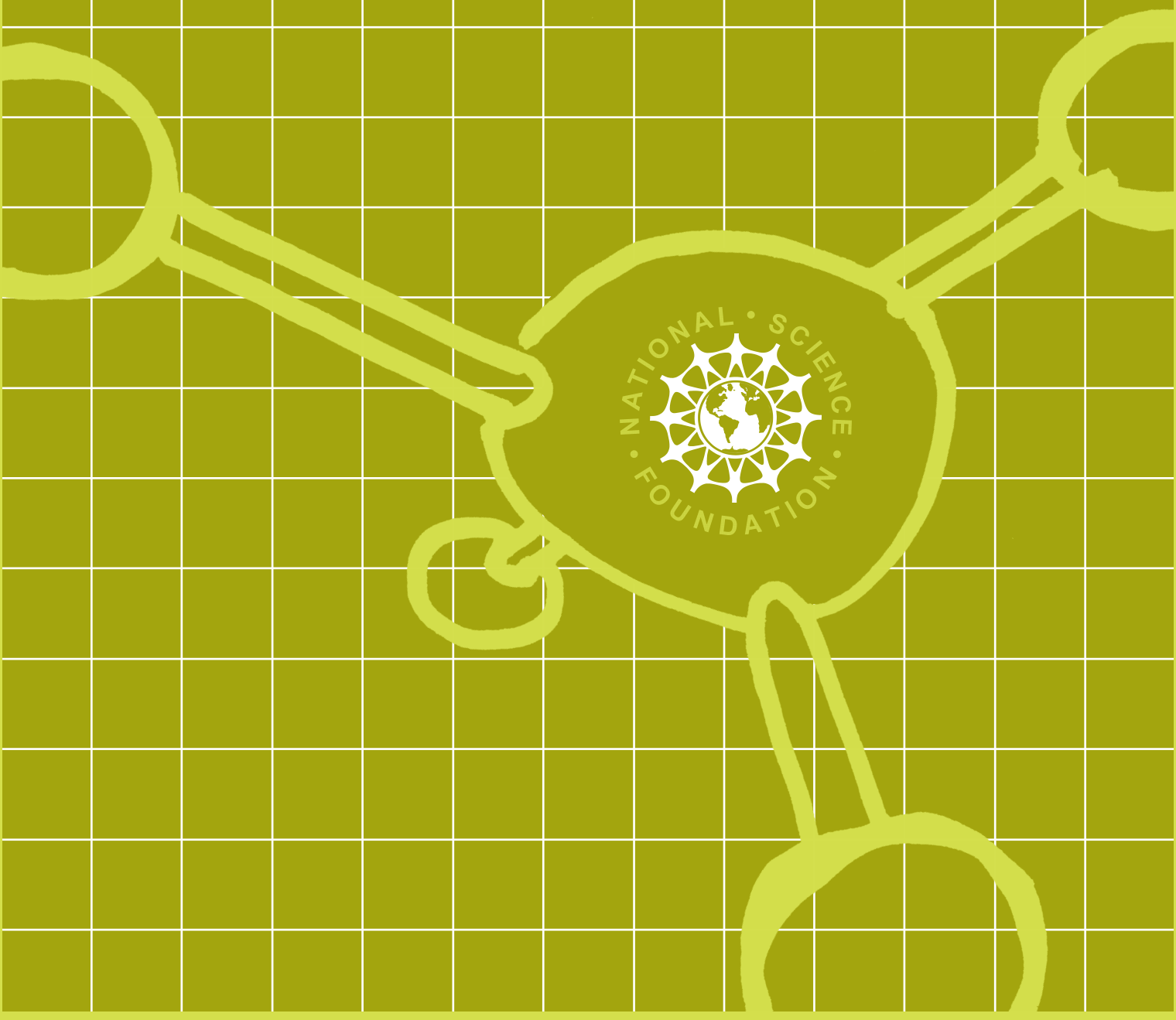
NEW FORMULAS FOR AMERICA'S WORKFORCE 2

GIRLS IN SCIENCE AND ENGINEERING



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ORIGINS

One of the National Science Foundation's key strategies is to cultivate a world-class, broadly inclusive science and engineering workforce and expand the scientific literacy of all citizens. Why is it important and timely to deepen the American talent pool in engineering and computer science? There are many reasons:

- After 9/11, the United States finds itself no longer able to depend as much on foreign talent for engineers and technology experts. We need more citizens available for classified work, especially to meet new challenges such as those presented by chemical and biological weapons and weapons of mass destruction.
- Companies are exporting jobs to meet their demands for talent in engineering and computer science.
- Having developed their own competitive educational institutions, other countries are growing their potential to produce more engineers and computer scientists than the United States.
- The diversity profile of faculty in U.S. colleges and universities has not kept up with the profile of graduates in science, technology, engineering, and math (STEM) fields. Graduates are available but are not entering the academic or corporate workforces, are not choosing to stay, or are not advancing to leadership positions.
- Congress recently directed the Government Accountability Office to assess the application of Title IX to higher education, and especially to the issues of equitable access, recruitment, and retention of underrepresented students in science and engineering.
- The National Science Board, the National Academies of Science and Engineering, American Association for the Advancement of Science, and other leading policy entities continue to voice concerns about the lack of diversity in the science and engineering workforce.
- Lawrence Summers, former president of Harvard University, launched a public discussion—including hundreds of pages of press coverage—on the topic "why aren't women in science?" Subsequently, Harvard University invested $30 million to change those of its policies and practices that contributed to the slow integration and advancement of women in faculty positions in these fields.
- While women's participation in medicine, law, and business management has increased to parity or near parity, it remains slow in the high-demand fields of science and engineering, especially with regard to workforce participation and advancement.
- Cross-cultural studies show that occupational participation and segregation by gender is cultural. That is, a society can encourage and support different trends, even in a short period of time, that could lead to a more diverse and dynamic workforce.

In 1981 the Equal Opportunities for Women and Minorities in Science and Technology Act acknowledged that it was United States policy and in the national interest to encourage all groups to participate in science and engineering. The act mandated that NSF report statistics on underrepresented groups and initiate programs fostering more proportionate representation. Among the suite of programs that followed was the Program for Women and Girls, created in 1993 and housed in NSF's Division of Human Resource Development, Directorate for Education and Human Resources.

The annual budget has varied from $7 million to $10 million. Although relatively small, the NSF program is the largest funding source, public or private, for efforts expressly addressing the need to broaden girls' and women's participation in STEM. To date, more than 350 grants have provided the national STEM education enterprise with new ideas, proven good practices, innovative products, research publications, and a leadership of savvy, experienced educators and education researchers. These grants are relatively small but reach nearly every state in the United States.

The program aims to change education policy and practice by supporting research, student and educator programs, dissemination of findings, and technical assistance projects. Program findings and outcomes help us understand, for example, how to

- Maintain girls' interest in science past middle school
- Bring more girls into elective high school math and advanced-placement science courses
- Increase young women's enrollment in STEM undergraduate studies, particularly in engineering and computer sciences (where there is a national need for more experts and more diverse faculty)

A study of its impact from 1993 to 1996 showed that the NSF program has been successful. Yet while much has been accomplished, national statistics reveal that much more remains to be done. Since 1993—even since 2003—the national need for a larger, more diverse, more science- and computer-literate and skilled workforce has steadily increased, as we progress toward an increasingly technological job market, a more scientifically complex society, and more intense global competition in engineering and technology innovation.

WHY THIS BOOK?

New Formulas for America's Workforce: Girls in Science and Engineering was published in September 2003. Within seven weeks of issue, the initial print run of 7,000 copies was exhausted and the NSF had to order reprints. Copies on CD-ROM and online were also in great demand. NSF's publications Web site showed *New Formulas* to be the second most requested print publication during October 2003. There were requests for up to 300 copies of the CD-ROM at a time, to be handed out at conferences. All copies (paper and CD-ROM) are free. The publication reached teachers, formal and informal educational practitioners, researchers, and even parents and students. Ensuing publicity in every major science publication (and the *Washington Post*) revealed the breadth of public interest.

The first *New Formulas* covered about 220 grants from 1993 through 2001. *New Formulas 2* updates the first volume by describing the roughly 100 grants made from 2002 through 2005. There are fewer educational demonstration projects but more social science research studies, dissemination activities, and projects that will provide technical assistance for the implementation of best practices. The publication led to

- New collaborations among education researchers,
- New and greater investments in educational programs for female students,
- Better understanding of gender differences in career interests and in how students engage in science and mathematics
- Awareness of and better access to widely scattered resources and information
- Deeper comprehension of the educational impacts of NSF's investments
- Faster and easier press access to findings and leading experts in a field of study that crosses many disciplines

In short, the book informed public discourse about the state of gender diversity in science and engineering, the critical role of education in preparing the workforce, and the constraints on national competitiveness that can result from failing to address diversity issues.

We expect the same spectrum of groups to be interested in this volume as the first: teachers, faculty, counselors, administrators, after-school program providers, researchers, deans, colleges of education, trainers of teachers, professional associations, foundations, industry, policymakers, the public media, parents, and students. All are interested in better education, better access to education, better student achievement, and more entrants (and more diverse entrants) into science and engineering careers.

MORE INFORMATION
ABOUT NSF: www.nsf.gov
ABOUT THE PROGRAM: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5475&org=HRD&from=home
ORIGINAL PROJECT SUMMARIES IN THE "AWARDS DATABASE" AT NSF:http://www.nsf.gov/awardsearch/index.jsp • GO TO THE TAB ALL FIELDS • IN PROGRAM ELEMENT ENTER "1544" • REMOVE CHECK FOR CURRENT AWARDS ONLY
Any NSF publication may be retrieved at http://www.nsf.gov/publications/. Type in the publication number, e.g., NSF 6-59, or the title.

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At large

The 75 Principal Investigators and their teams who carried out these projects and who responded with additional information, reviews, chapter introductions, and images

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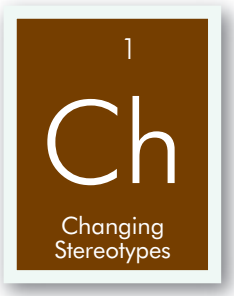

CHAPTER ONE · CHANGING STEREOTYPES

IN ELEMENTARY SCHOOL, ABOUT AS MANY GIRLS AS BOYS HAVE A POSITIVE ATTITUDE TOWARD SCIENCE. IN A RECENT SURVEY, FULLY 66 PERCENT OF FOURTH-GRADE GIRLS (AND 68 PERCENT OF FOURTH-GRADE BOYS) REPORTED THAT THEY "LIKE" SCIENCE.[1] BUT SHORTLY THEREAFTER, MORE GIRLS THAN BOYS BEGIN TO TURN AWAY FROM SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM).[2,3] THIS BEGINS THE "LEAKING PIPELINE" THAT RESULTS IN SIGNIFICANT UNDERREPRESENTATION OF WOMEN IN MANY STEM CAREERS.[4]

A PRINCIPAL REASON IS CULTURAL STEREOTYPES—STEREOTYPES THAT ARE CHANGING, BUT NOT QUICKLY ENOUGH. GIRLS' DECLINING INTEREST IN STEM OFTEN RESULTS FROM CULTURAL BELIEFS, IMAGES, AND PRACTICES THAT COMMUNICATE STEREOTYPED MESSAGES THAT THESE SUBJECTS ARE MORE APPROPRIATE FOR BOYS THAN FOR GIRLS. AS A RESULT, GIRLS BEGIN TO CONCLUDE THAT STEM IS NOT FOR THEM. THESE BELIEFS OFTEN BEGIN EARLY AND INFLUENCE CHOICES THEY MAKE THROUGHOUT SCHOOL.[5]

THE CONSEQUENCES OF GIRLS DROPPING OUT OF THE SCIENTIFIC PIPELINE ARE REAL. TODAY, WOMEN MAKE UP 49 PERCENT OF THE WORKFORCE BUT ONLY 25 PERCENT OF THE STEM WORKFORCE. CHANGING STEREOTYPES ABOUT GIRLS AND WOMEN IN STEM IS IMPORTANT. HERE'S WHY:

- SCIENCE AND TECHNOLOGY HELP DRIVE THE ECONOMY. TO ENSURE THE PLACE OF THE UNITED STATES IN INTERNATIONAL MARKETS AND AS A SCIENTIFIC WORLD LEADER, WE MUST TAP OUR AVAILABLE RESOURCES. IF THERE ARE 12-YEAR-OLD GIRLS WITH THE POTENTIAL TO BECOME SCIENTISTS OR ENGINEERS, WE MUST ENSURE THAT THEY HAVE OPPORTUNITIES TO DEVELOP THEIR TALENTS.
- SCIENCE IMPROVES AND GROWS ONLY THROUGH THE CONTRIBUTIONS OF ITS MEMBERS. EACH SCIENTIST BRINGS A UNIQUE PERSPECTIVE TO THE FIELD, AND EACH PERSPECTIVE IS IMPORTANT. FEW CAN PREDICT WHAT GOOD IDEA IS GOING TO BE THE NEXT GREAT IDEA OR WHO WILL COME UP WITH IT. OPENING THE FIELD TO AS MANY PEOPLE AS POSSIBLE IS ESSENTIAL FOR STEM TO FLOURISH.
- OUR SOCIETY REAPS BENEFITS WHEN ITS MEMBERS ARE SCIENTIFICALLY LITERATE. TECHNOLOGICAL, MEDICAL, AND SCIENTIFIC ADVANCEMENTS ARE BEING MADE RAPIDLY. A SOLID FOUNDATION IN SCIENCE IS VITAL TO UNDERSTANDING HOW TO INCORPORATE THIS NEW INFORMATION INTO OUR DAILY LIVES.

ALL THE PROJECTS DESCRIBED IN THIS CHAPTER SEEK TO CHANGE STEREOTYPES ABOUT GIRLS AND WOMEN IN STEM OR AT LEAST TO UNDERSTAND THEM FURTHER. THEY AIM AT A RANGE OF GRADE LEVELS, FROM UPPER ELEMENTARY TO UNDERGRADUATE. ULTIMATELY, ALL THE PROJECTS SEEK TO INSPIRE IN GIRLS AND YOUNG WOMEN THE CONFIDENCE, ENTHUSIASM, AND PERSISTENCE TO CONTINUE PURSUING THEIR SCIENTIFIC INTERESTS.

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REACHING PARENTS OF ELEMENTARY AND MIDDLE SCHOOL GIRLS

IN THE MEDIA, AT SCHOOL, AND AT HOME, GIRLS HEAR MESSAGES THAT CAN DISCOURAGE THEM, OFTEN SUBTLY, FROM MAINTAINING OR DEVELOPING AN INTEREST IN STEM. PARENTS, TEACHERS, AND PEERS OFTEN PLAY A ROLE IN SHAPING THESE NEGATIVE PERCEPTIONS, WHETHER CONSCIOUSLY OR NOT. RESEARCH SHOWS THAT FROM THE FOURTH TO EIGHTH GRADES IN PARTICULAR, GIRLS TURN AWAY FROM MATH AND SCIENCE IN GREATER NUMBERS THAN DO BOYS.

To help parents encourage their daughters' interest in STEM, Imaginary Lines (also known as Sally Ride Science) has created high-quality handbooks with the facts about girls and science, factors that impede girls' interest in STEM, and ways to overcome these obstacles. MacMillan/McGraw-Hill will print, promote, and distribute the English and Spanish versions of two handbooks, one for parents of girls in kindergarten through third grade, one for parents of girls in grades four through seven. Sally Ride Science and MacMillan/McGraw-Hill will also organize workshops in several school districts. Other partners include Center of Science and Industry-Columbus, the Center for Women and Information Technology, and the San Diego Supercomputer Center's Girls are GREAT program.

Sally Ride Science will complement publication of the booklets with informative and practical workshops for parents in both Spanish and English. The team is also developing an online discussion forum where parents can ask questions of experts and exchange ideas and experiences.

Founded by former astronaut Sally Ride, Sally Ride Science creates innovative programs for students, parents, and teachers to promote interest in science and engineering. Many such events will be used to field-test and distribute the handbooks.

GRADE LEVEL: ELEMENTARY, MIDDLE SCHOOL
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Keywords: dissemination project, self-confidence, self-efficacy, engagement, barriers, gender differences, environmental factors, workshops, parental involvement, engaged learning, mentoring, support system, multigenerational, dissemination plan, bilingual, publication, PowerPoint, radio, television, community-based, minorities, Hispanic, industry partners, tools, connections, after-school, informal education

MAKING TEAMWORK WORK FOR WOMEN

TEAMWORK AND COLLABORATION ARE OFTEN PROPOSED AS WAYS TO IMPROVE THE EXPERIENCES OF FEMALE STUDENTS IN STEM DISCIPLINES. HOWEVER, IN PRACTICE, WOMEN FREQUENTLY HAVE NEGATIVE EXPERIENCES WITH TEAM PROJECTS AND ARE LEFT FEELING EVEN MORE ALIENATED THAN BEFORE. THE UNIVERSITY OF LOUISVILLE IS EXAMINING THE EXPERIENCES AND ATTITUDES OF NEARLY 300 STUDENTS WORKING ON TEAM PROJECTS IN COMPUTER SCIENCE AND SCIENTIFIC AND TECHNICAL WRITING.

In the first phase, researchers observed teams working on technically oriented writing projects. Team interactions were transcribed and analyzed for quantity of interaction, interruptions, roles played by different individuals, reactions to different types of conversational interchanges, and different approaches to problem solving. These analyses were compared with questionnaire and interview data to assess how communication, problem solving, and knowledge styles can affect men's and women's experiences in teams.

The researchers found that men tend to dominate technology in groups, while women do a disproportionate share of the writing. Moreover, the written work produced by women was often downplayed or overlooked as unimportant, while men were often credited for written work they did not produce. The researchers suggest that men's and women's use of body language during face-to-face discussions of written work and differences in the way men and women complain may contribute to some of these inaccuracies in how teams evaluate men's and women's work.

More generally, the researchers also found that student teams spend too much time trying to draft materials in often competitive face-to-face situations; team leaders often inhibit rather than facilitate group progress and learning; and team members tend to do what they already know, without much collaboration or peer-to-peer education. Instructors are often unaware of major breakdowns in team collaboration.

In the second phase of the project, the researchers are testing the effects of various activities and interventions on team dynamics. The following have shown promise in creating more gender-equitable team environments:

- Activities and project instructions that encourage teams to use written communication as a management and collaboration tool. Teams that use written communication effectively have less conflict and distribute written work more equitably than teams that attempt to complete major portions of their projects face to face.
- Computer-mediated groupware tools that archive all e-mail and documents associated with a project. These tools increase students' confidence that their instructors and teammates will evaluate their project contributions accurately.
- Workshops analyzing videotapes of real team interactions for gender inequities and other communication problems. Women on teams completing these workshops have more involvement in the technical aspects of a project than their counterparts on teams that have not gone through the workshop training.

A textbook on teamwork (with accompanying CD-ROM) based on this research is currently under development. Articles based on this study have appeared in *Journal of Business and Technical Communication*, *Written Communication*, and *Proceedings of the Frontiers in Education Conference 2005*.

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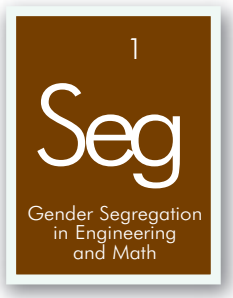
KEYWORDS: RESEARCH PROJECT, PROFESSIONAL DEVELOPMENT, LEADERSHIP SKILLS, GENDER-DIVERSITY AWARENESS, BARRIERS, GENDER DYNAMICS, TEACHER TRAINING, STUDY GROUPS, WORKSHOPS, PROJECT-BASED, TEAMWORK APPROACH, QUESTIONNAIRE, SCHOOL-BASED, MIXED-GENDER, COMPUTER SCIENCE, WRITING



GENDER SEGREGATION IN ENGINEERING AND MATH/COMPUTER SCIENCE

RESEARCH ON THE UNDERREPRESENTATION OF WOMEN IN STEM OFTEN LOOKS AT INDIVIDUALS AND THEIR IMMEDIATE SOCIAL ENVIRONMENTS. MANY EXPERTS FEEL THAT CHANGING THE GENDER COMPOSITION OF THESE FIELDS FUNDAMENTALLY WILL REQUIRE CHANGES IN BROADER CULTURAL IDEOLOGIES AND ORGANIZATIONAL PRACTICES. INVESTIGATORS AT THE UNIVERSITY OF CALIFORNIA–SAN DIEGO AND WESTERN WASHINGTON UNIVERSITY ARE EXAMINING DATA FROM 44 DEVELOPED, DEVELOPING, AND TRANSITIONAL COUNTRIES TO DETERMINE HOW CULTURAL IDEOLOGIES AND FEATURES OF NATIONAL EDUCATIONAL AND ECONOMIC SYSTEMS ARE RELATED TO LEVELS OF FEMALE PARTICIPATION IN STEM.

Studies have already found that cultural attitudes about gender roles factor into gender segregation in education. For this study, investigators have collected detailed data on eighth-grade boys' and girls' attitudes and achievement through the Third International Math and Science Surveys, which allow them to evaluate and compare factors across national and cultural lines. The investigators will also look at factors that affect gender segregation in higher education, including overall female enrollment rates, features of national higher education systems, economic opportunities for women, and national economic development.

Data from the study are available at http://weber.ucsd.edu/%7Emcharles/datadoc.html

GRADE LEVEL: MIDDLE SCHOOL (EIGHTH GRADE), UNDERGRADUATE

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KEYWORDS: RESEARCH PROJECT, GENDER-DIVERSITY AWARENESS, ENVIRONMENTAL FACTORS, LONGITUDINAL STUDY, ETHNOGRAPHIC, DATA COLLECTION, INTERNATIONAL COMPARISON, CULTURAL FACTORS, CROSS-CULTURAL STUDY

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Ra
Radio Series Tells the Stories About Girls and Women in Science

RADIO SERIES TELLS THE STORIES ABOUT GIRLS AND WOMEN IN SCIENCE

NORTHEAST PUBLIC RADIO (WAMC) REGULARLY FEATURES THE NATIONALLY SYNDICATED PROGRAMS, "51 PERCENT" AND "THE BEST OF OUR KNOWLEDGE." RESPECTIVELY, THESE SHOWS COVER ISSUES AFFECTING WOMEN AND TOPICS RELATED TO POLICY, RESEARCH, AND INNOVATION IN EDUCATION. OVER THE PAST FEW YEARS, WAMC HAS USED THESE SHOWS TO BROADCAST "HER-STORY," "OUT-LOUD," AND "THE TECH CLUB", THREE SPECIAL RADIO SERIES ABOUT WOMEN IN SCIENCE AND TECHNOLOGY.

Now WAMC is launching "Powerful Signals," a two-part series with another new approach to disseminating information critical to the national gender-equity effort in STEM. The first part consists of nine feature-length, magazine-style radio modules on innovative gender-diversity programs and projects around the country that demonstrate actual effects and measurable results, with an emphasis on methods and strategies that help increase girls' and women's participation in STEM. The second part comprises three multisegment "audio diaries," in which young women—both students and professionals—describe their experiences in STEM fields. Both parts highlight teaching styles, curriculum designs, pedagogical approaches, and studies that illuminate gender-related differences in STEM learning.

Content from both is now available on WAMC's Women in STEM radio Web site (http://www.womeninscience.org) as well as through distribution of CDs. Full audio of the radio stories, as well as text from the previous series, is already available on the site.

GRADE LEVEL: ELEMENTARY, MIDDLE SCHOOL, HIGH SCHOOL, UNDERGRADUATE, GRADUATE, PROFESSIONAL DEVELOPMENT		
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KEYWORDS: DISSEMINATION PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, RECRUITMENT, ENGAGEMENT, GENDER-DIVERSITY AWARENESS, BARRIERS, CAREER AWARENESS, GENDER IDENTITY, ACHIEVEMENT, TEACHER TRAINING, STAFF TRAINING, PARENTAL INVOLVEMENT, ENGAGED LEARNING, EXPLORATION-BASED, ROLE MODELS, MULTI-GENERATIONAL, REAL-LIFE APPLICATIONS, DISSEMINATION PLAN, RADIO, CD, MINORITIES, EDUCATION, INDUSTRY PARTNERS, INFORMAL EDUCATION, TRANSITION POINTS, CONNECTIONS, BIOGRAPHIES		

THINK AGAIN. . . GIRLS CAN!

THINK AGAIN. . . GIRLS CAN! IS A MEDIA CAMPAIGN TO IMPROVE PUBLIC PERCEPTIONS OF WOMEN IN STEM. DEVELOPED BY STONY BROOK UNIVERSITY IN COLLABORATION WITH THE LONG ISLAND FUND FOR WOMEN AND GIRLS, BRIARCLIFFE COLLEGE, AND TELEVISION STATION WLIW21, THE PROJECT HAS PRODUCED EIGHT INTERVIEWS IN WHICH ACCOMPLISHED WOMEN SCIENTISTS DISCUSS THEIR CAREERS AND THE CHALLENGES THEY FACE.

A DVD of these interviews is currently being disseminated to schools and community organizations, in conjunction with presentations about career opportunities in STEM. Accompanying data collection aims to determine whether "Think Again... Girls Can!" succeeds in increasing young women's interest in STEM careers.

All eight interviews can be seen online at the program Web site (http://www.girlscan.org). The site also includes instructions for obtaining a free copy of the DVD.

GRADE LEVEL: HIGH SCHOOL, UNDERGRADUATE	
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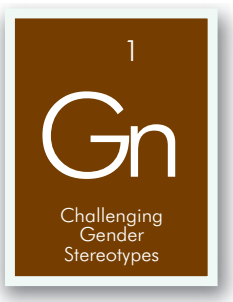

CHALLENGING GENDER STEREOTYPES WITH COMPUTER-BASED SOCIAL MODELS

RESEARCHERS AT FLORIDA STATE UNIVERSITY ARE EMPLOYING "PEDAGOGICAL AGENTS" TO INVESTIGATE HOW DIFFERENT ASPECTS OF COMPUTER-BASED SOCIAL MODELS AFFECT YOUNG WOMEN'S BELIEFS AND STEREOTYPES ABOUT ENGINEERING. PEDAGOGICAL AGENTS ARE THREE-DIMENSIONAL, ANIMATED, COMPUTER-BASED CHARACTERS THAT CAN SERVE AS TEACHERS. THREE DISTINCT POPULATIONS ARE BEING SAMPLED FOR THE RESEARCH: MIDDLE SCHOOL GIRLS, UNDERGRADUATES AT A HISTORICALLY BLACK COLLEGE, AND UNDERGRADUATES AT A SOUTHEASTERN PUBLIC UNIVERSITY. LARGE SAMPLE SIZES (AS MANY AS 200 STUDENTS) ARE STUDIED.

