USING A RESEARCH CENTER-BASED MENTORING PROGRAM TO INCREASE THE PARTICIPATION OF AFRICAN AMERICANS, HISPANICS AND NATIVE AMERICANS IN ENGINEERING

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Broadening Participation in Engineering Program
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The challenge as identified by NSF

- Minority individuals in faculty positions fall far short of their level of representation in the general population
- Only a small fraction of minority students graduating with doctoral engineering degrees become faculty
- NSF is part of the national push for a diverse engineering workforce and recognizes that to attain the latter diversity must increase within academic ranks

The Broadening Participation in Engineering (BPE) Program of NSF supports knowledge-based and knowledge-generating projects that can address the challenges associated with increasing diversity in engineering research and education

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504870
The challenge as identified in UK

UK College of Engineering minority enrollment

<table>
<thead>
<tr>
<th>Term</th>
<th>African American</th>
<th>Hispanic</th>
<th>Native American</th>
<th>Total UG Enrollment</th>
<th>Minority % of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2008</td>
<td>49</td>
<td>18</td>
<td>10</td>
<td>1,818</td>
<td>4.24%</td>
</tr>
<tr>
<td>Fall 2009</td>
<td>58</td>
<td>21</td>
<td>5</td>
<td>2,087</td>
<td>4.02%</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>69</td>
<td>33</td>
<td>6</td>
<td>2,344</td>
<td>5.46%</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>62</td>
<td>41</td>
<td>5</td>
<td>2,481</td>
<td>5.16%</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>81</td>
<td>61</td>
<td>7</td>
<td>2,729</td>
<td>7.15%</td>
</tr>
</tbody>
</table>

UK College of Engineering minority graduates

<table>
<thead>
<tr>
<th>Class</th>
<th>African American</th>
<th>Hispanic</th>
<th>Native American</th>
<th>Total BS Graduates</th>
<th>Minority % of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>324</td>
<td>1.85%</td>
</tr>
<tr>
<td>2009</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>298</td>
<td>4.36%</td>
</tr>
<tr>
<td>2010</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>337</td>
<td>1.48%</td>
</tr>
<tr>
<td>2011</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>346</td>
<td>3.76%</td>
</tr>
<tr>
<td>2012</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>349</td>
<td>3.44%</td>
</tr>
</tbody>
</table>

Minority enrollment and graduation rates fall well below state and national demographics (11.6 and 31.2%)
BPE – Our strategy

• Harness the resources of university research centers
• Complement mentoring activities in traditional engineering departments, which are challenged by:
  > Faculty role strain (teaching, administrative and research workloads limit faculty's ability to mentor students in a way that matches their expectations)
  > Relatively low faculty-to-student ratios
  > A less topical, applied or coherent research portfolio
• Liaise with other university units to help students acquire and develop the skills they need to succeed

The involvement of non-faculty research staff in a mentoring program is promising since lower teaching workloads are more propitious for mentoring
BPE – Our objectives

- To investigate if the involvement and mentoring of engineering students in research centers offers some advantages over mentoring these students in traditional engineering departments.
- To motivate African American, Hispanic and Native American students to choose engineering as their field of study, and to create a supportive learning environment that facilitates graduation with engineering degrees.
- To help individuals of underrepresented groups acquire the skills they need not only to pursue a successful career in academia, but also to become leaders in their professional environment, inspirational role models and champions for the cause of broadening participation in engineering.
A CAER-based mentoring program described

Recruitment
- The program will be promoted in recruitment venues
- 10 UGs will be recruited each fall starting in 2015
- 1 or 2 graduate students will be recruited each year

Mentoring
- Co-PI will serve as counselor at the UK CoEng
- PI will serve as point of contact at UK CAER
- Students will tour CAER and hear from Associate Directors
- Students will meet and follow-up with prospective mentors
- Students will be matched with a CAER research mentor
- Students will also be matched with a CoEng academic mentor
- Students will be helped to acquire the skills they need to succeed

Graduation
- Mentoring relationship will continue after graduation
- Continued contact and interaction with established networks
- Students will be expected to further the cause of BPE
# Skills to be developed through mentoring

## Schedule of when the development of different skills will be prioritized

- CAER mentors will be more involved in 2, 3, 5 and 6 above with support of the PI and other university units.
- The Co-PI will be more involved in 1 and 4 above with the support of CoEng mentors and other university units.

