM fields. In the last decade alone, these two foundations have invested nearly \$90 million to fund more than 400 projects specifically aimed at increasing the participation of girls and women in STEM fields. This body of projects presented a unique opportunity to explore the nature of gender equity intervention projects in STEM. Until now, no comparable survey of gender equity intervention projects in STEM has been done.

The research for this report, led by Yasmin Kafai and a team of researchers at the University of California, Los Angeles, was guided by several overarching questions: What types of projects have been funded within and across the various STEM disciplines? Are there areas where we have concentrated our efforts, and areas we have overlooked? What patterns emerge among the project types and disciplines?

The findings document impressive efforts in preparing girls and women for science, technology, engineering, and mathematics studies and careers and demonstrate a rich and diverse body of gender equity intervention projects within all STEM disciplines. About two-thirds of the projects involved extracurricular informal learning activities such as museum visits and field trips. Equally important were mentoring activities in many forms, ranging from traditional one-to-one to large-scale online versions, and professional development activities, such as course taking and network building, that were successfully integrated into projects.

At the same time, the findings reveal some troubling trends. Many projects focused predominantly on career advice without providing access to necessary skill and content development. A majority of projects occurred outside the school curriculum. While such extracurricular projects can be effective and valuable, the overall lack of integration into the school curriculum suggests that gender equity remains on the margins of teaching and learning in the STEM fields. Finally, an absence of data on participant demographics and a lack of project evaluation make it difficult to determine who is being served and if and how project outcomes are being measured.

Perhaps most notably, the findings reveal hundreds of excellent and dynamic projects but no consolidated collective strategy to advance gender equity in STEM. The recommendations in this report reflect this problem, suggesting among others the need for more integrated efforts inside and outside of school, more interdisciplinary and cross-age connections, and consistent documentation and evaluation across disciplines and project types.

The efforts of AAUW and NSF over the last decade have played a role in advancing the status and presence of girls and women in STEM, yet inequities persist and much work is needed. This report serves not as an evaluation of what works and what doesn't but as a synthesis of what projects AAUW and NSF have initiated and supported during a decade. As such, it provides an opportunity to examine what has been done and what has been missed so that in the future we can create, promote, and fund a body of projects that will have an even greater impact.

We hope this report stimulates a renewed interest in supporting gender equity in the STEM fields. AAUW remains committed to this goal and offers sincere thanks to those involved in developing this research report and in advancing the opportunities and potential for women and girls in the sciences.

A handwritten signature in cursive script that reads "Mary Ellen Smyth".

Mary Ellen Smyth
President, AAUW Educational Foundation
February 2004

Acknowledgments

This project was conducted by a team of researchers led by Yasmin B. Kafai, associate professor at the University of California, Los Angeles, Graduate School of Education and Information Studies, together with Pamela Aschbacher, director of the California Institute of Technology Precollege Science Initiative (CAPSI), and Sherry Hsi, director of research, Center for Learning and Teaching at the Exploratorium. The team also included UCLA doctoral students Debbie LaTorre, Althea Scott Nixon, and Nina Neulight and CAPSI staff members Cameron McPhee and Brooke Cutler. Additional support was provided by Daniel Battey and Linda Kao from UCLA. Ruta Sevo, senior program director at the National Science Foundation, provided valuable support and encouragement throughout the project.

The following members of the research project advisory board offered valuable guidance and expertise:

- Dorothy Bennett, senior project director, Education Development Center's Center for Children and Technology
- Cathy Kessel, mathematics education consultant
- Natalie Rusk, project researcher and developer, Computer Clubhouse Network, Massachusetts Institute of Technology Media Lab
- Linda Sax, associate professor-in-residence, University of California, Los Angeles, Graduate School of Education and Information Studies
- Jennie P. Yeh, vice president, Aerospace Corporation

The research for this report was generously sponsored by a grant from the National Science Foundation (PGE-0220556). The ideas expressed in this report do not necessarily reflect the positions of the supporting agency.

The AAUW Educational Foundation gratefully acknowledges the generous support and contributions of these institutions and individuals as well as the staff at AAUW who participated in the planning and development of the project.



Introduction

More than a decade has passed since the publication of the American Association of University Women Educational Foundation's groundbreaking report *How Schools Shortchange Girls* (1992). This report highlighted a noticeable absence of concern for girls in the educational debate and noted systematic disparities across all school levels, in classrooms, in testing procedures, and in curriculum design. For many, these disparities have served as one explanation for the “shrinking pipeline” in science, technology, engineering, and mathematics (STEM) fields and studies from kindergarten through high school, where girls feel disenfranchised, to universities, where fewer women pursue degrees and careers in these fields.

While some fields such as biology have made progress in bringing more women into the field, others such as computer science and physics have remained at a constant low. To encourage more girls and women to pursue STEM fields, research and demonstration projects have been implemented in a variety of settings during the past decade. These projects range from after-school programs to K–12 mentoring initiatives and lectures in higher education.

This report presents a synthesis of a large body of these projects to help STEM practitioners, researchers, and funders understand the efforts of

previous years and support and develop coordinated efforts for the future. The foundation for the synthesis was 416 research and intervention projects sponsored between 1993 and 2001 by the National Science Foundation (NSF) and the American Association of University Women (AAUW), two key foundations spearheading gender equity projects in the United States.

No attempt was made to evaluate effectiveness: Darke, Clewell, and Sevo (2002) already conducted such a study. Instead, the goal of this synthesis was to identify programmatic patterns, including strengths and weaknesses, during a decade. Such a synthesis not only reveals the focus of intervention projects but also provides a useful road map for the next decade of STEM gender equity projects.

At least two aspects make this synthesis stand apart from previous efforts: the integration of research and demonstration projects and the range of disciplines and ages covered. While most previous efforts focused on research and evaluation studies alone, leaving aside the large number of practitioner-initiated efforts to create gender equity intervention projects, this synthesis included efforts of both types. It also included all STEM disciplines and combinations thereof (rather than focusing on a single discipline) and examined projects ranging from kindergarten to graduate school.

Projects were analyzed by project setting, targeted participants, STEM disciplines, project approaches, and goals. Trends were then identified and are presented within this report by STEM discipline and project approach.

The findings from this synthesis reveal significant patterns in the last decade of STEM gender equity projects. These patterns illustrate the progress of gender equity in STEM and identify some critical areas of need. Most striking is the richness of project ideas and approaches. The synthesis reveals a wide range of projects that showcase an abundance of ideas for changing and enriching instruction, creating innovative learning opportunities inside and outside schools, and developing creative support systems. These projects demonstrate what K–12 and higher education teaching can look like, going beyond the traditional textbook and lecture hall to provide access to the world in which science, technology, engineering, and mathematics are explored and practiced every day.

While including a list of all the different approaches is not possible, short descriptions of sample projects are highlighted throughout the report. For more details, see information about AAUW projects at www.aauw.org/community_programs/scp_database.cfm and NSF projects in *New Formulas for America's Workforce: Girls in Science and Engineering* (2003a), which can be found at <http://www.nsf.gov/pubs/2003/nsf03207/start.htm>.

This synthesis identified other key patterns:

Extracurricular connections. Most of the gender equity intervention projects featured at least one extracurricular component, such as a visit to a science museum or manufacturing plant, a trip to a

nature reserve, or a meeting with professionals or experts in one or more of the STEM fields (see Appendix B, Table 5). Such projects recognized (but not always realized) the potential value of informal learning activities. Outside of these projects, such informal learning opportunities are, unfortunately, rare, and few systemic curricular efforts incorporate gender equity ideas. While informal learning efforts are important precursors to achieving gender equity, gender equity efforts also need to be integrated within existing state and national curriculum standards and implemented within classrooms.

Benefits for both genders. Contrary to common belief that gender equity interventions and research projects are for girls only, more than 40 percent of the projects also included boys (see Appendix B, Table 1). Project evaluations indicated that both girls and boys enjoyed and benefited from participating in proposed STEM activities with explicit gender equity goals. While some projects restricted access to girls only, gender equity projects in STEM have not been solely slated for girls.

A dearth of demographic data. The vast majority of projects noted the participation of boys and girls, however most projects did not report the participation of underrepresented students nor did they specify whether underrepresented students were specifically targeted. Underrepresented populations mentioned most often included Black/African American, Latino/Hispanic, and Native American Indian students. Reports also mentioned English language learners, Asian American students, White/European American students, and students with disabilities (see Appendix B, Table 3). In general, however, inadequate information prevented an examination of the distribution of projects for these students in any systematic way.

Inadequate information also affected the examination of the distribution of projects in suburban, rural, and urban areas. About 40 percent of the projects did not specify this demographic (see Appendix B, Table 4).

A network of support. Most projects engaged the additional support and assistance of teachers, parents, or other school or community members. These projects recognized that adults play a key role in changing girls' and boys' attitudes and made it a point to involve adults in various ways. Nearly half of the projects made use of human resources in their communities, including scientists from local universities or industries. About one-fifth included school principals—a practice that seems particularly important for any intervention project that hopes to become part of established schooling. Two kinds of participants, school counselors (who might help institutionalize intervention

projects) and college students (who might serve as mentors and tutors), were incorporated into only a few projects (see Appendix B, Table 6).

This collection of gender equity intervention projects represents an impressive diversity of enterprises. It is the combination and integration of these efforts rather than an abundance of discrete projects, however, that will lead to systemic and lasting change. How can we move beyond the model of isolated one-time efforts and create a network of strategic approaches to achieving gender equity in STEM? The first step is to understand what has been done and which approaches have been favored and ignored. The following sections of this report provide an overview of the projects by STEM discipline and project approach and provide recommendations to create a sustainable infrastructure of STEM gender equity intervention projects for the next decade and beyond.



Disciplines—Science, Technology, Engineering, and Mathematics

This section examines the background and synthesis findings of gender equity intervention projects for each STEM discipline—science, technology, engineering, and mathematics—recognizing that developments have not progressed in the same manner across all areas.