Over the three-year span of the project, research will be conducted in the following areas:

- *Year one*: agent appearance (age, gender, attractiveness, and "coolness")
- *Year two*: agent message and delivery (content of message and delivery mechanisms)
- *Year three*: agent persona (overall personality of agent, integrating voice, delivery, appearance, and message)

The research team will measure students' stereotypes of engineering, their motivation to pursue a career in the field, and self-efficacy. Results from this research could guide instructional programmers to the most important features for computer-based role models for young women. Results will also provide some insight into what makes an effective real-life, human role model.

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KEYWORDS: RESEARCH PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, PROBLEM-SOLVING SKILLS, COMPUTER SKILLS, BARRIERS, CURRICULUM MATERIALS, GENDER DIFFERENCES, INTERVENTION, ACHIEVEMENT, ENVIRONMENTAL FACTORS, LONGITUDINAL STUDY, CO-CURRICULAR, ENGAGED LEARNING, ACTIVITY-BASED, PROBLEM-BASED, EXPLORATION-BASED, COOPERATIVE LEARNING, ROLE MODELS, MENTORING, ELECTRONIC MENTORING, SUPPORT SYSTEM, COMPUTER-BASED TUTORING, INTERACTIVE, SOFTWARE, DESIGN-BASED, COMPUTER, SCHOOL-BASED, ENGINEERING EXPLORATION, AFRICAN AMERICAN, MINORITIES, COMPUTER TECHNOLOGY, ENGINEERING, INFORMATION TECHNOLOGY, TOOLS, ANIMATIONS, DATA COLLECTION, ASSESSMENT TOOLS, PEDAGOGICAL AGENTS, GIRLS AND TECHNOLOGY

THE IMAGE OF ENGINEERING

A COMPANY CALLED IMAGINARY LINES (ALSO KNOWN AS SALLY RIDE SCIENCE) IS CREATING TWO VIDEOS AND TWO COMPANION BOOKS AIMED AT ENCOURAGING UPPER ELEMENTARY AND MIDDLE SCHOOL GIRLS TO PURSUE STEM, AND ENGINEERING IN PARTICULAR. ONE VIDEO SHOWS GIRLS FROM DIVERSE BACKGROUNDS AS THEY DESIGN AND ENGINEER TOYS. THE SECOND PORTRAYS PROFESSIONAL FEMALE ENGINEERS DISCUSSING THEIR WORK AND ITS APPLICATIONS. THE FIRST COMPANION BOOK DESCRIBES THE ENGINEERING DESIGN PROCESS FOR ADULTS, INCLUDING RESEARCH-BASED STRATEGIES TO STIMULATE GIRLS' INTEREST IN STEM. THE SECOND IS AN ENGAGING CAREER GUIDE FOR GIRLS THEMSELVES, WITH INTERVIEWS FROM 12 WOMEN ENGINEERS AND ACTIVITIES TO PROMPT GIRLS TO THINK ABOUT THEIR OWN INTERESTS AND POSSIBLE ENGINEERING CAREERS.

Both the videos and the books will incorporate material from two existing projects created by Imaginary Lines: a national toy–design competition called TOYchallenge and a movie about the competition (funded separately). The TOYchallenge has been running for four years, and the company developed the research premises for the corresponding documentary film through a previous grant from NSF. In addition to new footage, hundreds of hours of footage shot for the movie will be available for use in creating both sets of products. The movie's award-winning producer will also produce and direct the videos.

The release of the videos and books will be coordinated with that of the documentary film. Special screenings will occur at

- Film festivals and corporate-sponsored events
- Programs for girls such as the Sally Ride Science Camps and Girl Scouts
- Science center and Engineers Week events
- National conventions, including those for Sigma Xi: The Scientific Research Society and the International Technology Education Association

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL
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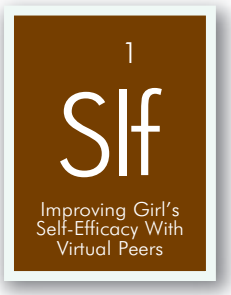
KEYWORDS: DISSEMINATION PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, ENGAGEMENT, SKILLS (PROBLEM-SOLVING, SCIENCE), BARRIERS, CAREER AWARENESS, CURRICULUM MATERIALS, GENDER DIFFERENCES, GENDER IDENTITY, ACHIEVEMENT, TRANSITION POINTS, EXTRACURRICULAR, ALL-YEAR, TEACHER TRAINING, PARENTAL INVOLVEMENT, HANDS-ON, ENGAGED LEARNING, PROJECT-BASED, PROBLEM-BASED, EXPLORATION-BASED, ROLE MODELS, MENTORING, SUPPORT SYSTEM, REAL-LIFE APPLICATIONS, DISSEMINATION PLAN, INTERDISCIPLINARY, DESIGN-BASED, EXPERIENTIAL LEARNING, VIDEOS, PUBLICATIONS, COMMUNITY-BASED SITES, ENGINEERING, INDUSTRY PARTNERS, INFORMAL EDUCATION, SELF-AUTHORSHIP, TOOLS, CONNECTIONS, AFTER-SCHOOL, BIOGRAPHIES



IMPROVING GIRLS' SELF-EFFICACY WITH VIRTUAL PEERS

A MULTIDISCIPLINARY RESEARCH TEAM AT UTAH STATE UNIVERSITY IS TRYING TO HELP GIRLS OVERCOME THEIR NEGATIVE SELF-IMAGES WHEN IT COMES TO STEM. IN PARTICULAR, THE TEAM WILL TEST THE POTENTIAL OF VIRTUAL PEERS IN CREATING A CONSTRUCTIVE SOCIAL ENVIRONMENT FOR GIRLS TO LEARN MATH. THESE PEERS ARE CALLED PEDAGOGICAL AGENTS AS LEARNING COMPANIONS, OR PALS, AND THEY HAVE BEEN DEVELOPED IN LINE WITH FINDINGS RELATED TO HUMAN PEER RESEARCH.

Unlike most technology-based programs, which concentrate on cognitive learning, this project aims to influence girls on an affective level. In the first year of a three-year program, the researchers will test whether the age (teacher-like versus peer-like) and gender of a PAL play roles in girls' choices of their PALs as learning partners and in enhancing the girls' self-efficacy. In the second year, the test will move to the areas of ethnicity and competency: girls will select from Caucasian or Hispanic PALs, and PALs at differing levels of competency. The third year will involve an "emotional" component: some PALs will be harsh, others friendly; some will be empathetic, others indifferent.

The study will be conducted in public high schools in middle- to large-size cities across the Mountain West states and will enlist approximately 200 high school girls. PAL interventions will take place regularly over the course of the semester, with researchers evaluating both qualitative and quantitative data.

If PALs are found to be successful, they may offer a cost-effective alternative to face-to-face teaching intended to improve girls' attitudes toward math and the sciences, from kindergarten through twelfth grade. Further, the results could offer specific solutions for girls of both Caucasian and Hispanic origins. The findings are important to influence the growing field of online learning technologies.

GRADE LEVEL: HIGH SCHOOL (NINTH GRADE)
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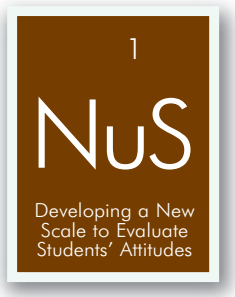
Keywords: research project, self-confidence, self-efficacy, engagement, math skills, barriers, gender differences, gender identity, intervention, environmental factors, curriculum materials, co-curricular, learning community, engaged learning, cooperative learning, collaborative learning, mentoring, electronic mentoring, support system, computer-based tutoring, interactive, software, design-based, computers, pedagogical agents, school-based, minorities, Hispanic, math, tools, connections, animations, data collection, assessment tools, site visits, girls and technology



DEVELOPING A NEW SCALE TO EVALUATE STUDENTS' ATTITUDES

TODAY'S UNDERGRADUATE POISED TO ENTER THE STEM CAREER PATH WILL GET HER STRONGEST SUGGESTIONS NOT FROM FRIENDS OR FAMILY BUT FROM HER CULTURAL ENVIRONMENT. TO CHANGE POPULAR ATTITUDES ABOUT WOMEN IN STEM, ONE MUST FIRST UNDERSTAND THEM.

North Carolina State University researchers are using an empirical, psychometrical scale to measure undergraduates' attitudes toward underrepresented groups in science and engineering. The scale's development and implementation will proceed in three stages over three years, gradually expanding from work with small groups of undergraduates to a nationwide campaign.

Year one: Researchers will observe undergraduate focus groups and record stereotyped beliefs about the ability of women and people of color to pursue STEM careers. They will then consider how STEM course content may have contributed to the formation of these student attitudes.

Year two: Using the information gathered during the first year, researchers will create an online survey of undergraduate attitudes about women and people of color in STEM disciplines. They will analyze data from 10,000 students across the country and create scales for measuring these attitudes. In addition to a standard scale applicable across disciplines, researchers will derive special scales adjusted for STEM subfields.

Year three: Researchers will conduct a field test to demonstrate the scale's uses and begin promoting its application to further research.

GRADE LEVEL: UNDERGRADUATE
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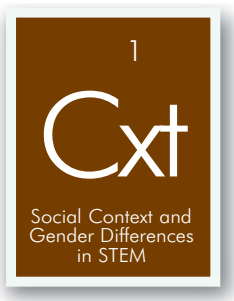
Keywords: research project, dissemination, gender-diversity awareness, research-based, dissemination plan, survey, questionnaire, minorities, departmental climate, evaluation, survey instrument, assessment tool, measurement of attitude



SOCIAL CONTEXT AND GENDER DIFFERENCES IN STEM

RESEARCHERS AT THE UNIVERSITY OF TEXAS–AUSTIN ARE EXAMINING HOW SOCIAL CONTEXT INFLUENCES MALE AND FEMALE STUDENTS' CHOICES ABOUT HIGH SCHOOL MATH AND SCIENCE COURSES AND COLLEGE MAJORS. THEY ARE LOOKING AT VARIOUS TYPES OF CONTEXT: THE SCHOOL ITSELF (E.G., FRIENDS, ACADEMIC PEERS, AND RIGOROUS ACADEMIC CURRICULA); THE SCHOOLS' BROADER SOCIAL AND ACADEMIC ENVIRONMENT; AND THE SPECIFIC MATH AND SCIENCE COURSES OFFERED. THEY ARE ALSO CONSIDERING SOCIOECONOMIC FACTORS, INCLUDING RACE AND ETHNICITY, SOCIAL CLASS, AND IMMIGRANT GENERATIONAL STATUS.

Students' choices are complex and do not necessarily follow one major pattern. Researchers want to know whether social factors affect discrete groups of students differently and whether different social contexts help shape different decisions. They are analyzing a new, large, nationally representative data set designed to measure multiple social contexts: the Adolescent Health and Academic Achievement component of the Longitudinal Study of Adolescent Health.

GRADE LEVEL: HIGH SCHOOL
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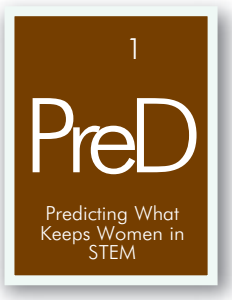
Keywords: research project, gender differences, environmental factors, survey, minorities, mixed-gender



PREDICTING WHAT KEEPS WOMEN IN STEM

THE UNIVERSITY OF WISCONSIN–MILWAUKEE AND ARIZONA STATE UNIVERSITY ARE COLLABORATING IN A STUDY TO IDENTIFY THE BARRIERS AND SUPPORTS AT VARIOUS STAGES (MIDDLE SCHOOL, LATE HIGH SCHOOL, AND SOPHOMORE YEAR IN COLLEGE) THAT AFFECT WOMEN AS THEY DECIDE WHETHER TO CONTINUE PARTICIPATING IN STEM. THE RESEARCHERS BELIEVE THE BARRIERS MAY NOT DIFFER FROM ONE STAGE OF LIFE TO THE NEXT, BUT THEIR STRENGTH MAY AFFECT GIRLS AND WOMEN DIFFERENTLY.

Data collection is taking place in two different metropolitan areas (Milwaukee and Phoenix), so the results will not be specific to a particular geographic region.

Once researchers test the validity of their findings, they will use them to suggest interventions that can help teachers, counselors, and parents keep women on the track toward STEM careers.

Preliminary analysis shows that teachers play an important role. A negative environment (such as a teacher not calling on a student or a student not being recommended for a gifted or talented program) has a powerful effect. Conversely, teachers who explain subjects well, make subjects interesting, or promote hands-on learning exert a strong positive influence.

GRADE LEVEL: MIDDLE SCHOOL, HIGH SCHOOL, UNDERGRADUATE
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Keywords: research project, retention, barriers, environmental factors, transition points, longitudinal study, school-based, taxonomy of barriers, pipeline study

1

M-lit

Media Literacy Training for Middle School Students

MEDIA LITERACY TRAINING FOR MIDDLE SCHOOL STUDENTS

FOR GIRLS IN AMERICAN SOCIETY, EARLY ADOLESCENCE CAN PRESENT AN ILL-TIMED CONVERGENCE OF EVENTS: GIRLS BEGIN TO MAKE PLANS FOR THE FUTURE—INCLUDING CAREER PLANS—AT A TIME MARKED BY WANING SELF-CONFIDENCE AND A GREATER AWARENESS OF THE CULTURAL NORMS OF FEMININITY. DURING THIS TIME, MEDIA PORTRAYALS OF WOMEN MAY REINFORCE GENDER STEREOTYPES FOR GIRLS AND BOYS, WHICH IN TURN MAY CONTRIBUTE TO THE GENDER GAP IN STEM.

In response, researchers at Western Michigan University are examining the efficacy of a media literacy program designed to spark critical thinking about stereotypes of women in the media. The investigators are assessing how the training affects middle school children's perceptions of women in STEM, their ability to recognize stereotypes in the media, and their attitudes toward STEM and STEM careers. Specifically, the investigators hope to learn whether media literacy training teaches children to recognize and resist gender stereotypes.

Participants are seventh-grade students from three middle schools in the Midwest, randomly assigned to one of three groups: control; training that includes interactive discussion; and training that includes interactive discussion plus critical viewing of videotaped clips featuring stereotypes and counterstereotypes of women in popular television programs and films. The investigators hope the findings will be used by science teachers and directors of educational programs in their training and instructional materials.

GRADE LEVEL: MIDDLE SCHOOL
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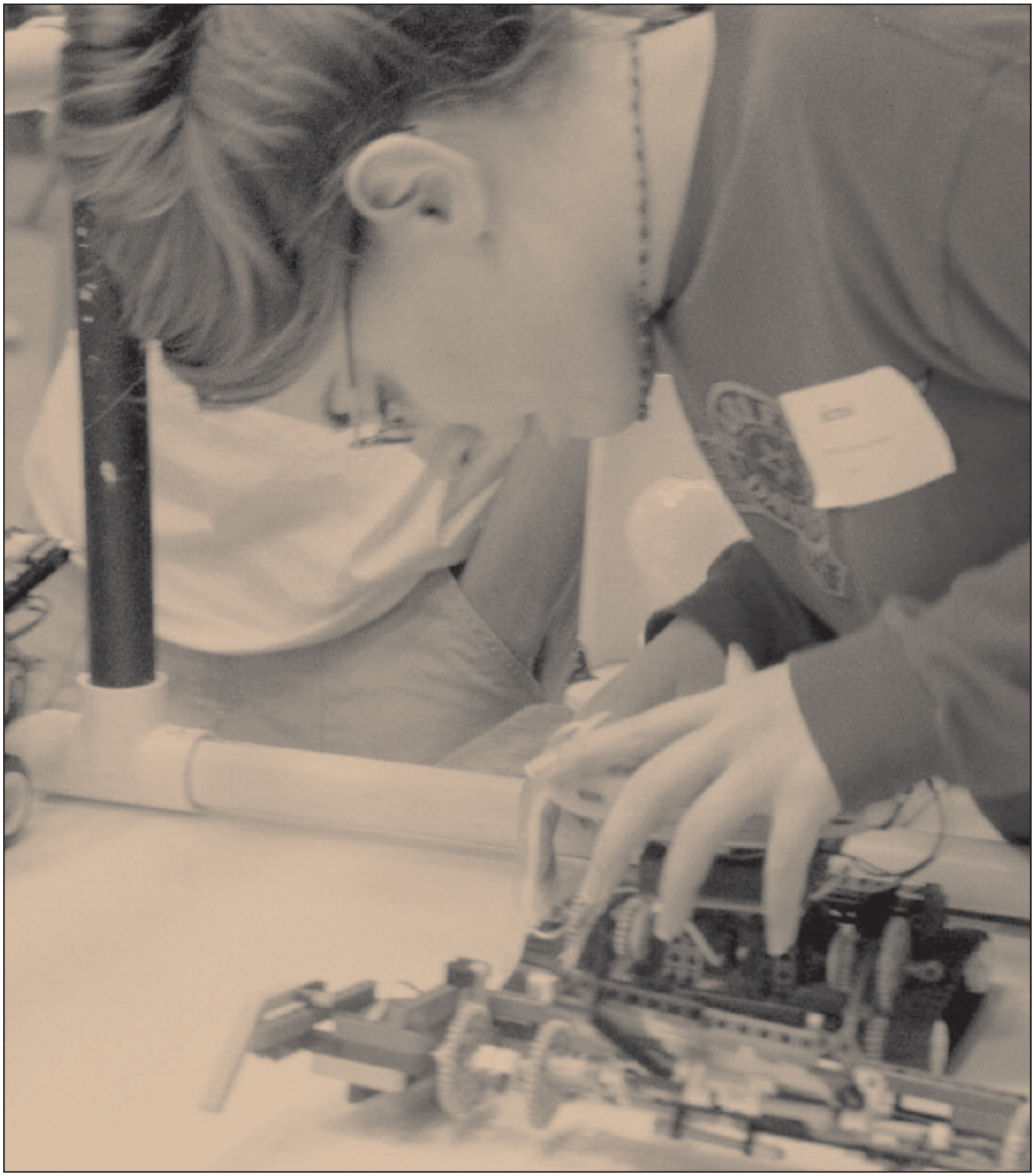
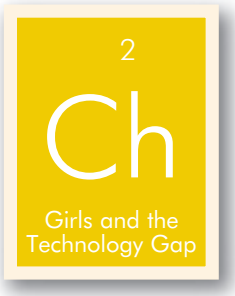
KEYWORDS: RESEARCH PROJECT, GENDER DYNAMICS, ENVIRONMENTAL FACTORS, MIXED GENDER, STEREOTYPES, MEDIA LITERACY





CHAPTER TWO · GIRLS AND THE TECHNOLOGY GAP

MORE THAN ANY OTHER GENERATION BEFORE THEM, TODAY'S TEENAGERS ARE COMFORTABLE WITH RAPID TECHNOLOGICAL CHANGE. THERE IS NO LONGER A GENDER GAP IN WHO USES TECHNOLOGY, THANKS ESPECIALLY TO THE INTERNET. HOWEVER, GIRLS AND WOMEN ARE STILL LESS LIKELY TO PARTICIPATE IN THE *CREATION* OF TECHNOLOGY. TO KEEP PACE WITH RAPID CHANGES IN INFORMATION TECHNOLOGY, IT IS NO LONGER SUFFICIENT FOR A PERSON TO BE COMPUTER LITERATE; PEOPLE MUST BECOME FLUENT WITH INFORMATION TECHNOLOGY (PER THE NATIONAL RESEARCH COUNCIL). *FLUENCY* INCLUDES LITERACY SKILLS, BUT IT ALSO INCLUDES A CONCEPTUAL KNOWLEDGE ABOUT WHEN AND HOW TO USE INFORMATION TECHNOLOGY, AND THE CAPABILITY TO APPLY THAT KNOWLEDGE TO NEW SITUATIONS AND TO MANAGE THE INEVITABLE PROBLEMS THAT OCCUR WHEN NEW APPROACHES ARE INTRODUCED.

THE RECENT EXPERIMENTAL EDUCATION PROJECTS DESCRIBED IN THIS CHAPTER ENGAGE GIRLS BY EMPHASIZING THE POTENTIAL OF INFORMATION TECHNOLOGY. THE PROJECTS TEND TO TARGET GIRLS IN MIDDLE OR HIGH SCHOOL. THEY PLACE GIRLS IN THE ROLE OF *CREATOR,* RATHER THAN *CONSUMER* OF TECHNOLOGY. THEY CREATE NEW PROGRAMMING ENVIRONMENTS, HAVING GIRLS DESIGN AND CREATE GAMES, BUILD WEB SITES, AND PROGRAM ROBOTS. SOME WILL PUT GIRLS INTO TEAMS AND MAKE THEM PARTNERS IN DESIGNING GAMES. OTHER PROJECTS ENABLE GIRLS TO USE THEIR OWN EXPERIENCES AS CAREER-PLANNING RESOURCES.

MANY OF THESE PROJECTS HAVE A LONG-TERM VISION. THEY CREATE SUPPORTIVE SOCIAL ENVIRONMENTS AND LINK GIRLS TO BOTH REAL AND VIRTUAL ROLE MODELS, MENTORS, AND TUTORS. MANY PROJECTS TRAIN PEOPLE AND PROVIDE RESOURCES TO THOSE WHO HAVE LONG-TERM RELATIONSHIPS WITH THE GIRLS—SUCH AS PARENTS AND TEACHERS. THESE SOCIAL SUPPORTS WILL EXIST LONG AFTER THE ACTUAL PROGRAMS HAVE ENDED. MANY OF THE PROJECTS ALSO CREATE PRODUCTS THAT ARE DESIGNED TO INCREASE THE GIRLS' PARTICIPATION IN INFORMATION TECHNOLOGY OUTSIDE THE GIVEN PROGRAM, INCLUDING THROUGH VIDEOS, COMPUTER GAMES, SAMPLE LESSONS, AND GIRL- AND KID-FRIENDLY PROGRAMMING LANGUAGES.

THESE INNOVATIVE STRATEGIES ARE MEANT TO INCREASE THE NUMBER OF GIRLS AND WOMEN WHO ARE PRODUCERS, AND NOT SIMPLY USERS, OF TECHNOLOGY. THE PROJECTS REACH BEYOND THE GIRLS AND WOMEN WHO ARE PARTICIPATING DIRECTLY. THEY PROMOTE THE VALUES THAT OUR WORKFORCE MUST BE DIVERSE AND THAT WE NEED TO ACTIVELY RECRUIT GIRLS NOW WHEN IT COMES TO TECHNOLOGY. IN ADDITION TO TESTING NEW EDUCATIONAL APPROACHES, MANY OF THE PROJECTS INVOLVE CONDUCTING A STUDY AT THE SAME TIME, COLLECTING DATA FROM AND ABOUT THE PARTICIPANTS. THE RESEARCH FINDINGS WILL BUILD OUR KNOWLEDGE OF HOW TO GET STUDENTS ENGAGED IN TECHNOLOGY, AND ESPECIALLY HOW TO GET AND KEEP GIRLS PARTICIPATING FULLY IN THE DESIGN AND DEVELOPMENT OF OUR TECHNOLOGY-BASED WORLD.

JILL DENNER, PH.D., SENIOR RESEARCH ASSOCIATE, ETR ASSOCIATES (EDUCATION, TRAINING, RESEARCH)

COMPUTER SCIENCE COMPUTING AND MENTORING PARTNERSHIP

EVEN THOUGH WOMEN ARE MAKING STRIDES IN SOME AREAS OF SCIENCE, THEIR PARTICIPATION IN COMPUTER SCIENCE IS DECLINING. FOR EXAMPLE, GIRLS TEND TO OPT OUT OF ADVANCED HIGH SCHOOL COMPUTING COURSES. RICE UNIVERSITY, IN COLLABORATION WITH THE HOUSTON INDEPENDENT SCHOOL DISTRICT, HAS ESTABLISHED THE COMPUTER SCIENCE COMPUTING AND MENTORING PARTNERSHIP (CS-CAMP) TO KEEP FEMALE STUDENTS INTERESTED AND INVOLVED IN PRECOLLEGE COMPUTER SCIENCE.

CS-CAMP gives high school girls the opportunity to learn computing in an all-girl environment outside school. It also encourages girls to enroll in advanced computer science classes in their high schools. Researchers hope the exposure to high-quality computing courses and mentors will help more girls make informed decisions about whether to pursue computer science as a college major and a life career.

The program targets eight high schools in the Houston area with strong, long-term commitments to improve their schools' computer science programs. CS-CAMP consists of a two-week summer computer camp and follow-up sessions. Computer camp concentrates on community building, computing-career awareness, mentoring, introductory computing courses, and fun activities for girls. In addition, the students attend monthly meetings at Rice to work on programming projects that reinforce what they learned in the summer.

CS-CAMP also provides professional development on gender diversity in technology. Each school has a counselor, administrator, and computer science teacher who meet bimonthly at Rice with the other schools' teams and CS-CAMP organizers to develop an action plan for their schools. Under the tutelage of master teachers, the participating computer science teachers facilitate the girls' computer camp, which gives them

- A solid knowledge of computer science content and curriculum
- Skill in a variety of approaches to instruction
- The opportunity to plan and reflect on instruction with other teachers

The CS-CAMP Web site (http://ceee.rice.edu/cs-camp//index.html) includes samples of participants' computer design work, links to computer games for girls, links to science sites with activities, and perspectives on the field of computer science.

GRADE LEVEL: HIGH SCHOOL	
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HTTP://CEEE.RICE.EDU/CS-CAMP/STUDENTS/INDEX.HTML	02-25023
KEYWORDS: EDUCATION PROJECT, PROFESSIONAL DEVELOPMENT, COMPUTER SKILLS, RECRUITMENT, ENGAGEMENT, RETENTION, GENDER-DIVERSITY AWARENESS, CAREER AWARENESS, CURRICULUM MATERIALS, SUMMER, AFTER-SCHOOL, TEACHER TRAINING, LEARNING COMMUNITY, SUMMER CAMP, HANDS-ON, ACTIVITY-BASED, MENTORING, URBAN, COMPUTER SCIENCE, GIRLS AND TECHNOLOGY	

CAN ROBOTICS KEEP GIRLS IN SCIENCE?

