Exploring STEM Trends in Enrollment and Persistence for Underrepresented Populations

Higher Education Collaborative

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Presentation Overview

• What is STEM?
• Reasons for Investigating STEM
• Historic Trends of STEM Participation
• Purpose of the Study
• Project Components
• Longitudinal Data
• Undergraduate Student Survey
• STEM Intervention Programs
What is STEM?

• Science, Technology, Engineering, and Mathematics (STEM)

• Disaggregating STEM
  – Physical Science, Computer Science, Mathematics, and Engineering (PSCSME)
  – Agricultural and Biological Sciences (ABS)
  – Health Sciences and Psychology (HSP)
Reasons for Investigation

• Social justice – Reducing inequality and improving opportunities
• Workforce preparation and economic competitiveness
• Changing demographics
• Benefits of diversity
• Connection between social stratification, opportunities for social mobility, and higher education
Historic Trends of STEM Participation
Figure 1. Minority Share of S&E and Non-S&E bachelor’s degrees (1995—2008)

Figure 2. Bachelor’s degrees earned in Physical Science, Computer Science, Math and Engineering, by sex, 1966–2006

Purpose of the Study

• Examine entrance into, persistence in and attainment in the STEM fields at large, public, research universities
  – By gender
  – By race/ethnicity
  – By SES

• Examine movement in, out, and within STEM between students’ enrollment and degree attainment
Purpose of the Study (con’t)

• Examine the design, implementation, and impact of STEM intervention programs on underrepresented undergraduate students

• Understand the reasons for and influences on students’ choice of major and persistence in major, including participation in intervention programs

• Disaggregate STEM fields
Project Components

- **Longitudinal Student-Level Data (8 universities)**
  - Transcript Data

- **Online Survey of Current Undergraduate Students (10 universities)**

- **STEM Intervention Programs (10 universities)**
  - Interviews with Program Directors & Administrators
  - Content Analysis of Intervention Program Documents
Longitudinal Data
Longitudinal Data

• Mellon Foundation’s *Public University Database*
• Fall 1999—Spring 2005
• 8 Universities
• Variables
  – Social background information
  – Academic qualifications
  – Semester-by-semester major
  – Semester-by-semester GPA
  – Financial aid information (for FAFSA filers)
• Transcript Data for Select Institutions
Topics of Investigation

- Initial choice of major
- Persistence in initial major
- Patterns of switching between majors
- Factors that impact persistence in initial major
- Comparisons between
  - Men and Women
  - Women by Race/Ethnicity
Data & Methodology

• Data:
  – 5 land-grant universities
  – First-time, full-time, domestic freshman who began college in Fall 1999 and completed a bachelor’s degree within 6 years
  – n=16,850

• Methods
  – Descriptive Statistics
  – Binary Logistic Regression
# Profile of Undergraduates

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>50.8%</td>
</tr>
<tr>
<td>Female</td>
<td>49.2%</td>
</tr>
<tr>
<td>Asian</td>
<td>5.9%</td>
</tr>
<tr>
<td>Black</td>
<td>4.1%</td>
</tr>
<tr>
<td>Latino/a</td>
<td>2.4%</td>
</tr>
<tr>
<td>Native American, Other, Unknown</td>
<td>1.5%</td>
</tr>
<tr>
<td>White</td>
<td>86%</td>
</tr>
<tr>
<td>Out-of-State</td>
<td>34.3%</td>
</tr>
<tr>
<td>In-State</td>
<td>65.7%</td>
</tr>
<tr>
<td>Average SAT Math</td>
<td>603</td>
</tr>
<tr>
<td>Average SAT Verbal</td>
<td>579</td>
</tr>
<tr>
<td>Average SAT Total</td>
<td>1181</td>
</tr>
</tbody>
</table>
Figure 3. Initial Major Choice, by field, sex, and race/ethnicity
Persistence in Major

- PSCSME - Men out-persisted women
- ABS and HSP - Women out-persisted men
- Asian women persisted at higher rates in PSCSME
- Black women have lowest levels of persistence in PSCSME and ABS
- Latinas persisted at the same rate as white women in PSCSME and ABS, and a higher rates than Asian and Black women in ABS
- Regardless of persistence status and their last major category, women graduated faster than men
Figure 4. Switching Majors, by sex and field

- Physical Science, Computer Science, Math & Engineering (PSCSME)
- Health Sciences & Psychology (HSP)
- Agricultural & Biological Sciences (ABS)
- Non-STEM

Arrows indicate directions of switching majors by sex: Men (orange) and Women (blue).
Factors that Impact Persistence

• Being female had a negative impact on persisting in PSCSME but a positive impact on HSP
• Context matters, particularly for female students
• Being an in-state resident had a negative impact on persisting in PSCSME
• Lower levels of parental income had a negative impact on persisting in HSP and Non-STEM
• Within women, race and ethnicity were non-significant (FAFSA: Latinas had a positive impact on PSCSME)
Limitations: Longitudinal Data