### Development of skills needed to pursue a successful career in engineering are strategically distributed
### Development of research skills

<table>
<thead>
<tr>
<th>CAER mentors</th>
<th>Other CAER staff</th>
<th>Other UK units</th>
</tr>
</thead>
</table>
| • Teach technical skills particular to research being performed  
• Teach ancillary skills such as proper lab notebook upkeep, report preparation, and lab etiquette | • Provide training in lab safety, hazardous waste, fire extinguisher safety, respirator use, etc.  
• Training on safe handling of pressurized gases, proper use of tubing and fittings, use of machine shop tools, etc.  
• Training on searching the scientific and patent literature | • Office of Undergraduate Research  
• Office of Research Integrity  
• Environmental Health and Safety  
• Intellectual Property Development Office |

*Students will acquire not only lab experience, but also a more complete set of skills needed in research*
## Development of communication skills

<table>
<thead>
<tr>
<th>CAER mentors</th>
<th>Other UK units</th>
<th>Engineering societies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Teach technical writing skills</td>
<td>• UK Writing Center</td>
<td>• NSPE, AIChE, ASCE, ASME, IEEE, etc.</td>
</tr>
<tr>
<td>• Familiarize students with publishing/peer-review process</td>
<td>• UK Multimodal Communication Consulting Center</td>
<td>• National Society of Black Engineers</td>
</tr>
<tr>
<td>• Teach students to prepare posters and presentations</td>
<td>• Albert C. Ray eStudio at the CoEng</td>
<td>• Society of Hispanic Professional Engineers</td>
</tr>
<tr>
<td>• Provide opportunities to practice and improve</td>
<td>• UK Thesis/Dissertation boot camp for graduate students</td>
<td>• Society of Women Engineers</td>
</tr>
</tbody>
</table>

**Students will acquire not only communication skills but also organizational and networking skills**
## Dev. of grantsmanship and management skills

| CAER mentors | • Involve students in proposal and budget preparation, exchanges with PMs, and proposal submission process  
|             | • Encourage and assist students pursue funding available to them (e.g. UK research summer grants)  
|             | • Involve students in project and budget management  |
| Other CAER staff | • Training on Sponsored Projects Information Network (SPIN)  
|             | • Contact with CAER’s accounting personnel  
|             | • Exposure to platforms such as FastLane, Research.gov, etc.  |
| Other UK units | • Office of Undergraduate Research  
|             | • Proposal Development Office  
|             | • Office of Sponsored Projects Administration  |

External funding/student support will be emphasized for graduate students and student support for UGs
### Development of outreach skills

| CAER mentors | • Train students to mentor more junior UG and HS students  
|              | • Involve students in K-12 STEM outreach efforts (e.g. Scientists in the Classroom, science fairs, etc.) |
| Other CAER staff | • Involve students in the work of the Development, Community and Engagement group (e.g. Mathcounts, Energy Fair, etc.)  
|              | • Help students liaise with external partners (e.g. Nerd Squad’s Cagney Coomer) |
| Other UK units | • Involve students in UK and CoEng recruitment and outreach efforts (e.g. K-Week, E-Day)  
|              | • Participate in CoEd’s outreach activities, particularly those at CAER (e.g. STEM Camp) |

**Students will also develop mentoring and role modeling skills resulting in multiplier and sustainability effects**
### Timeline and funding

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2012</th>
<th>2011</th>
<th>2010</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eng. UGs supported</td>
<td>35</td>
<td>35</td>
<td>49</td>
<td>63</td>
<td>48</td>
</tr>
</tbody>
</table>

Past UG engineering students engaged in research at CAER

*CAER’s track record of support for engineering UG research shows the capacity to support 40 students*

*NSF BPE student support*

*Student support from other sources*

*Albeit the NSF BPE grant has some initial student support the latter is meant to shift to other sources*
Duties of – and benefits to – CAER mentors

- Participate in recruitment efforts
- Develop a meaningful, pedagogical and impactful research plan for each student mentored
- Participate in the development of those skills requiring their involvement
- Actively seek and help procure student support
- Attend meetings of engineering societies in order for:
  a) students to present their research
  b) mentors to present a poster on the mentoring program

Albeit CAER mentors do have a number of responsibilities, they also have the chance to train a student who will be involved for years in their research and include said student in research proposals.
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