THE KISS INSTITUTE FOR PRACTICAL ROBOTICS' BOTBALL PROGRAM IS A TEAM-BASED ACTIVITY THAT ENGAGES THOUSANDS OF MIDDLE AND HIGH SCHOOL STUDENTS IN REGIONAL AND NATIONAL ROBOTICS COMPETITIONS AND EXHIBITIONS. SOUTHERN ILLINOIS UNIVERSITY–EDWARDSVILLE IS STUDYING PARTICIPANTS TO DETERMINE HOW THE PROGRAM AFFECTS SEVENTH-GRADE GIRLS' PERCEPTIONS OF THEIR ACHIEVEMENT IN STEM. THE RESEARCH IS A COLLABORATION BETWEEN FACULTY OF THE COMPUTER SCIENCE AND PSYCHOLOGY DEPARTMENTS.

Researchers will recruit teams for the Botball competition, supply them with robotics kits, and provide teachers with training, a stipend, and money to help cover the cost of materials. Then they will conduct interviews with the participants and survey them at three different times to determine their attitudes about and expectations of performance in STEM. They hope to learn whether participation in a robotics competition has an immediate effect on a girl's perception of her STEM abilities, and if so, whether this has long-term effects on study and career choices. If the effects are long lasting, the study will assess what factors sustain or strengthen her motivations. Researchers will also examine how a girl's perceptions of her abilities, expectations of success, and STEM-related choices are shaped by the gender makeup of her team and her motivations for participating in the program.

Results will show the creators of Botball and similar programs which of their educational elements actually affect girls' STEM-related choices. Results will be disseminated to educators, educational researchers, and developmental psychologists.

GRADE LEVEL: MIDDLE SCHOOL	
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http://www.botball.org/	05-22400
Keywords: research project, computer skills, self-confidence, retention, extracurricular, teacher training, peer groups, hands-on, activity-based, project-based, teamwork approach, survey, computer science, computer hardware, robotics, psychology, informal education, after-school, girls and technology	

GIRLS CREATING GAMES: INCREASING MIDDLE SCHOOL GIRLS' INTEREST IN TECHNOLOGY

COMPUTER GAMING IS TYPICALLY CONSIDERED A BOY'S ACTIVITY—AND A SOCIALLY ISOLATING ONE. THE GIRLS CREATING GAMES (GCG) PROGRAM IS A DEMONSTRATION AND RESEARCH PROJECT OF EDUCATION, TRAINING, AND RESEARCH ASSOCIATES THAT AIMS TO CHALLENGE THAT STEREOTYPE BY TEACHING GIRLS TO DESIGN AND PROGRAM THEIR OWN COMPUTER GAMES.

GCG meets for 23 sessions and is organized around four elements, each designed to help girls acquire competence in technological pursuits:

- *Learning by design*. Girls develop and produce their own original, narrative-based computer games using Flash MX software.
- *Scaffolding and modeling*. The use of hands-on, project-based learning, with support from peers, adults, and written materials, minimizes lecturing and helps girls gain a better understanding of concepts and a firmer grasp of concrete skills.
- *Collaborative learning*. Girls work in pairs on the computer, periodically exchanging roles as "driver" and "navigator."
- *Identity formation*. Fun interactive games (both on and off the computer) encourage career exploration and help girls discover what they like to do. Sessions are attended by female information technology students and professionals who demonstrate that women can be skilled and comfortable with computers. These role models strike a balance between helping the girls and encouraging them to solve problems independently.

Researchers analyzed data from 126 different middle school girls and found significant increases in participants' computer skills, confidence in working with computers, and independent problem-solving skills. There was also a decrease in girls' belief in the stereotype that boys do better than girls on computers. The project team has disseminated its findings at conferences, in book chapters, and in journal publications, and is currently preparing program guides so that others can use its activities.

GCG participants designed and programmed 48 games that deal with issues important to middle school girls, including negotiating peer pressure, doing well in school, and making friends. These games can be viewed and played at the project Web site.

GRADE LEVEL: MIDDLE SCHOOL
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http://webtecc.etr.org/gcgweb/protected/login/splash.cfm
Keywords: demonstration project, after-school, summer, self-confidence, self-efficacy, technology, informal education, research study, gender identity, real-life applications, evaluation, intervention, computer science, computer programming, computer games, intervention, urban, constructivism, role models, barriers, software, interactive, skills, teacher training, mentor training, peer groups, activity-based, cooperative learning, teamwork approach, Web site, data collection, girls and technology

2

Tch+

Tech Team

TECH TEAM

THE EDUCATIONAL TELEVISION ENDOWMENT OF SOUTH CAROLINA WORKED WITH THE SOUTH CAROLINA EDUCATIONAL TELEVISION NETWORK (SCETV) TO INCREASE MIDDLE SCHOOL GIRLS' ENTHUSIASM FOR TECHNOLOGY, TO IMPROVE THEIR UNDERSTANDING OF INFORMATION TECHNOLOGY, AND TO INTRODUCE THEM TO WOMEN WHO WORK IN SCIENCE AND TECHNOLOGY. TECH TEAM, WHICH WAS PRESENT IN THREE SOUTH CAROLINA SCHOOL DISTRICTS, INVOLVED AFTER-SCHOOL TECHNOLOGY CLUBS, WORKSHOPS IN COMPUTER APPLICATIONS AT SCETV, AND SUMMER TECHNOLOGY DAY CAMPS. PARTNERS INCLUDED LOCAL GIRL SCOUT TROOPS AND THE COLLEGE OF EDUCATION OF THE UNIVERSITY OF SOUTH CAROLINA.

In Tech Team's first year (2002–03), the girls used both informal and Internet-based research to identify local women in STEM fields, then conducted videotaped interviews with them, used a computer-based editing program to edit their interviews, and aired them via closed-circuit television to schools across South Carolina. They hosted two-way call-in shows, allowing students anywhere in the state to ask the girls questions.

In the second year of the project, the girls created a Web site about Tech Team, which was integrated into http://www.knowitall.org, SCETV's Web portal for teachers and students. In the third year, the girls created Flash-based educational animations that required them to learn computer codes. These were also posted on the Tech Team Web site. Each summer, the girls attended summer technology day camp at SCETV's Telecommunications Center in Columbia, where they worked in SCETV's computer labs and presented their work to an invited audience.

All along, a video crew documented Tech Team's progress and interviewed the participants. This material will form the basis of a CD-ROM to be produced for teachers' professional development. The CD-ROM will be mailed free of charge to every middle school in South Carolina and will be made available nationwide through SCETV's marketing division.

In partnership with TeacherLine (a Public Broadcasting System series of online professional development courses), Tech Team expanded its training to reach 150 more middle school teachers in South Carolina, North Carolina, and Georgia. The effort included Web conferences and on-site training opportunities to help teachers develop appropriate versions of Tech Team programs in their area. Each year of the two-year partnership culminated in a summer camp, where participating teachers addressed issues of program implementation and showcased their projects. The program offered 21 grants of $2,200, helping teachers who completed the first year of the program set up their own Tech Team after-school programs.

The Tech Team program received the 2005 Regional Innovator Award at the Summit on the Rural South conference, the 2005 Technology Innovative Programs Award at the South Carolina ED Tech Conference, and the 2004–05 Rural Education Program of the Year award from the South Carolina Association for Rural Education. It has also been cited as a model program by the National Alliance for Media Arts and Culture and the Department of Education's National Education Technology Plan. For more information about Tech Team, as well as resources for teachers and how to start a Tech Team, go to http://www.knowitall.org/techteam.

GRADE LEVEL: MIDDLE SCHOOL	
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http://www.knowitall.org/techteam	05-33585 and 02-17199
Keywords: education project, professional development, computer skills, communication skills, curriculum materials, career awareness, gender diversity awareness, summer, Saturday program, after-school, teacher training, workshops, clubs, summer camp, hands-on, project-based, inquiry-based, role models, real-life applications, Web site, television, broadcasting, school-based, computer technology, Girl Scouts, public television, mini-grant, informal education, girls and technology	

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sDn
Girls as Education Software Designers

GIRLS AS EDUCATION SOFTWARE DESIGNERS

COMPUTER GAMES CAN BE USEFUL TOOLS FOR TEACHING SCIENCE, BUT ARE THEY FRIENDLY TO GIRLS? EXPERTS URGE MORE WOMEN AND GIRLS TO BECOME INVOLVED IN SOFTWARE AND HARDWARE DESIGN SO THEY CAN BEGIN TO TRANSFORM COMPUTER CULTURE.

The Involving Girls as Designers project at Michigan State University allowed girls to envision their own technology-enhanced science learning experiences. Researchers sought to learn whether girls and boys approach the design process differently and, if so, what makes the process "girl friendly."

IGD invited fifth-grade and eighth-grade boys and girls to work in small, gender-segregated teams to design their ideal science learning experience. Professional software developers then created "promos" of the designs, as if the games actually existed. These promos were analyzed, and all-girl and all-boy team designs were compared. The researchers compared fifth-grade girls (an age when enthusiasm for have science parallels that of boys) with eighth-grade girls (an age when enthusiasm for and a self-confidence in science have declined), looking for similarities and differences in attitudes.

The promos were shown to 575 children in grades five through eight, without telling the respondents which gender created which games. Boys liked the game promos significantly better overall than did girls. Fifth- and sixth-graders rated the games significantly more fun overall than did seventh- and eighth-graders. Boys and girls did not differ significantly in their liking of the promos for all-girl-designed games. Boys rated the all-boy-designed games as significantly more fun than did girls. More gender differences emerged when researchers looked at how the children ranked the games. Girls ranked all-girl-designed games significantly higher than did boys. Boys ranked the all-boy-designed games significantly higher than did girls.

Research findings also showed that games designed by all-girl teams were perceived as being better for learning. Games designed by girls tended to emphasize storylines, multiple levels of difficulty, and sufficient instructions, while those designed by boys emphasized action, weapons, and challenging levels of difficulty.

Games are still a male-oriented medium. Students perceive games as being either for everyone or more for boys; none of the games was thought to be for girls only. The researchers hope the project will provide compelling evidence to software developers about the importance of involving girls as designers.

Current research findings and related papers are available at http://aliengames.org/. These findings are being applied in two follow-up projects. The research team designed a learning game that accommodates and collects information about male and female styles of play; it is being used in a large-scale research project to study the relationships between gender, learning, and style of play, and can be found at http://gel.msu.edu/lifepreservers/.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL
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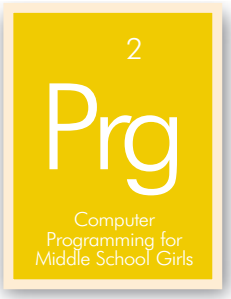
HTTP://ALIENGAMES.ORG/ AND HTTP://GEL.MSU.EDU/LIFEPRESERVERS/
KEYWORDS: RESEARCH PROJECT, DEMONSTRATION, ENGAGEMENT, COMPUTER SKILLS, GENDER DIFFERENCES, GENDER DYNAMICS, EXTRACURRICULAR, WORKSHOP, PEER GROUPS, HANDS-ON, PROJECT-BASED, TEAMWORK APPROACH, COMPUTER GAMES, MIXED GENDER, GIRLS AND TECHNOLOGY, PSYCHOLOGY, INFORMAL EDUCATION, AFTER-SCHOOL, GIRLS AND TECHNOLOGY



COMPUTER PROGRAMMING FOR MIDDLE SCHOOL GIRLS

TO ADDRESS THE SERIOUS SHORTAGE OF WOMEN IN COMPUTER SCIENCE, RESEARCHERS AT NEW YORK UNIVERSITY, HUNTER COLLEGE, AND THE UNIVERSITY OF SOUTHERN CALIFORNIA ARE DEVELOPING A SOFTWARE ENVIRONMENT FOR "REAL-TIME APPLIED PROGRAMMING FOR UNDERREPRESENTED STUDENTS' EARLY LITERACY" (RAPUNSEL). THE PROJECT, AIMED SPECIFICALLY AT TEACHING COMPUTER PROGRAMMING TO MIDDLE SCHOOL GIRLS, INVOLVES A SIMULATION GAME IN WHICH GIRLS CREATE AND MANIPULATE ON-SCREEN "CHARACTER AGENTS."

The RAPUNSEL environment offers an error-reducing code editor environment in which players can write code for dances and receive immediate feedback by observing changes in the way their characters move. Each time a player's code is viewed by another player, the author receives several points; when the code is actually borrowed and used by another player (and travels throughout the game-world), the originator receives many more points. This encourages players not only to concoct interesting and inventive dance sequences, but also to share them with their peers.

In designing, testing, and using RAPUNSEL projects, a team of scientists, artists, designers, and educators is working with small groups of girls as design partners. Education consultants include teachers from middle schools in New York City and the Los Angeles metropolitan area. These middle schools also serve as the locations for the large-scale assessment phase of the program.

GRADE LEVEL: MIDDLE SCHOOL	
NEW YORK UNIVERSITY, HUNTER COLLEGE, AND UNIVERSITY OF SOUTHERN CALIFORNIA	
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HTTP://WWW.RAPUNSEL.ORG/	03-32898
KEYWORDS: RESEARCH PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, SELF-AUTHORSHIP, ENGAGEMENT, SKILLS (PROBLEM-SOLVING, COMPUTER, SPATIAL), GENDER DIFFERENCES, ACHIEVEMENT, CO-CURRICULAR, ALL-YEAR, LONGITUDINAL STUDY, TEACHER TRAINING, PEER GROUPS, HANDS-ON, ENGAGED LEARNING, PROJECT-BASED, ACTIVITY-BASED, PROBLEM-BASED, EXPLORATION-BASED, COOPERATIVE LEARNING, COLLABORATIVE LEARNING, MENTORING, INTERACTIVE, SOFTWARE, COMPUTER GAMES, DISSEMINATION PLAN, DESIGN-BASED, WEB SITE, ONLINE TUTORIALS, SCHOOL-BASED, COMPUTER PROGRAMMING, COMPUTER TECHNOLOGY, COMPUTER SCIENCE, INDUSTRY PARTNERS, INFORMAL EDUCATION, TOOLS, CONNECTIONS, CARTOONS, ANIMATIONS, GIRLS AND TECHNOLOGY	

HEAR OUR VOICES AND THE COMPUTER CLUBHOUSE

IN 1993 THE COMPUTER CLUBHOUSE OPENED ITS DOORS AT THE COMPUTER MUSEUM IN BOSTON AS AN AFTER-SCHOOL RESOURCE FOR YOUNG PEOPLE AGED 8 THROUGH 18 TO EXPLORE THEIR OWN IDEAS AND INTERESTS THROUGH TECHNOLOGY. GUIDED BY ADULT MENTORS WHO SERVE AS ROLE MODELS. AS OF MAY 2005, A NETWORK OF 100 CLUBHOUSES WAS OPERATING IN SEVERAL STATES AND WASHINGTON, D.C., AS WELL AS AROUND THE WORLD. THIS NETWORK SERVES THOUSANDS OF YOUNG PEOPLE.

For girls specifically, the flagship Computer Clubhouse (which moved to the Boston Museum of Science in 1999) has offered access to technology resources, female mentors, a community of peers, and a supportive learning environment since 1995. The Hear Our Voices program, created in 2002, expands these services in the following ways:

- Nearly 20 Computer Clubhouses in the United States receive funding and support to hire and train staff dedicated to gender diversity and girls' programming.

- Network staff from the Museum of Science provide local Clubhouse coordinators with professional development and assistance for girls' programming.
- A secure Intranet-based program called Clubhouse Village supports both real and virtual Clubhouse communities. The Village's tools allow young people to communicate with one another and collaborate on projects, with one site area designated specifically for girls' activities. The Village also allows staff to share ideas and "best practices" across the Clubhouse network.
- In 2004 a Computer Clubhouse Youth Summit took place, allowing young people and staff in the virtual community to meet in person.

Clubhouses are usually located in Boys and Girls Clubs, Urban League centers, and other youth-oriented venues. With support from the Intel Corporation and other corporate sponsors, the Clubhouse Network is expected to continue serving youth across the country.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, HIGH SCHOOL	
COMPUTER CLUBHOUSE, BOSTON MUSEUM OF SCIENCE (MASSACHUSETTS)	
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HTTP://WWW.COMPUTERCLUBHOUSE.ORG/PROGRAMS/HOV/INDEX.HTM	02-17138
KEYWORDS: DEMONSTRATION PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, RECRUITMENT, ENGAGEMENT, SKILLS (COMPUTER), GENDER-DIVERSITY AWARENESS, BARRIERS, CAREER AWARENESS, ADVANCEMENT, ACHIEVEMENT, ENVIRONMENTAL FACTORS, AFTER-SCHOOL, EXTRACURRICULAR, ALL-YEAR, LEARNING COMMUNITY, PEER GROUPS, STUDY GROUPS, CLUB, RESOURCE CENTER, ENGAGED LEARNING, ACTIVITY-BASED, EXPLORATION-BASED, COOPERATIVE LEARNING, COLLABORATIVE LEARNING, MENTORING, SUPPORT SYSTEM, SOFTWARE, WEB SITE, COMMUNITY-BASED SITE, MINORITIES, UNDERPRIVILEGED, LATINA, NATIVE AMERICAN, AFRICAN AMERICAN, ASIAN AMERICAN, COMPUTER TECHNOLOGY, COMPUTER SCIENCE, TECHNOLOGY, INDUSTRY PARTNERS, MUSEUM, BOYS AND GIRLS CLUBS, INFORMAL EDUCATION, GIRLS AND TECHNOLOGY	

GIRLS AND INFORMATION TECHNOLOGY: A PROMOTIONAL VIDEO

THE CENTER FOR WOMEN AND INFORMATION TECHNOLOGY AT THE UNIVERSITY OF MARYLAND–BALTIMORE COUNTY HAS DEVELOPED AND DISSEMINATED A SHORT VIDEO ABOUT WOMEN'S ABILITY TO SUCCEED IN CAREERS. THE VIDEO USES POP MUSIC, STRIKING COLORS, AND FLASH ANIMATION TO CAPTURE THE ATTENTION OF YOUNG VIEWERS GATHERED AT CAREER FAIRS, SCHOOL ASSEMBLIES AND CLASSROOMS, AND OTHER EVENTS WHERE OPPORTUNITIES FOR WOMEN IN INFORMATION TECHNOLOGY ARE DISCUSSED AND PROMOTED.

Video Press, a small for-profit arm of the University of Maryland–Baltimore County, collaborated with a committee of UMBC faculty and staff to create a four-minute video titled "You Can Be Anything," aimed at girls and young women aged 12 through 20. The executive producer modeled the video on one developed by General Motors. The Women and IT Video Project (WITVP) also developed a speakers' program to train female students and faculty from UMBC, along with representatives from the local business community, to use the video to promote awareness of women in information technology.

WITVP used information gathered from the speakers program to formulate guidelines for integration of the video into any speaking event. These guidelines were included in a booklet initially distributed with the videos to institutions throughout Maryland. Currently, the information is hosted on the Center For Women and Information Technology Web site (http://www.umbc.edu/cwit/video.html), along with a lesson plan for using the video to educate eighth-graders about information technology career opportunities. In addition to its Web site, WITVP disseminates materials nationally through journals, conferences, public school systems, electronic discussion lists, radio and television, and community and four-year colleges and universities.

Partners in this project included Meade Middle School; Pine Grove Middle School; Parkville High School and Center for Science, Mathematics, and Computer Science; the Community College of Baltimore County; and a number of local and national businesses. The project had been expected to disseminate 100 copies of the DVD but ended up distributing 819 by

the conclusion of the grant; many were used to make additional copies for national and international distribution. Following the release of the video, Web site visitation increased by an average of 20,000 hits per month. The video also won two awards, a silver and a gold, at the International Film and Video Festival in New York City in 2004.

The project team worked with an external evaluator to assess whether the video helped speakers educate students about career opportunities for women in information technology fields. Reported outcomes of the evaluation were as follows:

- Females were significantly more appreciative of the video than males and gave a higher rating to the video's impact on their understanding of technology.
- Females reported more often than males that the video made them more confident in choosing a technology career.

GRADE LEVEL: MIDDLE SCHOOL, HIGH SCHOOL, UNDERGRADUATE	
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http://www.umbc.edu/cwit/video.html	02-25079
Keywords: dissemination project, self-confidence, engagement, career awareness, extracurricular, mentor training, field-trip, science clubs, dissemination plan, Web site, video, booklet, community-based site, computer technology, computer science, information technology, technology, industry partners, television, girls and technology	

TECH SAVVY

IN 2000, THE AMERICAN ASSOCIATION OF UNIVERSITY WOMEN (AAUW) PRODUCED A REPORT TITLED *TECH SAVVY: EDUCATING GIRLS IN THE NEW COMPUTER AGE*. THE REPORT SUMMARIZED RESEARCH INTO GIRLS' LACK OF INTEREST IN TECHNOLOGY BOTH AS A SUBJECT AND AS A POTENTIAL LINE OF WORK. IT SUGGESTED THAT IF GIRLS ARE TO DEVELOP A STRONGER INTEREST IN TECHNOLOGY FIELDS, EDUCATIONAL APPROACHES TO THE SUBJECT FROM EARLY CHILDHOOD THROUGH HIGH SCHOOL MUST CHANGE.

To help prompt the needed reforms, AAUW created a Tech Savvy video and resource guide for educators, parents, and community-oriented professionals. Using its national network of 100,000 members (including parents, educators, and students), 1,300 branches, and 600 college and university member institutions, the AAUW Educational Foundation distributed copies of the video and guide along with the original report. In addition, the video was broadcast over the Fairfax County, Virginia, Public Schools satellite television network and similar networks.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, HIGH SCHOOL
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Keywords: dissemination project, engagement, skills (computer), gender-diversity awareness, barriers, career awareness, curriculum materials, gender differences, gender identity, intervention, systemic reform, departmental climate, environmental factors, teacher training, staff training, mentor training, counselor training, role models, mentoring, support system, real-life applications, dissemination plan, television, broadcasting, manual, video, computer technology, computer science, computer hardware, information technology, industry partners, informal education, transition points, tools, connections, girls and technology

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PrP

Programming With a Purpose

PROGRAMMING WITH A PURPOSE

ACCORDING TO RESEARCH, COMPUTER PROGRAMMING IS NOT INTRINSICALLY INTERESTING TO MANY GIRLS. THEY ARE MORE LIKELY TO BE ATTRACTED TO LEARNING THAT INVOLVES A MEANINGFUL CONTEXT, ESPECIALLY AS A WAY TO SOLVE A GENUINE SOCIAL, PERSONAL, OR ENVIRONMENTAL PROBLEM. OBJECT-ORIENTED PROGRAMMING LANGUAGES (SUCH AS JAVA) ALLOW ONE TO PROGRAM BY MANIPULATING THE RELATIONSHIPS BETWEEN OBJECTS IN A NARRATIVE CONTEXT RATHER THAN EXECUTING ABSTRACT LINEAR CODE. THE CENTER FOR CHILDREN AND TECHNOLOGY AT THE EDUCATION DEVELOPMENT CENTER IN NEW YORK IS INVESTIGATING WHETHER THIS APPROACH DOES, IN FACT, MAKE PROGRAMMING MORE ACCESSIBLE TO GIRLS.

In this experimental research project, ninth-grade girls in an introductory computer programming class at a predominantly Latino urban high school (Union Hill High School in New Jersey) are learning to use flexible "drag and drop" software to choreograph ice-skating routines. The treatment group is designing ice-skating performances by combining and shaping various routine elements into an executable, cohesive program. The control group is using the same research tool to assemble subroutines identical to those of the treatment group, but instead of a graphic interface that shows skaters dancing in a rink, students in the control group work with abstract shapes moving across the screen (as in a screen saver).

The investigators are conducting surveys before and after the class, as well as interviews, to determine whether girls' understanding of core programming skills and concepts (e.g., sequential thinking, understanding parameters and variables, and the structure of code) improves when they learn programming within a rich narrative context.