Science

Background

In science, the gender gap has been closing in some respects. Girls now take as many high school science classes as do boys (though fewer girls than boys take physics), and girls' achievement levels are roughly the same as boys' (National Assessment of Educational Progress, 2001). While sex differences in K–12 achievement and course-taking are small, important disparities in aspirations and career paths remain. Many girls who take advanced science courses in high school do not continue with these courses in college (Martin et al., 2001). According to the National Science Foundation (2003b), most young women pursue science majors in the life sciences, and far fewer young women than men major in the physical sciences. For example, while women now earn more than half of the bachelor's degrees in the biological sciences, they earn just one-fifth (21 percent) of all bachelor's degrees in physics.

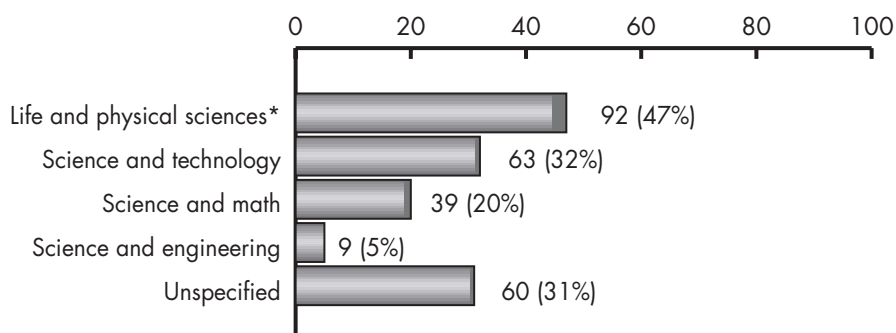
Studies have revealed that gender differences in attitudes and interest in science are present by the end of the elementary grades (Jones, Howe, & Rua, 2000). During middle school, the gap in boys' and girls' interest in science appears to grow (Jones, Mullis, Raizen, Weiss, & Weston, 1992; Catsambis, 1995). Some evidence suggests that pre-college programs incorporating hands-on activities, role models, internships, and field trips tend to increase self-confidence and interest in STEM courses and careers (Campbell & Steinbrueck, 1996; Darke, Clewell, & Sevo, 2002). Although such intervention projects have proven successful in promoting science careers for girls, these efforts have not been enough to close a pervasive gender gap in physical science education and careers.

Findings

Project Features

The synthesis included 196 gender equity projects that focused primarily on science. About half of the projects addressed science alone and another fifth addressed science in conjunction with another STEM field or a combination of STEM fields. About one-third of the projects failed to specify the STEM areas involved (see Figure 2.1). Although the documented gender gap occurs primarily in the physical sciences, these intervention projects focused on life sciences and physical sciences about equally (16 percent involved physical sci-

Figure 2.1 Subjects Covered in Science Projects (N=196)



* Includes life and physical sciences with a focus on biology, environment, physics, chemistry, earth science, astronomy, and combinations thereof

Note: Some projects included multiple subjects.

AAUW Educational Foundation

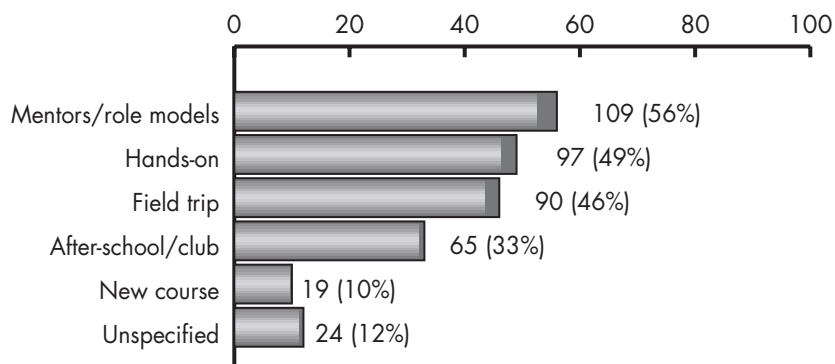
ences, 14 percent involved life sciences, 18 percent involved both major fields).

The majority of the science projects (59 percent) involved only girls, but 40 percent involved boys as well as girls (see Appendix B, Table 1). Middle school, a key time for changes in girls' interests and confidence, was the most frequently targeted age level for science projects (45 percent). Less than one-third of the projects targeted elementary school (29 percent) or high school (28 percent). Relatively few involved college students (13 per-

cent). About one-fourth of the projects brought together students from different school levels, such as middle school and high school or high school and college (see Appendix B, Table 2).

The majority (70 percent) of the science projects were not part of the regular school curriculum. Projects tended to be held after school, on weekends, or during the summer, sometimes involving visits to local museums, parks, and other science-related community resources. Few projects were located at universities (6 percent), and Internet-

Figure 2.2 Science Project Types (N=196)



Note: Some projects included multiple project types.

AAUW Educational Foundation

Science Project Examples

Working in a Bioinformatics Lab

High school girls participated in bioinformatics lab work at a college and lived on campus during the summer. The girls made presentations to teachers, principals, families, and professional conferences at the end of the project. The project intended to help students obtain knowledge of science content, the nature of science and scientific processes, awareness of science careers, and awareness of equity issues. (NSF-0086360)

Exploring Science and Technology

Middle school girls and boys in urban schools participated in field trips, workshops, and after-school club activities that included project-based explorations of science and technology. The project intended to increase confidence, engagement in performing science investigations, content knowledge, awareness of gender equity issues, and the likelihood of taking further science courses. Students visited community resources such as the Exploratorium (a hands-on science museum), a university campus, Hewlett-Packard, and Marine World. Club members competed in science fairs. (ERTF01-Johnson)

Learning About Water Quality

Urban high school girls participated in science club activities with mentors, hands-on pedagogy, and field trips to learn about water quality. The project intended to enhance content knowledge and increase girls' interest and likelihood of majoring in science. (ERTF97-Luberda)

Producing Multimedia Interviews

To improve awareness of science careers and gender equity issues in science, girls produced radio segments, live programs, and compact disks of interviews with women involved in STEM activities. The interviews provided role models for K–12 schoolgirls. School districts and the state education service agency are distributing the CDs for use in schools. (NSF-0114472)

based science projects were even more rare (2 percent) (see Appendix B, Table 5).

The most popular approaches in science intervention projects included the use of mentors or role models, hands-on pedagogy, and field trips (each of which was used in about half of the projects). One-third of the projects used clubs or after-school experiences (see Figure 2.2).

Project Goals

Science projects reported a broad variety of student goals, which were categorized into three types:

- *Awareness*—intends to increase participant knowledge of and familiarity with science careers or gender equity issues or both
- *Affect*—intends to increase participant engagement in the field of science
- *Academics*—intends to increase participant skills and achievement in science

The most common project goal was affect (in 67 percent of the projects). Academic (42 percent) and awareness goals (39 percent) were less common (see Appendix B, Table 7). Project goals sometimes focused on giving participants special opportunities that they might not ordinarily choose or have, such as visiting a science lab on a college campus or doing fieldwork with professional scientists.

In general, affect goals (to engage students in science) were achieved more readily than were academic and awareness goals, which claimed achievement only about half as often as intended.

One part of academic goals—understanding the nature of science, scientific thinking, and processes—was surprisingly rare (only 12 percent of projects set this goal) and points to an area that may warrant greater attention in project development and funding.

As might be expected, project goals were not always measured or achieved. While many of the projects provided information about achieved goals, 41 percent did not. This illustrates a larger pattern of inadequate reporting among all projects. In part, this lack of reporting by many funding recipients seems due to their limited understanding of and experience with project evaluation.

Technology

Background

For more than a decade, school- and career-related gender inequities in technology—computer interest, use, and performance—have been well documented. Girls are less likely than boys to enroll in computer science courses, and this disparity increases in more advanced classes. The percentage of girls participating in advanced placement computer exams, for example, remains at an all-time low. In addition, the notion of a “shrinking pipeline” (Camp, 1997) is supported by the decreasing number of women receiving higher education degrees in computer science. According to the National Science Foundation (2003b), women earned less than 27 percent of bachelor’s degrees in computer science in 1998.

While school- and career-related disparities have directed most gender equity technology projects to date, the relationship of girls and technology out-

side of schools is equally relevant but rarely discussed. A national survey conducted by the Kaiser Family Foundation (1999) found that no significant differences exist between girls’ and boys’ media use across all categories, namely Internet use, computer use, and the like. The one striking exception is the use of video games, which still appeal much more to boys than to girls. Even this picture is likely to change given the recent successes of online multiplayer games like SIMS Online and EverQuest that involve large numbers of female players.

These two pictures—computer use inside and outside of school—portray striking differences in girls’ and women’s relationships with and interest in technology. The pictures resonate with a finding from the AAUW Educational Foundation report *Tech-Savvy: Educating Girls in the Computer Age* (2000) in which girls stated over and over again, “We can but we don’t want to,” listing a lack of choices in technology as one of their main reasons for disengagement in school-based technology.

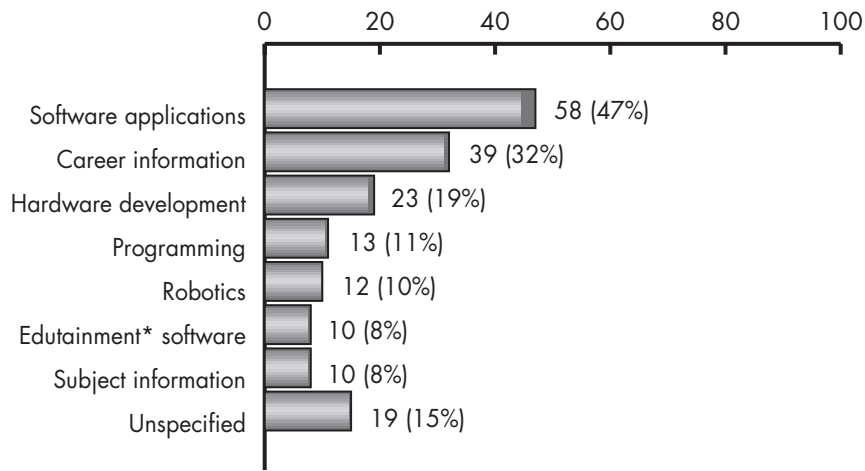
Findings

Project Features

This synthesis found a rich variety in the 123 technology projects, 71 percent of which were interdisciplinary in nature (combining technology with science, mathematics, or other fields). The majority of the projects focused on the use and development of software applications. A significant number of projects provided career information. Only a small number focused on programming and robotics projects (see Figure 2.3).

