Career-Smart: New Paradigms for STEM Education Abroad

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Frontier Challenges

“The frontier challenges of science and engineering are increasingly global. Future generations of the U.S. science and engineering workforce must collaborate across national boundaries and cultural backgrounds, as well as across disciplines to successfully apply the results of basic research to long-standing global challenges such as epidemics, natural disasters and the search for alternative energy sources.”

*National Science Foundation Investing in America’s Future Strategic Plan FY 2006-2011*
International Collaborations

More than two-thirds of global S&E articles had authors from different institutions or different countries in 2012, compared with just over half of such articles 15 years earlier.

– Coauthored articles with only domestic institutional authors increased from 36% of all articles in 1997 to 44% in 2012. Internationally coauthored articles grew from 16% to 25% over the same period.

– In the United States, 35% of its articles were coauthored with institutions in other countries in 2012, compared with 16% in 1997. The center of U.S. collaboration is the U.S. academic sector, which coauthored 53% of its articles with other U.S. sectors or foreign institutions in 2012.

NSF Science & Engineering Indicators, 2014
Diversity makes a difference

“... we find that papers with more authors in more locations and with longer lists of references tend to be published in relatively high impact journals and to receive more citations than other papers. These findings and those on homophily suggest that diversity in inputs into papers leads to greater contributions to science, as measured by impact factors and citations.”

### U.S. Study Abroad: Fields of Study as Report by *Open Doors 2013*

<table>
<thead>
<tr>
<th>Field of Study</th>
<th>2008/09</th>
<th>2009/10</th>
<th>2010/11</th>
<th>2011/12</th>
</tr>
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<tbody>
<tr>
<td>Social Sciences</td>
<td>20.7</td>
<td>22.3</td>
<td>22.9</td>
<td>22.4</td>
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<tr>
<td>Business &amp; Management</td>
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<td>20.8</td>
<td>20.5</td>
<td>20.5</td>
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<tr>
<td>Humanities</td>
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<td>12.1</td>
<td>11.3</td>
<td>10.8</td>
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<tr>
<td>Fine or Applied Arts</td>
<td>7.3</td>
<td>8.3</td>
<td>8.2</td>
<td>7.8</td>
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<tr>
<td>Physical or Life Sciences</td>
<td><strong>7.3</strong></td>
<td><strong>7.5</strong></td>
<td><strong>7.9</strong></td>
<td><strong>8.6</strong></td>
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<td>Foreign Languages</td>
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<td>5.8</td>
<td>5.6</td>
<td>5.3</td>
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<tr>
<td>Health Professions</td>
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<td>4.7</td>
<td>5.3</td>
<td>5.7</td>
</tr>
<tr>
<td>Education</td>
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<td>4.1</td>
<td>4.2</td>
<td>4.1</td>
</tr>
<tr>
<td>Engineering</td>
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<td><strong>3.9</strong></td>
<td><strong>3.5</strong></td>
<td><strong>3.9</strong></td>
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<tr>
<td>Math or Computer Science</td>
<td><strong>1.6</strong></td>
<td><strong>1.5</strong></td>
<td><strong>1.8</strong></td>
<td><strong>1.7</strong></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1.1</td>
<td>1.3</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Undeclared</td>
<td>3.5</td>
<td>4.5</td>
<td>2.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Other</td>
<td>8.9</td>
<td>3.2</td>
<td>4.8</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Total students</strong></td>
<td><strong>260,327</strong></td>
<td><strong>270,604</strong></td>
<td><strong>273,996</strong></td>
<td><strong>283,332</strong></td>
</tr>
</tbody>
</table>
ABET: “Engineering programs must demonstrate that their graduates have...”

a) An ability to apply knowledge of mathematics, science, and engineering
b) An ability to design and conduct experiments, as well as to analyze and interpret data
c) An ability to design a system, component, or process to meet desired needs
d) An ability to function on multi-disciplinary teams
e) An ability to identify, formulate, and solve engineering problems
f) An understanding of professional and ethical responsibility
g) An ability to communicate effectively
h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) A recognition of the need for, and an ability to engage in life-long learning
j) A knowledge of contemporary issues
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
The Global Mindset

A global mindset is characterized by three complementary aspects:

– an openness to and awareness of multiple spheres of meaning and action;
– complex representation and articulation of cultural and strategic dynamics; and
– mediation and integration of ideals and actions oriented both to the global and the local.

A competent engineer?

Competencies for professional engineers:

- **Flexibility**: Flexible problem solving in practice that yields creative engineering solutions

- **Interaction**: Students’ interactions with others, including the personal, professional, dimension of communication in the workplace

- **Plan**: Planning of work or time

- **Professional realities**: Competencies to cope with the realities of the professional engineering workplace.

- **Self**: Competencies that were directed towards regulating or improving their own working performance.

- **Social context**: Competencies that relate to the social setting of professional engineering work

- **Technical context**: Technical aspects of engineering work.

A globally competent engineer?