GRADE LEVEL: HIGH SCHOOL
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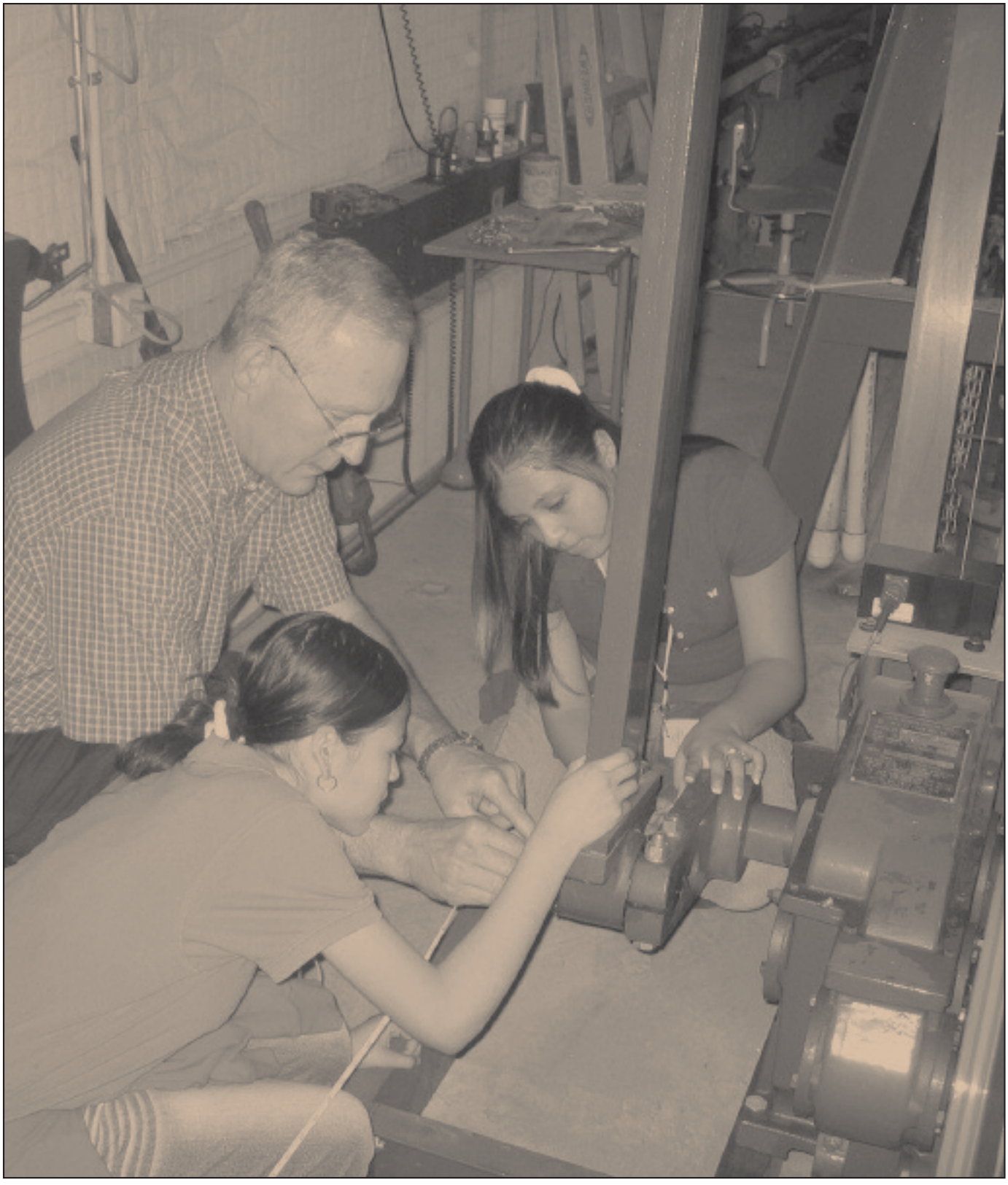
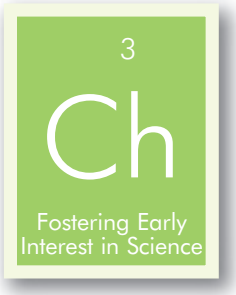
KEYWORDS: RESEARCH PROJECT, COMPUTER SKILLS, GENDER DIFFERENCES, ENGAGEMENT, CURRICULUM MATERIALS, HANDS-ON, SOFTWARE, SURVEY, SCHOOL-BASED, HISPANIC, URBAN, COMPUTER SCIENCE, COMPUTER PROGRAMMING, GIRLS AND TECHNOLOGY





CHAPTER THREE · FOSTERING EARLY INTEREST IN SCIENCE

A FEMALE SCIENCE COORDINATOR WENT INTO A FIFTH-GRADE TEACHER'S CLASSROOM AND ASKED FOR FOUR STUDENTS TO PARTICIPATE IN THE SCIENCE DEMONSTRATION. MISS JONES, THE CLASSROOM TEACHER, SELECTED FOUR BOYS.

THIS HAPPENED NOT IN 1956 BUT IN 2006. IT'S HARD TO BELIEVE THAT IN THE 21ST CENTURY, OLD HABITS STILL DIE HARD AND SOME TEACHERS ARE STILL CONDITIONED, ON AN UNCONSCIOUS LEVEL, TO ASSOCIATE SCIENCE WITH BOYS. THE PROJECTS HIGHLIGHTED HERE DEMONSTRATE HOW RESEARCH AND NEW STRATEGIES HELP OVERCOME STEREOTYPICAL THINKING AND FOSTER EARLY INTEREST IN SCIENCE.

RECOGNIZING THAT PARENTS AND TEACHERS HAVE A SPECIAL ROLE TO PLAY IN NURTURING EARLY CURIOSITY IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM), SOME OF THESE PROJECTS TARGET THEM DIRECTLY. NEW CURRICULAR MODULES THAT INCORPORATE STATE STANDARDS BUT PRESENT THE MATERIAL IN A "GIRL FRIENDLY" FORMAT ARE ONE EXAMPLE. TEACHING PARENTS AND TEACHERS TO CHALLENGE THEIR OWN STEREOTYPES AND APPROACH SCIENCE AND MATH IN A WAY THAT ENCOURAGES GIRLS IS ANOTHER.

OTHER PROJECTS ARE DESIGNED SPECIFICALLY TO ENGAGE GIRLS EARLY ON IN HANDS-ON ACTIVITIES OR IN DIRECT MENTORING RELATIONSHIPS WITH SCIENTISTS. THE USE OF CUTTING-EDGE TECHNOLOGY AND POPULAR MEDIA OUTLETS ALSO ENCOURAGES GIRLS TO EXPLORE SCIENCE AND MATHEMATICS IN INFORMAL AS WELL AS FORMAL EDUCATIONAL SETTINGS. MANY OF THESE PROJECTS INVOLVE EITHER CONDUCTING RESEARCH OR DIRECTLY USING RESEARCH-PROVEN METHODS TO DESIGN INTERVENTIONS THAT BUILD ON GIRLS' COMPARATIVE STRENGTHS—IN READING, FOR EXAMPLE—WHILE ALSO ENHANCING THEIR SCIENCE AND MATH SKILLS.

OVERALL, THESE PROJECTS USE MYRIAD DELIVERY SYSTEMS AND DESIGNS WHILE COLLABORATING WITH AN UNUSUAL RANGE OF INSTITUTIONS, BOTH FORMAL AND INFORMAL. THEY EMPLOY INTERACTIVE WEB SITES TO SUPPORT AND EXTEND LEARNING. UNIQUE IN THEIR IMPLEMENTATIONS, THEY PROVIDE US WITH NEW WAYS OF LOOKING AT LEARNING. SPECIFICALLY, THEY PROVIDE EXPERIENCES THAT HELP GIRLS KNOW THAT THEY CAN BE SUCCESSFUL IN STEM AND HAVE CAREERS IN STEM.

BONNIE BROWNSTEIN, PRESIDENT, INSTITUTE FOR SCHOOLS OF THE FUTURE

THE CASE OF MISSING HUMAN POTENTIAL

WVIZ/PBS IDEASTREAM℠, A PUBLIC BROADCASTING ORGANIZATION IN CLEVELAND, OHIO, PRODUCED A ONE-HOUR TELEVISION PROGRAM, "THE CASE OF MISSING HUMAN POTENTIAL," TO RAISE AWARENESS OF THE UNDERREPRESENTATION OF WOMEN IN THE STEM WORKFORCE. AVAILABLE ON VIDEO, THE PROGRAM USES RESEARCH AND EXAMPLES TO SHOW PARENTS, CAREGIVERS, AND THE COMMUNITY WHAT THEY CAN NEED TO DO TO SOLVE THIS "CASE" AND INVOLVE GIRLS IN STEM FIELDS. THE PROBLEM IS PRESENTED AS A FAST-PACED MYSTERY, WITH TOP-SELLING NOVELIST LES ROBERTS HOSTING THE INVESTIGATION. MR. ROBERTS IS ASSISTED IN THIS QUEST BY DR. KATHRYN SULLIVAN, THE FIRST WOMAN TO WALK IN SPACE.

"The Case of Missing Human Potential" attributes the underrepresentation of women to schools, examining NSF's research on women in STEM and exploring how teaching methods can be either a window of opportunity to young women or a closed door. It explores efforts by schools, communities, and businesses to address the gender gap and concludes with suggestions on what parents, community members, businesses, and educators can do to help girls realize their potential in STEM.

An interactive Web site, http://www.missingpotential.org, provides a storehouse of links to science and math camps in Ohio and science sites offering at-home activities and experiments. It also includes biographies of famous women in STEM and links to research and other organizations of interest to girls and women in STEM fields.

GRADE LEVEL: MIDDLE SCHOOL, PROFESSIONAL DEVELOPMENT	
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HTTP://WWW.MISSINGPOTENTIAL.ORG	02-17109
KEYWORDS: DISSEMINATION PROJECT, RETENTION, GENDER-DIVERSITY AWARENESS, BARRIERS, INQUIRY-BASED, TELEVISION, AFTER-SCHOOL, INFORMAL EDUCATION, BIOGRAPHIES, CURRICULUM MATERIALS	

SCIENCE ON PATROL

RESEARCH SHOWS THAT FROM KINDERGARTEN THROUGH COLLEGE, THE CULTURE AND FOCUS OF EDUCATION CONTRIBUTE TO THE UNDERREPRESENTATION OF GIRLS IN STEM. BUT STUDIES ALSO SHOW THAT THE FACTORS INITIALLY HOLDING GIRLS BACK CAN BE MITIGATED IN LATER YEARS OF THEIR EDUCATION.

The Institute for Schools of the Future, the Police Athletic League, and other partners, including detectives and police officers, are working together to continue Science on Patrol, a project aimed at motivating underrepresented minorities and middle and high school students, especially girls, to get involved in the sciences. In particular, the project encourages students to link science knowledge and skills with the real-world applications of forensic science. By allowing participants to use science to "solve crimes," this informal project helps them see how abstract concepts, when put to use, can be exciting. It also appeals to their interest in high-profile crimes covered in the news and on television programs.

In leading the project, an interdisciplinary team of educators, police detectives, instructional designers, and scientists have

- Developed, field-tested, and revised a minimum of 12 crime scenarios for students to solve
- Developed course materials, including a facilitators' guide, the Science on Patrol Web site, student activity kits with case folders for each "crime," and a manual for mentors and volunteers
- Helped participants apply science knowledge and processes to solve real-world problems
- Helped instructors foster gender-neutral academic environments that encourage collaboration and increase participation and achievement.

In its first year, Science on Patrol took place at Police Athletic League centers in the Bronx and, in its second year, at PAL centers throughout New York City. During the third year, a pilot project included five cities: Albany and Buffalo, New York; Portland, Oregon; Miami Beach, Florida; and Brick Township, New Jersey. During its fourth year, SOP conducted four workshops at the PAL national annual meeting, resulting in training sessions that included representatives from 20 cities. Along with training the adults, SOP has been introduced to students at their annual Youth Leadership Conference. SOP continues to scale up at PAL centers across the country.

Findings from the program have been disseminated widely as a model for other formal and informal science programs.

GRADE LEVEL: MIDDLE AND HIGH SCHOOL, INFORMAL EDUCATION	
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http://www.isof.org/sop/	02-17188
Keywords: demonstration project, self-confidence, self-efficacy, recruitment, engagement, skills (problem-solving, science), co-curricular, extracurricular, all-year, teacher training, peer groups, hands-on, engaged learning, project-based, activity-based, problem-based, exploration-based, cooperative learning, collaborative learning, teamwork approach, role models, mentoring, real-life applications, job shadow, experiential learning, outdoors, community-based site, minorities, forensics, industry partners, informal education, connections, school-to-work, curriculum materials, after-school, police	

GIRLS IN SCIENCE

TO ENCOURAGE YOUNG WOMEN FROM SOUTHEASTERN APPALACHIAN KENTUCKY TO PURSUE CAREERS IN STEM, THE UNIVERSITY OF KENTUCKY ESTABLISHED A PROGRAM CALLED GIRLS IN SCIENCE. IN 21 RURAL APPALACHIAN KENTUCKY COUNTIES, THIS PROGRAM REACHED A SELECT GROUP OF 120 GIRLS ENTERING SEVENTH GRADE. IT ALSO INVOLVED THESE GIRLS' PARENTS AND AT LEAST 30 MIDDLE SCHOOL TEACHERS FROM THE AREA.

The program included

- Weeklong summer institutes for the selected girls at the University of Kentucky campus, two summers in a row
- After-school and Saturday sessions over the course of the two academic school years
- Mentoring relationships with university scientists and local community members

To ensure that the girls got the most they could from the program, Girls in Science included professional development courses for their math and science teachers, designed to help these teachers give each girl individual attention. For parents of selected students, the program offered a series of workshops.

As part of this effort, the project team developed and disseminated a model middle school curriculum manual. Though girls and teachers enrolled in Girls in Science have benefited most from the program, its reach should ultimately extend to teachers, students, and their relatives throughout Appalachian Kentucky.

GRADE LEVEL: MIDDLE SCHOOL
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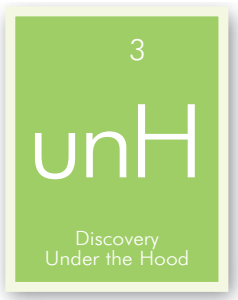
02-17196
Keywords: demonstration project, recruitment, engagement, skills (science), career awareness, advancement, achievement, transition points, summer, Saturday program, after-school, all-year, teacher training, peer groups, summer program, engaged learning, cooperative learning, mentoring, support system, dissemination plan, curriculum manual, school-based site, community-based site, rural, informal education, transition points



DISCOVERY UNDER THE HOOD

DISCOVERY UNDER THE HOOD INTRODUCED 24 FEMALE HIGH SCHOOL STUDENTS EACH SUMMER TO THE SCIENCE AND ENGINEERING OF AUTOMOBILES. OVER SEVEN DAYS IN A NONTHREATENING, PREDOMINANTLY FEMALE ENVIRONMENT, THESE YOUNG WOMEN FROM RURAL MADISON COUNTY, NEW YORK, FELT FREE TO EXPRESS THEIR CURIOSITY ABOUT A TRADITIONALLY MALE-DOMINATED FIELD. THEY EXPLORED THE SCIENCE OF INTERNAL COMBUSTION, THE MATHEMATICS OF FUEL ECONOMY, THE ENGINEERING OF THE POWER TRAIN, THE TECHNOLOGY OF COMPUTERIZED DIAGNOSTIC EQUIPMENT, AND HOW ALL THESE COMBINE INTO A WORKING AUTOMOBILE.

Students spent mornings at Morrisville State College, where the girls engaged in hands-on exploration of the automobile. Afternoons were spent at Colgate University, where they learned the scientific principles behind automotive operation and how those principles applied in other situations. Evening activities included college and career planning.

Female teachers largely ran the program. Female college students concentrating in science showed, by example, the diverse career paths open to women in STEM.

The girls' increased confidence that they could understand the science and technology of automobiles translated into the belief that they would succeed in other STEM fields and increased the likelihood they would later elect to take upper-level math and science courses.

GRADE LEVEL: HIGH SCHOOL	
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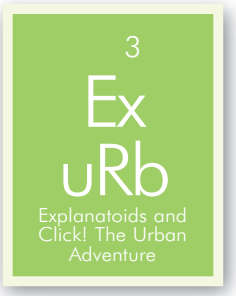
HTTP://DISCOVERYUNDERTHEHOOD.COM/	02-17146
KEYWORDS: DEMONSTRATION PROJECT, RURAL, INQUIRY-BASED, TRANSITION POINTS, ROLE MODEL, RESIDENTIAL CAMP, HANDS-ON, EXPLORATION-BASED, REAL-LIFE APPLICATIONS, EXPERIENTIAL LEARNING, PARTNERSHIPS BETWEEN UNIVERSITIES AND COMMUNITY OR TECHNICAL COLLEGES, CURRICULUM	



EXPLANATOIDS AND CLICK! THE URBAN ADVENTURE

RESEARCH SHOWS THAT ENGAGING GIRLS IN INFORMAL SCIENCE EDUCATION—MUSEUM VISITS, FOR EXAMPLE—INCREASES THEIR INTEREST IN STEM. YET RESEARCH ALSO SHOWS THAT FAMILIES WHO VISIT MUSEUMS ARE MORE LIKELY TO BRING THEIR SONS THAN THEIR DAUGHTERS. CARNEGIE MELLON UNIVERSITY AND THE UNIVERSITY OF PITTSBURGH ARE WORKING TOGETHER TO CONSTRUCT ENVIRONMENTS THAT INSPIRE GIRLS TO THINK AND ACT LIKE SCIENTISTS AND TO ENCOURAGE PARENTS TO TAKE THEM SERIOUSLY. EXPLANATOIDS AND CLICK! THE URBAN ADVENTURE ARE TWO WAYS THE PROJECT BRINGS STEM TO THE ATTENTION OF GIRLS AND THEIR FAMILIES.

Explanatoids

"Explanatoids" are signs posted in public spaces. Through a combination of text and graphics, explanatoids use children's direct experience of their surroundings to introduce scientific reasoning and concepts. A series of signs titled "The Scream Team," for example, was displayed at an amusement park near a roller coaster to explain the science behind the ride, proving that STEM has relevance in the most unexpected contexts.

The explanatoids Web site (http://www.explanatoids.com) provides support materials for parents and teachers in southwest Pennsylvania and for those who would like to replicate project activities elsewhere.

Click! the Urban Adventure

Click! the Urban Adventure invited 11 through 14-year-old girls to participate in a role-playing game in real and virtual space. Using Pittsburgh as their game board, the girls investigated a case of illegal water pollution.

In a five-week series of after-school training sessions, each team of four girls was provided with laptop computers and other technological gear to assist them in documenting, communicating, and problem solving. At the training sessions, each team met with one female science major from a local university, who led and encouraged the girls in STEM activities.

Click! culminated in an overnight adventure weekend at the Carnegie Science Center. Girls adopted their personas as Click! agents, and members of each team were provided with evidence to start them on their adventure. Players aimed to reconstruct the crime and presented their findings to a fictional environmental commission.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL	
CARNEGIE MELLON UNIVERSITY AND UNIVERSITY OF PITTSBURGH	
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HTTP://WWW.EXPLANATOIDS.COM	02-17033
KEYWORDS: EDUCATION PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, ENGAGEMENT, GENDER-DIVERSITY AWARENESS, SATURDAY PROGRAM, AFTER-SCHOOL, MENTOR TRAINING, FIELD TRIP, SCIENCE EXHIBITS, HANDS-ON, ENGAGED LEARNING, ACTIVITY-BASED, EXPLORATION-BASED, COLLABORATIVE LEARNING, TEAMWORK APPROACH, ROLE MODELS, MENTORING, REAL-LIFE APPLICATIONS, EXPERIENTIAL LEARNING, WEB SITE, POSTERS, COMMUNITY-BASED SITE, MINORITIES, UNDERPRIVILEGED, ENVIRONMENTAL SCIENCE, ECOLOGY, TECHNOLOGY, MUSEUM, ADVENTURE GAME, INFORMAL EDUCATION, CURRICULUM MATERIALS	

SCIGIRLS FROM DRAGONFLYTV

FOR THE PAST THREE TELEVISION SEASONS, PBS HAS BROADCAST DRAGONFLYTV, A WEEKLY PROGRAM THAT FEATURES THE WORK OF "KID SCIENTISTS" AGED 9 THROUGH 12. THE HALF-HOUR SHOW AIRS ON STATIONS COVERING 90 PERCENT OF THE UNITED STATES AND REACHES ALMOST A MILLION VIEWERS. OF THE KID SCIENTISTS ON DRAGONFLYTV, MORE THAN HALF ARE GIRLS, WITH NEARLY 200 PARTICIPATING IN THE SHOW'S FIRST THREE SEASONS. IN ADDITION TO ITS REGULAR WEEKLY BROADCASTS, DRAGONFLYTV OFFERS OUTREACH RESOURCES, INCLUDING EDUCATORS' GUIDES, CHILDREN'S SCIENCE JOURNALS, "FUN KITS," VIDEOTAPES, AND AN INTERACTIVE WEB SITE (HTTP://WWW.DRAGONFLYTV.ORG).

Since October 2004, Twin Cities Public Television, the PBS affiliate in St. Paul–Minneapolis, has been drawing on DragonflyTV's resources to develop a project aimed at encouraging girls to get involved in the sciences. The initiative is called SciGirls, and it involves a combination of video and print resources, supported by hands-on training.

PBS outreach professionals (trained by DragonflyTV staff) conduct training sessions with selected local partners across the country, including schools, after-school groups, libraries, and community youth organizations such as the YWCA, Girl Scouts, and Boys and Girls Clubs. These partners, along with their affiliated PBS station, also receive materials and financial resources from SciGirls.

This is the first effort by the PBS system to orchestrate a project designed specifically to involve girls in science.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL	
TWIN CITIES PUBLIC TELEVISION (MINNESOTA)	
RICHARD HUDSON	
HTTP://WWW.DRAGONFLYTV.ORG	04-36260
KEYWORDS: DISSEMINATION PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, SELF-AUTHORSHIP, SKILLS (ALL AREAS), GENDER-DIVERSITY AWARENESS, CAREER AWARENESS, ACHIEVEMENT, EXTRACURRICULAR, ALL-YEAR, TEACHER TRAINING, PEER GROUPS, FIELD TRIPS, SCIENCE CLUBS, HANDS-ON, ENGAGED LEARNING, INQUIRY-BASED, PROJECT-BASED, ACTIVITY-BASED, PROBLEM-BASED, EXPLORATION-BASED, EXPERIMENT-BASED, COOPERATIVE LEARNING, COLLABORATIVE LEARNING, TEAMWORK, ROLE MODELS, MENTORING, SUPPORT SYSTEM, INTERACTIVE, REAL-LIFE APPLICATIONS, COLLABORATIVE NETWORK, DISSEMINATION PLAN, EXPERIENTIAL LEARNING, WEB SITE, TELEVISION, VIDEO, PUBLICATIONS, OUTDOORS, COMMUNITY-BASED SITES, FIRSTHAND SCIENCE EXPLORATION, MINORITIES (GIRLS OF COLOR), INDUSTRY PARTNERS, GIRL SCOUTS, BOYS AND GIRLS CLUBS, INFORMAL EDUCATION, TOOLS, CURRICULUM MATERIALS, AFTER-SCHOOL	

3

Bks[1]

Bringing Young Girls Into Science With Books and Inquiry

BRINGING YOUNG GIRLS INTO SCIENCE WITH BOOKS AND INQUIRY

TRADITIONAL INSTRUCTION IN THE SCIENCES RELIES HEAVILY ON TEXTBOOK LEARNING. MORE RECENT STANDARDS-BASED INSTRUCTION EMPHASIZES FIRSTHAND INVESTIGATION OF SCIENTIFIC PHENOMENA. IN JUSTIFYING THE LATTER APPROACH, EDUCATORS SAY THAT STUDENTS SHOULD LEARN ABOUT SCIENCE THROUGH THEIR OWN ACTIONS, NOT FROM A TEXT. THE POTENTIAL CONFLICT: GIRLS TEND TO BE STRONG READERS, AND AN OVEREMPHASIS ON INVESTIGATION MAY HURT THEIR CHANCES OF EXCELLING.

Directed toward the elementary grade levels, this project examined how texts might be combined with direct investigation to engage girls in science. The three-year study proceeded as follows:

- *Year one:* Researchers spent time in four third-grade classrooms to observe how science-related texts were used. These texts included supplemental reading, such as books found during library visits, in classroom reading centers, and at students' homes. Researchers collected additional data on the usefulness of science texts through interviews with students, teachers, librarians, and parents.
- *Year two:* In "design experiments" conducted in the classroom, researchers incorporated texts into inquiry-based instruction in their effort to maximize girls' interest in science. Working together with teachers, they created a design/instruction cycle that allowed research and teaching practice to influence each other.
- *Year three:* Researchers analyzed the results of the design experiments and compared the first and second years of the study. One early finding was that girls were often more interested in science books than their parents thought they would be. For example, girls showed enthusiasm for animal-related books and an interest in books in the "informational narrative" subgenre—a category that encourages learning and is often considered to be fun.

Researchers also prepared papers for submission to science and literacy-education journals and are developing a Web-based curriculum unit for use in teacher-education programs, including an NSF-sponsored education reform effort.

GRADE LEVEL: ELEMENTARY SCHOOL

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02-17144

KEYWORDS: RESEARCH PROJECT, ENGAGEMENT, SKILLS (SCIENCE), BARRIERS, CURRICULUM MATERIALS, GENDER DIFFERENCES, ENVIRONMENTAL FACTORS, CO-CURRICULAR, LONGITUDINAL STUDY, TEACHER TRAINING, STAFF TRAINING, ENGAGED LEARNING, INQUIRY-BASED, RESEARCH-BASED, EXPLORATION-BASED, EXPERIMENT-BASED, DISSEMINATION PLAN, DESIGN-BASED, BOOKS, SCHOOL-BASED, RESEARCH EXPERIENCE, DATA COLLECTION, ASSESSMENT TOOLS, PEDAGOGY

3

Girls' Science Practices in Urban, High-Poverty Communities

GIRLS' SCIENCE PRACTICES IN URBAN, HIGH-POVERTY COMMUNITIES

RESEARCHERS AT TEACHERS COLLEGE, COLUMBIA UNIVERSITY, ARE INVESTIGATING THE WAYS IN WHICH GIRLS WHO ATTEND URBAN SCHOOLS WITH HIGH POVERTY RATES ACQUIRE SCIENCE LITERACY, AND HOW THEY INTEGRATE THIS KNOWLEDGE INTO THEIR UNDERSTANDINGS OF THEMSELVES AND THEIR COMMUNITY.

Using data gathered from four middle schools in Harlem and the South Bronx, the project is developing a framework to describe urban girls' "science practices" (that is, their manner of engaging in science and their motives for doing so) according to three interrelated categories: understanding of science concepts, development of scientific habits of mind, and participation in science activities.

With this framework, researchers aim to give a full picture of the way urban girls bring science into their lives—how, for example, do they use the science they've learned in school to choose a healthful diet, or conserve natural resources such as water and petroleum? Researchers are also interviewing girls to find out how they experience classroom science instruction. Do they feel like full members of their activity groups? If so, why? And if not, how can teachers modify their instruction to give urban girls a sense of full participation?

So far, researchers have observed that urban girls who participate successfully in science classes act from three basic motivations: they wish to support their teachers by following instructions to achieve an expected outcome; they wish to extend classroom activities beyond what teachers have planned by introducing new ideas and perspectives; and they wish to express their views to avoid feeling left out of the group.

This preliminary analysis is only the first stage of a three-year study that will lead to the formulation of pedagogical approaches specially suited to the needs of urban girls in high-poverty schools and will culminate in a campaign to disseminate the project's findings and recommendations nationwide.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, HIGH SCHOOL	
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HTTP://ED-WEB3.EDUC.MSU.EDU/CALABRESEBARTON/URBAN.GIRLS.HTML	04-29109
KEYWORDS: RESEARCH PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, ENGAGEMENT, GENDER IDENTITY, GENDER DYNAMICS, SYSTEMIC REFORM, ENVIRONMENTAL FACTORS, PEER GROUPS, RESEARCH-BASED, CONSTRUCTIVISM, REAL-LIFE APPLICATIONS, SCHOOL-BASED, MINORITIES, UNDERPRIVILEGED, URBAN, DATA COLLECTION, PEDAGOGY, SCIENCE BELIEFS AND PRACTICES	

3
grL
GO-GIRL

GO-GIRL

IN GO-GIRL (GAINING OPTIONS: GIRLS INVESTIGATE REAL LIFE), URBAN MIDDLE SCHOOL GIRLS FROM DIVERSE BACKGROUNDS IN FIVE SITES ARE FORMING SMALL RESEARCH GROUPS UNDER UNIVERSITY STUDENT-TEACHER GUIDANCE, DESIGNING AND CONDUCTING A SOCIAL SCIENCE RESEARCH PROJECT.