Although more than half of the projects (57 percent) were intended for girls only, in 41 percent of the projects, boys and girls worked together (see

Figure 2.3 Subjects Covered in Technology Projects (N=123)



* Combination of educational and entertainment
 Note: Some projects included multiple subjects.

AAUW Educational Foundation

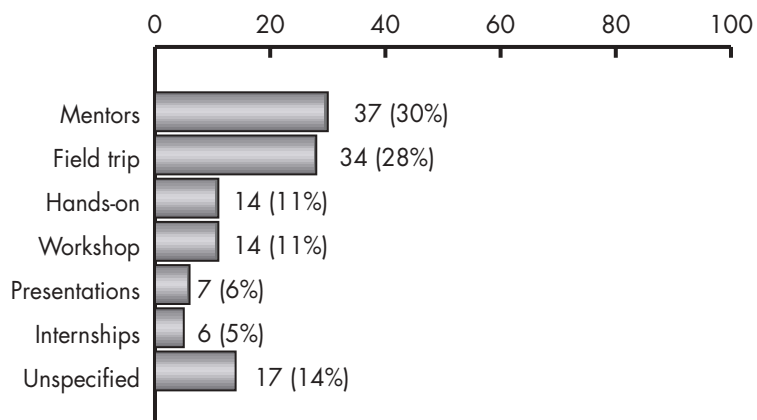
Appendix B, Table 1). Most projects targeted middle school students (41 percent), followed by high school students (35 percent) (see Appendix B, Table 2).

Many of the technology projects included a mentoring or field trip component. Far fewer included hands-on or workshop components. Internships

were the least common component (see Figure 2.4).

Only 33 percent of the projects were a part of the regular school curriculum or classes. While this is a small number, it is the highest percentage among the STEM disciplines. Technology was also the discipline with the most number of projects set at a

Figure 2.4 Technology Project Types (N=123)



Note: Some projects included multiple project types.

AAUW Educational Foundation

university (21 percent), and, not surprisingly, technology projects were also most likely to be web or Internet-based (see Appendix B, Table 5).

Project Goals

Unlike projects in the other STEM disciplines, every technology project specified a goal. More than two-thirds (68 percent) of technology project goals focused on affect (increasing student engagement in technology), while less than one-third (28 percent) centered on academics (see Appendix B, Table 7).

To further examine this limited emphasis on academics, technology goals were classified into four fluency levels, as defined in the report *Being Fluent With Information Technology* (National Research Council, 1999):

- *Awareness, motivation, and interest*—These efforts, often in the form of career mentoring, intended to raise participants’ interest and motivation in technology.
- *Application skills*—Participants learned to use popular applications such as PowerPoint, web design software, and spreadsheet programs.
- *Leadership and teamwork*—Participants learned to practice teamwork when working on technology projects.
- *Depth of knowledge*—Participants learned programming or participated in robotics projects.

An analysis of technology goals using these fluency levels revealed that more than half of the projects (54 percent) focused on application skills; 41 percent on awareness, motivation, and interest activi-

Technology Project Examples

Working With Computer Hardware

During a two-year period, women and girls at five sites learned to diagnose, upgrade, and repair computer hardware. The project reached K–12 students, teachers, and college students. (NSF-9714759)

Coding Web Pages

To learn about the knowledge and skills necessary to create web pages, girls studied types of coding, such as binary and HTML, through hands-on activities. For example, the girls counted beans to learn about 0’s and 1’s and imitated the code on existing websites to create their own sites and understand how code could be used to manipulate site content and appearance. They created documents in WordPad and explored existing websites to see how the sites used code to affect font, color, and text. They also evaluated existing science websites. (NSF-0114859)

Creating Robots

In this after-school computer club, first-, second-, and third-graders met weekly. They went on a field trip to see how robots are used (under water, in space, and in industry) and worked in teams to make robots to present to the school board. (ERTF97-Creech)

ties; and 17 percent on leadership and teamwork activities. Only 14 percent targeted depth of knowledge activities, the most sophisticated technology fluency, mirroring the low percentage of projects that reported “academic” goals.

While an awareness of and connection to the discipline is essential, and career mentoring and leadership are important aims, this synthesis suggests the need for more emphasis on “technical capital” and advanced levels of technology fluency among technology projects.

Engineering

Background

Engineering probably best exemplifies the lack of women's participation in higher education. Engineering encompasses a wide range of subdisciplines, such as agricultural, electrical, mechanical, and chemical engineering. According to a survey by the American Association of Engineering Societies (1998), the disparity between the number of engineering degrees awarded to men and women has not changed significantly during the last 10 years. For every woman who receives a degree, five to six men receive a degree, a ratio that becomes even worse for doctoral degrees. Chemical and agricultural engineering have a slightly better ratio, while electrical and mechanical engineering show the greatest gender gaps. According to the National Science Foundation (2003b), less than 14 percent of electrical and mechanical engineering students are female.

Many U.S. engineering departments have attempted to redress this disparity by improving the climate in classes and research labs, changing curricula with new course offerings, or training faculty and graduate students in mentoring activities. None of these programmatic intervention projects alone has achieved sustainable change.

Findings

Project Features

The smallest of the STEM clusters, engineering contained only 64 projects. In addition, the project reports provided little data. Two-thirds (66 percent) of the projects addressed engineering in a general way, such as building robots or bridges. Projects focusing solely on mechanical engineering,

Engineering Project Examples

Creating Lego Models and Programs

This project attempted to broaden girls' knowledge and interests through software. Using Lego Mindstorms RCX bricks, girls created models and programmed them to perform various functions. In the process, the girls were introduced to basic design concepts, programming motion, creativity, and team building. Using MicroWorlds software, the girls learned basic document management such as saving, printing, and retrieving work as well as learning to program a button, save a sound, and incorporate music. The girls also created autobiographies and calendars. (CAG00-Johnson)

Retaining First-Year Undergraduates

This project sought to retain first-year female undergraduates by giving them access to collaborative laboratory research work. The evaluation found that the retention rate was nearly double that of a control group of students. The project is being disseminated to other colleges. (NSF-9632168)

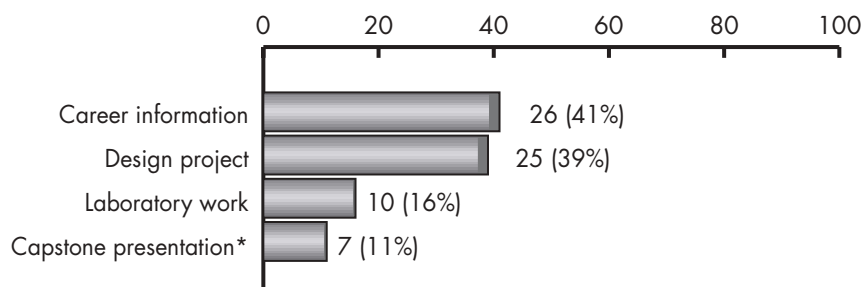
Looking at Engineering Team Dynamics

This project studied team dynamics in an engineering design course and the impact of dynamics on the design process. The evaluation found that men and women tended to assume different roles in a team: Men become more task-focused, whereas women become both task-focused and group-oriented, thus assuming a double function in teams. (NSF-9979444)

electrical engineering, or material science made up less than 2 percent of the projects.

The majority of the projects (59 percent) involved girls only. Another 34 percent involved girls and boys (see Appendix B, Table 1). Middle school was the most frequently targeted age level (55 percent), followed by high school (28 percent) and college (22 percent) (see Appendix B, Table 2).

Figure 2.5 Engineering Project Types (N=64)



*In the final part of an engineering design course, students present the development of a technical solution to a problem.
 Note: Some projects included multiple project types.

AAUW Educational Foundation

A surprisingly large number of engineering projects (66 percent) took place during the summer, while few projects (22 percent) were part of the in-school curriculum (see Appendix B, Table 5). Slightly more than one-fourth (28 percent) of the projects were one-time events, such as workshops or meetings. Only 8 percent provided a research experience, and even fewer projects (3 percent) provided an offsite internship.

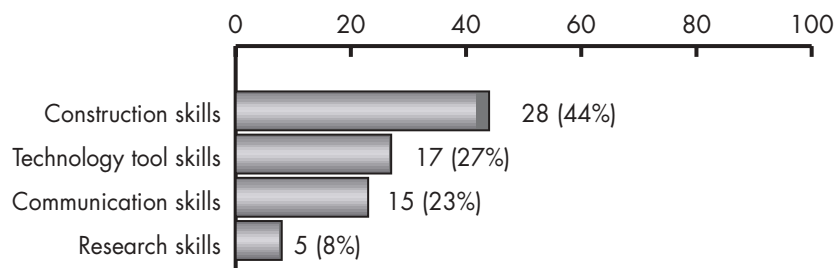
The development of construction skills, such as building robots or bridges, was prominent, followed by technology tool skills and communication skills. Research skill development was rarely found (see Figure 2.6).

Project Goals

The pattern for engineering project goals was similar to the other STEM disciplines: Affect (52 percent) and awareness (38 percent) goals were the most prominent, followed by academics (28 percent). Only six projects did not specify a goal (see Appendix B, Table 7). While many projects listed goals, only a few measured them in a systematic way that went beyond informal testimonials.

By far, engineering was the STEM discipline with the least amount of attention and development. Considering the relatively weak project focus on academics, an emphasis on academic content and skills in the field of engineering is an area for potential and perhaps necessary growth.

Figure 2.6 Engineering Skill Development (N=64)



Note: Some projects developed multiple skills.

