



CHAPTER SIX · CREATING A DIVERSE S&E WORKFORCE

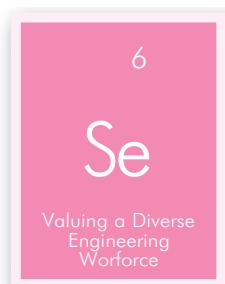
THE PROJECTS IN THIS CHAPTER ADDRESS DIVERSITY WITHIN THE SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) WORKFORCE, PARTICULARLY REGARDING GENDER AND RACE OR ETHNICITY. RECENT RESEARCH HAS BEGUN TO DOCUMENT THE DRAMATIC BENEFITS OF DIVERSITY IN EDUCATIONAL INSTITUTIONS AND WORKPLACES. FOR EXAMPLE, 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.

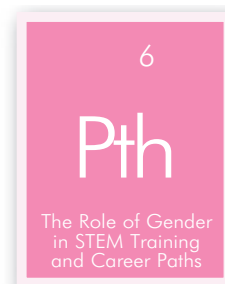
GRADE LEVEL: UNDERGRADUATE

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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.

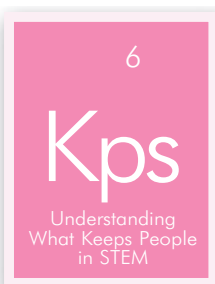
GRADE LEVEL: DOCTORAL RECIPIENTS

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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:

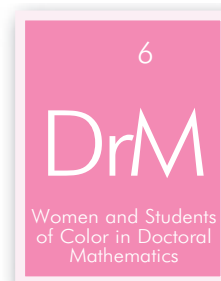
- The Cohort Study of STEM Career Outcomes tracks the courses taken and postsecondary outcomes of 82,000 Florida high school graduates from the class of 1996–97, uncovering demographic and experience variables associated with the pursuit of STEM-related careers. The researchers are also analyzing outcomes 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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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	

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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