The GO-GIRL program helps girls develop mathematical and scientific reasoning by engaging them in research in an all-girl, technologically rich environment over 10 Saturdays. The mentors are enrolled in a university service-learning course in education, psychology, and women's studies.

GO-GIRL assumes that girls will be more interested in math if they learn it in the context of a social science question. Each week, participants meet in small groups to learn how to explore questions of interest to them with social science research methods. The girls develop their hypotheses and then construct their own survey, which is posted online. They use the statistical tools they have learned to analyze the data and draw conclusions. The program works in collaboration with curriculum and software developers at TERC, Inc. Participants use TERC's Tabletop 2, which includes both data-literacy tools for analysis and a Web-based component for data collection.

Major topics are introduced when the girls come together for whole-group discussions. Whole groups are used as a setting for visiting researchers and to work through major group questions (e.g., selection of general survey topics). With their mentors, the girls review basic math skills and statistical techniques.

GO-GIRL was successfully piloted by researchers at the University of Michigan and Wayne State University as a component of the Girls Explore Mathematics through Social Science program funded by NSF. More than 120 college students have mentored 240 seventh-grade girls. Evaluation data show the girls have higher confidence in their mathematical ability and greater interest in mathematics after completing the program, and follow-up data show the positive impact is long lasting. The mentors are more interested in pursuing teaching careers and in serving underrepresented groups and are more understanding of diversity. Those planning teaching careers said they feel better prepared to teach minority and female students. The GO-GIRL Urban Partnership expands GO-GIRL to Bloomington, Illinois (Illinois Wesleyan University), Philadelphia, Pennsylvania (University of Pennsylvania), Chicago, Illinois (Roosevelt University), and Washington, D.C. (Howard University).

GRADE LEVEL: MIDDLE SCHOOL, UNDERGRADUATE	
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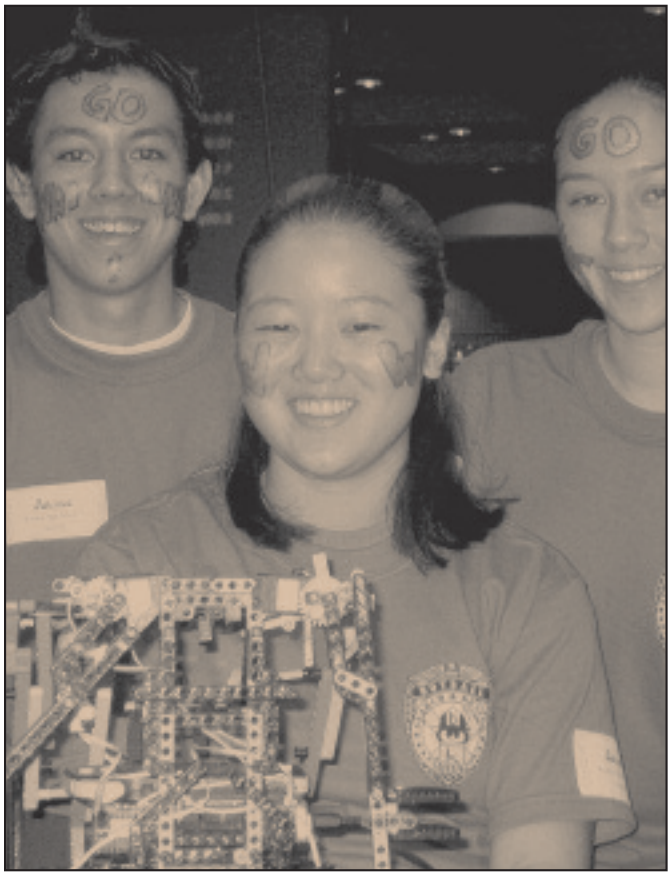
http://www.smartgirl.org/ and http://www.gogirls.wayne.edu/	05-07902
Keywords: education project, professional development, engagement, skills, extracurricular, mentor training, peer groups, hands-on, engaged learning, project-based, activity-based, mentoring, role models, software, service-learning, online survey, Web site, research project, minorities, underprivileged, urban, computer technology, math, statistics, policy, data collection, curriculum materials, social science skills	

3
wiE
4 Schools for Women in Engineering

4 SCHOOLS FOR WOMEN IN ENGINEERING

RESEARCHERS AT TEACHERS COLLEGE, COLUMBIA UNIVERSITY, ARE INVESTIGATING THE WAYS IN WHICH GIRLS WHO ATTEND URBAN SCHOOLS WITH HIGH POVERTY RATES ACQUIRE SCIENCE LITERACY AND HOW THEY INTEGRATE THIS KNOWLEDGE INTO THEIR UNDERSTANDING OF THEMSELVES AND THEIR COMMUNITY.



The consortium deployed groups of specially trained, engineering-savvy women (called STEMTeams) into the classrooms of eight middle schools in the greater Boston area. STEMTeam members are mostly female and represent engineering faculty, practicing engineers, college engineering students, and middle school teachers—strong role models for girls.

Four STEMTeams, each associated with one university, developed and implemented gender-inclusive engineering activities to help teachers prepare their students for the engineering component of the compulsory Massachusetts Comprehensive Assessment System, which tests students' proficiency in the state-mandated Science and Technology/Engineering Curriculum Framework.

In one activity, titled "The Great Orange Juice Squeeze," students are challenged to provide good-tasting orange juice to Boston schools for 25 cents per glass by following the engineering design process: identifying and researching the problem; selecting the best of several proposed solutions; then constructing, testing, and refining a prototype.

The STEMTeams approach is replicable at a low cost. Training materials (including the STEMTeam manual and modules for activities like the one described above) are available at the program's Web site (http://www.STEMTeams.org).

GRADE LEVEL: MIDDLE SCHOOL	
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HTTP://WWW.STEMTEAMS.ORG	02-17110
KEYWORDS: DEMONSTRATION PROJECT, ROLE MODELS, COLLABORATION, EDUCATION PROGRAM, PROFESSIONAL DEVELOPMENT, CAREER AWARENESS, CO-CURRICULAR, TEACHER TRAINING, HANDS-ON, ENGAGED LEARNING, ACTIVITY-BASED, MENTORING, MANUAL, SCHOOL-BASED, URBAN, CURRICULUM MATERIALS, ENGINEERING SKILLS	

3

mod

Gender-Based Science Performance Models

GENDER-BASED SCIENCE PERFORMANCE MODELS

RONALD STEVENS, A MEDICAL PROFESSOR AT THE UNIVERSITY OF CALIFORNIA–LOS ANGELES (UCLA), DEVELOPED AN INTERACTIVE COMPUTER WEB SITE THAT EXPOSES STUDENTS OF ALL AGES TO ONLINE PROBLEM-SOLVING EXERCISES IN VARIOUS SUBJECTS. THE INNOVATIVE PROGRAM (CALLED IMMEX), NOW USED BY THOUSANDS OF STUDENTS ACROSS THE COUNTRY, ALSO HELPS TEACHERS UNDERSTAND HOW STUDENTS ADDRESS PROBLEMS AND THE STEPS THEY TAKE TO SOLVE THEM.

Now Stevens is leading a team of UCLA researchers to analyze students' problem-solving activities by gender. Working with students in chemistry courses, the researchers are investigating how females and males from middle school to the university level develop strategies for finding answers and how they retain knowledge over time. They will use their findings to identify how online, collaborative activities and environments can be organized to maximize male and female students' problem-solving strengths.

Thousands of students from two school districts and two universities are taking part, in all-female, all-male, and mixed-gender groupings. Supporting data will include pre- and post-tests of content knowledge, science attitudes, and teacher and student technology use, as well as overall academic performance, including standardized state test data. The project team includes researchers, educators, and students in California, South Carolina, Kentucky, and Italy.

Findings will be disseminated to teachers, the gender research community, basic science educators, and members of the intelligent tutoring and collaborative learning communities. The problem-solving tasks will be available online to other teachers and researchers worldwide, along with the results of the analysis and performance models.

GRADE LEVEL: MIDDLE SCHOOL, HIGH SCHOOL, UNDERGRADUATE	
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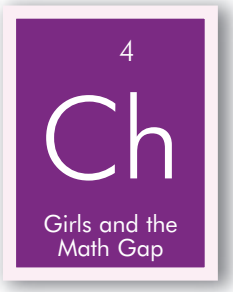
KEYWORDS: RESEARCH PROJECT, PROBLEM-SOLVING SKILLS, GENDER DIFFERENCES, LONGITUDINAL STUDY, PROBLEM-BASED, INTERACTIVE, WEB SITE, SCHOOL-BASED, MIXED GENDER, CHEMISTRY, MEASUREMENT OF ATTITUDE, MEASUREMENT OF SKILLS, ONLINE LEARNING	



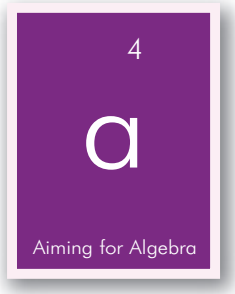
CHAPTER FOUR · GIRLS AND THE MATH GAP

STEM—THE ACRONYM FOR SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS—PROFESSIONS HAVE BEEN AND WILL CONTINUE TO BE ENGINES OF U.S. ECONOMIC GROWTH AND NATIONAL SECURITY. THESE FIELDS HAVE BEEN STRUGGLING TO INCREASE THE PARTICIPATION OF WOMEN FOR DECADES. TO QUOTE WILLIAM A. WULF, PRESIDENT OF THE NATIONAL ACADEMY OF ENGINEERING, "WE NEED TO UNDERSTAND WHY IN A SOCIETY SO DEPENDENT ON TECHNOLOGY, A SOCIETY THAT BENEFITS SO RICHLY FROM THE RESULTS OF ENGINEERING, A SOCIETY THAT REWARDS ENGINEERS SO WELL, ENGINEERING ISN'T PERCEIVED AS A DESIRABLE PROFESSION . . . OUR PROFESSION IS DIMINISHED AND IMPOVERISHED BY A LACK OF DIVERSITY." ALTHOUGH THIS QUOTE REFERRED SPECIFICALLY TO ENGINEERING, PROFESSIONALS IN ALL STEM FIELDS WOULD AGREE.

MATHEMATICS IS THE FUNDAMENTAL KEY THAT UNLOCKS THE DOOR TO THE OTHER STEM FIELDS. IT CONTAINS THE UNDERPINNINGS AND LANGUAGE OF TECHNOLOGICAL THINKING AND PROCESSES. CALCULUS WAS DEVELOPED TO DESCRIBE PHENOMENA IN THE PHYSICAL WORLD, INCLUDING THE MODERN-DAY TOPICS OF QUANTUM MECHANICS AND RELATIVITY. CHEMISTS USE COMPUTATIONAL METHODS TO PREDICT AND ANALYZE THE STRUCTURE OF COMPLEX MOLECULES SUCH AS PROTEINS AND DNA. MEDICAL RESEARCHERS USE STATISTICS AND PROBABILITY TO DETERMINE EFFECTIVE TREATMENT STRATEGIES AND PHARMACEUTICALS. ENGINEERS USE DIFFERENTIAL EQUATIONS IN THEIR ANALYSIS AND DESIGN ENDEAVORS TO MODEL RESPONSES OF STRUCTURES. CLOSING THE GENDER GAP IN MATHEMATICS IS AN ESSENTIAL FIRST STEP IN INCREASING THE PARTICIPATION OF WOMEN IN ALL THE STEM FIELDS. IN FACT, LITTLE SUBSTANTIVE PROGRESS CAN BE MADE—IN TERMS OF BOTH MOTIVATION AND SKILLS—UNLESS WE CAN BRIDGE THIS GAP.

THE PROJECTS DESCRIBED IN THIS CHAPTER ASPIRE TO NARROW THE GENDER GAP IN MATHEMATICS. TWO PROJECTS ADDRESS STRATEGIES TO ENHANCE GIRLS' ABILITIES IN AREAS IMPORTANT FOR SUCCESS IN STEM AND WHERE GENDER DIFFERENCES PERSIST: MEASUREMENT ABILITY AND 3-D SPATIAL VISUALIZATION SKILLS. OTHER PROJECTS SEEK TO IMPROVE GIRLS' MOTIVATION FOR STUDYING MATHEMATICS, WITH THE HOPE THAT THIS INCREASED MOTIVATION WILL EXTEND TO ALL STEM LEARNING. THE PROJECTS RANGE IN LEVEL FROM THE EARLY ELEMENTARY GRADES THROUGH HIGH SCHOOL. IMPROVING MATHEMATICS TEACHING METHODS TO INCLUDE STRATEGIES SUCH AS COLLABORATION AND REFLECTION, THE PREFERRED LEARNING STYLES OF GIRLS, IS ALSO BEING INVESTIGATED AS A MEANS OF ENHANCING MOTIVATION TO STUDY MATHEMATICS.

SHERYL SORBY, PH.D., ASSOCIATE DEAN OF ENGINEERING, MICHIGAN TECHNOLOGICAL UNIVERSITY



AIMING FOR ALGEBRA

IN AUSTIN, TEXAS, A NONPROFIT CALLED GIRLSTART HAS DESIGNED AIMING FOR ALGEBRA, A PROJECT THAT PREPARES MIDDLE SCHOOL GIRLS TO COMPLETE ALGEBRA I IN EIGHTH GRADE. IF GIRLS CAN COMPLETE ALGEBRA I IN EIGHTH GRADE, THEY CAN THEN TAKE HIGH SCHOOL MATH AND SCIENCE CLASSES THAT LEAD THEM TO STEM MAJORS IN COLLEGE.

Aiming for Algebra has two broad components: a girls-only science and math club, and several community- and Internet-based math and science projects. Many of these activities involve girls' parents.

The objectives of the project, to take place over three years, are to

- Improve girls' confidence and academic self-esteem
- Increase girls' awareness of STEM careers and the high school and college coursework needed to enter such careers
- Enhance girls' knowledge of algebra and ability to use it in their lives.
- Improve parents' awareness of STEM careers for women
- Help parents encourage their daughters to succeed in algebra and subsequent math and science courses
- Help teachers raise girls' expectations of themselves in math and science classes
- Collect empirical data on how informal programming can help women from groups underrepresented on the basis of ethnicity and race, income level, and language

Through Aiming for Algebra's cohort design and rigorous evaluation process, investigators can determine the effectiveness of specific interventions on girls' attitudes and skills. The program also includes a plan to make methodologies available to other interested communities.

GRADE LEVEL: MIDDLE SCHOOL	
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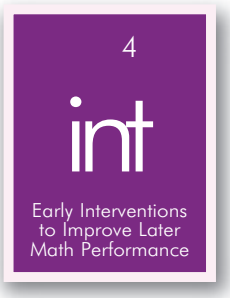
HTTP://WWW.CLUBGIRLSTART.ORG/	02-17038
KEYWORDS: DEMONSTRATION PROJECT, SELF-CONFIDENCE, SELF-EFFICACY, ENGAGEMENT, MATH SKILLS, CAREER AWARENESS, CURRICULUM MATERIALS, BEST PRACTICES, ADVANCEMENT, ACHIEVEMENT, TRANSITION POINTS, EXTRACURRICULAR, CO-CURRICULAR, CURRICULUM TRAINING, TEACHER OUTREACH, LEARNING COMMUNITY, PEER GROUPS, STUDY GROUPS, CLUBS, PARENTAL INVOLVEMENT, ENGAGED LEARNING, PROJECT-BASED, ACTIVITY-BASED, COOPERATIVE LEARNING, COLLABORATIVE LEARNING, TEAMWORK APPROACH, MENTORING, DISSEMINATION PLAN, WEB SITE, SCHOOL-BASED, COMMUNITY-BASED, MINORITIES, UNDERPRIVILEGED, MATH, INFORMAL EDUCATION, TRANSITION POINTS, ALGEBRA, DATA COLLECTION, ASSESSMENT TOOLS	

EARLY INTERVENTIONS TO IMPROVE LATER MATH PERFORMANCE

THE UNIVERSITY OF GEORGIA IS TEAMING WITH THE UNIVERSITY OF MASSACHUSETTS–AMHERST TO EXAMINE WHETHER MATHEMATICS PERFORMANCE CAN BE IMPROVED BY A COMPUTER PROGRAM DESIGNED TO ENHANCE CHILDREN'S USE OF STRATEGIES IN SOLVING PROBLEMS AND FACILITY WITH NUMBERS ("COMPUTATIONAL FLUENCY"). THE STUDY ALSO TESTS WHETHER THE PROGRAM REDUCES OR ELIMINATES GENDER DIFFERENCES IN THESE AREAS. SUCH DIFFERENCES, WHEN DEVELOPED EARLY IN LIFE, HAVE BEEN SHOWN TO AFFECT MATH PERFORMANCE LATER ON.



Students in Georgia and Massachusetts will be randomly assigned to one of four experimental conditions. Investigators hope to determine whether focused instruction improves mathematics achievement, particularly for girls. If early intervention can ameliorate gender differences in math learning, changes in instruction might improve girls' ability to perform at higher levels of mathematics in early adulthood and increase their interest in the advanced study of STEM.

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KEYWORDS: RESEARCH PROJECT, STRATEGY SKILLS, MATH SKILLS, GENDER DIFFERENCES, ACHIEVEMENT, LONGITUDINAL STUDY, COMPUTER-BASED TUTORING, MIXED-GENDER, MATH, CURRICULUM MATERIALS

4
Rf
Collaboration, Reflection, and Role Models

COLLABORATION, REFLECTION, AND ROLE MODELS

TRADITIONAL MATH INSTRUCTION IN THE CLASSROOM OFTEN ASSUMES THAT LEARNERS WILL WORK ALONE AND ARE BEST MOTIVATED BY COMPETITION. GIRLS, HOWEVER, OFTEN LEARN BEST THROUGH COLLABORATIVE ACTIVITIES AND DIALOGUE. RESEARCHERS AT THE INFORMATION SCIENCES INSTITUTE, UNIVERSITY OF SOUTHERN CALIFORNIA, HYPOTHESIZE THAT GIRLS' MATH CONFIDENCE AND PERFORMANCE WILL IMPROVE IF MATH IS TAUGHT AS AN ACTIVITY IN WHICH STUDENTS HELP EACH OTHER CONSIDER VARIOUS APPROACHES TO PROBLEM SOLVING, AND HAVE FREQUENT OPPORTUNITIES TO ARTICULATE THEIR UNDERSTANDING OF MATHEMATICAL CONCEPTS.

The project team has developed and tested two gender-inclusive features for Wayang Outpost (http://www.wayangoutpost.net), a Web-based intelligent tutoring system (ITS) for SAT math created with prior NSF support. (An ITS is a computer-based tutoring program that customizes instruction for each student.) With the "reflection" feature, students having difficulty with a math problem receive a prompt—"Why is this problem challenging to you?" for example, or "What insight is required to solve this problem?"—with space to write a response. This allows the student to describe the problem and to articulate the steps necessary to solve it, which helps to consolidate learning and make skills accessible for future problems. With the "chat" feature, a student having difficulty with a problem can request help from a fellow student who has already solved it; in this way, one student reinforces her knowledge by articulating it, while the other gets needed guidance and support.

Evaluation studies conducted in urban Los Angeles high schools reveal that students show significant improvement in their math problem solving after working with the Wayang Outpost tutoring system, as indicated by pretest–posttest comparisons. Students who start with the weakest math skills show the greatest improvement and are most likely to use the multimedia help features in the ITS. Female students are most likely to use the chat feature and to report that it is a valuable tool for learning. In addition, female students show more interest than male peers in the identity of the chat partner and in learning math in the context of social connections. Current analyses examine gender differences in seeking help and the relative quality of dialogue within male–male, female–male, and female–female pairs.

GRADE LEVEL: HIGH SCHOOL	
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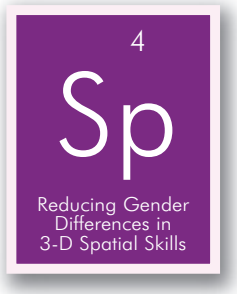
KEYWORDS: RESEARCH PROJECT, SELF-CONFIDENCE, SKILLS, GENDER DIFFERENCES, GENDER DYNAMICS, TRANSITION POINTS, CO-CURRICULAR, ENGAGED LEARNING, COOPERATIVE LEARNING, COLLABORATIVE LEARNING, TEAMWORK APPROACH, ROLE MODELS, ELECTRONIC MENTORING, COMPUTER-BASED TUTORING, WEB SITE, ONLINE TUTORIALS, SCHOOL-BASED, MINORITIES, UNDERPRIVILEGED, SELF-CONFIDENCE, COMPUTER PROGRAMMING, SAT PREP COURSE, BIOINFORMATICS, COMPUTER SCIENCE, TECHNOLOGY, MATH SKILLS, CURRICULUM MATERIALS	



REDUCING GENDER DIFFERENCES IN 3-D SPATIAL SKILLS

SPATIAL VISUALIZATION IS CONSIDERED TO BE ONE OF EIGHT HUMAN INTELLIGENCES AND HAS BEEN THE SUBJECT OF EDUCATIONAL RESEARCH OVER THE PAST HUNDRED YEARS. TWO DISTINCT THEMES HAVE EMERGED FROM THE RESEARCH:

1. WELL-DEVELOPED 3-D SPATIAL SKILLS ARE CRITICAL TO SUCCESS IN STEM FIELDS.
2. THE 3-D SPATIAL SKILLS OF WOMEN TYPICALLY LAG BEHIND THOSE OF MEN.

In 1993, a course for the development of 3-D spatial skills was introduced at Michigan Technological University and has been continuously offered since that time. Each year, engineering students are administered a spatial skills test during orientation, and those who fail this test are counseled into the spatial course. Since spatial skills are critical to success in many introductory engineering courses, and since females are nearly three times more likely to fail the spatial-skills test than are males, participation in the course helps remove a barrier to success for women. Over the years, participation in this course has led to significant improvements in retaining female engineering students and higher grades in their follow-on engineering courses. In 1998, corresponding multimedia software and a workbook for developing 3-D spatial skills through self-paced learning were developed by the Michigan Tech team. These user-friendly, gender-neutral materials have been proven to be effective in developing the spatial skills of first-year engineering students and similar improvements in retention and success in follow-on courses were observed. The current project will test these same materials with college students in other STEM fields and students at the middle and high school levels, paying particular attention to gender differences and preferred learning styles.

Principal Investigator Sheryl Sorby was awarded the 2005 Betty Vetter Research Award by the Women in Engineering Programs and Advocates Network for her outstanding research in 3-D spatial skills.

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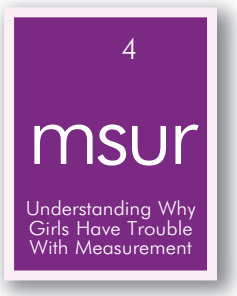

UNDERSTANDING WHY GIRLS HAVE TROUBLE WITH MEASUREMENT

STUDIES OF STUDENTS' ACHIEVEMENT IN MATHEMATICS HAVE SHOWN THAT THE STRONGEST AND MOST CONSISTENT GENDER AND SOCIOECONOMIC STATUS DIFFERENCES ARE IN MEASUREMENT ABILITY, AN IMPORTANT PREREQUISITE FOR SUCCESS IN STEM FIELDS. BOSTON COLLEGE RESEARCHERS WILL INVESTIGATE THE BASIS FOR THESE DIFFERENCES AMONG FOURTH-GRADERS, WHEN CHILDREN BEGIN TO WORK WITH STANDARD MEASUREMENT TOOLS.

The study will advance in three phases. In the first, researchers will identify which specific aspects of measurement skill differ with gender and socioeconomic status, using a systematic and comprehensive test battery. Researchers will examine whether students' performance varies according to the task's cognitive demands—that is, students' performance on tasks that depend primarily on the knowledge of facts, procedures, and numerical formulas will be compared with students' performance on tasks that depend on an understanding of measurement principles and spatial sense.

In the second phase, researchers will identify the factors that mediate gender and socioeconomic differences on the measurement test, specifically these differences in spatial or numerical skills (or both).

In the third phase, researchers will systematically vary procedures for introducing measurement concepts to girls and lower socioeconomic status students in particular. These systematic tests will provide stronger evidence of causality than correlation alone. The new measurement scales and the most effective teaching strategies will be made available online.

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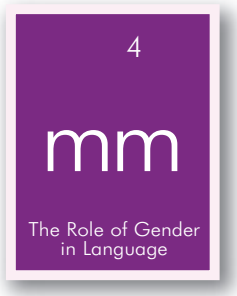
Keywords: research project, skills, research-based, survey, underprivileged, math, quantitative sciences, assessment tools, data collection, curriculum materials, math skills, gender differences



THE ROLE OF GENDER IN LANGUAGE USED BY CHILDREN AND PARENTS WORKING ON MATHEMATICAL TASKS

RESEARCHERS AT THE CURRICULUM RESEARCH AND DEVELOPMENT GROUP OF THE UNIVERSITY OF HAWAII ARE INVESTIGATING GENDER-RELATED DIFFERENCES IN THE LANGUAGE AND BEHAVIORS OBSERVED AMONG THIRD- AND FOURTH-GRADE CHILDREN AND PARENTS WORKING TOGETHER ON MATHEMATICAL TASKS.

Each child–parent pair will be videotaped as they work on three mathematical tasks (number and operations, geometry, and algebraic reasoning) that have been developed to foster intense interactions between parent and child. The recordings will then be coded to identify gender-related differences in how parents and children communicate about the different areas of mathematics. Researchers will use a variety of investigative techniques, such as counting the number of conceptual questions asked and assessing the reliance on specific mathematical terms.

The theoretical framework for the study is based on prior research on the role of gender on children's self-efficacy, parents' competency beliefs for their children, and ways in which these affect cognitively demanding language. Data will be gathered on children's self-efficacy and parents' competency beliefs for their children to determine how these are related to the cognitively demanding language used by the four types of child–parent pairs: daughter–mother, son–mother, daughter–father, and son–father.