- **Appreciation** of other cultures
- Proficiency working in **cross-cultural team**
- **Communication** across culture
- **Practicing** engineering in a **global** environment
- Effectively dealing with **ethical issues** arising from cultural differences

RISE - Research Internships in Science and Engineering

- 8-12 weeks in summer
- Web-based matching process
- Undergrads work directly with German doctoral students at top labs across country
- Knowledge of German not required
- Scholarships and housing assistance provided
- 314 interns placed in 2013
RISE professional

- For undergraduate DAAD alumni, recent graduates or graduate students
- 6-26 week summer placements in **industry internships** with leading German companies
- German requirements depend on the nature of the internship
- **Scholarships** and housing assistance are provided
- 2 week intensive **language course** for RISE and RISE pro participants with little or no German
- €250/monthly for graduates, €500/monthly for PhD students + €500/monthly from host company
- Health insurance, travel reimbursement
Study & Internship Program (UAS7)

- 1 semester coursework at a UAS7 member + 1 semester internship (SIP)
- 1 study semester at one of the seven UAS7 members (SP)
- An internship of 2-6 months at a UAS7 campus lab (IP)
- For sophomores and juniors (at time of application)
- Language requirements depend on individual program
- € 700/month; travel stipend; insurance
EA at Morehouse College

• From 2007 to 2012: 934 students participating in EA
• Most of these students have participated in short term programs of less than a semester. Ca.10 students have participated annually in semester long EA programs
• The majority of the students participating in these programs have been business students (60%) with the remaining being humanities and social sciences (30%) and STEM students 10%
• Out of the 11 students participating in long term study abroad programs for a semester or more in 2013 only 1 was a STEM student, who participated in the special math program in Budapest, Hungary
## U.S. Study Abroad: Student Profile as Report by Open Doors 2013

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>2008/09</th>
<th>2009/10</th>
<th>2010/11</th>
<th>2011/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>80.5</td>
<td>78.7</td>
<td>77.8</td>
<td>76.4</td>
</tr>
<tr>
<td>Asian, Native Hawaiian or Other Pacific Islander</td>
<td>7.3</td>
<td>7.9</td>
<td>7.9</td>
<td>7.7</td>
</tr>
<tr>
<td>Hispanic or Latino(a)</td>
<td>6.0</td>
<td>6.4</td>
<td>6.9</td>
<td>7.6</td>
</tr>
<tr>
<td>Black or African-American</td>
<td>4.2</td>
<td>4.7</td>
<td>4.8</td>
<td>5.3</td>
</tr>
<tr>
<td>Multiracial</td>
<td>1.6</td>
<td>1.9</td>
<td>2.1</td>
<td>2.5</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total students</strong></td>
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Nine STEM students and one faculty member participated in a short-term summer program in Germany funded by The Halle Foundation launched in 2013, in partnership with Spelman College.

Positive outcomes from the STEM students participating in the program include:

- Students applied for summer internship opportunities in Germany and Singapore
- All participants have expressed their desire to seek other opportunities to travel and study abroad
- These students have developed an appreciation for the need to learn and speak a foreign language fluently
STEM LAUNCH (group, local)

- Funded by The Halle Foundation (Atlanta)
- Two Atlanta HBCUs: Morehouse & Spelman Colleges
- Study Tour (Year 1) & Internship Program (Year 2)
- 20 participants/year: 9 students + 1 faculty leader from each institution; 3 student fellowships/summer
Please rate the degree to which you agree with the following statements. As a result of my experience, I anticipate that I will...

- Pursue an internship in Germany
- Pursue an internship in another country
- Study abroad in Germany
- Study abroad in another country
- Pursue a graduate degree in the U.S.
- Pursue a graduate degree in Germany
- Learn German
- Learn a second/third language
- Travel more internationally
- Consider a PhD or MD program in general
Program outcomes: values

• 100% to travel more internationally
• 89% to pursue an internship abroad
• 94% to study abroad
• 94% to learn another language (61% German)
• 83% strongly consider a MD / PhD degree program in STEM
• 28% consider a graduate degree in Germany
4 applied for the STEM LAUNCH internship program; 1 selected to go
2 applied for CV Fellowship to Singapore; 1 selected to go
4 applied for DAAD RISE & RISE pro; 2 selected to go
Approaches to STEM programming

**Group Model**
- Study Tours *(STEM LAUNCH)*
- Fellowships *(CV Fellowship)* *(CBYX)*

**Custom Model**
- University Internship Programs

**Individual Model**
- Global Technical Exchanges *(IAESTE)*
- Internship Placements *(Internships Abroad)*
Discussion (Group A): ADVISING

1. *Role play exercise:* Imagine you’re a STEM student on your campus. What are the major obstacles affecting your ability to participate in education abroad?

2. What learning outcomes do you expect for STEM students participating in education abroad programs? How are they different from those for students in other fields?

3. What support do you receive from STEM faculty for your STEM students to participate in education abroad initiatives? What is missing?
Discussion (Group B): DESIGN

1. Role play exercise: If you were asked to design the ideal education abroad program for your STEM students, what would it look like?

2. What services does your institution provide for underrepresented STEM students? How does this translate when they go abroad?

3. Is internationalization part of your institution’s mission? If so, how is that reflected in the STEM divisions on campus? What may be missing?
Discussion (Group C): INCLUSION

1. *Role play exercise:* How would you convince a STEM student of the value of experiential learning and professional programs abroad? What is the added ROI compared to domestic internships and traditional study abroad programs?

2. What types of education abroad programs would be most attractive for underrepresented STEM students on campus? How would you convince their families to support them in going abroad?

3. How could you engage peer advisors and alumni ambassadors in mobilizing STEM students for education abroad? What models for student outreach are available on campus, and how could you apply these to STEM?