STEMming the Tide? Investigating the Outcomes of Formal Research Opportunities for Undergraduate Women in STEM Programs

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Disparities in STEM

• Women earn 58.1% of bachelor’s degrees in the biological and agricultural sciences, yet only 18.3% of degrees in engineering and computer science.

• Women earn 46.8% of doctorate degrees, with only 23.1% in engineering, 19.6% in physics, and 25.2% in math/computer science (NSF, 2011).

• 26% of the science and engineering college-educated workforce are women.
Causes of Disparities in STEM

- Cultural pressure to conform to traditional gender roles and lack of role models
- Lack of opportunities for collaborative learning
- Chilly climate, discrimination, harassment, and marginalization (Johnson, 2012; Seymour & Hewitt, 1997)
Undergraduate Research

- A potentially important way in which to engage women in STEM
- Participation in undergraduate research is positively associated with students’ retention and persistence—and positively promotes science career pathways (Nagda et al., 1998)
Research Question

• Is there an association between participation in a variety of undergraduate research opportunities, sense of belonging, and campus climate among women in STEM programs?
Conceptual Framework

• Science identity framework (Carlone & Johnson, 2007)
  – Important to students’ decisions to remain in science fields
  – Three components: recognition, performance, competence

• Input-environment-output (I-E-O) framework (Astin, 1991)
Methods

• Instrument:
  – Student Experience in the Research University (SERU) survey
  – Administered spring 2012 to six large, public research universities (n = 140,170)
  – Response rate 27% (n = 39,736)
  – 5,109 women in STEM
  – Items from survey module (n = 1,016)
Should this be a big "N"?
Christine Lepkowski, 11/7/2013
Sample

- 17% Asian
- < .01% Pacific Islander
- 4% Black
- 7% Multiracial
- < .01% Native American
- 4% Hispanic
- 5% International
Measures

• Dependent variables
  – Sense of belonging
  – Campus climate for gender
• Demographics
• College experiences
  – Importance of research
  – Academic engagement
  – Faculty interactions
  – Classmate interactions
Measures

• Undergraduate research
  – At least one student research course
  – At least one independent study course
  – Assist faculty w/credit
  – Assist faculty for pay w/o credit
  – Assist faculty as a volunteer w/o credit
  – Work on creative projects under faculty w/credit
  – Work on creative projects under faculty for pay w/o credit
  – Work on creative projects under faculty as a volunteer w/o credit
## Participation in UG Research

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least one student research course</td>
<td>.35</td>
<td>.48</td>
</tr>
<tr>
<td>At least one independent study course</td>
<td>.21</td>
<td>.40</td>
</tr>
<tr>
<td>Assist faculty in research with course credit</td>
<td>.24</td>
<td>.43</td>
</tr>
<tr>
<td>Assist faculty in research for pay without course credit</td>
<td>.20</td>
<td>.40</td>
</tr>
<tr>
<td>Assist faculty in research as a volunteer without course credit</td>
<td>.20</td>
<td>.40</td>
</tr>
<tr>
<td>Work on creative projects under the direction of faculty with course credit</td>
<td>.21</td>
<td>.41</td>
</tr>
<tr>
<td>Work on creative projects under the direction of faculty for pay without course credit</td>
<td>.05</td>
<td>.21</td>
</tr>
<tr>
<td>Work on creative projects under the direction of faculty as a volunteer without course credit</td>
<td>.08</td>
<td>.27</td>
</tr>
</tbody>
</table>
Regression

• Hierarchical multiple regression
  – Block one: race, ethnicity, and age
  – Block two: college experiences
  – Block three: undergraduate research
## Sense of Belonging Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>Sig.</th>
<th>$R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>-.120</td>
<td>***</td>
<td>.045</td>
</tr>
<tr>
<td>Black</td>
<td>-.086</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>-.110</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.037</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>.154</td>
<td>***</td>
<td>.131</td>
</tr>
<tr>
<td>Importance of research</td>
<td>.207</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Faculty interactions</td>
<td>.154</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Classmate interactions</td>
<td>.148</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Assist faculty w/credit</td>
<td>-.063</td>
<td>*</td>
<td>.019</td>
</tr>
<tr>
<td>Assist faculty as a volunteer</td>
<td>-.113</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>
## Campus Climate Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>Sig.</th>
<th>R² Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other/Unknown Race/Ethnicity</td>
<td>-0.073</td>
<td>*</td>
<td>0.025</td>
</tr>
<tr>
<td>Black</td>
<td>-0.121</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>Multiracial</td>
<td>-0.067</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Importance of research</td>
<td>0.119</td>
<td>**</td>
<td>0.011</td>
</tr>
<tr>
<td>Assist faculty w/credit</td>
<td>-0.090</td>
<td>*</td>
<td>0.021</td>
</tr>
<tr>
<td>Assist faculty as a volunteer</td>
<td>-0.099</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>
Limitations

• Lack of information about the specific experiences of students when they participated in undergraduate research

• Variance explained in both models predicting sense of belonging and campus climate for gender is very low
Discussion

• Research with faculty for course credit or volunteers
  – Lower sense of belonging and less welcoming campus climate for gender
  – Contradictory results may be due to negative peer/faculty interactions, discrimination, harassment, stereotype threat

• Classmate and faculty interactions
  – Positively associated with sense of belonging
  – Confirms the results of previous research
Conclusion

• Implications for research
  – Consider additional factors
  – Examine specific disciplines
  – Experimental design

• Implications for practice
  – Improve women’s experiences in undergraduate research
  – Collaborate on other types of programs to promote women’s success
Thank you!

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