Following the study, investigators will develop recommendations for parents on how to talk about mathematics with their daughters in a way that encourages them to pursue academic study and careers in STEM.

Investigators believe that previous, related research was limited by assumptions that parents would be well-educated, middle-class professionals. Participants in this study are from underrepresented groups in STEM: those who are female, of diverse ethnicity, and of low socioeconomic status.

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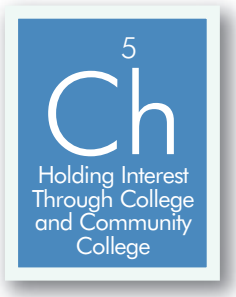

CHAPTER FIVE · HOLDING INTEREST THROUGH COLLEGE AND COMMUNITY COLLEGE

THE PAST 15 YEARS HAVE SEEN WELCOME CHANGES IN HOW WE APPROACH RETENTION; NO LONGER ARE WE CONCENTRATING ON "FIXING THE GIRLS," BUT WE ARE NOW EXPLORING WAYS IN WHICH THE SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) CULTURE AND CURRICULUM CAN BE ENHANCED TO INCLUDE WOMEN. THE PROGRAMS HERE ARE CONCERNED WITH MEETING THE NEEDS OF WOMEN IN STEM IN WAYS THAT RECOGNIZE HOW THEIR NEEDS DIFFER FROM THOSE OF THEIR MALE COUNTERPARTS. MANY OF THE PROGRAMS IN THIS CHAPTER ARE RESEARCH BASED, WHICH DIVERGES FROM PAST PROJECTS THAT APPEARED TO WORK (PARENTS THOUGHT) BUT DID LITTLE TO ENCOURAGE YOUNG WOMEN TO REMAIN IN STEM MAJORS AND CAREERS.

FOUR OF THE TEN PROJECTS HIGHLIGHTED HERE SEEK TO BURROW INTO SUCCESSFUL ENGINEERING COLLEGES OR DEPARTMENTS AND FIND OUT WHAT HAS HELPED THEM SUCCEED WHERE OTHERS HAVE FAILED. THE PROJECTS DRAW INFORMATION FROM ALL INSTITUTIONAL LEVELS—ADMINISTRATORS, STUDENTS, AND FACULTY—IN ORDER TO DISCOVER THE COMMON FACTORS THAT WILL HELP OTHER INSTITUTIONS MAKE EFFECTIVE AND ACCEPTABLE CHANGES TO INCREASE THE DIVERSITY OF THEIR PROGRAMS.

OTHER PROJECTS ARE BASED ON FOUNDATIONAL RESEARCH WELL KNOWN IN FEMINIST SCIENCE STUDIES: THE NEED FOR FAMILY AND PEER SUPPORT AND AN INTEREST IN THE REAL-WORLD APPLICATIONS AND POSITIVE SOCIAL OUTCOMES OF RESEARCH AND SCIENTIFIC FINDINGS. UNFORTUNATELY, WORK WITH WOMEN ATTENDING COMMUNITY COLLEGES HAS LAGGED BEHIND RESEARCH ON WOMEN AT FOUR-YEAR SCHOOLS, DESPITE THE FACT THAT THE COMMUNITY COLLEGE POPULATION CONSTITUTES 26 PERCENT OF ALL STUDENTS SEEKING EDUCATION BEYOND HIGH SCHOOL AND IS 58 PERCENT FEMALE. THIS IS A DIFFICULT POPULATION TO STUDY BECAUSE IT IS MORE HETEROGENEOUS AND HAS LESS SOCIAL OR ATHLETIC INVOLVEMENT WITH THE SCHOOL, AND BECAUSE MANY STUDENTS MUST HOLD FULL-TIME JOBS OR CARE FOR FAMILIES WHILE ATTENDING SCHOOL. BECAUSE A FULL 45 PERCENT OF ALL FIRST-TIME STUDENTS ATTEND A COMMUNITY COLLEGE, THIS PROJECT WILL MAKE AN IMPORTANT CONTRIBUTION TO OUR UNDERSTANDING OF EFFECTIVE STRATEGIES FOR WOMEN TO CONSIDER IN PURSUING A BACHELOR'S DEGREE IN A STEM DISCIPLINE.[1]

THE BREADTH AND DEPTH OF THESE PROJECTS WILL EXPAND OUR KNOWLEDGE ABOUT HOW INSTITUTIONS CAN BEST APPROACH STEM RETENTION, AND IT WILL GIVE THEM THE TOOLS TO SUCCEED.

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Changing College Freshmen's Attitudes Toward Women in STEM

CHANGING COLLEGE FRESHMEN'S ATTITUDES TOWARD WOMEN IN STEM

ATTITUDES ABOUT GENDER ROLES ARE WIDELY THOUGHT TO DETER COLLEGE-AGE WOMEN FROM PURSUING STEM COURSES, MAJORS, AND SUBSEQUENT CAREER PATHS. ILLINOIS STATE UNIVERSITY (ISU) AIMS TO CHALLENGE SUCH ATTITUDES THROUGH A "WHOLE COMMUNITY" APPROACH. BY GETTING STUDENTS, THEIR PARENTS, STUDENT ADVISORS, AND FACULTY INVOLVED, ISU SHAPES AWARENESS, ATTITUDES, AND KNOWLEDGE ABOUT GENDER ISSUES IN STEM BEFORE AND DURING STUDENTS' FRESHMAN YEAR.

Activities take place in three overlapping spheres: families, peers, and university courses and programs.

In the family context, as part of the two-day summer orientation sessions for all incoming freshmen and their parents, ISU hosts an orientation session with students and parents that addresses the importance of STEM education to all students, regardless of career plans. Undergraduate advisors also participate in a workshop.

In the peer context, ISU forms learning communities that nurture freshman women's interest in STEM. The learning communities are modeled on ISU's existing Connections program (which provides staff-led out-of-class meetings for freshmen enrolled in a particular class to explore common concerns). Each learning community consists of up to 30 students (men and women), their instructor, a minimum of six STEM professionals on or off campus who serve as role models, and a student leader (a university junior or senior in one of the STEM fields) to help students see the applicability of STEM knowledge in a wide variety of fields and occupations.

Additionally, STEM-related gender issues are addressed in a four-week "topical excursion" (learning module, or collection of learning modules) as part of an existing general education course required of all freshmen. For example, a module on science, technology, and society may incorporate a gender-related subtext, highlighting women scientists as authors, showing women at work in STEM, or raising the issue of gender bias in science research.

The researchers involved in this project have developed and validated an instrument that measures attitudes of college freshmen about science and technology. For more information about the Gokhale–Machina–Brauchle Attitudes Toward Science and Technology instrument, contact Paul Brauchle at pebrauc@ilstu.edu.

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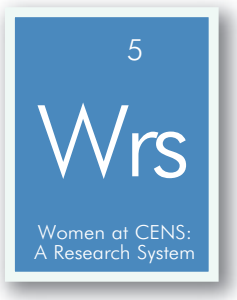

WOMEN AT CENS: A RESEARCH SYSTEM

RESEARCH EXPERIENCES FOR UNDERGRADUATES CAN BE PARTICULARLY EFFECTIVE AT ENGAGING STUDENTS. BUT THERE IS LITTLE RESEARCH TO SHOW WHY SOME SUCCEED WHILE OTHERS FALL SHORT.

At UCLA's Center for Embedded Networked Sensing (CENS), researchers are designing a "model undergraduate research experience" aimed at encouraging women's commitment to science and engineering in the long term. The model will encompass engineering, computer science, and physical science, as women are underrepresented in these disciplines.

In creating Research Experiences for Undergraduates, the research team is concentrating on three factors, based on data from comparable efforts around the country:

- A *research environment* in which undergraduate women lead investigations with direct implications for society—for example, the environment or education. This connection between research environments and real-life implications can be an effective recruitment strategy.
- A *research experience* structured so that students can be productive and successful.
- A *support structure* ensuring that each student integrates into the experience both academically and socially.

Students are being recruited from Mills College and Harvey Mudd College, in partnership with the UCLA Center for Excellence in Engineering and Diversity. The model research experience will be tested and evaluated at CENS.

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EVALUATING LIVING–LEARNING PROGRAMS

WHEN IT COMES TO FOSTERING SUCCESS FOR WOMEN IN STEM MAJORS, LIVING–LEARNING (L/L) PROGRAMS REPRESENT ONE OF THE MOST PROMISING INTERVENTIONS IN HIGHER EDUCATION. BASED IN THE RESIDENCE HALL, L/L PROGRAMS USE MENTORING, SUPPORT, AND COLLABORATION, WHILE BLENDING CURRICULAR AND CO-CURRICULAR ACTIVITIES, TO KEEP STUDENTS ENGAGED AND EXCELLING IN STEM.

In 2004 the National Study of Living–Learning Programs (NSLLP) elicited responses from nearly 24,000 students at 34 universities. More than 1,650 STEM majors participated in the NSLLP, about half of whom were involved in one of 41 L/L programs designed for either single-sex or coeducational settings.

Because most respondents were first-year students—not uncommon for L/L participants—researchers could not yet evaluate L/L programs' lasting effects. This year, researchers at the University of Maryland–College Park (those who led last year's study) are continuing and expanding the NSLLP, in part to probe the long-term effects of L/L participation on women's persistence in college in general, and in STEM disciplines in particular.

The study will employ a number of methods:

- A follow-up survey for participants of the 2004 NSLLP study
- Visits to three to five college campuses that, according to data from the study, offer modestly to high-performing STEM-related L/L options for women
- Expanded data collection from new participating institutions, with the goal of recording continuing trends on women in STEM

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Because the study collects data from multiple institutions, it will allow investigators to generalize the results: those campuses interested in developing effective L/L programs for women in STEM will be able to use the study's findings as a blueprint for best models and practices.

PRODUCING WOMEN ENGINEERS: A STUDY OF UNDERGRADUATE ENGINEERING PROGRAMS FOR WOMEN

AT PRESENT, WOMEN EARN ONLY 20.1 PERCENT OF THE ENGINEERING BACHELOR'S DEGREES IN THE UNITED STATES. YET SOME ENGINEERING PROGRAMS DO BETTER THAN OTHERS AT ATTRACTING AND RETAINING FEMALE STUDENTS. TO DETERMINE WHAT MAKES THESE PROGRAMS MORE SUCCESSFUL, THE URBAN INSTITUTE IS CONDUCTING A STUDY OF THE 344 SCHOOLS WITH ACCREDITED PROGRAMS ACROSS THE COUNTRY.

Urban Institute researchers classify each program into one of four "productivity" categories based on enrollment and graduation of women. One goal of the comprehensive study will be to assess the "productivity status" of undergraduate engineering programs across the country.

In particular, the study will examine what approaches, strategies, and interventions lead to a successful program. Researchers will analyze institutional and departmental characteristics to identify patterns both across the nation's programs and within each productivity category. Specific variables include

- Institutional and program selectivity
- Institutional type (Carnegie classification, public or private, minority-serving institution)
- Size of engineering college
- Presence of an engineering graduate program
- Engineering enrollment and number of engineering degrees awarded
- Percentage of engineering faculty that is female
- Percentage of engineering students that is female

Urban Institute researchers will also carry out case studies of six to eight engineering programs rated "highly productive" in graduating women, aiming to analyze the conditions that influence their success. Half of these programs will fit the category "high enrollment and high graduation"; the other half will fit "low enrollment and high graduation." A comparative analysis should yield an improved understanding of the relationship between enrollment and productivity. Researchers will travel to selected campuses and interview department chairs, top administrators, and engineering faculty, and conduct sex-segregated focus groups of engineering students. Researchers will also collect information on departments' histories and the interventions and strategies they use.

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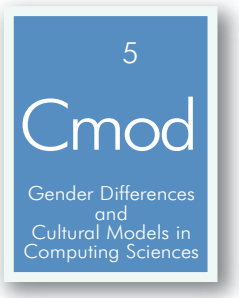

GENDER DIFFERENCES AND CULTURAL MODELS IN THE COMPUTING SCIENCES

A RESEARCH TEAM AT XAVIER UNIVERSITY OF LOUISIANA IS INVESTIGATING THE UNDERREPRESENTATION OF WOMEN IN THE COMPUTING DISCIPLINES. TEAM MEMBERS HOPE THEIR RESEARCH WILL LEAD TO NEW MODELS OF MORE EQUITABLE AND INVITING COMPUTING EDUCATION.

The researchers are conducting a three-year longitudinal study among 70 male and female undergraduates in computing disciplines at each of 50 institutions of higher education from across the nation: 25 historically black colleges and universities and 25 non-HBCUs. As a baseline, each year at each institution they are also surveying 30 first-year undergraduates not studying a computing discipline.

With this large nationwide sample, the investigators hope to gain more accurate knowledge regarding gender, ethnicity, and culture in the computing disciplines and better support understanding of the computing disciplines across the fields of psychology, sociology, and education. The comprehensive study features a multidisciplinary, culturally diverse, collaborative team. (Microsoft, Inc., and Apogen Technologies, Inc., are corporate partners.)

The architecture of the project was presented in February 2005 at the Association for Computing Machinery Special Interest Group in Computer Science Education conference in St. Louis, Missouri (http://doi.acm.org/10.1145/1047344.1047477). Members of the research team also described the challenges of conducting a national computing discipline study in October 2005 at the American Society for Engineering Education/Institute of Electrical and Electronics Engineers Frontiers in Education conference in Indianapolis, Indiana (http://fie.engrng.pitt.edu/fie2005/papers/1297.pdf).

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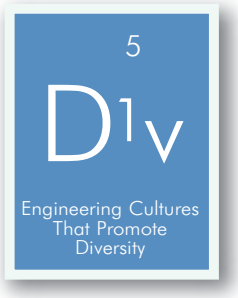

ENGINEERING CULTURES THAT PROMOTE DIVERSITY

TO DETERMINE WHAT WORKS BEST IN RECRUITING YOUNG WOMEN TO STEM AT THE UNDERGRADUATE LEVEL—AND KEEPING THEM IN THESE DISCIPLINES—A TEAM OF RESEARCHERS AT VIRGINIA TECH IS CONDUCTING A STUDY OF ENGINEERING DEPARTMENTS AROUND THE COUNTRY. THE STUDY WILL USE QUANTITATIVE AND QUALITATIVE DATA TO EXAMINE DEPARTMENTS WITH FEMALE COMPLETION RATES BOTH ABOVE AND BELOW THE NATIONAL AVERAGE.

A central premise of the study is that the culture of engineering departments and colleges has a substantial impact on the success rates of young women. "Culture" here refers to the attitudes, values, beliefs, and practices of institutional leaders, faculty, and students. "Practices" consist of pedagogy, curricula, and policies both formal and informal.

The team will identify elements of departmental (and institutional) culture for schools with female engineering graduation rates above the national average. Research tools will include a questionnaire and self-assessment guide that address schools' cultures regarding women in STEM. Using a student questionnaire, the team will predict women's interest in, and choice of, STEM majors on the basis of individual, environmental, and structural factors. Ultimately the researchers will write case studies of best practices for maintaining a climate friendly to women in engineering fields.

Schools participating in this study will receive two-hour training workshops on getting women involved in engineering fields, and faculty modules, to be available online, containing case studies and other resources:

- A follow-up survey for participants of the 2004 NSLLP study
- Visits to three to five college campuses that, according to data from the study, offer modestly to high-performing STEM-related L/L options for women
- Expanded data collection from new participating institutions, with the goal of recording continuing trends on women in STEM

Because the study collects data from multiple institutions, it will allow investigators to generalize the results: those campuses interested in developing effective L/L programs for women in STEM will be able to use the study's findings as a blueprint for best models and practices.

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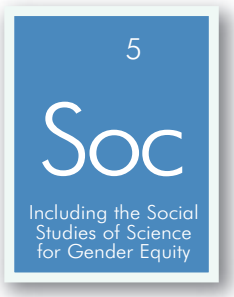
INCLUDING THE SOCIAL STUDIES OF SCIENCE IN SCIENCE COURSES FOR GENDER EQUITY



THE BIOLOGY DEPARTMENT AT VIRGINIA TECH ADDRESSES THE LEAKY PIPELINE IN STEM—THE FALLING AWAY OF WOMEN AND MINORITIES AS THEY PROGRESS THROUGH EDUCATION, TRAINING, AND THE WORKPLACE—BY INCORPORATING THE SOCIAL STUDIES OF SCIENCE INTO ITS BASIC BIOLOGY CURRICULUM. THE CURRICULUM DESIGN TAKES THE POSITION THAT TRADITIONAL SCIENCE COURSES UNCONSCIOUSLY REINFORCE AND TRANSMIT THE EXISTING CULTURES OF SCIENCE AND THAT THESE CULTURES ALIENATE WOMEN AND MINORITIES. REVEALING THE RULES OF SCIENCE MAY PROVIDE A PERSPECTIVE FOR STUDENTS TO RECOGNIZE AND UNDERSTAND BIASES AND DEVELOP STRATEGIES FOR RESISTANCE AND CHANGE.

In a transformed cell and molecular biology course, the content included readings on and discussions of history, ethics, and the influence of science on society and vice versa. Typical topics for student presentations were the social impact of the Human Genome Project and genetically modified foods. Tests consisted of short essays and fill-in-the-blank questions instead of multiple-choice options; answers were analyzed for students' demonstrating a broader view of biological epistemology and practice.

Student feedback indicates that going beyond memorizing and reciting facts helps students better understand material. For example, one student found that studying genetically modified foods led to an understanding of multinational corporations, governing authorities such as the World Bank, the economies of third world nations, and the lives of their people. Other students began to look at science from a perspective outside of science, asking why an experiment was done, or questioning the political and personal motivations that affect scientists and the relationship between science and social institutions.

A paper on the theory behind the project, titled "Teaching Science with the Social Studies of Science for Gender Equity," by Muriel Lederman, has been published in the *Journal of Women and Minorities in Science and Engineering*. A manuscript on the implementation of the theory, by Jill Sible, Dayna Wilhelm, and Muriel Lederman, "Teaching Cell and Molecular Biology for Gender Equity," has been accepted by *Cell Biology Education*. A chapter, "Biological Diversity," reflecting on the course transformation and its effects, will appear in *Letters from the Future: Linking Students and Teaching with the Diversity of Everyday Life,* by D. L. Brunson and others (Stylus Publishers, Sterling, Va.).

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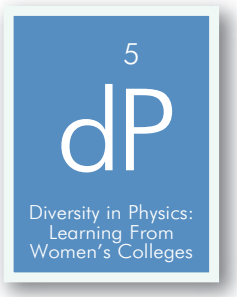
KEYWORDS: RESEARCH PROJECT, SELF-EFFICACY, CURRICULUM MATERIALS, LONGITUDINAL STUDY, MIXED GENDER, BIOLOGY, RETENTION, SCIENCE IN SOCIETY, SOCIAL STUDIES OF SCIENCE, ENGAGEMENT, EDUCATION, INTERDISCIPLINARY, CROSS-DISCIPLINARY CONTENT, REFLEXIVE WRITING, CURRICULAR CHANGE



DIVERSITY IN PHYSICS: LEARNING FROM WOMEN'S COLLEGES

WOMEN'S COLLEGES PRODUCE FEMALE SCIENTISTS AT TWICE THE RATE OF COEDUCATIONAL INSTITUTIONS. COLORADO COLLEGE RESEARCHERS ARE STUDYING THE PEDAGOGY, CURRICULUM, AND CULTURE OF PHYSICS DEPARTMENTS AT SIX WOMEN'S COLLEGES TO DETERMINE WHICH FACTORS LEAD TO THEIR SUCCESS IN RECRUITING AND RETAINING FEMALE PHYSICS MAJORS.

The study concentrates on physics departments because, of all the sciences, physics has the lowest rate of female participation at every professional level. Women earn 22 percent of bachelor's degrees granted in physics, as compared with 40 percent in life sciences; they earn 18 percent of Ph.D.,s in physics; and women hold only 10 percent of college faculty positions in physics.

The project builds on a previous NSF-sponsored study that compared the practices of undergraduate physics departments with low proportions of female majors against those with higher proportions. Researchers observed that departments successful at attracting female majors had several traits in common: a female-friendly departmental culture, an emphasis on cooperation rather than competition, and a strong connection with alumni. Researchers hypothesized that physics departments at women's colleges would exhibit similar characteristics.

A research team (consisting of two experienced female physicists, a sociologist, and a newly graduated physics major) visited institutions of diverse profiles, including Wellesley, Bryn Mawr, and Spelman colleges, and a Roman Catholic college. In addition, the team investigated one program in which physics majors took courses at a separate, coeducational institution.

Researchers interviewed female and male faculty, observed classes, and studied curricula to determine how physics instruction was modified for all-female classes. Tapes of interviews, notes on classroom observation, and other information were transcribed and coded using NUD*IST, a qualitative database program that allows cross-referencing among different categories of information. Researchers also referred to data from the earlier study for comparison.

In addition to confirming the results of the previous study, the researchers found that physics department faculty at women's colleges recruit students into the major by

- Providing an attractive curriculum and interactive pedagogy in the introductory class
- Including introductory students in the professional and social activities of the department
- Using astronomy and astrophysics to encourage students to major in physics
- Being more aware of gender issues
- Emphasizing high academic standards and goals
- Fostering a spirit of cooperation
- Building their students' self-confidence

Results are being presented at meetings of the American Association of Physics Teachers and the American Physical Society. They will also be submitted for publication in journals read by physics instructors and made available on a Web site.

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KEYWORDS: RESEARCH PROJECT, RECRUITMENT, RETENTION, GENDER-DIVERSITY AWARENESS, BARRIERS, GENDER DIFFERENCES, GENDER DYNAMICS, DEPARTMENTAL CLIMATE, ROLE MODELS, MENTORING, AFRICAN AMERICAN, PHYSICS, SITE VISITS, DATA COLLECTION

PATHWAY TO A STEM BACCALAUREATE DEGREE

MORE THAN 5 MILLION STUDENTS PURSUE CREDIT COURSES AT APPROXIMATELY 1,100 PUBLIC TWO-YEAR COLLEGES IN THE UNITED STATES. KNOWN FOR THEIR OPEN-ACCESS PHILOSOPHY, FLEXIBLE SCHEDULES, AND RELATIVELY LOW COSTS, THESE INSTITUTIONS ARE THE SCHOOLS OF CHOICE AMONG AMERICA'S MINORITIES, WHO REPRESENT ABOUT 30 PERCENT OF COMMUNITY COLLEGE ENROLLMENTS NATIONWIDE. FIFTY-EIGHT PERCENT OF COMMUNITY COLLEGE STUDENTS ARE WOMEN. THIS PROJECT SEEKS TO GIVE STUDENTS ENROLLED IN COMMUNITY COLLEGES THE TOOLS TO SUCCEED ACADEMICALLY IN THEIR PRE-STEM PREPARATION AS WELL AS IN THE TRANSFER PROCESS TO FOUR-YEAR COLLEGES OR UNIVERSITIES.

Three products are under development at Iowa State University:

- An instructional video series about the transition from two- to four-year colleges
- The Transfer Student Guide, which will contain research, recommendations, students' reflections, a time line, and a transfer checklist
- A Web site (http://www.pathway2stemdegree.org/) through which these two products and other educational resources will be disseminated to students in two-year colleges, educators in both two-year and four-year institutions, academic counselors and advisors, transfer-center coordinators, personnel in business and industry, researchers, policymakers, and the public

The instructional video series, titled *STEM Pathway: Community College to University*, will consist of four half-hour videos and accompanying manuals. To make these products, the research team will travel to community colleges across the country and interview faculty, program coordinators, and students. The Transfer Student Guide, intended primarily for students who aspire to transfer to four-year institutions, will be made available in Spanish as well as English for the benefit of Spanish-speaking parents.

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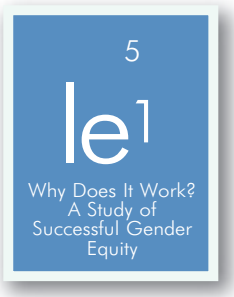
http://www.pathway2stemdegree.org/	05-07882
Keywords: dissemination project, education program, recruitment, career awareness, advancement, transition points, resource center, support system, dissemination plan, Web site, resource guide, minorities, community college, tools	



WHY DOES IT WORK? A STUDY OF SUCCESSFUL GENDER EQUITY IN INDUSTRIAL ENGINEERING AT THE UNIVERSITY OF OKLAHOMA

AS OF FALL 2001, 58 PERCENT OF THE UNDERGRADUATE MAJORS IN THE SCHOOL OF INDUSTRIAL ENGINEERING AT THE UNIVERSITY OF OKLAHOMA WERE WOMEN, A PROPORTION STRIKINGLY HIGHER THAN BOTH THE NATIONWIDE PROPORTION IN INDUSTRIAL ENGINEERING AND THE PROPORTION IN OTHER STEM DEGREE PROGRAMS AT THE UNIVERSITY. FURTHERMORE, THE PROPORTION MORE THAN DOUBLED IN THE SPACE OF FIVE YEARS, HAVING INCREASED STEADILY FROM 27 PERCENT IN 1996. THIS PHENOMENON WAS ESPECIALLY PUZZLING BECAUSE THE INDUSTRIAL ENGINEERING PROGRAM DID NOT SET OUT SPECIFICALLY TO ACCOMPLISH GENDER PARITY AMONG ITS UNDERGRADUATE MAJORS.

A multidisciplinary team of researchers investigated this phenomenon using an ethnographic research methodology, including interviews with students and faculty in the Industrial Engineering department, in other STEM departments, and at other institutions. Additional data included student academic transcripts, historical documents, and other artifacts. The team will also interview representatives from local industries that tend to employ interns and graduates of the program and will continue to disseminate its findings in a wide range of conference presentations and published articles.

To date, analysis points to four key findings:

- Industrial engineering majors seem to have a better-developed sense of professional identity than students in other majors and describe industrial engineering in ways that jibe with what the literature suggests attracts women.
- The industrial engineering student–faculty ratio is small and faculty members have taken advantage of this situation to nurture social networks. Furthermore, the department has a large number of faculty members whom the students perceive as caring about them.
- The department at University of Oklahoma does have a high proportion of women faculty, but this alone does not account for the gender parity at the undergraduate level. Other departments and fields show disparity between the proportion of women faculty and proportion of women students. In contrast to these other departments and fields, however, women faculty in industrial engineering at University of Oklahoma are highly visible to students before and after the students declare IE as a major, and female students in particular see these women as having characteristics that they value.
- The department has fostered strong ties among students. This sense of community seems to be especially important to the female majors. In addition, many of the women majors have been visible leaders in the department and in the college.

