Underrepresented Students in STEM: An Examination of Departmental Climate

Abstract

This study seeks to examine underrepresented undergraduate students' experiences within the fields of Science, Technology, Engineering, and Mathematics (STEM). For the purpose of this paper, underrepresented students within STEM include women and traditionally underrepresented minority students. Specifically, this paper focuses on factors of department climate that may contribute to underrepresented students' experiences within STEM majors.

Retention rates for underrepresented students continue to be dismal in a time when an increase in STEM degrees is necessary in order to ensure the nation's global economic future. This study seeks to examine non-academic factors—specifically departmental climate—that may influence student retention in the STEM fields. To investigate undergraduate students' experiences, an online student survey was launched at nine large, public, research institutions. The preliminary findings suggest that there are subtle but significant differences in regards to departmental climate perceptions among gender, substantial and significant differences among race/ethnicity, and significant findings when we examine the departmental climate at the intersection of race/ethnicity and gender.

Problem Statement

• Need to increase U.S. STEM participation and success
• Changing demographics (e.g. Latina/os)
• Continued underrepresentation of specific minority groups in STEM fields
• Decrease in female representation within Mathematics, Computer Science, and some Engineering fields
• Dismal retention rates within STEM for both female and underrepresented minority students
• Improve STEM workforce preparation
• Lack of empirical evidence in departmental climate issues of students in STEM fields in colleges and universities

Research Questions

• How do women and underrepresented Minority Students experience their departmental climate within STEM fields?
• Do women and underrepresented minority students within traditionally "hard" or "soft" STEM experience STEM differently?
• To what extent do faculty experiences, academic factors, social support, gender, race/ethnicity, and type of STEM field impact students' sense of belonging ?

Data and Methodology

The online survey data consists of current undergraduate students at nine universities collected in the summer and fall of 2010. The survey investigates students' experiences in the STEM fields, including pre-undergraduate and undergraduate factors that impacted their decision to enter the STEM fields. The analysis of this data thus far has primarily focused on issues pertaining to department climate, science identity, and students' self-efficacy.

Profile of Participants (n= 1881)

	N%		N%
Female	1151 (61.2%)	Male	716 (38.1%)
African American	81 (4.3%)	Hard STEM	1028 (54.7%)
Latina/Latino	89 (4.7%)	Soft STEM	594 (31.6%)
Asian American	218 (11.6%)	Non STEM	214 (11.4%)
Native American	11 (0.6%)		
White	1361 (72.4%)		

Source: Project STEP-UP, 2011.

Current Majors of Survey Respondents
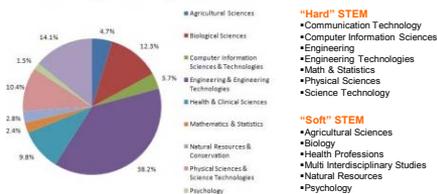
"Hard" STEM
• Communication Technology
• Computer Information Sciences
• Engineering
• Engineering Technologies
• Math & Statistics
• Physical Sciences
• Science Technology

"Soft" STEM
• Agricultural Sciences
• Biology
• Health Professions
• Multi Interdisciplinary Studies
• Natural Resources
• Psychology

Descriptive statistics, cross-tabulations, factor analysis, and regression analysis were used to answer the research questions.

Principal Axis Factor Analysis Results

• 21 measures of department climate were reduced to four factors:

1. *Sense of Belonging* (Cronbach's Alpha = 0.901)
2. *Faculty Influence* (Cronbach's Alpha = 0.829)
3. *Social Support* (Cronbach's Alpha = 0.770)
4. *Academic Climate* (Cronbach's Alpha = 0.629)

A composite score was created for *Sense of Belonging*, which includes the following items:

• My major field department is my intellectual home
• I enjoy working with other students in my department
• The students in my department make me feel welcome
• In courses for my major, my input is valued in group assignments
• I feel included in group assignments for my major
• I feel comfortable in classes for my major
• I have a sense of belonging in my major
• There are other students like myself in my major

Results

Gender

• Cross-tabulations indicate that female and male students experience their department climate similarly.
• Women within traditionally "hard" STEM were more likely to indicate that they enjoyed working with other students in their department.
• Within traditionally "soft" STEM however, women were less likely to indicate that they were confident that they would succeed within their major.
• Women within traditionally "hard" STEM reported having more social support within their major than both underrepresented minority students and majority males.

Social Support in Major, by Race/Ethnicity and Gender
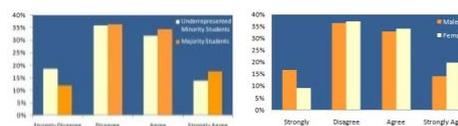
Race/Ethnicity

• Underrepresented minority students are less likely to report that they have a sense of belonging in their major.
• Underrepresented minority students were more likely to perceive the overall departmental climate as less welcoming.
• Underrepresented minority students within "soft" STEM were less likely to report that they had a sense of belonging in their major.
• In both traditionally "hard" and "soft" STEM majors, underrepresented minorities are more likely to feel that students and faculty are unwelcoming in comparison to their peers.

Faculty In Department Make Me Feel Welcome, by Race/Ethnicity
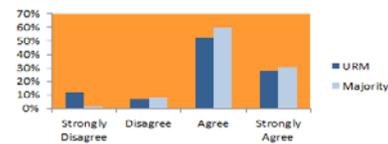
Intersection of Race/Ethnicity & Gender

• Underrepresented minority males consistently indicated having substantially more negative experiences in regards to sense of belonging than their majority counterparts.
• Underrepresented minority males were more likely to indicate that students in their department made them feel unwelcome, that they were not included within group assignments, and did not have a sense of belonging within their major.
• Minority males were also least likely to indicate that they had a social support system within their major.

Implications

• Foster a sense of belonging for underrepresented minority students in STEM through:

• Recruitment and retention programs in the STEM fields
• Research opportunities with faculty members
• Engagement activities sponsored by departments and colleges
• Student-based organizations, such as the National Society of Black Engineers

• Opportunities for departments, colleges, and universities to examine the many climates that exist on campus and how students perceive and react to those climates
• Provide Cultural Competency Training for Faculty and Staff

Limitations & Future Research

Limitations

• Analysis does not consider students' perceptions of overall campus climate
• Derived from longer survey (approximately 800 additional respondents started but did not complete the survey)
• Number of responses varied by campus
• Number or responses varied by major
• Lack of comparisons to students in non-STEM majors
• Low Response rate for underrepresented minority students

Future Research

• Investigate sense of belonging in relation to academic engagement measures
• Further disaggregate "hard' and "soft" STEM fields to determine if differences exist within these categories
• Follow-up data collection will occur in Fall 2011, allowing for changes in students' sense of belonging to be examined over time.
• The importance of disaggregating experiences by type of major, by gender, and by race/ethnicity when researching students in STEM fields

Project Staff

William Trent (PI) ; Lorenzo Baber (Co-PI)
Research Assistants: Chanee Anderson; Shywon Berry; Diane Fuselier-Thompson; Mariana G. Martinez; Kimberly S. Walker; Montrischa Williams

Blanca Rincon
Casey E. George-Jackson

http://stepup.education.illinois.edu/
stem@education.illinois.edu