AAUW Educational Foundation

Mathematics

Background

Mathematics is one of the few STEM areas where both girls and boys, in particular fourth- and eighth-grade students, have made impressive achievement gains between 1990 and 2000, according to the National Assessment of Educational Progress (2001). In the higher grades, equal numbers of girls and boys take the AB calculus advanced placement exam (although fewer girls take the advanced placement exam for advanced BC calculus). These numbers paint a decidedly more positive picture for K–12 and college preparation than has been accomplished for the graduate level and the work force.

While nearly half of mathematics bachelor's degrees are awarded to women, the percentage plunges to 27 percent for doctoral degrees (National Science Foundation, 2003b). The number of women working as mathematicians and mathematics professors remains strikingly low. According to a recent report on faculty diversity, women make up less than 5 percent of full mathematics professors in the top 50 science and engineering departments (Nelson & Rogers, 2004).

Findings

Project Features

Of the 128 mathematics projects, most had an interdisciplinary focus. Eighty projects (63 percent) also focused on science, and 50 projects (39 percent) also focused on technology. A significant number of projects focused on providing information on mathematics careers as well (see Figure 2.7).

Overall, 52 percent of the projects targeted girls only, while 45 percent targeted boys and girls (see Appendix B, Table 1). Most projects (43 percent)

Mathematics Project Examples

Mathematics Mentors for Rural Girls

This project focused on increasing girls' interest in mathematics careers. The girls came from a rural community that did not have many women professional role models. To accomplish the goal, the project included a camp with women mathematics and science professionals serving as mentors to the students. (CAG93-Lassen)

Multidisciplinary Skill-based Summer Program

This residential summer project for high school girls was multidisciplinary, integrating mathematics, science, and technology. The skilled-oriented project concentrated on several mathematics content areas, including algebra, statistics, and geometry. Through career counseling, the girls also increased their awareness of careers in mathematics and related fields. (NSF-9553486)

Math Computer Tutors

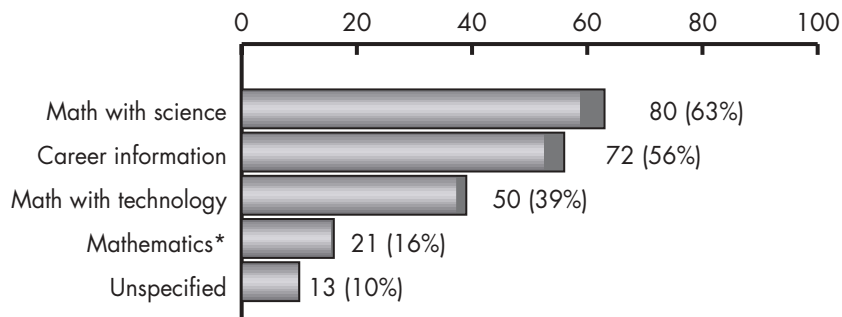
This project focused on increasing girls' interest, enjoyment, and confidence in mathematics. The project used computer-based tutoring, which included graphics and help features, to accomplish the goals. (NSF-9555737)

focused on middle school students, followed by elementary school students (31 percent) and high school students (26 percent). Few projects (9 percent) targeted college students (see Appendix B, Table 2).

Only 13 percent of the mathematics projects specified that they were integrated into the classroom curriculum. Half of the projects (52 percent) occurred after school, in the summer, or in community settings (see Appendix B, Table 5).

As shown in Figure 2.8, most student activities involved hands-on pedagogy, field trips, or workshops. Students usually received mentoring on career opportunities in mathematics and related

Figure 2.7 Subjects Covered in Mathematics Projects (N=128)



*Includes number sense, geometry, algebra, calculus, measurement, and data and probability
 Note: Some projects included multiple subjects.

AAUW Educational Foundation

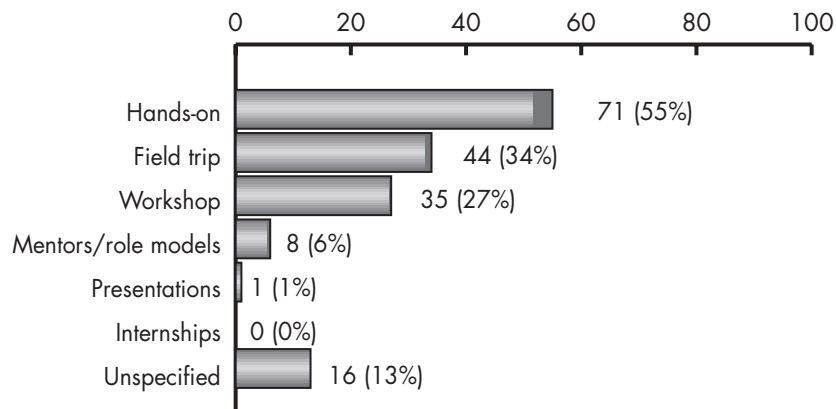
fields (41 percent). Few projects (3 percent) incorporated direct, one-on-one mentoring opportunities for students.

Project Goals

A strong majority of mathematics projects aspired to interest and engage students in the field of mathematics (53 percent). Although most projects

were multidisciplinary, incorporating multiple science and technology subject areas, few projects (19 percent) were described as academic—those in which participants learn specific mathematics content, such as number sense, geometry, algebra, data and probability, calculus, or measurement. A large number of projects (37 percent) did not specify a goal (see Appendix Table 7).

Figure 2.8 Mathematics Project Types (N=128)



Note: Some projects included multiple project types.

AAUW Educational Foundation

Project Approaches

This section focuses on approaches to gender equity efforts across STEM disciplines—science, technology, engineering, and mathematics. Three key approaches were identified among the projects in this synthesis: informal learning, mentoring, and professional development.

Informal Learning

Background

While schools have always been a major focus of reform efforts, informal learning settings such as after-school centers, summer camps, science museums, and community centers play an equally important role. The National Science Foundation Directorate for Education and Human Resources describes informal learning as “self-directed, voluntary, and motivated mainly by intrinsic interests, curiosity, exploration, and social interaction.” Researchers have argued that such learning experiences are more likely to affect a student’s identity as a learner than are classroom experiences (Baker & Leary, 1995; Paris & Mercer, 2002). Thus, informal-learning settings are well positioned to develop young people’s interests in STEM topics. The growth of science museums (such as the Exploratorium in San Francisco) and community technology centers (such as the worldwide Computer Clubhouse) throughout the United States is a testament to the success of these learn-

ing experiences. The “hands-on,” experiential nature of these informal learning settings and activities has been shown to awaken and foster the interest of girls (and boys) in STEM fields, particularly students in economically disadvantaged schools and communities.

Research and support for informal learning activities, particularly after-school activities, have increased and improved the potential for these activities to positively influence students’ participa-

Informal Learning Project Examples

Urban Area Support Network

This project created an urban area network to support elementary and middle school girls and boys in science and technology through clubs, hands-on pedagogy, field trips, and role models. (NSF-9555807)

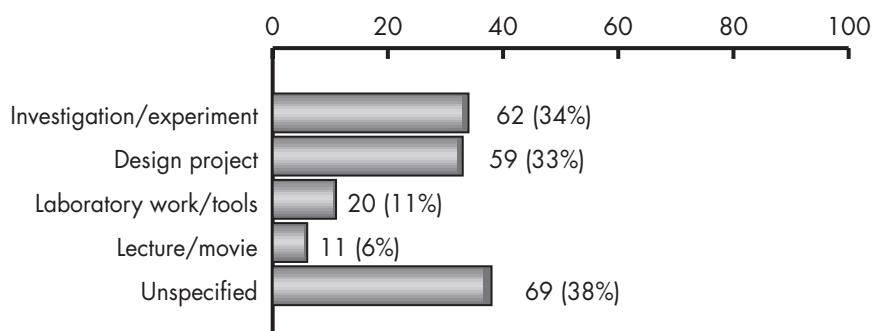
Hands-on After-School Club

This project included field trips and hands-on projects, such as dissecting owl pellets, building rockets, and programming computers. The after-school club for girls continued the next year and included boys from underrepresented minority groups. The students who were previously mentored by adult professionals mentored their peers. (ERTF99-Long&Caryn)

Wildlife Workshops for Girls

The Bronx Zoo continued and fine-tuned the Wildlife Science Career Program for girls in conjunction with the Girl Scout Council of Greater New York. The project set up mentor training sessions and organized workshops for 315 Cadettes and Girl Scouts, including a night at the zoo and a Career Science Fair. (NSF-9714791)

Figure 3.1 Informal Learning Types (N=180)



Note: Some projects included multiple types.

AAUW Educational Foundation

tion in STEM education and careers. Still, these predominantly “out-of-school” activities face major challenges as they struggle to recruit and retain quality staff, garner sustainable funding, and connect to formal “in-school” curricula and standards of learning.

Findings

Project Features

For the purpose of this synthesis, informal learning approaches included structured and unstructured activities housed in schools, community centers, universities, business offices, and museums. Across all four STEM disciplines, 180 projects included some type of informal learning approach. About half of the projects (48 percent) were after-school clubs in school buildings, followed by university (34 percent), museum (19 percent), and industry (10 percent) site visits.

The type of informal learning activities ranged from lectures and movies to design activities, laboratory work, and investigations/experiments. Investigations/experiments and design activities were particularly prominent, each representing

about one-third of the informal learning activities. Few projects involved laboratory work, and even fewer involved lectures and movies (see Figure 3.1). While some informal learning activities (11 percent) were one-time occurrences, more than 85 percent of the projects included multiple meetings or a series of activities.

About two-thirds (68 percent) of the projects involved girls only, and more than half (52 percent) included boys and girls. Three-fifths (60 percent) concentrated on middle school students, followed by high school (36 percent) and elementary school (33 percent) students. Few projects took place at the college level (16 percent). Most proposed activities (56 percent) were structured in advance; only 9 percent allowed free choice of activities. Falk, Brooks, and Amin (2001) consider the voluntary participation in informal learning environments an essential feature of project design. Further investigations of why gender equity intervention projects do not take advantage of this feature and what potential impact it can have might be worthwhile.