GRADE LEVEL: UNDERGRADUATE	
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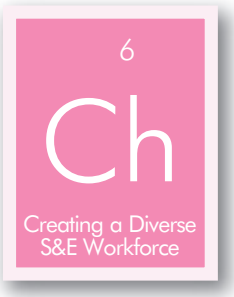
http://www.ou.edu/rise/Publication/PGE-RES/PGE-RES.htm	02-25228
Keywords: research project, recruitment, retention, gender-diversity awareness, career awareness, gender dynamics, departmental climate, engineering, evaluation, assessment	



CHAPTER SIX · CREATING A DIVERSE S&E WORKFORCE

THE PROJECTS IN THIS CHAPTER ADDRESS DIVERSITY WITHIN THE SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) WORKFORCE, PARTICULARLY REGARDING GENDER AND RACE OR ETHNICITY. RECENT RESEARCH HAS BEGUN TO DOCUMENT THE DRAMATIC BENEFITS OF DIVERSITY IN EDUCATIONAL INSTITUTIONS AND WORKPLACES. FOR EXAMPLE, IN HIGHER EDUCATION SETTINGS, WE KNOW THAT STUDENT INTERACTIONS WITH DIVERSE OTHERS CONTRIBUTE TO COMPLEX THINKING, INTELLECTUAL SELF-CONFIDENCE AND ENGAGEMENT, MOTIVATION TO UNDERSTAND THE PERSPECTIVES OF OTHERS, CITIZENSHIP, MOTIVATION TO ACHIEVE, AND INTEREST IN OBTAINING ADVANCED DEGREES.

HOWEVER, THE BENEFITS OF SUCH DIVERSITY ARE NOT BEING REALIZED IN STEM FIELDS, BECAUSE WOMEN AND RACIAL OR ETHNIC MINORITIES ARE NOT PRESENT IN MANY OF THOSE COLLEGE MAJORS IN REPRESENTATIVE NUMBERS—THEY FAIL TO ENTER, AND THOSE WHO DO TEND TO DROP OUT OF STEM MAJORS IN GREATER NUMBERS THAN DO THEIR WHITE MALE COUNTERPARTS. WE ALSO KNOW THAT THEY FACE A NUMBER OF BARRIERS TO ACADEMIC INCLUSION AND SUCCESS IN STEM MAJORS, INCLUDING INADEQUATE FACULTY SUPPORT AND MENTORING, STEREOTYPING, ABSENCE OF ROLE MODELS, PEER PRESSURE AND HARASSMENT, LACK OF CO-CURRICULAR OPPORTUNITIES, POOR SELF-EFFICACY, LOW PERFORMANCE EXPECTATIONS, AND NEGATIVE ATTRIBUTION PATTERNS.

IN WORKPLACES, THE EFFECTS OF INCREASED GLOBALIZATION, FLATTENED ORGANIZATIONAL HIERARCHIES, LARGE INFLUXES OF WOMEN, MINORITIES, AND IMMIGRANTS, AND WIDESPREAD USE OF WORK GROUPS AND TEAMS HAVE CREATED AN UNPRECEDENTED NEED TO ATTEND TO WORKER DIVERSITY (BRINGING PEOPLE "IN THE DOOR") AND INCLUSION (BRINGING PEOPLE "TO THE TABLE"). HOWEVER, STEM WORKPLACES HAVE BEEN INDICTED BOTH FOR INADEQUATE ATTAINMENT OF DIVERSITY (I.E., THE CONTINUED UNDERREPRESENTATION OF WOMEN AND MINORITIES IN STEM FIELDS, PARTICULARLY PHYSICS, ENGINEERING, COMPUTER SCIENCE, AND MATHEMATICS) AND FOR THE CONTINUED EXCLUSION OF WOMEN AND MINORITIES FROM POSITIONS OF POWER WITHIN ORGANIZATIONS (E.G., ATTAINING ORGANIZATIONAL TENURE OR MOVING INTO POSITIONS OF LEADERSHIP).

WE KNOW THAT A STRONG STEM WORKFORCE IS CRITICAL TO THE CONTINUED ECONOMIC LEADERSHIP OF THE UNITED STATES IN A GLOBAL MARKETPLACE. RESEARCH ALSO TELLS US THAT DIVERSITY CAN BE HIGHLY EFFECTIVE IN WORKPLACE TASKS REQUIRING INNOVATION AND EXPLORATION OF NEW OPPORTUNITIES AND IDEAS, THE HALLMARKS OF SCIENTIFIC PROGRESS. HOWEVER, WE ALSO KNOW THAT THE INTEGRATION OF DIFFERENT CULTURAL AND GENDERED BACKGROUNDS AND STYLES INTO PRODUCTIVE, SATISFIED WORK GROUPS CAN BE CHALLENGING. UNDERSTANDING THE UNIQUE POSITIONS AND CONCERNS OF DIVERSE WORKERS IS THE FIRST STEP TOWARD EFFECTIVE ATTEMPTS TO CREATE AND MAINTAIN A TRULY INCLUSIVE WORKFORCE, INCLUDING THE STEM WORKFORCE. EACH OF THE PROJECTS DESCRIBED IN THIS CHAPTER REPRESENTS AN ATTEMPT TO BETTER UNDERSTAND AND ARTICULATE THE CRITICALLY IMPORTANT INTERSECTION OF DIVERSITY AND THE STEM WORKFORCE.

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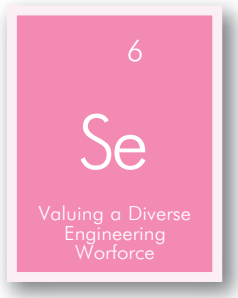

VALUING A DIVERSE ENGINEERING WORKFORCE

RECENT YEARS HAVE MARKED A RELATIVE DECLINE IN U.S. PRODUCTION OF ENGINEERING GRADUATES.

Montana State University is developing a technique to quantify the public and private economic benefits gained when universities produce a more diverse and, consequently, larger pool of STEM graduates.

A project team combining expertise in economics, engineering education, and diversity recruitment will apply the theory of "human capital" (which posits that investment in the training and education of personnel results in measurable economic returns) to a selected set of academic institutions. Researchers will determine the economic benefit of achieving STEM diversity and, conversely, the opportunity cost of failing to encourage women and minorities to enter the STEM career path.

The project team will interview engineers, academic administrators, and members of groups underrepresented in STEM fields in order to generate a framework for the systematic assessment of the economic benefit associated with STEM diversity. Because the framework will correlate economic benefit with specific institutional characteristics, it will serve as a valuable tool for designers and administrators of STEM diversity programs, as well as for policymakers wishing to ground their commitment to gender diversity in sound economic principles.

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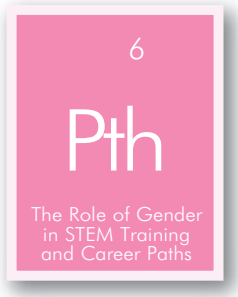
KEYWORDS: RESEARCH PROJECT, RECRUITMENT, SYSTEMIC REFORM, DESIGN-BASED, MINORITIES, QUANTITATIVE SCIENCES, ECONOMICS, DIVERSITY, ECONOMIC ANALYSIS, HUMAN CAPITAL, WORKFORCE



THE ROLE OF GENDER IN STEM TRAINING AND CAREER PATHS

WOMEN DROP OUT AT EVERY STEP ALONG THE PATH FROM A BACHELOR'S DEGREE TO A FACULTY POSITION IN STEM. INVESTIGATORS AT SETON HALL UNIVERSITY COMPARED THE ACADEMIC DEVELOPMENT OF WOMEN AND MEN IN PHYSICS, ENGINEERING, AND MATHEMATICS TO IDENTIFY REASONS FOR DIFFERENCES IN THEIR CAREER CHOICES.

A questionnaire sent to doctoral recipients who graduated in the years 1988–92 from the top 10 ranked universities in physics, engineering, and mathematics (as identified by the National Research Council) found that men, overall, were more satisfied than women with the support they received during their studies and in looking for a job. Men were twice as likely as women to report that a faculty or thesis advisor helped them land their first job. Although women pursue tenure-track faculty positions at the same rate as men, they continue to be hired at a lower rate. Thirty-six percent of women surveyed said the combination of discrimination and sexual harassment drove them out of the field of chemistry altogether.

These and other findings will be communicated widely and especially to the administrators at the elite academic institutions in the sample. The researchers hope the findings will form the basis for thoughtful and critical discussion of the status of women and lead to institutional self-evaluation and reform.

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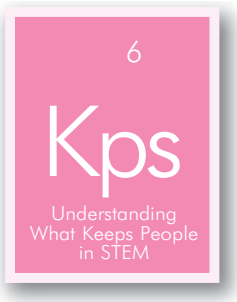
KEYWORDS: RESEARCH PROJECT, GENDER DIVERSITY AWARENESS, ADVANCEMENT, DEPARTMENTAL CLIMATE, LONGITUDINAL STUDY, QUESTIONNAIRE, MIXED GENDER, ENGINEERING, PHYSICS, MATH SKILLS, WORKFORCE, DIVERSITY, DEPARTMENTAL CLIMATE, CAREER CHOICE



UNDERSTANDING WHAT KEEPS PEOPLE IN STEM

AT PRESENT, IT IS NOT WELL UNDERSTOOD HOW THE RESPONSES TO SCHOOL- AND WORK-RELATED EXPERIENCES OF INDIVIDUALS WHO PURSUE CAREERS IN STEM DIFFER FROM THOSE WHO DO NOT. RESEARCHERS AT THE UNIVERSITY OF SOUTH FLORIDA ARE LOOKING AT RESULTS FROM TWO INTERRELATED STUDIES TO UNDERSTAND HOW STRUCTURAL SUPPORTS AND BARRIERS AFFECT STUDENT OUTCOMES, INCLUDING STUDENTS' MOTIVATION TO EMBARK ON STEM-CAREER PATHWAYS:

- The Cohort Study of STEM Career Outcomes tracks the courses taken and postsecondary outcomes of 82,000 Florida high school graduates from the class of 1996–97, uncovering demographic and experience variables associated with the pursuit of STEM-related careers. The researchers are also analyzing outcomes for two additional cohorts of Florida university and college graduates who received degrees in both STEM and non-STEM fields. These cohorts finished their studies in either 1996–97 or 2002–03.
- The Retrospective Study of STEM Career Outcomes provides a detailed look at the range of motivations, opportunities, obstacles, and structural constraints of 150 individuals in STEM careers. The data will be compared with a matched group of 150 individuals with similar credentials who have not pursued STEM careers. Data from the 1996–97 high school cohort are being used in this analysis.

Combining and analyzing the results of these studies will provide information on the key background factors and experiences that affect STEM career persistence. Investigators will examine in detail the differences in career paths of individuals who have pursued different types of STEM careers. Both studies are informed by an interest in the economic outcomes of affirmative action policies in higher education.

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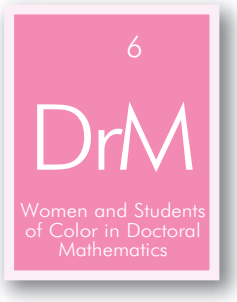
http://web3.cas.usf.edu/main/depts/ANT/AAREA/STEM.html	03-37543
Keywords: research project, barriers, environmental factors, longitudinal study, mixed-gender, career choice, retention	

WOMEN AND STUDENTS OF COLOR IN DOCTORAL MATHEMATICS

AT THE UNIVERSITY AT ALBANY, STATE UNIVERSITY OF NEW YORK, A RESEARCHER IS EXAMINING FACTORS THAT AFFECT THE PARTICIPATION OF WOMEN, LATINOS AND LATINAS, AND AFRICAN AMERICANS IN GRADUATE PROGRAMS IN THE MATHEMATICAL SCIENCES. THE RESEARCH WILL INCLUDE CASE STUDIES OF FIVE DOCTORAL PROGRAMS IN WHICH WOMEN AND STUDENTS OF COLOR HAVE BEEN MORE SUCCESSFUL THAN HAS BECOME THE NORM ELSEWHERE.



The investigator is looking at student success from both institutional and individual points of view, guided by policy and situated learning perspectives. She hopes to identify what it takes to succeed in doctoral mathematics, the obstacles faced by women and students from underrepresented groups, and the actions some programs have taken to help all students succeed. One explicit goal is to develop concrete recommendations that mathematics faculty and policymakers can follow to increase the diversity of students who enroll in and graduate from doctoral mathematics programs. Another is to improve the experiences of students while they are enrolled.

Study results will be disseminated within the mathematics community through conference presentations and publications and will be used to help leaders in other mathematical sciences programs enhance their diversity efforts. The project will also train elementary and secondary mathematics teachers to engage children of all backgrounds.

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Keywords: research project, professional development, retention, persistence, barriers, advancement, departmental climate, longitudinal, mentoring, ethnographic, survey, minorities, mathematics, policy, women, case studies, diversity, graduate students, doctoral students, situated learning, career choice

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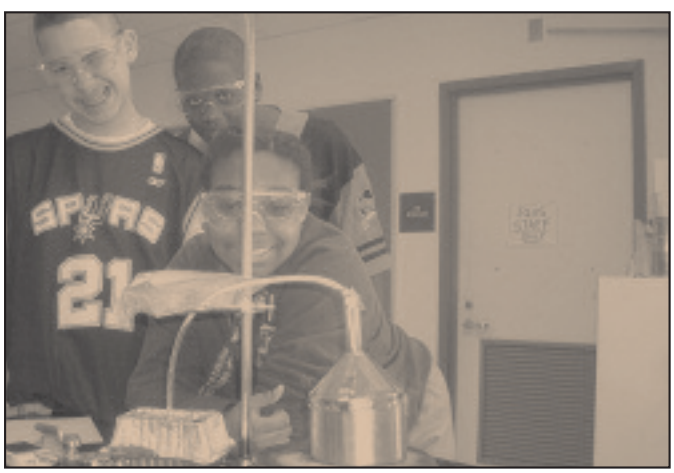
Women in Chemical Business and Industry

WOMEN IN CHEMICAL BUSINESS AND INDUSTRY

MUCH RESEARCH HAS EXPLORED WHY WOMEN ARE UNDERREPRESENTED IN ACADEMIC STEM SETTINGS, BUT THERE ARE VIRTUALLY NO DATA REGARDING WHY WOMEN FAIL TO ENTER INDUSTRIAL SETTINGS IN PREDICTABLE NUMBERS OR WHAT HAPPENS TO WOMEN WHO DO. MOREOVER, VERY LITTLE IS KNOWN ABOUT THE PREVALENCE OR EFFECTIVENESS OF STRATEGIES CURRENTLY USED TO ADDRESS THE SCARCITY OF WOMEN IN INDUSTRY.

Through Project ENHANCE, investigators at the University of Maryland–College Park are seeking to understand the experiences of women scientists and engineers. Project ENHANCE uses the chemical industry as a model sector to document and analyze the career paths of women formally trained in science and engineering and then identify effective corporate practices for recruiting, retaining, and promoting women.

The Project ENHANCE researchers are seeking out patterns and influences that affect the roles women play in the chemical industry. They are looking at women's individual experiences to uncover both barriers and supports to women's careers. Finally, they are aiming to identify formal and informal strategies for increasing women's participation in the chemical industry and the effectiveness of these strategies.



Investigators have collected survey data on more than 1,700 women trained in science and engineering who work in the chemical industry. These women represent 25 Fortune 1000 companies, and the researchers were assisted by several professional organizations, including the American Chemical Society's Women Chemists Committee, the Women's Initiatives Committee of the American Institute of Chemical Engineers, the Association for the Advancement of Women in Science, and the American Chemistry Council. Survey questions addressed such issues as stress and coping, career advancement, support from others, workplace climate, the home–work interface, advancement into leadership, and mentoring.

In addition, the investigators have conducted follow-up interviews with a diverse subset of the survey respondents. They are also analyzing data collected from 250 company managers and are identifying interventions that are effective in supporting women's careers in industry.

Preliminary survey results are available at the Project ENHANCE Web site (http://www.education.umd.edu/EDCP/enhance_site/). The site also offers links to resources for women in science. The researchers are disseminating their findings through presentations and written publications.

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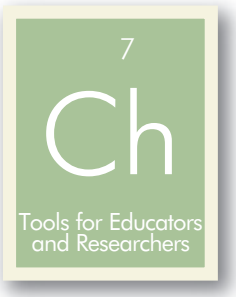
KEYWORDS: RESEARCH PROJECT, RECRUITMENT, BARRIERS, GENDER DIFFERENCES, INTERVENTION, BEST PRACTICES, ADVANCEMENT, ENVIRONMENTAL FACTORS, LONGITUDINAL STUDY, MENTORING, QUESTIONNAIRE, CAREER CHOICE, WORKFORCE	



CHAPTER SEVEN · TOOLS FOR EDUCATORS AND RESEARCHERS

WORKING ON THE COMPLEX CHALLENGES OF NARROWING THE GENDER GAP IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) REQUIRES A BROAD ARRAY OF STRATEGIES AND RESOURCES. INFORMAL EDUCATION PROGRAMS VARY IN STRUCTURE AND PROCESS FROM CLASSROOM INSTRUCTION AND OFTEN REQUIRE SPECIFIC TRAINING AND MATERIALS TO CREATE AN EFFECTIVE INTERVENTION. SIMILAR CHALLENGES EXIST IN DEVELOPING INITIATIVES TO ENGAGE HIGHER EDUCATION FACULTY FROM SCIENCE AND ENGINEERING DISCIPLINES IN PROGRAMS AND ACTIVITIES THAT ENCOURAGE GIRLS AND WOMEN TO CHOOSE STEM CAREERS.

PROJECTS IN THIS CHAPTER SEEK TO DISSEMINATE TOOLS AND KNOWLEDGE DEVELOPED FOR AUDIENCES RANGING THROUGH ALL LEVELS OF EDUCATION, AS WELL AS FORMAL AND INFORMAL LEARNING ENVIRONMENTS. INNOVATIVE IMPLEMENTATION STRATEGIES, SUCH AS COMPREHENSIVE SUPPORT SYSTEMS, COLLABORATIVE NETWORKS, HANDS-ON ACTIVITY KITS, EFFECTIVE USE OF DIGITAL RESOURCES, AND TRANSLATION OF RESEARCH INTO PRACTITIONER-FRIENDLY PROGRAMS, PROVIDE OPPORTUNITIES TO ENGAGE A BROADER AUDIENCE IN STEM EDUCATION AND PROGRAMS.

THE POTENTIAL FOR SIGNIFICANT PROGRESS TOWARD SUSTAINABLE OUTCOMES IS GREATLY ENHANCED BY THE PROJECTS HIGHLIGHTED HERE. BUT EVEN MORE PROGRESS WILL RESULT AS FUTURE RESEARCHERS TAKE ADVANTAGE OF THE EXPERTISE AND OUTCOMES OF THESE NSF-FUNDED PROJECTS AND THOSE OF OTHER GENDER-EQUITY SCHOLARS AND REGIONAL AND NATIONAL EXTENSION SERVICES.

KAREN PETERSON, EXECUTIVE DIRECTOR, PUGET SOUND CENTER FOR TEACHING, LEARNING, AND TECHNOLOGY

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Intergenerational Working Conference on Women

INTERGENERATIONAL WORKING CONFERENCE ON WOMEN AND SCIENCE RESEARCH

TWO GENERATIONS OF WOMEN-IN-STEM SCHOLARS—THOSE WHOSE RESEARCH EMERGED IN THE 1960S AND THOSE WHO BEGAN THEIR WORK IN THE 1990S—WILL GATHER IN LOWELL, MASSACHUSETTS, FOR A CONFERENCE ON WOMEN'S WORKPLACE ISSUES IN STEM HOSTED BY THE CENTER FOR WOMEN AND WORK AT THE UNIVERSITY OF MASSACHUSETTS–LOWELL. SENIOR SCHOLARS WILL PASS KNOWLEDGE AND EXPERIENCE TO THEIR JUNIOR COLLEAGUES, AND TOGETHER THEY WILL CREATE NEW, INTERGENERATIONAL PROFESSIONAL NETWORKS AND RESEARCH COLLABORATIONS.

In the project's first stage, conference organizers and core participants (nominated by the organizers in consultation with an advisory panel) will identify critical themes in past research on the status of women in STEM. Then a larger group of scholars will discuss these themes at the working conference. Finally, participants will reunite for a workshop to digest conference results and plan conference-associated publications.

In addition to engaging the questions that emerge from this unique dialogue across generations, conference participants will define current standards by creating a women-in-STEM research review applicable across disciplines, incorporating citation analysis and the use of the Delphi method. Most important, the conference will ensure that today's women-in-STEM scholars preserve and build upon the insights of the generation that preceded them.

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KEYWORDS: DISSEMINATION PROJECT, PROFESSIONAL DEVELOPMENT, CAREER AWARENESS, SYSTEMIC REFORM, ROLE MODELS, MENTORING, MULTIGENERATIONAL, PUBLICATION, RESEARCH TRENDS, WORKFORCE

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kd
Resources for K–12 Services and Experiential Learning

RESOURCES FOR K–12 SERVICE AND EXPERIENTIAL LEARNING IN STEM

THE UNIVERSITY OF DAYTON IS DEVELOPING A WEB SITE OF RESOURCES FOR K–12 STEM TEACHERS, OFFERING INFORMATION ON HANDS-ON (EXPERIENTIAL) AND COMMUNITY-BASED (SERVICE) LEARNING. THE INVESTIGATORS WILL EVALUATE, DISTILL, AND CLASSIFY THE MOST EASY-TO-USE, INEXPENSIVE, AND EFFECTIVE METHODS. HAVING A CENTRAL, USER-FRIENDLY, AND EASILY ACCESSIBLE REPOSITORY FOR THESE RESOURCES WILL MAKE IT EASIER FOR TEACHERS TO IDENTIFY AND USE THEM IN THEIR CURRICULA.

Hands-on and community-based projects help students make connections between STEM subjects and real-world issues, which in turn increases student interest in STEM disciplines. This approach has been shown to enhance the interest of girls and other underrepresented populations in these fields. The use of service learning also teaches students social responsibility and ethics, showing them the human side of science, math, and engineering.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, HIGH SCHOOL, PROFESSIONAL DEVELOPMENT
UNIVERSITY OF DAYTON
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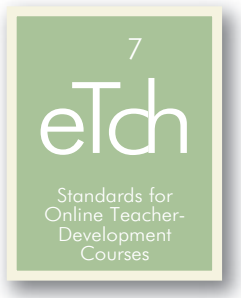
05-33544
KEYWORDS: DISSEMINATION PROJECT, ENGAGEMENT, SKILLS, LEARNING COMMUNITY, RESOURCE CENTER, HANDS-ON, ENGAGED LEARNING, EXPERIMENT-BASED, REAL-LIFE APPLICATIONS, COMMUNITY SERVICE, EXPERIENTIAL LEARNING, WEB SITE, COMMUNITY SERVICE, CURRICULUM MATERIALS, PEDAGOGY



STANDARDS FOR ONLINE TEACHER-DEVELOPMENT COURSES

TERC, A NOT-FOR-PROFIT EDUCATION RESEARCH AND DEVELOPMENT ORGANIZATION BASED IN CAMBRIDGE, MASSACHUSETTS, IS CONDUCTING A STUDY TO DETERMINE WHICH CHARACTERISTICS OF ONLINE SCIENCE COURSES FOR TEACHERS CORRELATE WITH POSITIVE LEARNING OUTCOMES FOR FEMALE STUDENTS.

The study has two phases. In the first, researchers surveyed and analyzed 40 online science courses for teachers. For the second phase, researchers have selected a subset of 25 courses for in-depth examination and are now using their findings to develop recommendations for national standards, addressing interactivity, accessibility, and other topics.

The project staff and the advisory committee comprise highly experienced online developers, science educators, professional development experts, and educational researchers with experience in diversity and gender issues. Half of the programs being examined in depth are nonprofit educational organizations; the others are university affiliated. Two are associated with master's programs for teachers.

GRADE LEVEL: PROFESSIONAL DEVELOPMENT	
TERC (Massachusetts)	
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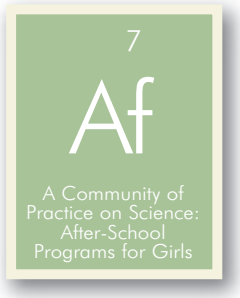
03-32602	
Keywords: research project, professional development, best practices, teacher training, research-based, design-based, survey, online tutorials, computer technology, computer programming	



A COMMUNITY OF PRACTICE ON SCIENCE: AFTER-SCHOOL PROGRAMS FOR GIRLS

THE INFORMAL, NONCOMPETITIVE ATMOSPHERE OF AFTER-SCHOOL PROGRAMS MAKES THEM ESPECIALLY SUITED TO ENGAGING GIRLS' INTEREST IN STEM. THE EDUCATIONAL EQUITY CENTER AT THE ACADEMY FOR EDUCATIONAL DEVELOPMENT, IN COLLABORATION WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, HAS CREATED A WEB SITE (HTTP://WWW.AFTERSCHOOL.ORG/SGA/) WHERE TEACHERS, RESEARCHERS, AND POLICYMAKERS CAN SHARE KNOWLEDGE ABOUT THE INTERSECTION OF SCIENCE, GENDER, AND AFTER-SCHOOL (SGA) PROGRAMS.

The SGA Community of Practice allows after-school practitioners from across the country to share their research, program evaluations, curricula, "best practices," and publications. Members engage in dialogue through online Webcasts, threaded discussions, bulletin boards, and electronic discussion lists.

The forum is an extension of the 2002 Science, Gender, and Afterschool Conference. At the conference, participants developed *Science, Gender, and Afterschool: A Research-Action Agenda* (publication available on the SGA Web site). The *Agenda* divides SGA research into three key areas: recruiting girls to after-school programs and retaining them once they've joined; program content and pedagogy; and staffing and professional development. The Web site includes discussion of these issues along with links to research materials, curriculum information, and other organizations dedicated to advancing STEM education through after-school programs.