• Data
  – Secondary data
  – Limited generalizability
  – Selection bias

• Methodology
  – First and last major
  – Movement within major fields
Main Findings

• Importance of disaggregating STEM
• Importance of examining where students “go”
  – A departure from some STEM fields is not necessarily a departure from science
• Understanding the complexity of STEM participation
Undergraduate Student Survey
Undergraduate Student Survey

• 10 Universities
• Survey current undergraduate students
• Examine factors that influence choice of major and persistence in major, including:
  • Participation in intervention programs
  • Pre-College experiences
  • College experiences
  • Financial Aid
  • Influence of peers, family members, teachers, and counselors
Topics of Interest

• Science Identity
  – Do science identities differ by gender? If so, how do they differ?
  – Do students’ perceived self-efficacy in math and science differ by gender?

• Campus Climate
  – To what extent do undergraduate students experience campus climate differently?
    • By Gender
    • By Race/Ethnicity
Science Identity

• One campus (n = 448)
• 47% male, 51.6% female
• Science Identity Constructs
  – I identify as a scientist
  – My faculty recognize me as a scientist
  – My peers recognize me as a scientist
  – Seeing other people who look like me within my field reinforces my scientist identity
Science Identity Results

• A greater percentage of women identify as scientists
• A greater percentage of females agree or strongly agree that faculty recognize them as scientists
• Females report having to work harder than males in order to be recognized as a scientist by others due to their gender
Science Identity Results (con’t)

• 60% of women and 73% of men reported feeling very confident in their math and science skills

• Women who reported no or little confidence in math and science skills felt the need to have a female role model to reinforce their science identity.
Climate Study

- Two campuses (n=892)
- 38.7% male, 42.5% female
- 55% white, 10% Asian or Pacific Islander, 3.7% Black, 5.2% Latino, 0.5% Native American or Alaskan Native

- Current majors:
  - 25.9% Engineering
  - 20.5% Biological and Biomedical Sciences
  - 16.4% Health Professions and Related Clinical Sciences
  - 8.5% Physical Sciences
  - 3.4% Computer and Information Sciences
  - 2.8% Mathematics/Statistics
  - 0.6% Natural Resources and Conservation
Climate Study Constructs

• My major field department is my intellectual home
• The faculty in my department make me feel welcome
• The students in my department make me feel welcome
• I have a sense of belonging in my major
• The faculty in my department want me to succeed.
Climate Study Findings

• Female and males both reported feeling that their department served as their intellectual home
• Female students were less likely to perceive departmental faculty as welcoming as compared to male students
• Latino/a students were less likely to identify their department as their intellectual home
• Latino/a students were less likely to perceive their department faculty and peers as welcoming in comparison to white and Black students.
Limitations: Survey Data

- Data collection is on-going
  - Responses have varied by university
- Representation of STEM fields varies
- Low number of responses by students of color
- Length of survey
STEM Intervention Programs
STEM Intervention Programs

- 10 Universities
- Interviews with directors and administrators
- Examined design, implementation, impact on students, and benefits of programs
- Gathered existing data, reports, and evaluations from participating programs
Guiding Questions

• What theories or perspectives guide the design of STEM intervention programs?
• How are STEM intervention programs – Structured?
  – Staffed?
  – Funded?
• What are the common challenges that STEM intervention programs face?
Profile of Participants

• Data
  – Interview data has been gathered from 9 large, public, research universities.
  – 47 participants
  – 11 male, 36 female
  – 27 white, 19 African American, 4 Hispanic, 1 Native American, and 1 Asian American
  – A total of 97 documents and reports were gathered from the STEM intervention programs.

• Methods
  – Qualitative Methods
  – Semi-structured interviews with program administrators
  – Content Analysis*
Common Trends Among Intervention Programs

• Evolution of Programs
  – Change of Mission
  – Selection of Participants
  – Student Qualifications

• Collaborative Efforts

• Financial Support and the Impact on Delivery of Services
  – National & State Budget Deficits
  – Sources of Funding

• Assessment Efforts in Measuring Outcomes

• Staff/Program Expertise
Recommendations

• Pursue stable, recurring funding
• Purposeful staffing
• Investigate opportunities for collaboration inside & outside home institution to assist with
  • Service delivery
  • Program design
  • Program assessment
  • Funding
Limitations: Interview Data

- Nine large, four-year, research-intensive, and predominantly white universities
- Response rate based on self-selection
- Recruitment to participate based on publicly available information of STEM intervention programs on each institutions’ website
- Programs are housed in certain STEM fields
- No contemporaneous statements from students participating in programs
Future Research & Next Steps

• Incorporate transcript-level data
• Additional analyses of Mellon data
  – Merge Common Core Data on high schools
• Complete survey data collection and expand analysis
• Content Analysis of STEM intervention programs’ documents
• CIC-wide graduate-level course on Access to and Success in STEM (Spring 2012)
Questions & Discussion

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