Project Goals

Informal learning activities usually focus on growing participants' confidence in STEM activities, and 73 percent of the projects reported doing so. Yet one-third (36 percent) of the projects also claimed to further academic understanding of STEM topics, and one-third (33 percent) aimed to increase awareness (engagement and interest).

Mentoring

Background

Mentoring has always been a central feature in gender equity intervention efforts. Researchers and practitioners have long realized the importance of individual mentoring relationships between teacher and student or faculty and apprentice researchers. Biographies of famous researchers provide compelling illustrations of a mentor's impact at school and work. In its most essential form, the personal relationship covers career and content advice in combination with access to a professional network. Through the years, mentoring has evolved from this traditional direct model to peer mentoring (in which students help each other) and cascading models (in which faculty mentor undergraduates who, in turn, mentor high school students). Many mentoring initiatives have attempted to replicate these aspects on a larger scale and make them part of formal instructional practice. More recently, the Internet has become a popular tool for creating mentoring networks that transcend local boundaries.

Findings

Project Features

Of the 416 projects, more than one-third (145) included at least one mentoring component, although mentoring itself was not well defined. For

Mentoring Project Examples

Tiered Mentoring at Summer Camp

This summer camp for middle school girls focused on enhancing their interest in mathematics and science. The project included a tiered mentoring component in which each group of students had one college and one high school student mentor. The students and their mentors also met during reunions throughout the school year. (CAG99-Hensel)

Tech Mentors for Latina Students

This project introduced Latina students to the field of technology. The girls went to museums, listened to speakers from technology companies, and met with mentors. The girls shadowed their mentors at work and then discussed what the girls learned about their mentors' occupations. (ERTF94-Ehlers)

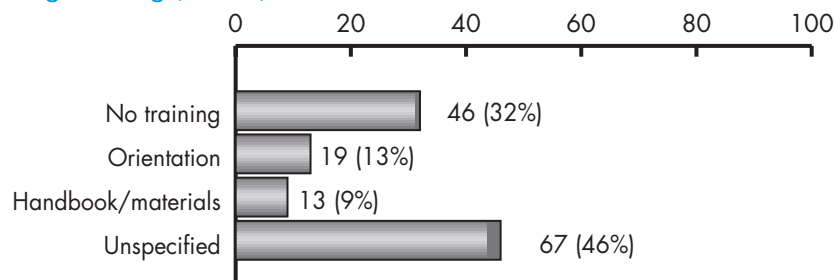
Intergenerational Mentoring for Science Faculty

This project provided a short course, faculty institute, freshman seminar, scholarships, and intergenerational mentoring to interest more women from rural and tribal areas in science. It also provided small grants to faculty or secondary teachers for course and project development. Evaluations revealed that the project had a positive impact on course design and perceptions and resulted in higher retention rates for females. Participants had a positive view of their mentoring experiences. (NSF-9618855)

example, many projects referred to mentoring in their descriptions, but closer inspection revealed that no particular mentoring arrangements had been established. In many instances, the meeting of "role models" in workshops or lectures qualified as mentoring.

In about two-thirds of the projects (65 percent), participants met multiple times, with 14 percent meeting only once, often in workshops or lectures. Only four projects established long-term relationships. Few projects offered training to mentors, even though training has been recognized as

Figure 3.2 Mentoring Training (N=145)



Note: Some projects included multiple types of training.

AAUW Educational Foundation

instrumental for the success of mentoring projects. A few offered at least orientation or provided a handbook or reference materials for their students (see Figure 3.2).

More than two-thirds (68 percent) of the projects were for girls only; 24 percent included girls and boys. Half of the projects (50 percent) targeted middle school students followed by high school (38 percent) and college (31 percent) students. Fewer mentoring activities (23 percent) existed for elementary students; the exclusion of projects that used only role models might account for this.

Project Goals

In 76 percent of the projects, mentoring focused on career issues; 51 percent focused on academic topics. More than half of the projects (54 percent) used traditional one-to-one mentoring. Cascading mentorship occurred in only 26 percent of the projects, probably due to the logistical demands of establishing and implementing the relationships.

Mentors and mentees held face-to-face meetings in 59 percent of the projects. A few projects (12 percent) featured a mixed form of mentoring, combining face-to-face meetings with online and telephone conversations. Although recent attention has been

given to the potential of distance mentoring and online mentoring programs, only 8 percent of the projects were solely based on online and telephone meetings. The structure of mentoring relationships varied among projects. Regularly scheduled meetings between the same mentor and mentee were held in 41 percent of the projects; 17 percent included regularly scheduled meetings but changed the pairing of mentor and mentee. One-fourth (27 percent) of the projects did not include regularly scheduled meetings between mentors and mentees.

Professional Development

Background

Programmatic efforts play a significant role in making gender equity ideas an essential part of professional practice. A National Academy of Education report (1999, p. 14) stated, “Without improving our understanding of what it will take to produce a well-prepared and professional corps of teachers, school improvement will not be possible.” Wilson and Berne (1999) identified several successful approaches to professional development, the most important being opportunities for teachers to talk about subject matter, student thinking, and teaching itself. Multifold challenges to putting these

Professional Development Project Examples

Teachers Reading About Technology

This district-wide school book club for teachers aimed to increase understanding of gender and technology issues in school and introduced participants to new technologies, such as chat features. (ERTF00-VanOort)

Lessons in Gender Equity

This project examined the relationship between students' view of the nature of science and their interest in science and developed and offered a course that focused on gender equity and developing lessons that advance student understanding. Monthly lunch seminars brought successful female scientists into the middle school classroom. (ERTF01-Paolucci)

School-to-Work Tools

This project developed tools to train educators to increase the number of women in school-to-work STEM areas. The tools were piloted with 32 teachers in North Carolina and then distributed to other schools and through additional workshops. The project developed videos with young women moving through internships into technology-related careers and featured comments from parents, counselors, and teachers. It also provided a train-the-trainer workshop and an Internet e-mail discussion list. (NSF-9710975)

Summer Leadership Institute for Counselors

This project created summer leadership institutes for 12 elementary, middle, and high school counselors who provided services to other counselors, teachers, and parents. Counselors produced videotapes and a website that participating teachers could use in their in-service training. Mini-grant activities successfully supported smaller outreach projects. The project also produced *A Guide to Gender Fair Counseling for Science, Technology, Engineering, and Mathematics*, by Carol J. Burger and Mary L. Sandy, which was published by the Virginia Space Grant consortium. (NSF-9714637)

approaches into practice exist, including the poor reputation of traditional professional development, the difficulty of “mandating” learning in workshops and courses, and the hard and long-term work involved, but often not allowed for, in current reform and accountability movements.

One large group of funding recipients was identified as a potential candidate for professional development: the AAUW Eleanor Roosevelt Teacher Fellows (K–12 teachers), who propose and implement gender equity projects. This fellowship stipulates a variety of activities such as implementing a project that addresses gender equity, creating an administrative infrastructure for setting up the project, taking courses to develop content knowledge in STEM disciplines and pedagogy, and participating in conferences to learn and inform about gender equity awareness. On the surface none of these activities alone qualifies as an unusual feature of professional development, but the combination and integration of them in one fellowship creates a powerful professional development model.

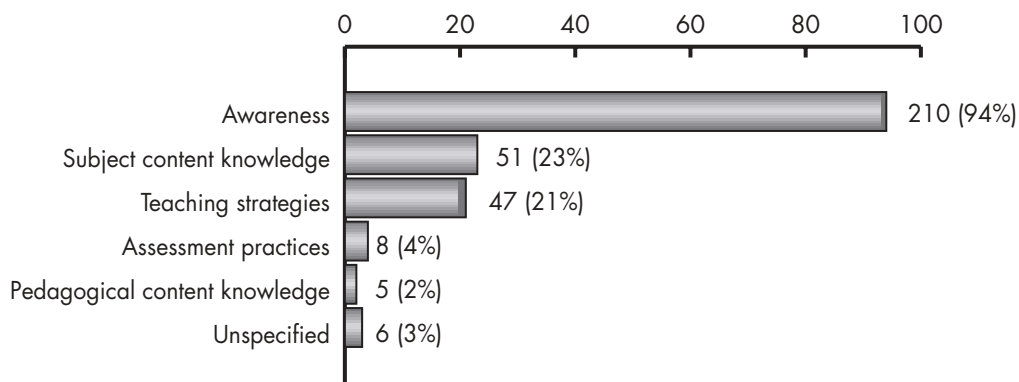
Next to K–12 professionals (teachers, counselors, and administrators), university teachers (graduate students and faculty) play key roles in implementing and sustaining change. While teaching professionals in higher education generally do not have problems with subject matter knowledge (one of the key issues for K–12 teachers), they often lack a knowledge of different pedagogical approaches. Thus, professional development for university teachers needs to address different issues.

Findings

Project Features

More than half of the projects in the synthesis featured professional development. Nearly all of these

Figure 3.3 Professional Development Types (N=223)



Note: Some projects included multiple types.

AAUW Educational Foundation

projects concentrated on K–12 educators, with only 9 percent targeting higher education faculty and research assistants.

Projects implemented professional development in a wide variety of ways. Most projects (85 percent) addressed large groups of professionals, with only some (10 percent) making use of small group instruction. Many projects (82 percent) provided access to resources such as guides, web pages, or curriculum materials, and almost as many (79 percent) engaged participants in some form of inquiry-based learning in which teachers practiced

the work or tasks they would later use in their regular classes.

Project Goals

Of the professional development projects, nearly all (94 percent) focused on gender equity awareness. Some concentrated on STEM content knowledge and on teaching strategies or best practices. Few focused on assessment practices, and even fewer addressed pedagogical content knowledge that would facilitate teachers’ integration of content, pedagogy, and gender equity (see Figure 3.3).



Recommendations

The 416 gender equity intervention projects in science, technology, engineering, and mathematics (STEM) disciplines funded by the National Science Foundation and the American

Association of University Women Educational Foundation during the past decade attempted to provide extraordinary opportunities for girls from elementary through graduate school. Thousands of girls and young women have had opportunities to investigate the world in scientific ways, meet mentors to guide and support STEM interests, and gain some understanding of gender equity issues that may help sustain their participation in the STEM pipeline. Many projects also touched adults—parents, teachers, administrators, scientists, and community members—and raised their awareness of gender equity issues and their commitment to providing girls and women with the knowledge, contacts, and support they need to aspire to careers in STEM fields.