GRADE LEVEL: PROFESSIONAL DEVELOPMENT	
Educational Equity Concepts, Inc., Academy for Educational Development, and American Association for the Advancement of Science (New York)	
Merle Froschl (mfroschl@aed.org)	
http://www.afterschool.org/sga/	04-10552
Keywords: dissemination project, professional development, recruitment, engagement, after-school, resource center, collaborative network, dissemination plan, Web site, manual, resource guide, informal education, best practices, retention, teacher training, conference, action plan, school-based, after-school, curriculum materials, community of practice	

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Collaborative Projects Across the Nation

COLLABORATIVE PROJECTS ACROSS THE NATION

THE EXPERIENCE OF GIRLS' STEM EDUCATION PROGRAMS ACROSS THE COUNTRY HAS GENERATED A WEALTH OF EXPERTISE IN PROMOTING STEM DIVERSITY. THE PUGET SOUND CENTER FOR TEACHING, LEARNING, AND TECHNOLOGY (PSCTLT) HAS FORMED TWO REGIONAL NETWORKS THAT ENABLE ORGANIZATIONS TO SHARE KNOWLEDGE: THE NORTHWEST GIRLS COLLABORATIVE (NWGC), WHICH BROUGHT TOGETHER PROGRAMS FROM WASHINGTON AND OREGON, AND THE NATIONAL GIRLS COLLABORATIVE PROJECT (NGCP), WHICH EXTENDS THE NETWORKING EFFORT TO CALIFORNIA, INDIANA, AND MASSACHUSETTS. IN ADDITION, THE TEXAS CENTER FOR EDUCATIONAL TECHNOLOGY AT THE UNIVERSITY OF NORTH TEXAS HAS ESTABLISHED THE SOUTHCENTRAL GIRLS COLLABORATIVE PROJECT (SCGCP), LINKING ORGANIZATIONS FROM ARKANSAS, LOUISIANA, NEW MEXICO, OKLAHOMA, AND TEXAS.

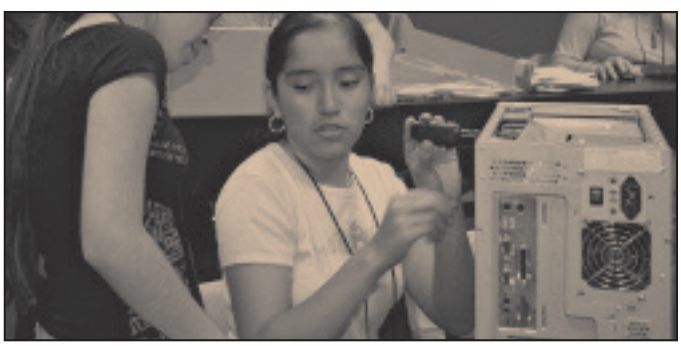
In an allied project, the Midwestern Rural-Urban Collaborative (MRUC), a joint effort of Southwest Missouri State University and Drury University, will build networks in Missouri, Kansas, and northeastern Oklahoma. MRUC's special mission will be to reach girls in rural communities, which typically lack access to such resources.

All these programs were designed using the PSCTLT strategy for network-building, which has four main components:

- *Outreach:* A regional industry and community "Champions Board" involves the community and engenders support and visibility. This advisory board, with members drawn from STEM fields, identifies regional organizations promoting girls' STEM education.
- *Forums and conferences:* At events throughout the targeted region, facilitators of STEM diversity programs share ideas and information, using videoconferencing and online technology to maximize participation and supplement face-to-face networking.
- *Minigrants:* To encourage collaboration, small grants are awarded to groups developing projects that will enhance the delivery of STEM programs to girls.
- *Online program directory:* STEM programs provide information about needs and resources to help organizations network, identify collaboration opportunities, and share resources.

United by NWGC into a regional network, organizations in the Northwest have gained from one another's experience, collaborated to develop a standard rubric for program evaluation, and managed resources to the greatest advantage of girls' STEM education. By forging connections among researchers and advocates for STEM diversity, they have formed the infrastructure needed to sustain and develop smaller, local programs. And their combined public profile has raised community awareness of the need for increased girls' participation in STEM.

NGCP, MRUC, and SCGCP will carry the network to further regions, so that knowledge gained by one program will be shared by all.



GRADE LEVEL: PROFESSIONAL DEVELOPMENT	
NATIONAL GIRLS COLLABORATIVE PROJECT AND NORTHWEST GIRLS COLLABORATIVE	
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SOUTHCENTRAL GIRLS COLLABORATIVE PROJECT	
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KEYWORDS: DISSEMINATION PROJECT, GENDER-DIVERSITY AWARENESS, RESOURCE CENTER, SUPPORT SYSTEM, COLLABORATIVE NETWORK, DISSEMINATION PLAN, WEB SITE, CONNECTIONS, RURAL, URBAN, EVALUATION, AFTER-SCHOOL, INFORMAL EDUCATION, REGIONAL NETWORK	

OPPORTUNITIES FOR WISCONSIN WOMEN

WHILE WISCONSIN HAS MANY SCIENCE AND ENGINEERING PROGRAMS AIMED AT GIRLS AND YOUNG WOMEN, TEACHERS AND CAREER COUNSELORS ARE OFTEN UNAWARE OF THESE RESOURCES. OPPORTUNITIES FOR WISCONSIN WOMEN IN SCIENCE, TECHNOLOGY, AND ENGINEERING (OWWSTE) WILL INTRODUCE WISCONSIN EDUCATORS TO REGIONAL AND NATIONAL PROGRAMS THAT PROMOTE GIRLS' STEM EDUCATION.

OWWSTE will work closely with the Wisconsin Department of Public Instruction, the Wisconsin Science Network, and the Wisconsin Academy for Staff Development Initiatives to identify school districts that have a low percentage of women taking upper-level STEM courses. These agencies will then help select appropriate counselor and teacher leaders for program training; these educators will be invited to a summer workshop, where they will acquire media, instructional tools, and training they can then share with peers in their districts. Materials disseminated through the workshop will include detailed outlines of lesson plans for in-service workshops. Also included will be a video featuring a discussion of gender-conscious pedagogy, information about STEM programs available to girls and young women in Wisconsin, and interviews with successful women scientists from Wisconsin.

Educators will discuss ways to avoid gender bias in STEM education and strategies to draw promising female students into STEM careers. University of Wisconsin faculty trained by the NSF-sponsored Women and Science Project will participate in workshop sessions.

The program aims to increase girls' interest in STEM fields by 10 percent, as measured by a survey of female juniors and seniors at participating high schools.

GRADE LEVEL: HIGH SCHOOL, POSTGRADUATE
Opportunities for Wisconsin Women in Science, Technology, and Engineering, Wisconsin Department of Public Instruction, Wisconsin Science Network, and Wisconsin Academy for Staff Development Initiatives
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Keywords: dissemination project, education program, professional development, retention, co-curricular, teacher training, counselor training, workshop(s), role models, video, publication, tools, collaborative network, regional network

SEEING GENDER: TOOLS FOR CHANGE

TO ENCOURAGE SENSITIVITY TO GENDER ISSUES IN SCIENCE INSTRUCTION, KANSAS STATE UNIVERSITY IS DEVELOPING AN INTERACTIVE CD-ROM SET FOR INCOMING AND ACTIVE HIGH SCHOOL TEACHERS, TEACHER EDUCATION FACULTY, AND COLLEGE FACULTY IN STEM FIELDS.

The CD-ROM set includes

- Segments on research, bias, and classroom interventions
- Interviews with high school teachers and college faculty about how they became sensitive to gender issues and helped promote reform
- Interviews with researchers familiar with studies on gender bias in the fields of psychology and education
- Abstracts of relevant journal articles
- Essays that invite further reflection
- Interactive activities to support reflection by the users
- Resources for teachers to use in their classrooms

To ensure the product's effectiveness, researchers have conducted field tests with STEM teachers and faculty. They have also created guidelines for introducing the CD-ROM to incoming teachers in classroom settings and to active teachers and college faculty in professional development seminars.

GRADE LEVEL: PROFESSIONAL DEVELOPMENT
Kansas State University
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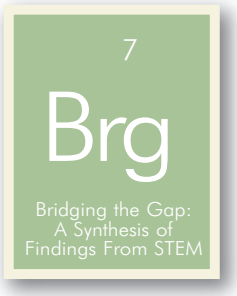
Keywords: demonstration project, engagement, gender-diversity awareness, barriers, gender differences, gender dynamics, systemic reform, departmental climate, environmental factors, all-year, teacher training, staff training, counselor training, support system, dissemination plan, survey, CD-ROM/DVD, journal articles, school-based, informal education, tools, curriculum materials



BRIDGING THE GAP: A SYNTHESIS OF FINDINGS FROM STEM

FROM 1993 THROUGH 2001, NSF AND THE AMERICAN ASSOCIATION OF UNIVERSITY WOMEN (AAUW) FUNDED HUNDREDS OF PROJECTS INTENDED TO INCREASE GIRLS' AND WOMEN'S PARTICIPATION IN AND EQUAL ACCESS TO LEARNING OPPORTUNITIES IN STEM. TO DOCUMENT THIS PERIOD, AAUW COMPILED A SUMMARY OF 175 PROJECTS SUPPORTED BY NSF AND 200 BY AAUW.

The research team summarized findings in the following areas:

- Gender differences in math and science skills and performance
- Differences among girls based on ethnicity and race
- Approaches that successfully engage female students
- Factors that influence girls and women to pursue study in STEM fields
- Turning points for female STEM majors in higher education
- Factors that determine persistence in STEM at the graduate school level

These findings are published in the report *Under the Microscope: A Decade of Gender Equity Projects in the Sciences*. They have been disseminated widely to education policymakers, teachers, and administrators through AAUW's publishing and marketing programs.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, HIGH SCHOOL, UNDERGRADUATE, POSTGRADUATE, PROFESSIONAL DEVELOPMENT, INFORMAL	
AMERICAN ASSOCIATION OF UNIVERSITY WOMEN (DISTRICT OF COLUMBIA)	
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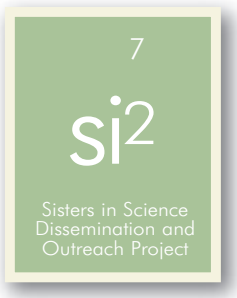
HTTP://WWW.AAUW.ORG/RESEARCH/MICROSCOPE.CFM	02-20556
KEYWORDS: DISSEMINATION PROJECT, EVALUATION, ENGAGEMENT, RETENTION, GENDER-DIVERSITY AWARENESS, GENDER DIFFERENCES, GENDER DYNAMICS, ACHIEVEMENT, SURVEY, PUBLICATIONS, MARKETING MATERIALS, MINORITIES (ETHNIC AND RACIAL), MATH, TRANSITION POINTS, TOOLS, DATA COLLECTION, ASSESSMENT, EVALUATION, RESEARCH TRENDS	



SISTERS IN SCIENCE DISSEMINATION AND OUTREACH PROJECT

THE SISTERS IN SCIENCE DISSEMINATION AND OUTREACH PROJECT (SISDO) DISSEMINATES TO A NATIONAL AUDIENCE THE CURRICULA, RESEARCH FINDINGS, AND PROFESSIONAL DEVELOPMENT METHODS GENERATED BY THE NSF-SUPPORTED SISTERS IN SCIENCE EQUITY REFORM PROJECT (SISERP).

SISERP, a CUNY Queens College initiative, developed and implemented five programs committed to STEM gender diversity: Sisters in Science, All Sisters in Science, Sisters in Science in the Community, Sisters in Science in Career Choices That Matter, and Sisters in Sports Science.

These programs have proven their efficacy with measurable results. Girls who participated in Sisters in Science, for example, showed statistically significant increases on math and science assessment tests and expressed more positive attitudes toward STEM careers. After two years of participation in the study, the girls also displayed more self-confidence and assertiveness in STEM classrooms. Teachers benefited as well: they reported heightened awareness of gender-diversity issues, especially regarding the different learning styles of girls and boys.

A wide variety of SISDO materials are available at its Web site (http://www.sistersinscience.org). They include curriculum modules, a quarterly newsletter that reports new research findings, a publication series on gender diversity and science education, and a book that synthesizes teachers' experience and academic research.

In addition, SISDO facilitates educational programs, including an annual conference, a three-day Summer Institute for K–12 educators, and a range of workshops, symposia, and in-service courses.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, HIGH SCHOOL, PROFESSIONAL DEVELOPMENT	
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PENNY HAMMRICH (PENNY_HAMMRICH@QC.EDU)	
HTTP://WWW.SISTERSINSCIENCE.ORG	04-36221
KEYWORDS: DISSEMINATION PROJECT, PROFESSIONAL DEVELOPMENT, RESEARCH FINDINGS, GENDER-DIVERSITY AWARENESS, CURRICULUM MATERIALS, BEST PRACTICES, TEACHER TRAINING, RESOURCE CENTER, DISSEMINATION PLAN, WEB SITE, NEWSLETTER, PUBLICATION, SUMMER, URBAN, DISABLED, BARRIERS, INFORMAL EDUCATION, INTERNSHIPS, INTERVENTION, INFORMAL, AFTER-SCHOOL, MULTIGENERATIONAL, BOOK SERIES, CONFERENCE	

DISSEMINATING NATIONAL SCIENCE PARTNERSHIP KITS

THE FRANKLIN INSTITUTE AND GIRL SCOUTS OF THE USA ARE DISSEMINATING MATERIALS AND RESOURCES DEVELOPED BY THE NSF-SUPPORTED NATIONAL SCIENCE PARTNERSHIP FOR GIRL SCOUTS AND SCIENCE MUSEUMS (NSP). AT THE HEART OF THE NSP PROGRAM ARE SCIENCE ACTIVITY KITS THAT LEADERS CAN USE TO ENGAGE THEIR GIRLS IN SCIENTIFIC THINKING AND HANDS-ON DISCOVERY. EACH KIT INCLUDES A RANGE OF GROUP AND INDIVIDUAL ACTIVITIES DESIGNED FOR ABOUT 15 GIRLS, AND CONTAINS A LEADER GUIDE WITH INSTRUCTIONS AND EXPLANATION OF THE RELEVANT SCIENCE IN CLEAR, STRAIGHTFORWARD LANGUAGE. THE ACTIVITIES ARE ORGANIZED BY WEEK, CAN BE COMPLETED IN FIVE TO SEVEN SESSIONS, AND INCLUDE HANDOUTS IN SPANISH AND ENGLISH.

In addition, NSP has published *Partners in Science: An NSP Guidebook,* a manual for the development of new site partnerships between Girl Scouts and other science-strong institutions, as well as strategies for implementating NSP in a variety of venues, including camps, public housing, rural communities, detention centers, homeless shelters, schools, and after-school programs.

NSP's new dissemination model eliminates its previous requirement that museums or Girl Scout councils become network members or that troop leaders undergo special training by their area museum or Girl Scout council partners in order to gain access to the kits. Instead, kits are now available to any Girl Scout leader through the NSP Web site (http://www.fi.edu/tfi/programs/nsp.html), along with instructional aids, video, and Web-based support.

GRADE LEVEL: ELEMENTARY SCHOOL, MIDDLE SCHOOL, PROFESSIONAL DEVELOPMENT	
FRANKLIN INSTITUTE AND GIRL SCOUTS OF THE USA (PENNSYLVANIA)	
DALE MCCREEDY	
HTTP://SLN.FI.EDU/TFI/PROGRAMS/NSP.HTML	04-36249
KEYWORDS: DISSEMINATION PROJECT, GIRL SCOUTS, INFORMAL EDUCATION, ENGAGEMENT, TEACHER TRAINING, MENTOR TRAINING, CLUB, HANDS-ON, ENGAGED LEARNING, ACTIVITY-BASED, MENTORING, SUPPORT SYSTEM, DISSEMINATION PLAN, RURAL, MUSEUM, AFTER-SCHOOL, CURRICULUM MATERIALS	

ENGINEERING EQUITY EXTENSION SERVICE

OVER A FIVE-YEAR PERIOD, THE CENTER FOR THE ADVANCEMENT OF SCHOLARSHIP ON ENGINEERING EDUCATION OF THE NATIONAL ACADEMY OF ENGINEERING WILL IMPLEMENT AN ENGINEERING EQUITY EXTENSION SERVICE (EEES). EEES WILL BE A COMPREHENSIVE, RESEARCH-BASED CONSULTATIVE AND PEER-MENTORING INFRASTRUCTURE THAT SUPPORTS GREATER GENDER DIVERSITY IN ENGINEERING EDUCATION BY REACHING OUT TO TEACHERS AND FACULTY WHO MAY NOT ALREADY HAVE AN INTEREST IN GENDER-DIVERSITY ISSUES.

EEES will promote understanding of issues that affect recruitment and retention in engineering in

- Preparing girls in grade six through sophomore year of college for engineering studies
- Social environment inside and outside the classroom
- Curricular content
- Curricular scope and course sequence
- Curriculum delivery and instructional style

EEES will engage faculty and teachers by facilitating access to STEM gender-studies experts and the resources of National Academy of Engineering. Campbell-Kibler Associates is providing expertise in applying research on gender-diversity principles to teacher and faculty professional-development activities, such as instructional practices, curricular and laboratory content, and outreach work.

Additional partners in developing EEES include the American Society of Mechanical Engineers, the Institute of Electrical and Electronic Engineers, Project Lead the Way, and the National Association of Partnerships for Equity. This will allow the service to provide a network of "extension agents" on gender diversity among national engineering organizations. All such partner organizations will be selected on the basis of their broad reach, existing emphasis on professional development for their members and affiliates, and demonstrated capacity to influence activities in classrooms where engineering is taught.

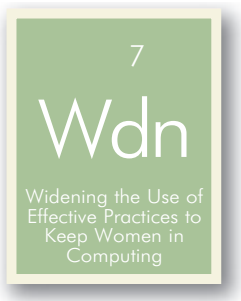
Various opportunities for professional development will be available for teachers and faculty on the Web, including

- Expert-mediated technical assistance forums
- Peer-led discussion sessions
- Access to archived materials

EEES will also provide a handbook for proposing and managing engineering education projects and for conducting workshops on engineering education at regional and national meetings. This handbook will unite the areas of gender diversity, engineering education, and project management into a seamless whole.

In evaluating the service, Goodman Research Group will look for changes in instructor attitudes and measure the impact and extent of instructor participation.

GRADE LEVEL: PROFESSIONAL DEVELOPMENT
National Academy of Engineering (California, District of Columbia, Massachusetts)
Norman Fortenberry (nfortenb@nae.edu)
05-33520
Keywords: extension service project, recruitment, engagement, retention, gender-diversity awareness, curriculum materials, gender differences, systemic reform, best practices, departmental climate, environmental factors, all-year, longitudinal study, teacher training, staff training, workshops, action plan, publications, school-based, engineering, industry partners, transition points, tools, assessment tools



WIDENING THE USE OF EFFECTIVE PRACTICES TO KEEP WOMEN IN COMPUTING

THE NATIONAL CENTER FOR WOMEN AND INFORMATION TECHNOLOGY IS AIMING TO EFFECT A SIGNIFICANT AND SUSTAINED INCREASE IN WOMEN'S ENROLLMENT IN AND GRADUATION FROM INFORMATION TECHNOLOGY BACHELOR'S PROGRAMS NATIONWIDE. THROUGH ITS UNIFIED PROGRAM OF CHANGE, THE CENTER IS CREATING AN EXTENSION SERVICE WITH THE INITIAL OBJECTIVE OF WORKING WITH AN EXISTING COALITION OF ACADEMIC DEPARTMENTS. KNOWN AS THE NCWIT ACADEMIC ALLIANCE, THE PARTNERS IN THIS COALITION WILL STRIVE TO IMPLEMENT PRACTICES THAT INCREASE WOMEN'S PARTICIPATION IN THEIR PROGRAMS.

A main step in creating the extension service will be the swift development of "exemplar institutions," or models of success. Information on the processes these exemplar institutions employ and their outcomes will be widely disseminated to other institutions, which will in turn receive support to help them emulate the successful programs.

The Unified Program of Change includes annual workshops to disseminate effective practices and support outreach and recruitment. Participating institutions will also receive support through customized consultations with industry members and experts in implementation. For faculty, small grants will be made available for research-based innovation and development.

All Academic Alliance members are committed to implementing only those interventions shown through research to increase recruitment and retention of women, so rigorous evaluation will be built into every stage of the project. Each member institution will be supported in collecting and analyzing its own data, which will then be sent to the National Center for Women in Information Technoloy for further analysis. A nationally recognized leader in assessing educational reform will undertake an external evaluation of the extension service.

GRADE LEVEL: UNDERGRADUATE	
National Center for Women and Information Technology (Colorado)	
Lucinda Sanders (lucinda.sanders@colorado.edu)	
http://www.ncwit.org/	05-33580
Keywords: extension service project, recruitment, retention, curriculum materials, intervention, systemic reform, best practices, departmental climate, environmental factors, longitudinal study/service, all-year, teacher training, staff/faculty training, workshops, engaged learning, support system, real-life applications, action plan, dissemination plan, survey, questionnaire, school-based, computer technology, information technology, technology, industry partners, tools, connections, data collection, assessment tools, mini-grants	

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Moving Beyond Anecdote to Informed Discussion

MOVING BEYOND ANECDOTE TO INFORMED DISCUSSION

THE WELLESLEY CENTERS FOR WOMEN AT WELLESLEY COLLEGE AND CAMPBELL-KIBLER ASSOCIATES SEEK TO HELP RESEARCHERS IN GENDER AND THE SCIENCES BETTER COMMUNICATE THEIR WORK TO THE MEDIA, POLICYMAKERS, AND ADVOCATES WHILE HELPING THE MEDIA BETTER UNDERSTAND ISSUES ASSOCIATED WITH STEM.

This project is developing a variety of materials to do this, including

- A series of research briefs on "hot topics" in gender and STEM education and careers
- Short downloadable audio visual messages from researchers on compelling issues related to gender and STEM research
- Interactive modules on how gender ideologies influence what people do and don't hear from research and how researchers can use a knowledge of gender ideologies to better ensure that their results can be heard and understood
- Tools, including PowerPoint presentations and talking points, that can help communicate research results in ways that are accurate and that the public can understand and use
- Tips for finding and assessing research on gender and race/ethnicity and STEM

The materials are being distributed through the project Web site, http://www.FairerScience.org. In addition, a FairerScience blog is being developed, and work is being done on ways to use "wikis" or wiki-like tools to expand the electronic community of STEM gender researchers and advocates.

GRADE LEVEL: POSTGRADUATE	
Wellesley College and Campbell-Kibler Associates (Massachusetts)	
Susan Bailey (sbailey@wellesley.edu)	
Patricia Campbell (Campbell@campbell-kibler.com)	
http://www.fairerscience.org/	05-33486
Keywords: dissemination project, gender-diversity awareness, media resource center, gender research briefs, science policy, electronic community	

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aCdm

Effective Strategies to Diversify Academic STEM

EFFECTIVE STRATEGIES TO DIVERSIFY ACADEMIC STEM

UNIVERSITY DEANS AND DEPARTMENT HEADS PLAY A CRITICAL ROLE IN BRINGING ABOUT REFORM AT THEIR INSTITUTIONS. SUCH OFFICIALS MUST TRANSLATE THE BROAD GOALS OUTLINED BY HIGH-LEVEL COMMITTEES, SUCH AS BOARDS OF REGENTS, INTO EFFECTIVE POLICY AND RESULTS.

For this reason, New Mexico State University assembled leading academic administrators from six Carnegie Doctoral/Research University institutions to develop a publication tentatively titled "Effective Strategies to Diversify Academic STEM," along with a PowerPoint presentation. Each of the participating institutions is either a minority-serving institution or an ADVANCE-funded institution.

The administrators synthesized—in an accessible format—existing literature on gender, race, and ethnicity as they relate to the recruitment of students and faculty in STEM. In doing so, they have assembled a set of effective, concrete strategies to increase participation of women and minorities in science and technology fields.

Dissemination of the products will take place in three ways:

- Presentations by participants at conferences in their respective fields
- Distribution of the publication to presidents, provosts, and deans at all 151 Carnegie Doctoral/Research University–Extensive institutions
- Posting of a PDF version of the documents on the New Mexico State University Web site

GRADE LEVEL: UNDERGRADUATE, GRADUATE	
NEW MEXICO STATE UNIVERSITY	
LISA FREHILL (LFREHILL@NMSU.EDU), MARY O'CONNELL, AND ELBA SERRANO	
HTTP://DIVERSEFACULTY.NMSU.EDU/INDEX.HTML	04-36071
KEYWORDS: DISSEMINATION, RECRUITMENT, ENGAGEMENT, GENDER EQUITY AWARENESS, GENDER DIFFERENCES, SYSTEMIC REFORM, ADVANCEMENT, ENVIRONMENTAL FACTORS, STAFF TRAINING, SUPPORT SYSTEM, DISSEMINATION PLAN, BOOKLET, POWERPOINT PRESENTATION, MINORITIES, INDUSTRY SPONSORS, TOOLS, DATA COLLECTION	

APPENDIX

AAUW	American Association of University Women
CENS	Center for Embedded Networked Sensing
CS-CAMP	Computer Science Computing and Mentoring Partnership
EEES	Engineering Equity Extension Service
GCG	Girls Creating Games
GO-GIRL	Gaining Options: Girls Investigate Real Life
HBCU	Historically Black Colleges and Universities
ISU	Illinois State University
IT	Information Technology
ITS	Intelligent Tutoring System
L/L	Living/Learning Programs
MRUC	Midwestern Rural–Urban Collaborative
NGCP	National Girls Collaborative Project
NSF	National Science Foundation
NSLLP	National Study of Living–Learning Programs
NSP	National Science Partnership
NWGC	Northwest Girls Collaborative
OWWSTE	Opportunities for Wisconsin Women in Science, Technology, and Engineering
PALS	Pedagogical Agents as Learning Companions
PSCTLT	Puget Sound Center for Teaching, Learning, and Technology
RAPUNSEL	Real–time Applied Programming for Underrepresented Students
SCETV	South Carolina Educational Television Network
SCGCP	Southcentral Girls Collaborative Project
SGA	Science, Gender, and After School programs
SISDO	Sisters in Science Dissemination and Outreach Project
SISERP	Science Equity Reform Project
SOP	Science on Patrol
STEM	Science, Technology, Engineering, and Math
UCLA	University of California–Los Angeles
YWCA	Young Women's Christian Association

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