Building on a base of recommendations proposed and discussed in existing publications and research reviews (National Council for Research on Women, 2001; Darke, Clewell, & Sevo, 2002), this synthesis analyzes actual projects and project trends over the course of a decade. It provides an account of concentrations and absences within the field and suggests how researchers, practitioners and funders can create stronger and more inclusive STEM interventions.

The following recommendations present a set of key strategies to help improve the development and support of projects designed to advance gender equity in the sciences.

1. Integrate STEM gender equity efforts into the curriculum. Because most projects were not part of regular schooling, they were more difficult to institutionalize and their impact on school experiences and school-based learning was limited. This is not to argue against informal learning environments—to the contrary. These outside-of-school experiences are an admirable and essential component of gender equity intervention projects and have been proven to provide girls with important opportunities for hands-on learning and investigation that are often absent from the school curriculum. The majority of efforts in the past decade, however, have been focused on these out-of-school activities, which unfortunately have limited success in changing the regularities of schooling. As girls continue to show more interest and engagement in personal and extracurricular contexts, greater attention should be paid to infusing gender equitable STEM activities into the formal school curriculum.

2. Focus on content and skills. The synthesis highlighted an abundance of career information activities in the gender equity intervention projects while fewer projects provided access to content and skills of STEM disciplines. Certainly awareness and motivation activities are important for any

gender equity project. These activities need to be supplemented, however, with access to the necessary academic content and skills. This is particularly true in low-performing schools and districts where students, both boys and girls, have access to fewer qualified teachers and less rigorous academic instruction. Preparation in early grades followed by a high school curriculum of high academic rigor is crucial in ensuring equal opportunity in the sciences at the college level and beyond.

3. Support professional development. To advance gender equity in the sciences, well-trained, science-literate teachers are needed. More than half of the projects in this synthesis included a professional development component, but few provided teachers with the skills and knowledge needed to integrate content, pedagogy, and gender equity. As the backbone of our educational system from preschool through higher education, teachers and an emphasis on their professional development must remain a key priority.

Professional development activities for teachers and higher education faculty that promote and integrate science literacy, the integration of technology in the curriculum, and gender equity awareness are particularly important and worthy of greater attention and support. Training for teachers on how to assess these integrated practices is another area of professional development that could benefit from additional support.

Professional development for counselors in the area of gender equity and STEM also deserves additional attention and support. Although counselors play a key role in student course selection and enrollment and in career preparation, few projects in this synthesis included counselor participation.

4. Connect across age and disciplines. Most projects did not involve participants of different ages, with the exception of some projects that involved cascading mentoring, i.e., a university professor mentors graduate students who, in turn, mentor high school students. Given the recognized advantages of cross-age tutoring and mentoring, this feature deserves future exploration. Similarly, interdisciplinary efforts warrant continued attention. While many projects combined STEM disciplines and offered participants a view of how science, technology, engineering, and mathematics are used in other contexts, some connections were notably absent. For example, few projects combined engineering with science, a combination that would provide a great opportunity for future projects since most K–12 students have not yet been introduced to engineering and do not know what design or engineering entail. It is equally important to support activities that allow students to explore new areas such as bioinformatics and projects that promote the idea that gender equity projects should make use of the new developing areas of research and manufacturing.

5. Explore online territory. Few projects specified that they were Internet-based, and future projects could mine this territory in more depth. Recent research has found few gender differences in the use of electronic and online media; in fact, girls and women have been described as being attracted to communicative aspects of online interactions. Although the time frame of this synthesis precluded the inclusion of current and emerging Internet-based projects, more projects will undoubtedly capitalize on this medium in the future. Online projects seem well suited to promote gender equitable participation and merit the attention and support of practitioners, researchers, and funders.

6. Emphasize data collection and evaluation.

Few projects provided detailed demographic and socioeconomic information about participants. To successfully address the needs and interests of underrepresented groups, we need to know not only what works but also what works for whom. It is important then for projects to document any targeted groups and whether such groups participate. Particularly in the STEM fields, which have proven exclusive in many respects, data on gender alone is not enough. Information on racial and ethnic groups and groups by disability and socioeconomic and immigrant status would greatly improve knowledge of who projects are serving and affecting. Data on rural, urban, and suburban settings is equally useful because it provides important clues about participation and barriers to participation.

Many funding recipients lacked sufficient project evaluation skills or tools. About half of the evidence was informal testimonials from participants.

Funders should expand resources and opportunities for participants to increase their capabilities in data collection and project evaluation.

Based on a synthesis of actual projects implemented over the course of the last decade, these recommendations offer concrete strategies to strengthen the pipeline of girls and women in the sciences. In most respects, the recommendations focus on developing and supporting good STEM teaching practices for any and all classrooms, irrespective of whether the activities are designed for girls. Yet these recommendations also acknowledge the critical need to engage and sustain the interest of girls and women in the STEM fields. This is vital not only to afford girls and women the full range of educational and career opportunities but also to ensure that the science and technology fields are not deprived of the immense pool of talent that girls and women offer.



Appendix A: Methodology

Synthesis Approach

This synthesis was based on research and demonstration projects funded between 1993 and 2001 by the National Science Foundation and the American Association of University Women Educational Foundation to examine and promote gender equity. Three programs at both foundations initiated these projects. At NSF, the Gender Diversity in STEM Education program (previously Gender Equity in STEM and before that, Program for Women and Girls) funded research, innovation, and evaluation of gender equity projects. AAUW supports two programmatic efforts: Eleanor Roosevelt Teaching Fellowships for K–12 classroom teachers and Community Action Grants for individuals, AAUW branches, and community organizations. During each year studied, these foundations sponsored between 30 and 40 research and demonstration projects. The final reports by funding recipients supplemented with publications and other materials provided the starting point. Rather than evaluating project outcomes as previous reports have done (see Darke, Clewell, & Sevo, 2002), the synthesis provides an overview of themes and trends that emerged in the analysis of project reports.

Project reports came in a variety of formats, the most traditional being the research report. The research studies ranged from empirical studies with quantitative information about girls' achievement

and other program evaluation findings to more qualitative work that provided ethnographic descriptions of school and community settings. In some cases, reports came from outside organizations that conducted formal evaluations of project activities and outcomes. In many instances, especially from the practitioner side, reports offered concrete examples of activities and outcomes with the occasional evaluation. Some projects also created videos, guidebooks, or websites. Variations in the organization and detail of project reports resulted from changes in NSF and AAUW reporting requirements during the years under investigation.

Case Survey

To deal with the diversity in reporting detail, a case survey method was adopted (Yin & Heald, 1975) and every final report was treated as a case study. This method allowed the inclusion all reports, whether research studies or demonstration projects, that focused on gender equity aspects in STEM activities irrespective of their data reporting and detail. Using this method allowed the development of clusters of projects large enough to identify trends of prominent or missing project features. One drawback of this approach is that some specific features of projects were not captured, e.g., a determination could be made that projects involved underrepresented students but specific numbers of students could not be captured.

The first phase began in September 2002 with the collection of all available final reports from the two funding agencies—a total of 452 reports, 226 from AAUW and 226 from NSF. Updates were requested from all funding recipients based on the contact information provided in the funding documents. Web searches were conducted to locate project investigators when necessary. During the course of five months, two rounds of calls for additional information were initiated. In some instances final reports were unavailable, so mid-year reports were used. For the synthesis, 416 reports were collected, 216 from AAUW and 200 from NSF. All reports were entered into a master spreadsheet and classified according to a basic set of identifiers: STEM discipline, grade level, professional development, informal education, and mentoring. At this stage a set of identifiers that had been developed and applied to projects funded by NSF were used (with some modifications). Thus the NSF reports did not need to be reclassified.

To identify trends, clusters were developed based on STEM disciplines (science, technology, engineering, and mathematics) and STEM approaches (informal learning, mentoring, and professional development) that demonstrated concentrated gender equity efforts. Most reports were represented in two or three clusters. For example, one AAUW project that proposed a science after-school club in which girls investigated the composition of shampoo and participated in career days was classified under “science,” “informal learning,” and “mentoring.” These clusters made it possible to connect and expand on previous review efforts in these areas.

For the second phase starting in February 2003, a team of six researchers developed a codebook with two parts: a set of demographic categories that

would apply to all clusters, and specific categories that would apply to only one discipline or crosscutting cluster. The demographic categories covered aspects such as participants, settings, nature of the project, adult participant activities, results, data sources, and implementation issues. Specific categories were developed within each cluster, and more information was provided about the type of activities and level of complexity. Most categories provided a set of specific codes, but some categories had open fields to allow for narrative descriptions. The categories and specific codes were developed in an iterative process. Two or more team members coded each cluster. In the first step, a random subset of 10 percent of the reports in each cluster was selected and then read and coded independently. Researchers’ initial coding achieved an agreement of 70 percent. As a consequence, the coding criteria were revised, and the process was repeated, resulting in 89 percent agreement. The revised coding criteria were then applied to the remaining reports. This phase took about five months.

After the reports were read and coded, the findings for each cluster were synthesized. The cluster-based approach provided a sense of how project features and outcomes within a STEM discipline were distributed. It did not, however, allow merging of these findings into one large data set. The only exceptions were the demographic variables such as targeted gender of participants, location, and underrepresented groups, which were consolidated into a single consistent coding for each cluster. Implementation and outcome features differed because they were always coded with the STEM discipline or approaches in mind.

Several important project features were difficult to synthesize across clusters. One example is project

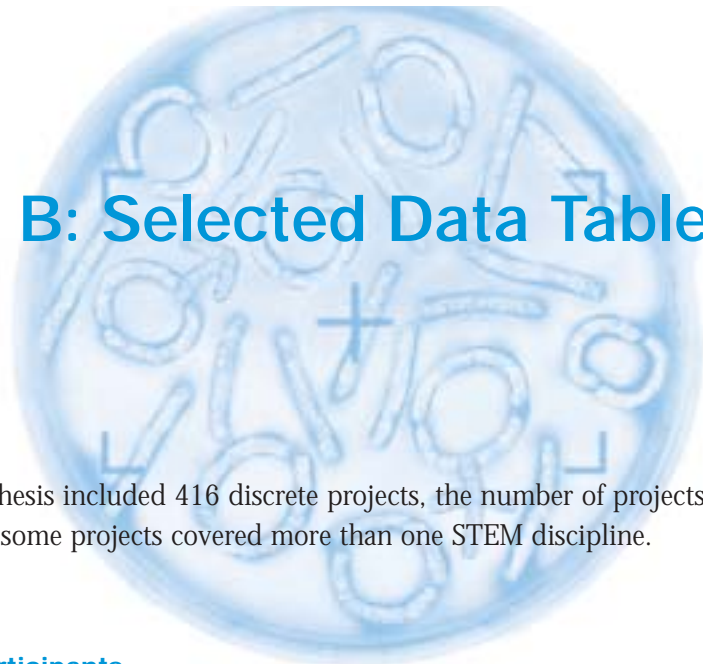
recruitment procedures. While a few projects included information about whether participants volunteered or were recruited, most projects did not list specific procedures. An attempt was also made to examine the longer lasting impact of these intervention projects by assessing the development of new classes, administrative positions, or other factors. This impact was also difficult to assess because the reports did not often provide this information. Last, the evaluation of project implementations left many questions.

Many reports presented mostly informal testimonials, some included surveys and questionnaires, and a few had pre- and post-project assessments. Some funding recipients listed helpful components of the

projects, such as collaboration with volunteers, teachers, and other participants; effective planning before the start of the project; and career mentoring at professionals' work sites. Several funding recipients mentioned problems, including student and adult volunteer attendance, lack of funds, insufficient time, resistance from colleagues and administration, and boys' feelings of exclusion.

In general, insufficient or missing information in many reports explains the large number of unspecified listings in tables and figures. With the constraints noted above, this case survey presents a comprehensive synthesis of what has been addressed in gender equity research and intervention projects during the last decade.

Appendix B: Selected Data Tables



Note: Although the synthesis included 416 discrete projects, the number of projects in the tables below adds up to 511 because some projects covered more than one STEM discipline.

Table 1 Gender of Participants

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
Girls only	115 (59%)	70 (57%)	38 (59%)	67 (52%)
Girls and boys	78 (40%)	51 (41%)	22 (34%)	58 (45%)
Unspecified	3 (1%)	2 (2%)	4 (6%)	3 (2%)

Table 2 School Levels

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
Elementary school	57 (29%)	37 (30%)	12 (19%)	40 (31%)
Middle school	88 (45%)	51 (41%)	35 (55%)	55 (43%)
High school	54 (28%)	43 (35%)	18 (28%)	33 (26%)
College	25 (13%)	15 (12%)	14 (22%)	12 (9%)
Unspecified	30 (15%)	12 (10%)	3 (5%)	23 (18%)

Note: Some projects included more than one school level.

Table 3 Underrepresented Groups

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
Race/ethnicity				
Black/African American	34 (17%)	13 (11%)	24 (38%)	23 (18%)
Latino/Hispanic	31 (16%)	16 (13%)	21 (33%)	21 (16%)
Native American Indian	14 (7%)	4 (3%)	8 (13%)	10 (8%)
Disabilities	7 (4%)	3 (2%)	1 (2%)	6 (5%)
English as a second language	1 (1%)	2 (2%)	1 (2%)	5 (4%)
Others	41 (21%)	13 (11%)	16 (25%)	39 (30%)
Unspecified	126 (64%)	96 (78%)	26 (41%)	73 (57%)

Note: Some projects included more than one underrepresented group.

Table 4 Locations

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
Rural	49 (25%)	22 (18%)	9 (14%)	29 (23%)
Suburban	44 (22%)	23 (19%)	5 (8%)	34 (27%)
Urban	43 (22%)	24 (20%)	15 (23%)	28 (22%)
Unspecified	75 (38%)	57 (46%)	35 (55%)	39 (30%)

Note: Some projects included more than one location.

Table 5 Settings

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
In school	56 (29%)	41 (33%)	14 (22%)	16 (13%)
After school	64 (33%)	38 (31%)	0 (0%)	20 (16%)
Community	33 (17%)	6 (5%)	0 (0%)	18 (14%)
Museum	1 (1%)	4 (3%)	0 (0%)	0 (0%)
Park	7 (4%)	0 (0%)	0 (0%)	0 (0%)
Summer	38 (19%)	21 (17%)	42 (66%)	28 (22%)
University	11 (6%)	26 (21%)	0 (0%)	0 (0%)
Web/Internet	4 (2%)	12 (10%)	0 (0%)	1 (1%)
Unspecified	43 (22%)	21 (17%)	11 (17%)	60 (47%)

Note: Some projects included more than one setting.

Table 6 Involvement of Adults

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
Community groups	88 (45%)	6 (5%)	24 (38%)	59 (46%)
Educators				
K-12 administrators	42 (21%)	5 (4%)	11 (17%)	25 (20%)
K-12 counselors	15 (8%)	4 (3%)	4 (6%)	9 (7%)
K-12 teachers	136 (69%)	63 (51%)	32 (50%)	88 (69%)
Graduate students	20 (10%)	4 (3%)	6 (9%)	10 (8%)
Parents	109 (56%)	17 (14%)	24 (38%)	67 (52%)
Professionals/university faculty	88 (45%)	11 (9%)	29 (45%)	52 (41%)
Unspecified	10 (5%)	46 (37%)	8 (13%)	13 (10%)


Note: Some projects involved more than one adult category.

Table 7 Project Goals

	Science N=196	Technology N=123	Engineering N=64	Mathematics N=128
Academics (increase skills and achievement)	83 (42%)	35 (28%)	18 (28%)	24 (19%)
Affect (increase interest and engagement)	132 (67%)	84 (68%)	33 (52%)	68 (53%)
Awareness (increase knowledge of careers or gender equity issues)	77 (39%)	42 (34%)	24 (38%)	39 (30%)
Unspecified	23 (12%)	0 (0%)	6 (9%)	47 (37%)

Note: Some projects had more than one project goal.

References

- 
- American Association of Engineering Societies. (1998). *Engineering and technology degrees*. Washington, DC.
- American Association of University Women Educational Foundation. (1992). *How schools shortchange girls: The AAUW report*. Washington, DC.
- American Association of University Women Educational Foundation. (2000). *Tech-Savvy: Educating girls in the new computer age*. Washington, DC.
- Baker, D., & Leary, R. (1995). Letting girls speak out about science. *Journal of Research on Science Teaching*, 32(1), 3–27.
- Camp, T. (1997). The incredible shrinking pipeline. *Communications of the ACM*, 40(10), 103–110.
- Campbell, P. B., & Steinbrueck, K. (1996). *Striving for gender equity: National programs to increase student engagement with math and science*. Washington, DC: American Association for the Advancement of Science.
- Catsambis, S. (1995). Gender, race, ethnicity, and science education in middle grades. *Journal of Research in Science Teaching*, 32(3), 243–257.
- Darke, K., Clewell, B., & Sevo, R. (2002). Meeting the challenge: The impact of the National Science Foundation's Program for Women and Girls. *Journal of Women and Minorities in Science and Engineering*, 8(3/4), 285–303.
- Falk, J. H., Brooks, P., & Amin, R. (2001). Investigating the role of free-choice learning on public understanding of science: The California Science Center L.A.S.E.R. Project. In J. H. Falk (Ed.) *Free-choice science education: How we learn science outside of school* (pp. 115–132). New York: Teachers College Press.
- Jones, L. R., Mullis, I. V. S., Raizen, S. A., Weiss, I. R., & Weston, E. A. (1992). *The 1990 science report card: NAEP's assessment of fourth, eighth, and twelfth graders*. Washington, DC: National Center for Education Statistics.
- Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences, interests and attitudes toward science and scientists. *Science Education*, 84(2), 180–192.
- Kaiser Family Foundation. (1999). *Kids & media @ the new millennium*. Menlo Park, CA. Retrieved January 20, 2004, from <http://www.kff.org/entmedia/1535-index.cfm>.
- Martin, M. O., Mullis, I. V. S., Gonzales, E. J., O'Connor, K. M., Chrostowski, S. J., Gregory, K. D., et al., (2001). *Science benchmarking report: TIMSS 1999-eighth grade: Achievement for U.S. states and districts in an international context*. Boston, MA: International Study Center, Lynch School of Education, Boston College. Retrieved January 20, 2004, from http://isc.bc.edu/timss1999b/pdf/TB99_Sci_all.pdf.
- National Academy of Education. (1999). *Recommendations regarding research priorities: An advisory report to the National Educational Research Policy and Priorities Board*. New York. Retrieved January 20, 2004, from <http://www.nae.nyu.edu/pubs/reportfinal399.doc>.
- National Assessment of Educational Progress. (2001). *The nation's report card science 2000*. Retrieved January 20, 2004, from <http://nces.ed.gov/nationsreportcard/science/>.
- National Council for Research on Women. (2001). *Balancing the equation: Where are women and girls in science, engineering and technology?* New York.
- National Research Council. (1999). *Being fluent with information technology*. Washington, DC: National Academy Press. Retrieved January 20, 2004, from <http://books.nap.edu/catalog/6482.html>.
- National Science Foundation. (2003a). *New formulas for America's workforce: Girls in science and engineering*. Report NSF03207. Washington, DC: U.S. Government Printing Office. Retrieved January 20, 2004, from <http://www.nsf.gov/pubs/2003/nsf03207/start.htm>.
- National Science Foundation. (2003b). *Women, minorities and persons with disabilities in science and engineering: 2002*. Report NSF03312. Arlington, VA. Retrieved January 20, 2004, from <http://www.nsf.gov/pubs/ods/>.
- Nelson, D. J., & Rogers, D. C. (2004). *A national analysis of diversity in science and engineering faculties at research universities: Executive summary*. Retrieved January 20, 2004, from http://www.now.org/issues/diverse/diversity_report.pdf.

Paris, S. G., & Mercer, M. J. (2002). Finding self in objects: Identity exploration in museums. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 401–423). Mahwah, NJ: Lawrence Erlbaum Associates.

Wilson, S. M., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. *Review of Research in Education*, 24, 173–209.

Yin, R. K., & Heald, K. A. (1975). Using the case survey method to analyze policy studies. *Administrative Science Quarterly*, 20, 371–381.

A note about the references: This is not intended to be a comprehensive listing of research and policy studies in this field. See the report *Balancing the Equation* by the National Council for Research on Women (2001) for additional related references and resources.

AAUW Equity Library



Beyond the "Gender Wars": A Conversation About Girls, Boys, and Education

Report of the key insights presented during a symposium convened by the AAUW

Educational Foundation in September 2000 to foster a discussion among scholars who study both girls' and boys' experiences in and out of school. Participants share their insights about gender identity and difference, challenge popular views of girls' and boys' behavior, and explore the meaning of equitable education for the 21st century.

AS49 ■ 60 pages/2001 ■ \$9.95



Gaining a Foothold: Women's Transitions Through Work and College

Examines how and why women make changes in their lives through education.

Profiles three groups—women going from high school to college, from high school to work, and from work to college—using qualitative and quantitative methods. Findings include an analysis of women's educational decisions, aspirations, and barriers.

AS37 ■ 100 pages/1999 ■ \$6.49



Gender Gaps: Where Schools Still Fail Our Children

Measures schools' mixed progress toward gender equity and excellence since the 1992 publication of *How Schools Shortchange Girls: The AAUW Report*. Research compares student course

enrollments, tests, grades, risks, and resiliency by race and class as well as gender. It finds some gains in girls' achievement, some areas where boys—not girls—lag, and some areas, like technology, where needs have not yet been addressed.

AS35 ■ 150 pages/1998 ■ \$6.99

Executive Summary

AS36 ■ 24 pages/1998 ■ \$3.99



Girls in the Middle: Working to Succeed in School

Engaging study of middle school girls and the strategies they use to meet the challenges of adolescence. Report links girls' success to school reforms like team teaching and cooperative learning, especially where these are used to address gender issues.

AS29 ■ 128 pages/1996 ■ \$7.49



Growing Smart: What's Working for Girls in School

Comprehensive academic review of more than 500 reports identifies approaches that promote girls' achievement and healthy development. Culturally conscious report urges experimentation with single-sex programs, cooperative learning, and other nontraditional approaches.

AS26 ■ 97 pages/1995 ■ \$14.50

Executive Summary and Action Guide

AS25 ■ 48 pages/1995 ■ \$6.49



Hostile Hallways: Bullying, Teasing, and Sexual Harassment in School (2001)

One student in five fears being hurt or bothered in school; four students in five personally experience sexual harassment. These are

among the findings of this nationally representative survey of 2,064 eighth- through 11th-graders. The report investigates sexual harassment in public schools, comparing the findings with AAUW's original survey in 1993 and exploring differences in responses by gender, race/ethnicity, grade level, and area (urban or suburban/rural). Conducted by Harris Interactive.

AS50 ■ 56 pages/2001 ■ \$9.95



Hostile Hallways: The AAUW Survey on Sexual Harassment in America's Schools (1993)

The first national study of sexual harassment in public schools. Includes gender and racial/ethnic data breakdowns. Conducted by Louis Harris and Associates.

AS17 ■ 28 pages/1993 ■ \$5.99



How Schools Shortchange Girls: The AAUW Report

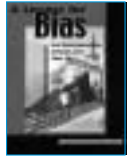
A startling examination of how girls are disadvantaged in U.S. public schools. Includes recommendations for educators and policy-makers as well as concrete strategies for change.

AS22 ■ 224 pages/Marlowe, 1995 ■ \$6.49

Executive Summary

AS14 ■ 8 pages/1992 ■ \$2.50

*Unless otherwise noted, reports are published
by the AAUW Educational Foundation.*



A License for Bias: Sex Discrimination, Schools, and Title IX

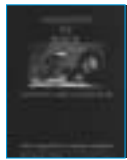
Examines uneven efforts to implement the 1972 civil rights law that protects some 70 million students and employees from sex discrimination in schools and universities.

AS48 ■ 84 pages/AAUW Legal Advocacy Fund, 2000 ■ \$12.95

SchoolGirls: Young Women, Self-Esteem, and the Confidence Gap

Riveting book by journalist Peggy Orenstein in association with AAUW shows how girls in two racially and economically diverse California communities suffer the painful plunge in self-esteem documented in *Shortchanging Girls, Shortchanging America*.

AS27 ■ 384 pages/Doubleday, 1994 ■ \$12.95



Separated by Sex: A Critical Look at Single-Sex Education for Girls

The foremost educational scholars on single-sex education in grades K-12 compare findings on whether girls learn better apart from boys. The report, including a literature review and a summary of a forum convened by the AAUW Educational Foundation, challenges the popular idea that single-sex education is better for girls.

AS34 ■ 99 pages/1998 ■ \$12.95



Shortchanging Girls, Shortchanging America Executive Summary

Summary of the 1991 poll that assesses self-esteem, educational experiences, and career aspirations of girls and boys ages 9 through 15. Revised edition reviews poll's impact, offers action strategies, and highlights survey results with charts and graphs.

AS20 ■ 20 pages/AAUW, 1994 ■ \$5.99

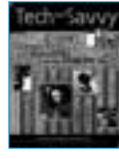


¡Sí, Se Puede! Yes, We Can: Latinas in School

Comprehensive look at the status of Latina girls in the U.S. public education system. Explores conflicts between institutional expectations and the realities of student lives and discusses the social, cultural, and community factors that affect Hispanic education.

AS46 (English) ■ 84 pages/2001 ■ \$12.95

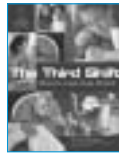
AS47 (Spanish) ■ 90 pages/2001 ■ \$12.95



Tech-Savvy: Educating Girls in the New Computer Age

Explores girls' and teachers' perspectives on today's computer culture and technology use at school, home, and work. Presents recommendations for broadening access to computers for girls and others who don't fit the "male hacker/computer geek" stereotype.

AS45 ■ 84 pages/2000 ■ \$12.95



The Third Shift: Women Learning Online

Through distance education, technology offers new opportunities for women to achieve educational goals. This report explores why women pursue education; how they balance work, family, and education; and what would make distance learning easier for them. Includes recommendations for improvements.

AS51 ■ 80 pages/2001 ■ \$9.95



Under the Microscope: A Decade of Gender Equity Projects in the Sciences

Examines and analyzes more than 400 gender equity projects specifically aimed at increasing the participation of girls and women in science, technology, engineering, and mathematics (STEM). Reveals trends in the development and support of these projects during the last decade and offers recommendations for strengthening the advancement of gender equity in the sciences for the future.

EF002 ■ 40 pages ■ \$12.00



Voices of a Generation: Teenage Girls on Sex, School, and Self

Compares the comments of roughly 2,100 girls nationwide on peer pressure, sexuality, the media, and school. The girls participated in AAUW teen forums called Sister-to-Sister Summits. The report explores differences by race, ethnicity, and age, and offers the girls' action proposals to solve common problems.

AS39 ■ 95 pages/1999 ■ \$7.50



Women at Work

Combines interview and survey data with recent U.S. census statistics to explore how women are faring in today's work force and what their prospects are for future job success and security.

AS55 ■ Report ■ 56 pages/2003 ■ \$15.95

AS56 ■ Action Guide ■ 20 pages/2003 ■ \$6.95

AS57 ■ Set (Report and Action Guide) ■ \$19.95

AAUW Educational Foundation

2003–05 Board of Directors

Mary Ellen Smyth, President
Bets Brown, Program Vice President
Dee Mickey, Development Vice President
Jo Herber, Finance Vice President
Barbara O'Connor, Secretary
Evelyn Blackburn
Kathleen Brenniman
Myrna Brown
Judy Horan
Barbara Knapp
Sally Little
Darleana McHenry
Joanne Stern
Shirin Velji
Neola Waller

Ex Officio

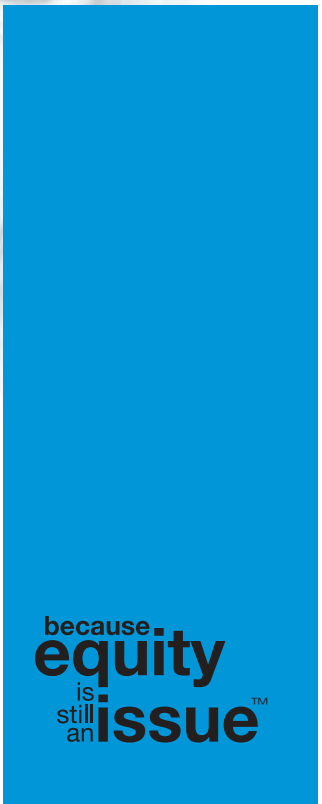
Nancy Rustad, AAUW President
Jacqueline E. Woods, AAUW Executive Director
Eleanor "Coco" Stewart, Parliamentarian

Project Staff

Nancy Eynon Lark, Director, AAUW Educational Foundation
Elena Silva, Director of Research, AAUW Educational Foundation

The AAUW Educational Foundation provides funds to advance education, research, and self-development for women and to foster equity and positive societal change.

In principle and in practice, the AAUW Educational Foundation values and supports diversity. There shall be no barriers to full participation in this organization on the basis of gender, race, creed, age, sexual orientation, national origin, disability, or class.



1111 Sixteenth St. N.W.
Washington, DC 20036
Phone: 202/728-7602
Fax: 202/463-7169
TDD: 202/785-7777
E-mail: foundation@aauw.org
www.aauw.org

because
equity
is
still
an **issue**™